

International Conference on Long-Term Ecological Research

Meeting the challenges of sustainable ecosystem
management from Local to global scales

ABSTRACTS



Chinese Ecosystem Research Network

International Conference on Long-Term Ecological Research

Meeting the Challenges of Sustainable Ecosystem Management from

Local to Global Scales

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Chinese Ecosystem Research Network

August 2007, Beijing

Foreword

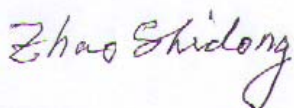
The International Long-Term Ecological Research (ILTER) Network was established in 1993. As of August, 2007, a total of 34 member networks have joined the ILTER Network, which has been playing a more and more important role in facilitating the global communication and collaboration among long-term ecological researchers.

The International Conference on Long-Term Ecological Research: *Meeting the Challenges of Sustainable Ecosystem Management from Local to Global Scales* took place from 20-21 August, 2007 in Beijing, China. It was sponsored by the Ministry of Science and Technology of People's Republic of China(MOST), National Natural Science Foundation of China (NSFC) , Chinese Academy of Sciences (CAS) and ILTER Network; and organized by the Institute of Geographic Sciences and Natural Resources Research, CAS and Chinese Ecosystem Research Network (CERN). The meeting brought together more than 210 scientists and representatives from 32 countries and regions, with a total of 209 paper abstracts received.

The conference is divided into three parts: plenary session, parallel workshops and posters. In the plenary session, seven(7) distinguished scientists—Drs. G. Phillip Robertson, Mark E. Harmon from US LTER, Andrew Macdonald and Terry Parr from ECN, UK, Riccardo Valentini from Italy, FU Bojie and HAN Xingguo from CERN, are invited as keynote speakers to present the major achievements and new directions of long-term ecological research globally.

Meanwhile, six(6) parallel workshops are organized, covering the topics of biodiversity conservation; ecosystem restoration; carbon, nitrogen and water cycling of ecosystems; environmental changes and their impacts to ecosystems; information management; and LTER science agenda. About 70 scientists make oral presentations on their research and major findings dealing with these issues. In addition, about 58 posters are presented in the poster session. This provides a good chance for the scientists from the ILTER community to meet together and exchange their ideas.

The goal of ILTER Network is to promote long-term ecological research, and provide scientific basis for managing sustainable ecosystems, which is a major challenge for the society in the 21st century. Through the joint efforts of all the participants, this conference will make a great contribution in this process.



ZHAO Shidong

Vice-chair of the Organizing Committee and Secretary General of the Conference

International Conference on Long-Term Ecological Research

Meeting the Challenges of Sustainable Ecosystem Management from Local to Global Scales

Institute of Geographic Sciences and Natural Resources Research

Chinese Academy of Sciences

20-21 August, 2007

Sponsored by:

Ministry of Science and Technology (MOST), People's Republic of China

National Natural Sciences Foundation of China (NSFC)

Chinese Academy of Sciences (CAS)

International Long-Term Ecological Research Network (ILTER)

Locally organized by

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Table of Contents

Plenary Session

Chinese Ecosystem Research Network(CERN): achievements and perspectives	<i>Fu Bojie</i> 2
.....	
New directions for U.S. long-term ecological research	<i>G. Philip Robertson</i> 4
The Rothamsted Long-term Experiments – Past, Present and Future	<i>A.J.Macdonald</i> 5
The development of the Environmental Change Network and its role in addressing current and future environmental issues within the UK and the international community	<i>Terry Parr</i> 8
Developing a general understanding of the decomposition process: results of a network experiment.....	<i>Mark E. Harmon</i> 11
The role of flux networks to understand terrestrial biosphere feed-backs to the global carbon cycle	<i>Riccardo Valentini</i> 12
Data mining from a long term grassland monitoring data base	<i>Han Xingguo</i> 13

Workshop 1 Biodiversity Conservation

Towards a global biodiversity observation network: the GEOSS framework	<i>Bruno A. Walther</i> 15
Change of soil microbial diversity with landuse alteration from paddy field to vegetable land	<i>Suo Bo</i> 18
Spatial and time scales of biodiversity trends –the role of LTER to understanding interactions between land use and species distribution.....	<i>J. Baudry</i> 20
Population structure and dynamics of <i>Neobalanocarpus heimii</i> (Chengal) in a lowland dipterocarp forest.....	<i>Kassim, Abd Rahman</i> 22
Long-term changes forest soil mesofauna on the background of climate warming	<i>Viesturs Melecis</i> 26
Global change research on South Africa’s plant biodiversity	<i>Kgope B.S.</i> 28
Biodiversity monitoring in China --on Chinese forest biodiversity monitoring network.....	<i>Ma Keping</i> 29
Assessment and conservation of biodiversity in Malindang Range, Mindanao, Philippines.....	<i>Victor B. Amoroso</i> 30
Dynamics of tree species ecological groups in logged and unlogged tropical forests in the Venezuelan western plains	<i>Hirma Ramirez-Angulo</i> 32
Phylogenetic diversity of nitrogen-fixing bacteria in mangrove sediments assessed by PCR- Denaturing Gradient Gel Electrophoresis	<i>Zhang Yanying</i> 33
Biodiversity research in the cross-border Lithuanian-Belarusian and Lithuanian-Russian LTER sites.....	<i>Saulius Svazas</i> 34

Workshop 2 Ecosystem Restoration

Monitoring the recovery of the vegetation in two conservation areas in the Succulent

Karoo, South Africa	<i>M.W. van Rooyen</i>	37
Vegetation restoration of the abandoned cropland in Horqin Sand Land of China	<i>Zhao Xueyong</i>	38
Indigenous knowledge in wetland management in Lake Victoria Basin	<i>Shadrack Mwakalila</i>	39
Evaluating vegetation recovery following forest fires in humid subtropical mountain forest ecosystem in central Taiwan using multi-temporal SPOT images	<i>Lee Mengfen</i>	40
Long-term ecological studies and ecosystem rehabilitation on the Loess Plateau of China—challenge and prospective	<i>Fu Bojie</i>	41
Activity report of Shimane University and the future prospects of the nature restoration in Lakes Shinji and Nakaumi, newly registered Ramsar sites in Japan	<i>Hidenobu Kunii</i>	42
Evolution characteristics of the restoration desert ecosystem and its influence on infiltration patterns in the Tengger Desert, Northern China	<i>Wang Xinping</i>	43
Long-term cyanobacteria dominance in a polymictic nutrient-poor tropical lake (Gambazinho Lake, South-East Brazil)	<i>Barros, C.F.A.</i>	45

Workshop 3 Carbon, Nitrogen and Water Cycling of Ecosystems

Processes controlling the increasing trends of dissolved organic carbon concentrations in the surface waters of a boreal catchment	<i>Martin Forsius</i>	47
Recent progress and future directions of ChinaFLUX	<i>Yu Guirui</i>	49
Dissolved organic carbon and nitrogen in precipitation, throughfall, soil solution, and stream water in the subtropics of the Fushan Forest	<i>Liu Chiungpin</i>	50
Carbon density and storage of bamboo forest in China	<i>Wang Bing</i>	51
Analysis on the impacts of various factors on leaf litter decomposition from an intersite decomposition experiment across China	<i>Zhou Guoyi</i>	53
Spatial and temporal pattern of dissolved carbon and nitrogen in stream water with topographical gradient in forested basins in Northern Japan	<i>Hideaki Shibata</i>	54
CO ₂ flux in a tropical seasonal rain forest in Xishuangbanna, Southwest China	<i>Sha Liqing</i>	56
Stable carbon isotope variation in plants and their indicating significances along the inland Heihe River basin of Northwestern China	<i>Su Peixi</i>	57
Fog and precipitation chemistry at a mid-land humid forest in central Taiwan	<i>Liang Yangling</i>	58
Nitrogen fertilization enhances soil water deficit and results in accumulation of nitrate in a semiarid soil profile.	<i>Guo Shengli</i>	59
Effects of long-term cycling of organic nutrient on soil nitrogen supplying capacity in a red soil paddy ecosystem	<i>Chen Anlei</i>	60
Influence of nitrate amendment on the fate of nonylphenol under anoxic conditions in submerged paddy soils	<i>Liu Qin</i>	62
Characteristics of nitrate leaching loss from slope cropland of purple soil	<i>Zhu Bo</i>	63
Study on the relationship between the soil organic matter content and soil		

productivity	<i>Song Chunyu</i>	64
Longterm study on the nutrient cycling and soil organic matter dynamics and its implications to the sustainable management of Chinese fir plantations	<i>Wang Silong</i>	65
Carbon and nitrogen coupling processes and responses to climate change in forest ecosystem along North-South Transect of Eastern China (NSTEC)	<i>Fang Huajun</i>	67
Development of a distributed eco-hydrological model for water management in irrigation districts of the Yellow River Basin, China	<i>Luo Yi</i>	68
Soil water and nutrients use and balance and their environmental effects in the rainfed cropland eco-systems: a long-term experiment study on the loess plateau	<i>Liu wenzhao</i>	69
Growth, biomass production, water-use efficiency and leaf anatomy of two leguminous shrubs in response to water stress.....	<i>Li Fanglan</i>	71
Sustainable water management in irrigation regions: understanding the impact of precipitation trend on crop productivity in the North China Plain.....	<i>Sun Hongyong</i>	72
Impact of fog on the energy budget of a subtropical cypress forest in Taiwan	<i>Eva Beiderwieden</i>	73
Nutrient budget of irrigation-drainage system of paddy field in the Yangtse Delta region	<i>Wang Dejian</i>	74
Impact of temperature and moisture on soil respiration: deconvolution analysis of field data in subtropical forests in southern China.....	<i>Tang Xuli</i>	75
Soil water dynamics as influenced by land use changes in Karst Mountainous Region in Northwest Guangxi.....	<i>Chen Hongsong</i>	76

Workshop 4 Environmental Changes and their Impacts to Ecosystems

Climate change and grazing impacts at the Mongolian long-term ecological research network site, Lake Hovsgol, Mongolia.....	<i>Clyde E. Goulden</i>	79
Oil spill in panay island: its effects and need for post-marine biodiversity assessment.....	<i>Pacienta A.</i>	80
Long term dynamics of biophysical structure and bioeconomy of the Lower Danube River System (LDRS)	<i>Cristofor, Vadineanu, S.</i>	81
Detecting the impacts of anthropogenic and climatic changes on water, carbon and nitrogen cycling of ecosystems in Eastern Asia.....	<i>Wang Qinxue</i>	82
Climate change and its ecological impacts—The evidences from the field experiments on northeastern Tibetan plateau.....	<i>Zhao Xinquan</i>	84
LTER for adaptation to global warming in Veracruz, Mexico.....	<i>Miguel Equihua</i>	86
Monitoring of natural processes in Doñana at landscape scale ..	<i>Ricardo Díaz-Delgado</i>	88
Toward an understanding of typhoon effects on soil nutrient dynamics of a subtropical forest ecosystem	<i>Shihchieh Chang</i>	91
Climate change from 1980 to 2005 in the Ailao Mountains, Southwest China	<i>Liu Yang</i>	93
Applicability assessment and improvement of CLIGEN non-precipitation		

parameters on the Loess Plateau	<i>Chen Jie</i>	95
Energy partitioning and evapotranspiration from a typical freshwater marsh in the Sanjiang Plain, northeast China	<i>Sun Li</i>	96
Long-term variations of nutrients and its structure and ecological responses in Jiaozhou Bay, China.....	<i>Shen Zhiliang</i>	97
A province-scale long-term forest ecosystem monitoring in Zhejiang—Proposal of the establishment and development of ecological station in major public-welfare forest in Zhejiang	<i>Song Xuzhong</i>	98
Spatio-temporal characteristics of ultraviolet radiation and photosynthetically active radiation derived from the ground-based measurements taken in CERN.	<i>Wang Yuesi</i>	100
Influences of human activities and global climate change on the Jiaozhou Bay Ecosystem	<i>Sun Song</i>	102
Comparative studies on different determining methods of underground biomass in grassland ecosystems	<i>Zhang Lin</i>	103
‘Fertile island’ effect of Tamarix and Haloxylon ammodendron shrubs in the south Gurbantunggut desert, Xinjiang, China	<i>Li Jun</i>	105
An overview of long-term hydro-meteorological researches during forest restoration in small watersheds underlain by weathered granite in warm-temperate mountainous area in the Central Japan.....	<i>Shibano, Hirofumi</i>	107
Hydrochemical responses of two debris-torrent impacted watersheds to the 2005 typhoon Talim event--a case study in the Chitou Experimental Forest, Central Taiwan.....	<i>LihJih Wang</i>	108
Comparative study of the dynamics of simulated daily soil moisture content at Mt. Namsan, Seoul, Korea and Hubbard Brook Experimental Forest, New Hampshire, USA for the last 50 years	<i>Kim, Eun-Shik</i>	109
Influence of ecological restoration on forest soil carbon turnover rate influence of ecological restoration on forest soil carbon turnover rate.....	<i>Wang Shaoqiang</i>	110
Effects of plant organs on root hydraulic traits in American elm (<i>Ulmus americana</i> L.) and red oak seedlings (<i>Quercus rubra</i> L.) chang in elevated CO ₂	<i>Cheng Song</i>	111

Workshop 6 Information Management

Research advance of data management, Chinese Ecosystem Research Network (CERN)	<i>He Honglin</i>	113
Metadata management with Ecological Metadata Language (EML) ...	<i>Chau Chin Lin</i>	114

Abstracts for Poster Presentation

Long-term effects of air pollution on selected forest ecosystems in the Bucegi Natural Park, Romania	<i>Badea, Ovidiu</i>	116
Biomass and nutritive elements accumulation, distribution of <i>rodgersia aesculifolia</i> bata in different soil and vegetation types.....	<i>Bai Jingwen</i>	118
Positive linear relationship between productivity and diversity: evidence from the Eurasian Steppe.....	<i>Bai Yongfei</i>	119
The role of NH ⁴⁺ toxicity in the decline of the submersed macrophyte, <i>Vallisneria</i>		

natans, in lakes of the Yangtze River basin, China	<i>Cao Te</i>	120
16S rRNA gene analyses of bacterial community structures in the soils of evergreen broad-leaved forests in Southwest China	<i>Chan, On Chim</i>	121
A study of ecological characteristics of eremophytes in Minqin	<i>Chang Zhaofeng</i>	122
Effects of long-term cycling of organic nutrient on soil phosphorus supplying capacity in a red soil paddy ecosystem in China	<i>Chen Anlei</i>	124
Effects of long-term organic nutrient recycling on soil fertility and productivity in rice cropping system of red soil region of China	<i>Chen Anlei</i>	125
Responses of microbial biomass P to the changes of organic C and P in paddy soils of long-term fertilization systems	<i>Chen Anlei</i>	127
Response of crop yield, water productivity and water balance to agricultural water management under variable climate in the North China Plain	<i>Chen Chao</i>	128
Establishment of long term ecological research for agricultural ecosystem in taiwan and its application	<i>Chen Chi-Ling</i>	129
Reproductive allocation, seed dispersal and germination of myricaria laxiflora, an endangered species in the Three Gorges reservoir area	<i>Chen Fangqing</i>	131
Effect of ration on growth, faecal production, nitrogenous excretion and energy budget of Juvenile ovate pampano (<i>Trachinotus ovatus</i> L.)	<i>Chen Haoru</i>	132
In situ studies on the distribution patterns and dynamics of microcystins in a biomanipulation fish—bighead carp (<i>Aristichthys nobilis</i>)	<i>Chen Jun</i>	133
Natural succession and carbon accumulation of sub-alpine forest in the east Tibet Plateau	<i>Cheng Genwei</i>	134
Soil characteristics and nutrient budget in three agricultural long term ecological research sites in Taiwan: first year report	<i>Chiang, C. F.</i>	135
Data management in a collaborative GIS	<i>Chuntharpursat Avinash</i>	136
Effect of intercropping with medicinal plants on microbial communities and peanut yield in a long continuous peanuts cropping system	<i>Dai Chuanchao</i>	137
In situ determination of NH ₃ volatilization in the field after different application of fertilizer	<i>Dong Wenxu</i>	138
Spatial and seasonal variations of cyanobacteria and their nitrogen fixation rates in Sanya Bay, South China Sea	<i>Donga, Junde</i>	139
Variation of water sources for the four dominant species on the Tibetan Plateau	<i>Duan Deyu</i>	140
Water sources of dominant species in three alpine ecosystems on the Tibetan Plateau, China	<i>Duan Deyu</i>	141
Impacts of exotic species of acacia mearnsii De Wilde on species diversity of undergrowth plants	<i>Fu Zengjuan</i>	142
Artificial rubber forest ecosystem hydrological process: mechanism of runoff response to complex factors	<i>Gao Fu</i>	143
A leaf litter decomposition experiment of typical forest ecosystems across China	<i>Guan Lili</i>	144
Use of silver and bighead carps to control cyanobacteria blooms: a case study	<i>Guo Longgen</i>	145
Impact of wetlands reclamation on water resources of the Sanjiang Plain		

.....	<i>Guo Yuedong</i>	146
CO ₂ emission from a black soil as influenced by land use and management	<i>Han Xiaozeng</i> 147
Long-term monitoring of the coastal environment in the Seto Inland Sea, Japan using macro-algal biodiversities, and the selection of Awaji Island as a long-term monitoring site.	<i>Hanyuda, Takeaki</i>	148
Study on traits evolution of wheat in Wei-bei Dryland.....	<i>Hao Mingde</i>	149
Forest diversity and dynamics plot network of China: broad-leaved Korean pine mixed forest plot in Changbai Mountain	<i>Hao Zhanqing</i>	150
Storage and dynamics of carbon and nitrogen in soil following grazing exclusion in <i>Leymus chinensis</i> grassland of northern China	<i>He N. P.</i>	152
Climatic dynamics of middle-mountain areas of upper reaches of Minjiang River	<i>He Qihua</i>	153
Composition and organic carbon distribution of organo-mineral complex in black soil under different land use.....	<i>Hou Xueying</i>	154
Dynamics of groundwater resources in the region irrigated using groundwater in North China Plain: Its ecological effects and strategies for conservation	<i>Hu Chunsheng</i>	155
Vegetation productivity along China Grassland Transect.....	<i>Hu Zhongmin</i>	156
Population structure and dynamics of <i>Neobalanocarpus heimii</i> in Pasoh	<i>Kassim, Abd Rahman</i>	157
Long-term ecological research on food web structure in a temperate paddy field using stable isotope ratio analysis.....	<i>Kim, Sejin</i>	158
Major activities and achievements of the international Long Term Ecological Research (ILTER) from 2003 to 2006.....	<i>King, Henbiau</i>	160
Activity report of shimane university and the future prospects of the nature restoration in lakes Shinji and NakaumiI, newly registered ramsar sites in Japan	<i>Kunii, Hidenobu</i>	161
National long-term ecological research and Monitoring in Coastal Ecosystem of Korea.....	<i>Lee, Jeomsook</i>	162
Recent development of Taiwan Ecological Research Network (TERN)	<i>Lee, Ling-ling</i>	163
Research of dendroclimatology of subtropical region in China	<i>Leng Ling</i>	164
Effect of temperature and salinity on germination of two Halophytes (<i>Chenopodiaceae</i>) in Northwest of China.....	<i>Li Li</i>	165
Switzerland: are critical values for atmospheric deposition and ozone in forests exceeded?.....	<i>Li Maihe</i>	166
The effects of groundwater depth on distribution and growth of dominant perennials at southern margin of the Taklamakan desert.....	<i>Li Xiangyi</i>	169
Effects of controlled irrigation on nitrate accumulation in North China Plain	<i>Li Xiaoxin</i>	170
Long-term recovery of topsoil physicochemical properties in revegetated sites in the sand-burial ecosystems of the Tengger Desert, northern China.....	<i>Li Xinrong</i>	171
Long-term fertilization response of corn-wheat system in North China Plain	<i>Li Yunsheng</i>	172

The cropping system in solar greenhouse for sustainable vegetable productivity	<i>Liang Y. L</i>	173
A metadata-based framework for multilingual ecological information management	<i>Chau-Chin Lin</i>	174
Edge effects on forest understory vegetation and soil seed banks.....	<i>Lin Luxiang</i>	175
Effects of exogenous nitrogen supply on photosynthetic characteristics and carbon sequestration potential of <i>Calamagrostis angustifolia</i> in Sanjiang plain Marshes	<i>Liu Deyan</i>	177
Distributed Hydrology Model for Tianranwenyan Agricultural Basin of North China Plain	<i>Liu Jintao</i>	178
Uncertainty analysis of ecosystem photosynthesis and its parameters.....	<i>Liu Min</i>	180
Monsoonal temperate glaciers as a sensitive climate proxy: variation characteristic of Hailuogou Glacier, Gongga Mountain.....	<i>Liu Qiao</i>	181
Fog drip and its sources in a tropical seasonal rain forest of Xishuangbanna, Southwest China	<i>Liu Wenjie</i>	182
Seasonal Dynamics of CO ₂ Fluxes over a Sub-tropical Coniferous Forest Ecosystem	<i>Liu Yunfen</i>	183
Effect of different utilization pattern and fertilizer management on soil active aluminum forms and mechanism research.....	<i>Lv Huanzhe</i>	185
Adsorption on soil of dissolved organic carbon and nitrogen from cattle manure: a preliminary study	<i>Ma Junhua</i>	187
From LTER to LTSER: incorporating the social dimension to the Mexican LTER network.....	<i>Manuel Maass</i>	188
Detecting scale-dependent processes of environmental heterogeneity and dispersal limitation in a subtropical <i>forest</i> of Gutian Plot, south China.....	<i>Mi Xiangchen</i>	189
Simulating the response of crop productivity and water consumption to climate change for the north and south counties of the Huang-Huai-Hai (3H) Plain based on VIP model	<i>Mo Xingguo</i>	190
40 years of studies in oak-hornbeam forest in Báb/Slovakia.....	<i>Oszlányi, Július</i>	192
GRID- based assessment on eco-environmental sensitivity in Wushen Banner.....	<i>Pan Donghua</i>	193
Differential nitrogen uptake and allocation patterns among coexisting plant species in a semiarid steppe community.....	<i>Pan Qingmin</i>	194
Leaf nitrogen and phosphorus ecological stoichiometry in temperate forest ecosystem in Northeast China.....	<i>Ren Shujie</i>	195
Monitoring the recovery of the vegetation in two conservation areas in the Succulent Karoo, South Africa	<i>Rooyen, M.W. van</i>	196
Designing conservation landscape for Giant pandas in Min Mountains, China.....	<i>Shen Guozhen</i>	198
Conservational status of plant seedlings a tool for biodiversity conservation in Northern Pakistan.....	<i>S. Aneel Gilani</i>	199
Monitoring water and energy fluxes in irrigated agricultural lands of North China Plain	<i>Shen Yanjun</i>	200
The quality evaluating and assessment for soil datasets for long -term monitoring...		

.....	<i>Shi Jianping</i>	201
Carbon sink limitation and tree growth of <i>Abies faxoniana</i> at treeline ecotone in eastern Qinghai-Tibetan Plateau	<i>Shi Peili</i>	202
Comparison of methods for estimating evapotranspiration of a temperate mixed forest: eddy covariance, Bowen ratio energy balance, Priestley-Taylor and Penman-Monteith equation	<i>Shi Tingting</i>	203
Modelling fuelwood demand availability in the Northern Sofala province, Mozambique.....	<i>Sitoe, Almeida</i>	205
Ecosystem photosynthesis and its environmental factors in a tropical seasonal rain forest, Southwest, China	<i>Song Qinghai</i>	207
Long-term effect of fertilizer and manure application on soil carbon sequestration and soil fertility on silt loam soil in northwest China	<i>Su Yongzhong</i>	208
Nitrogen leaching in upland crop system on an acidic soil in subtropical China: lysimeter measurement and simulation.....	<i>Sun Bo</i>	209
Dynamic analysis of phytoplankton community characteristics in Daya Bay, China	<i>Sun Cuici</i>	210
Soil Cu and Zn availability and plant uptake as affected by a long-term straw amending with soil	<i>Sun Ruijuan</i>	211
The background atmosphere monitoring network of CAS	<i>Sun yang</i>	212
Land use and landscape structure changes at sakaerat biosphere reserve ILTER	<i>Trisura, Yongyut</i>	213
Nitrogen cycling in larch forests on permafrost in central Siberia	<i>Tokuchi, Naoko</i>	214
An application of inverse Lagrangian dispersion analysis method on the calculation of latent and sensible heat flux.....	<i>Wang Anzhi</i>	215
Response of soil enzyme activities to long-term fertilizer systems.....	<i>Wang Can</i>	217
Long-term effect of chemical fertilizer, straw and manure on labile organic matter fractions in a paddy soil	<i>Wang Dejian</i>	219
Environmental effects on recharge groundwater with the Yellow River supplementary in Shangqiu Region	<i>Wang Hezhou</i>	220
Effect of long-term fertilization on paddy soil quality in subtropical China.....	<i>Wang Kaifeng</i>	222
Free-air temperature enhancement (FATE) experiment in Qinghai-Tibet Plateau.....	<i>Wang Shiping</i>	224
Nitrogen loss through overland flow and subsurface flow from Slope Cropland in Purple Soil.....	<i>Wang Tao</i>	226
Soil heterotrophic respiration in a mixed plantation: seasonal dynamics and contributions.....	<i>Wang Xiaoguo</i>	227
Measurement of greenhouse gases in CERN stations.....	<i>Wang Yinghong</i>	228
Spatial structure analysis of urban green space based on high-resolution RS image: a case study of Beijing	<i>Wang Yiting</i>	229
Long-term changes of the ecological environment in Daya Bay from 1982 to 2004	<i>Wang Youshao</i>	230
Methane and nitrous oxide emissions from wheat straw addition paddy fields	<i>Wang Yuying</i>	231

Comparative studies on different determining methods of underground biomass in grassland ecosystems	<i>Wei Wenshan</i> 232
The basic changes and health evaluation of agro-ecosystem in irrigated area on lower reaches of Yellow River	<i>Wu Lanfang</i> 235
Modeling gross primary production of a temperate grassland ecosystem in Inner Mongolia, China using MODIS and climate data.....	<i>Wu Weixing</i> 237
Carbon accumulation and distribution in particle-size fractions of two soils as affected by long-term fertilizations	<i>Xie Hongtu</i> 238
The potential of visible—near-infrared reflectance spectroscopy to predict soil organic matter and heavy metal content — a case study of soils around a cooper smelter in Jiangxi Province, China	<i>Xie Xianli</i> 240
Aerosol optical properties observed by the Chinese Sun Hazemeter Network and evaluation of the MODIS AOD products over China	<i>Xin Jinyuan</i> 242
A Smart Network Monitoring System for Soil Moisture.....	<i>Xin X. L.</i> 243
Stable carbon isotope variations in surface bloom scum and subsurface seston among shallow eutrophic lakes	<i>Xu Jun</i> 244
Changes of soil nitrogen dynamics in a suburban pine forest in Hefei: effect of dieback from pine wilt disease.....	<i>Xu Xiaoniu</i> 245
Evolution of Soil Bio-characteristics in the Ecological Restoration Process in the hilly Loess plateau.....	<i>Xue Sha</i> 246
Distribution characteristics of soil organic matter and nitrogen on the Yajiageng-Dadu River vertical belt, Mt.Gongga	<i>Yan Yan</i> 248
Influence of underground water table to niche of plant population at fringe of Minqin Oasis	<i>Yang Zihui</i> 249
Seasonal and spatial variations of dissolved inorganic carbon in the Xijiang River and its export flux.....	<i>Yao Guanrong</i> 250
Effect of organic matter incorporation on flooded soil solution CO ₂ concentration and growth and yield formation of rice.....	<i>Ye Wenpei</i> 251
Seasonal variations of ecosystem respiration in different terrestrial ecosystems of ChinaFLUX.....	<i>Yu Guirui</i> 253
Water characteristics of <i>Populus euphratica</i> growing in different heights of sand dune in the foreland of Takelamakan Desert.....	<i>Zeng Fanjiang</i> 254
Yield trends, soil structure change of a long-term fertilization experiment for intensive rice monoculture system in southeast China	<i>Zhang Bin</i> 255
Effect of heavy metal stress on antioxidative enzymes and lipid peroxidation in leaves and roots of two mangrove plant seedlings (<i>Kandelia candel</i> and <i>Bruguiera gymnorhiza</i>).....	<i>Zhang Fengqin</i> 256
Sustainable Productivity and Environmental Impact of Intensive Farmland Ecosystem in HuangHuaiHai Plain.....	<i>Zhang Jiabao</i> 257
Dominant zooplankton species shift in Changjiang River Estuary: possible causes	<i>Zhang Guangtao</i> 261
Satellite-based long-term estimate of carbon/water fluxes over an old-growth Chinese temperate mixed forest: 2000-2006.....	<i>Zhang Junhui</i> 262
Temporal and spatial dynamic of litterfall of a mixed Beech forest in Shennongjia	

area, China	<i>Zhang Mi</i>	264
Biomass allocation and clonal growth in response to nutrient availability in the stoloniferous herb <i>potentilla reptans</i> L var. <i>sericophylla</i>	<i>Zhang Shumin</i>	265
Spatial and seasonal variations of nitrogen and phosphorous in the surface and ground waters within typical terrestrial ecosystems in China	<i>Zhang X. Y</i>	266
Evaluation of the CERES-wheat model for predicting wheat growth, development and yield on the Tibet Plateau	<i>Zhang Xianzhou</i>	267
Changing in farmland water use and grain production associated with cultivars and agronomic practices in the North China Plain	<i>Zhang Xiying</i>	268
Aggregate pools of soil organic carbon in a Chinese Mollisol and Alfisol as influenced by long-term fertilizations	<i>Zhang Xudong</i>	270
Soil net nitrogen transformation during the non-growing season in Inner Mongolia, China	<i>Zhang Xuelin</i>	272
Seasonal and vertical variations of phytoplankton biomass and their response to upwelling in Sanya Bay, South China Sea	<i>Zhang Yanying</i>	273
Climate change from 1960 to 2000 in the Lancang River Valley, China ..	<i>Zhang Yiping</i>	274
Nitrous oxide emissions and denitrification from long-term fertilized wheat and maize fields in the North China Plain	<i>Zhang Yuming</i>	275
Canopy water use efficiency at 8 sites of ChinaFlux	<i>Zhao Fenghua</i>	276
Soil respiration characteristics of four forest types in Dagangshan in Jiangxi province	<i>Zhao Guangdong</i>	277
A seasonal round observation of soil respiration in three types of communities along grass-shrub transition in Inner Mongolia, China	<i>Zhao Jin</i>	278
Disturbance and succession of forest communities in an arid inland river basin	<i>Zhao Wenzhi</i>	280
A preliminary study on ecosystem quantitative assessment	<i>Zhou Hua</i>	281
Ammonia volatilization in relation to N application rate and climate factors in upland red soil in spring and autumn	<i>Zhou Jing</i>	282
Water balance and nitrate leaching losses under intensive crop production on Ochric Aquic Cambosols in the North China Plain	<i>Zhu Anning</i>	285
Non-point-source nitrogen pollution in a small catchment in the Sichuan Basin, China	<i>Zhu Bo</i>	287
Patterns of species composition and cover between two managements in Inner Mongolia	<i>Zhu Guilin</i>	288
Annual time-series analyses of total gaseous mercury measurement and its influence factors in the Gongga Mountain on the south-eastern fringe of the Tibetan Plateau	<i>Zhu Wanze</i>	289

Plenary Session

Chinese Ecosystem Research Network (CERN): Achievements and Perspectives

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The Chinese Ecosystem Research Network (CERN) was established in 1988 by the Chinese Academy of Sciences (CAS). It consists of 36 field stations, representing the major ecosystems in China, i.e. cropland, forest, grassland, marsh, lake and bay; as well as 5 sub-centers, and 1 synthesis center based in Beijing, with an aggregated number of over 2000 ecologists, technicians and graduate students engaging in its activities. The vision of CERN is to conduct long-term monitoring and research on the major ecosystems and develop the techniques for ecosystem restoration, and offer data and information to scientists and policy-makers, and educate ecological knowledge.

The major missions of CERN are defined as monitoring, research and demonstration. Core research areas of CERN include:

- Ecosystem structure, functions and dynamics;
- Cross-site observation and experiment on global change;
- Ecological degradation and ecosystem restoration;
- Biodiversity conservation;
- Ecosystem assessment and sustainable management; and,
- Eco-informatics.

Through two decades of development, CERN has grown to be an important research facility for the sites and its partners both at home and abroad, thanks to the data measured and collected on long-term and continuous basis, as well as the up-to-date facilities and instruments in the field stations. The major achievements include:

- 1) The network has edited and published monitoring protocols for the field stations. A total of more than 800 indicators are measured on annual basis.
- 2) A large number of significant research outputs have been achieved on site and cross-site levels in CERN, turning it into a critical platform to implement the key research programmes funded by the Ministry of Science and Technology(MOST), National Natural Science Foundation of China(NSFC), and CAS, among others. Some important outputs based in the Inner Mongolia, Dinghushan and other research stations have been published in *Science*.
- 3) Some 20 demonstration models have been developed by the field stations under CERN, disseminating the best practices and tools in ecosystem management and rural development, i.e. ecosystem restoration, soil erosion control, sustainable agricultural development and protected areas management, to the wider areas across China.
- 4) On the basis of the datasets collected and synthesized, a series of database have been established by CERN and made available to the scientific community and the public, i.e. long-term monitoring database, basic information database of the field stations,

observation database for the carbon budget of terrestrial ecosystems in China, land resources database in China, and 1×1 km meteorological elements database in China.

- 5) As a major component of CERN, ChinaFLUX (www.chinaflux.org) is the only network in China that measures the water, carbon and energy fluxes, as well as the dynamics of micro-meteorological and eco-physical process of plant communities on a long-term and continuous basis, using open-chamber and eddy-covariance methods. It has become an integral part of FLUX Net.
- 6) On the basis of CERN, the China National Ecosystem Observation and Research Network was launched in 2005, among which 33 out of the 36 field stations of CERN are included. Meanwhile, the synthesis center of the CNEN is also based in CERN.
- 7) Since 1988 when it was established, CERN has been linking closely with the ILTER network and its member networks. It became an official member of ILTER network in 1993, and the EAP (East Asia and Pacific Regional Network)-ILTER Secretariat is now based in CERN. In addition, the GCP(Global Carbon Project) Beijing Office is also based in CERN.

CERN needs to take advantage of these favorable opportunities, such as the national policies to promote Science and Technology Platform development, including the field observation and research stations; the CAS' listing CERN development as a priority to improve monitoring equipment and facility.

Looking ahead, CERN should work further in the following areas, for example:

- Capacity building, including provision of facilities and equipment, communication, education and public awareness;
- Synthesis studies on water-carbon cycling of terrestrial ecosystems, latitude transect driven by water-gradient and longitude transect driven by heat-gradient;
- Integrated ecosystem management, including the ecosystem restoration studies and demonstration in the China, eutrophication of lakes and non-point pollution control in East China ; and,
- Long-term network-based monitoring, experiment and research on biodiversity based large-scale plot sampling, ecosystem vulnerability and adaptation to climate changes

New directions for U.S. long-term ecological research

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Twenty five years of LTER Network research in the U.S. has led to the development of a new synergistic research model that links the biophysical and social sciences in explicit ways using the provision of ecosystem services as a main focus. The model grew from the recognition that environmental challenges faced by society demand solutions that meet human needs and protect essential ecosystem functions that vary in complex ways across different temporal and spatial scales. A new transdisciplinary effort is needed to detect change, to understand its basis and impacts on socio-ecological systems, and to inform the development of tenable solutions. Collaborative partnerships are required among the geological, ecological, and social sciences. Highly coordinated research networks need to include knowledge exchange among key user groups, advanced information systems, new research technologies for synthesis, and innovative education and public outreach.

A new research initiative has been proposed to the U.S. National Science Foundation to initiate this effort: Integrative Science for Society and the Environment (ISSE). U.S. LTER scientists are now engaged in proposing a research plan to undertake the cross-site, synthetic research necessary to address key questions that emerge from the general conceptual model described in Figure 1. Traditionally LTER research and ecological research in general has focused principally on interactions among elements of biotic structure (e.g. populations, communities, and other assemblages) and ecosystem function (e.g. energy flow and nutrient cycling). The ISSE model considers ecosystem services as an outcome of these interactions, and their recognition and valuation by humans as additional, crucial components of the entire socioecological system. The degree to which humans subsequently change personal or institutional behaviors, and the degree to which these behaviors then influence ecological systems (their biotic structure and function) – either directly via intentional management or indirectly via unintended consequences – completes the causal loop. Key questions emerge at the interface of each of these major model components, and form the basis for the major hypotheses that follow from the need to understand model linkages and feedbacks in different socioecological systems.

Keywords: U.S. LTER research; socioecological research; ISSE

The Rothamsted Long-term Experiments – Past, Present and Future

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Background

Rothamsted is the oldest agricultural research station in the world. Its foundation dates from 1843 when John Bennet Lawes, the owner of the Rothamsted Estate, appointed Joseph Henry Gilbert, a chemist, as his scientific collaborator. In 1843 they started the first of a series of what became long-term field experiments. The main object of these experiments was to compare the effect of inorganic and organic fertilisers on crop yield and soil fertility. These so-called “Classical Field Experiments” included:

- The Broadbalk Wheat Experiment- started in 1843
- Hoos Barley - started in 1852
- The Alternate Wheat and Fallow - started in 1856
- The Exhaustion Land - started in 1856
- Park Grass - started in 1856
- Barnfield - started in 1843
- Garden Clover - started in 1854
- Broadbalk and Geescroft Wildernesses - started 1880s

Other more recent long-term experiments started at Rothamsted and on contrasting soils at Woburn include:

- The Woburn Ley Arable – started 1938
- The Highfield and Fosters Ley Arable – started 1948
- Woburn Organic Manuring – started 1964
- Two Straw incorporation experiments – started 1987
- Two Continuous maize experiments – started 1997

In many cases the older experiments have been modified to reflect changes in agricultural practice and address new scientific questions. On Broadbalk, for example, crop rotations were introduced by splitting the original plots and short-strawed winter wheat varieties were introduced in 1968. Herbicides and fungicides are now used routinely on most plots on Broadbalk, but on some plots they are withheld. Chalk is applied to maintain soil pH. Crop and soil samples are taken from these experiments and added to the Rothamsted Sample Archive. The Archive is a unique collection, of some 300,000 samples with a fully documented history, with continuity from 1843 until now. In addition, the Electronic Rothamsted Archive (e-RA) provides a permanent managed database for secure storage of increasing amounts of Rothamsted's long-term experimental data. Together with the accompanying meteorological records, associated documentation and sample archive the Rothamsted long-term experiments provide a unique historical record of the effects of agricultural practices on soils, crops and associated ecosystems over the past 160 years.

Results

Crop yields

Many of the early experiments at Rothamsted were designed primarily to provide information on the value of both organic and inorganic manures for crop production. Consequently, a considerable amount of information has been collected to help formulate agricultural advice to farmers and advisors. Some examples include:

1. Where continuous winter wheat on Broadbalk received 35t ha⁻¹ of FYM, containing *c.* 240 kg N (but mainly as organic N), grain yields were almost equal to those for wheat given 144 kg ha⁻¹ of inorganic N. By contrast, after introduction of a rotation, wheat yields from FYM plus extra inorganic N averaged at least 0.5 t ha⁻¹ more than from inorganic fertilisers alone, although more recently the difference has disappeared following a change of variety.
2. The newer short straw varieties first introduced in 1968 gave much greater grain yields in all treatments with FYM or inorganic fertiliser than the previous varieties.
3. The first wheat crop after a non-cereal in the rotation introduced in 1968 gave about 50% greater yields than wheat grown in monoculture.
4. Where soil pH has been maintained there is no evidence for a decline in yields due to fertilisers damaging the soil.
5. The unmanured/unfertilised treatment has continued to yield 1-2 t ha⁻¹ of grain throughout the duration of the experiment, removing 20-30 kg N ha⁻¹ yr⁻¹ even though soil organic N content has remained constant. This has only been possible because of substantial N inputs from wet and dry deposition from the atmosphere.
6. In 2001 a test for crop sulphur (S) response was introduced on Broadbalk. In 2002 plots without S yielded 0.5 t ha⁻¹ less than the corresponding plots receiving S, demonstrating the widespread occurrence of S deficiency in the UK due to a decline in sulphur dioxide emissions from coal burning and heavy industry.

Soil properties and functions

Soil properties usually change slowly in response to management practices so LTEs are ideal for research on these issues. Some examples include:

1. Measuring changes in soil organic carbon (C) content in response to agricultural management or land use change, comparing data between contrasting soil types, environments and cropping systems and using data to develop and evaluate models of soil carbon dynamics.
2. Testing the hypothesis that the soil microbial biomass responds more rapidly than total soil C content to changes in organic C input and so can be used to give an early indication of future changes in soil C content.
3. Quantifying the influence of long-term applications of different fertilisers and manures on the total and mineralisable soil organic N content.
4. Examining the long-term impact of different fertiliser and manure applications on losses of both organic and inorganic N in drainage from arable land.

Environmental monitoring

As with changes in soil properties, LTEs have proved to be ideal research tools for investigating a wide range of environmental issues; archived samples of soil or plant material are particularly valuable. Some examples include:

1. The Park Grass experiment has provided valuable information on the impact of nutrient and lime applications to grassland on species diversity, and is the main site at Rothamsted for the Environmental Change Network. This is a UK wide network of sites where weather, flora, fauna and either water or soil conditions are monitored and changes noted.
2. Estimating inputs of S from atmospheric deposition to a soil/crop system by measuring changes in the ratio of S isotopes in archived soil and crop samples.
3. Analysis of archived plant material from the Rothamsted Park Grass experiment for plutonium and uranium have provided evidence that fallout from atmospheric bomb tests carried out in the Nevada Desert in 1952/3 reached northwest Europe.
4. Quantifying nitrogen deposition to land and its implications for nutrient enrichment and soil acidification.
5. Determining the impact of land use and N fertilisers on the populations of soil bacteria capable of oxidising atmospheric methane.
6. Examining factors influencing loss of phosphate from soil to water by comparing P budgets from three long-term experiments in contrasting environments across Europe.

Recent developments

More recently, the use of the long-term experiments in conjunction with new scientific techniques has provided valuable new information in several areas, including:

1. Analysis of wheat grain has shown that both S-containing fertilisers and the deposition of S from the atmosphere both reduce the concentrations of the important micro-nutrient selenium in grain.
2. There appear to be differences in gene transcription in winter wheat crops given inorganic or organic manures.
3. Differences in the relative abundance of plant pathogens have been identified in relation to changes in atmospheric S deposition.

Conclusions

The Rothamsted Long-term Experiments together with their archived samples and data have proved especially useful for examining the impact of land use and management on agricultural productivity, soil fertility and functions, and environmental changes. They continue to yield important information and are an increasingly valuable experimental resource for today's scientists. Whilst their future uses cannot be predicted, provided they are maintained, the application of new scientific techniques to examine both fresh and archived samples will certainly provide new information of environmental and ecological significance to future generations.

Keywords: agriculture; archive; data; environment; long-term; winter Wheat

The development of the Environmental Change Network and its role in addressing current and future environmental issues within the UK and the international community

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The UK Environmental Change Network is a Long-term Ecosystem Research Network (LTER) that has been in operation for 15 years. In this paper I will review the evolution of the ECN and describe how it has contributed to addressing some key research and policy questions. I will also discuss how it has evolved to meet emerging environmental and funding challenges and the next steps it must take if it is to develop its position at the cutting-edge of ecological and policy relevant research. Finally, I will outline the integration challenges it faces, including the role it must play in the larger scale partnerships needed to meet emerging European and global challenges, especially in the context ofILTER.

The UK Environmental Change Network (ECN – www.ecn.ac.uk) was started in 1992 as the UK's Long-term Ecosystem Research and Monitoring Network. It was established as a multi-agency programme with the aim of creating a well-designed and cost-effective national network to identify, assess and research environmental change nationally and to provide a basis for European and international collaboration. Its specific objectives were:

1. To establish and maintain a selected set of sites within the UK from which to obtain comparable long-term datasets by means of measurement at regular intervals of variables identified as being of major environmental importance.
2. To provide for the integration and analysis of these datasets, so as to identify environmental change and improve understanding of the causes of change.
3. To make these long-term datasets available as a basis for research and prediction.
4. To provide, for research purposes, a range of representative sites where there is good instrumentation and reliable environmental information.

After 10 years ECN had largely achieved these establishment phase objectives. It had a network of 54 terrestrial and freshwater sites across the UK. These sites made regular measurements (using standard protocols) of the main drivers of change (e.g. climate, atmospheric chemistry, land use) and associated ecosystem responses (e.g. soil, flora, fauna and water quality). A central database had been established and quality control and assurance procedures had been developed and implemented, as well as a pioneering web interface for access to data. This long-term ecosystem monitoring and informatics approach also underpinned short-term research projects that enabled ECN to address a wide range of contemporary and emerging environmental issues.

After its establishment phase, ECN moved to exploit the research and policy potential of its data and sites and extend the range of its partnerships. Its new mission was “to develop and maintain a multi-agency network and early-warning system to detect, present, interpret and predict long-term ecosystem change and help society mitigate and adapt to global change.” It produced a research

and development strategy that built on the existing inter-disciplinary strengths of the network, but which in many cases required further more detailed measurements or experiments that could only be undertaken in collaboration with the wider research community in Universities and Research institutes. ECN now has 3 research themes on:

- biogeochemical cycles in relation to environmental pressures and their impacts on ecosystem services;
- biodiversity change in relation to environmental pressures and their impacts on ecosystem processes and services;
- underpinning knowledge on patterns and magnitude of natural variation in relation to ecosystem resistance, resilience and stability.

But ECN's most important function is to contribute to the national and international capability to provide sound environmental data for decision making at all levels. It therefore also has 6 development themes aimed at:

- improving the quality and fitness for use of the data collected by ECN;
- development of database and informatics capability to promote data use;
- the establishment of long-term ecosystem experiments at ECN sites to address science questions;
- the development of automated techniques for the presentation of change, including trends and extreme events;
- the development of links to other UK and international networks to enhance our capability for early warning of environmental change impacts; and
- the use data in education to promote public understanding of environmental change.

A few examples of recent advances in these areas including their relevance to key policy areas such as climate change mitigation and adaptation, water quality and catchment management and biodiversity protection will be provided. For example, major research results have included the characterisation of spatial and temporal variability in ecosystem components (e.g. of Carabid beetle assemblages), impacts of climate change on lake ecosystems, identification of the ecological impacts of climate change and improved understanding of the climatic and other factors controlling nitrogen and carbon dynamics in upland catchments. ECN data have also been incorporated into the system of indicators used by the UK government and ECN's pioneering use of the Internet in the mid-90s for data dissemination now forms the basis for a widely used system for accessing data and information on environmental change.

As a national network ECN has not expanded its number of sites at the rate originally anticipated. But the original sponsors have retained their commitment to long-term approaches and this stability has enabled ECN to develop effective programmes of data management, knowledge transfer to policy and international collaboration that have enabled it to survive and adapt to rapid organisational and funding changes within the UK.

But the world continues to change at an alarming rate. ECN now needs to develop its research strategy to respond to the new challenges at UK, European and Global levels. Central to this will be the requirement to demonstrate its current and future relevance to sustainable development, integrated resource management, climate change and biodiversity protection. Within the UK the immediate challenges for ECN are to contribute to large-scale ecosystem assessments by linking

data and models from our LTER sites to more extensive data sets from wider scale surveys (e.g. Countryside Surveys <http://www.countrysidesurvey.org.uk>) and remote sensing. On continental and global scales it is also important to us that our data are used by scientists around the world in comparative studies of ecosystem change and to contribute to global scale syntheses on the drivers and consequences of ecosystem change as a basis for understanding and forecasts of future conditions and knowledge-based policy assessments. To achieve this, ECN will contribute to the new LTER-Europe Network (<http://www.lter-europe.ceh.ac.uk/index.htm>) and ILTER also has a key role to play in meeting this challenge.

The research and policy framework has evolved greatly since ECN was started. In particular, we have witnessed the emergence of global climate change as an issue of local, national and international concern and the increasing importance of new strategies promoting sustainable development at the UK, EU and global levels. In parallel to changes in the policy framework, integrated assessment and the evaluation of ecosystem services has become a major scientific challenge as illustrated in the launch of the Millennium Ecosystem Assessment in 2003. The concepts of ‘natural resource management’ and ‘ecosystem goods and services’ (e.g. purification and detoxification; cycling processes; regulation and stabilisation, habitat provision; regeneration and production; and life-fulfilling/aesthetic services) are particularly relevant in both science and policy and must now be addressed directly by LTER. The recent development of the Global Earth Observation System of Systems (GEOSS) also highlights the importance of in situ and ecosystem-level data to support sound decision making on environmental issues across 9 global societal benefit areas.

Looking to the future, LTER must also develop its relevance to these inter-disciplinary challenges, for example, through:

- large-scale assessments of the current state and past trends in the potential of natural resources to provide key ecosystem services; and
- the development of integrated Driver-Pressure-State-Impact-Response models to predict the impact of environmental pressures on the delivery of ecosystem services.

In developing the partnerships necessary to do this, the LTER community should not neglect its roots in its national networks and its core strengths in the fields of ecological research. It should promote its real value as one of the few real sources of ecosystem level data that has the potential to address issues on a global scale. But potential is not the same as delivery. The immediate challenge for ILTER is to tackle the ever-present problems of data sharing and deliver some large-scale collaborative projects with global-scale end products. This will not be easy to do.

Developing a general understanding of the decomposition process: results of a network experiment

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Although leaf and fine root litter undergo many changes during the process of decomposition, there is relatively little long-term data to develop a general, global level understanding of this process. The LIDET (Long-term Intersite Decomposition Experiment Team) study, conducted at 27 sites in North and Central America using a wide range of litter types, created a database suitable for this purpose. Analysis of the long-term pattern of mass loss indicated that while a slower, later phase of decomposition occurred in most cases a substantial fraction (20%) it did not. These results imply that average long-term decomposition rates may be overestimated by at least a factor of 2 if based on short-term (1 year) decomposition losses. The relationship between wooden dowel decomposition and climatic indices indicated limits on the ability to predict decomposition rates for sites more favorable for decomposition, with a maximum coefficient of determination of 70%. Regression analysis of the relationship between climatic and substrate quality indices and decomposition rates indicated controls on decomposition processes changed from the early to late stages, with early-stage processes controlled by climate and initial litter chemistry, but late-stage processes more likely controlled by other factors such as the soil environment.

Development of a mechanistic model based on AIC analysis indicates at least 3 pools need to be considered and that a climatic index that combines the effects of temperature and moisture explains the most variation (70%). Downscaling of global relationships to two biomes (tropical forests and grasslands) indicated that not all biomes behave in a manner consistent with global patterns, with grasslands exhibiting controls more related to moisture and UV-related processes than temperature and substrate quality. Analysis of the relationship between nitrogen release and mass loss indicated a global relationship exists that is largely dependent on the initial nitrogen content with 77% of the variation explained by this simple model. Overall the LIDET study indicated that there are general global patterns to long-term decomposition dynamics, however, current models indicate limits to our ability to predict global patterns of this important process.

The role of flux networks to understand terrestrial biosphere feed-backs to the global carbon cycle

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Large interannual variations have been observed in the growth rates of atmospheric CO₂ concentrations over the last few decades. The magnitude of these swings, associated with changes in the biospheric (ocean and terrestrial) exchange, has been as high as [6 pgC/yr], of the same order of magnitude as the gross fossil fuel emissions. A clear understanding of the role of the terrestrial biosphere in these temporal variations seems essential for predicting the future changes and the efficacy of human interventions (such as Kyoto Protocol) in the global carbon cycle.

Inter annual and seasonal variations of carbon exchanges are observed also at local scale in response to climate and disturbances as results of complex interactions between physical and biological controls. Sometimes changes in carbon uptake at ecosystem level can be as much as 1 2 tC ha⁻¹ in response to inter-annual variations. Also at seasonal level significant differences are observed in response to droughts, temperature extremes, phenology etc. Disturbances also show a distinct temporal variations and they can rapidly shift ecosystems from a sink to a source of carbon. Due to such variety of temporal responses we could expect even larger variations in atmosphere. However there are a lot of cancellations over the landscape. Sources at area/point x are cancelled by sinks at area/point y. Since the global atmosphere is an efficient integrator of the biospheric carbon exchanges the reported large variability in the atmosphere suggests some coherency in the distribution of sources and sinks over the globe. One of the most challenging issue in understanding the temporal vaiation of the global carbon cycle is to identify those large scale coherencies and the causes for them.

Key words: carbon fluxes, carbon cycle, flux networks, climate change

Data mining from a long term grassland monitoring data base

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Data mining from a long-term grassland ecosystem monitoring dataset

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Since 1980, we started to monitor the biomass reproduction in two Inner Mongolia grasslands. This dataset consists of biomass production of the two grasslands from budding to completely senescing of every species encountered in the five quadrats. A preliminary analysis of the dataset has generated several major findings.

For example, numerous studies have suggested that biodiversity reduces variability in ecosystem productivity through compensatory effects; that is, a species increases in its abundance in response to the reduction of another in a fluctuating environment. But this view has been challenged on several grounds. Because most studies have been based on artificially constructed grasslands with short duration, long-term studies of natural ecosystems are needed. Based on a 24-year study of the Inner Mongolia grassland, Bai et al. (2004) present three key findings. First, that January–July precipitation is the primary climatic factor causing fluctuations in community biomass production; second, that ecosystem stability (conversely related to variability in community biomass production) increases progressively along the hierarchy of organizational levels (that is, from species to functional group to whole community); and finally, that the community-level stability seems to arise from compensatory interactions among major components at both species and functional group levels. From a hierarchical perspective, our results corroborate some previous findings of compensatory effects. Undisturbed mature steppe ecosystems seem to culminate with high biodiversity, productivity and ecosystem stability concurrently. Because these relationships are correlational, further studies are necessary to verify the causation among these factors. Our study provides new insights for better management and restoration of the rapidly degrading Inner Mongolia grassland.

Understanding how net primary production (NPP) of drylands (47% of the earth's land surface) responds to variations in precipitation is crucial for assessing impacts of climate change on terrestrial ecosystems. Rain use efficiency (RUE) is an important measure for acquiring this understanding. However, little is known about the response pattern of RUE for the extensive Asian drylands. Our study of 21 dryland ecosystems across northern China shows that, with increasing annual precipitation, RUE increases in space across different ecosystems, but decreases in time for a given ecosystem. These seemingly conflicting patterns of RUE in space versus time may be due largely to interactions between precipitation and soil N. Our results also show that the common maximum RUE can be increased substantially by altering resource availability, such as by N addition.

This dataset can also be used to test the allometric law as proposed by Enquist, West and Brown, as well as to test Neutral Theory proposed by Hubbell.

Workshop 1 Biodiversity Conservation

Towards a global biodiversity observation network: the GEOSS framework

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The Global Earth Observation System of Systems (GEOSS) intends to realize a future wherein decisions and actions are informed by coordinated, comprehensive and sustained Earth observations and information. To achieve this, GEOSS has identified nine "Societal Benefit Areas" and has appointed task groups for each of them. DIVERSITAS and NASA have been appointed to lead the Biodiversity Task BI-07-01 of the GEOSS framework which intends to "develop and implement a global biodiversity observation network that is spatially and topically prioritized, based on analysis of existing information, identifying unique or highly diverse ecosystems and those supporting migratory, endemic or globally threatened species, those whose biodiversity is of socio-economic importance, and which can support the 2010 CBD target".

To start the process of monitoring biodiversity on a global scale, the GEO Biodiversity Observation Network (<http://www.bioobservation.net/>) was initiated which is a global partnership to collect, manage, analyze and report on the status and trends of the world's biodiversity. The network will generate biodiversity data and information from many different provider communities (e.g. museum collections, organism observations, remote sensing systems, intensive plot-type biodiversity measuring and monitoring systems, etc.), provide tools for their analysis, generate regularly repeated assessments of global biodiversity trends, and make data and reports available to users via the internet using the GEOSS framework. It is made up of many relevant programs and networks, e.g. Census of Marine Life, DIVERSITAS, GBIF, GOOS, GTOS, IUCN, NASA, UNESCO-MAB and 2010 BIP, to name just a few.

Future goals are to establish the network's shared IT data architecture, scales and standards, observatory network planning and strategic planning for implementation. In particular, it will further consolidate the community, review the current state of available methodologies and networks, facilitate interoperability among system components, develop new information technology and analytical techniques and tools, refine data requirements of user groups, and prioritize research activities both spatially and topically. Working groups will be set up for (a) data architecture, (b) scales and standards, (c) observatory network planning and, (d) strategic planning for implementation. Future activities will be planned with a high priority given to the design of systems that can be used for sustainable use and management of biodiversity, including analysis, prediction, early warning, conservation planning, policy making, and management effectiveness evaluation, and the needs of relevant international treaties concerning the conservation and sustainable use of biodiversity. For these purposes, it is envisioned to establish adequate long-term infrastructures with adequate international funding to support them.

In this presentation, we will report on some of the ongoing activities towards the goal of the GEO Biodiversity Observation Network and some of the key questions that need to be answered. For example, the 2010 BIP (Biodiversity Indicators Partnership) was established in direct response to

the establishment of the CBD 2010 Targets. It has brought together numerous organisations and agencies working on biodiversity indicators in support of the 2010 Targets and will facilitate the regular delivery of regional and global biodiversity indicators in a way that is useful for policy intervention and communicating degree of success in achieving the 2010 Targets. Through its partnership with DIVERSITAS and NASA, it will administer the biodiversity task of GEOSS and play a crucial role in developing global indicators that use various sources of monitoring data to report on global biodiversity status and trends to GEOSS.

In further support of this initiative, DIVERSITAS has assembled an expert group of monitoring and modelling scientists under its bioDISCOVERY Core Project which will develop scientific goals to improve global biodiversity monitoring. Specifically, they will work on improving the mapping of species' spatial distributions, review and refine global biodiversity indices, review present monitoring efforts to then prioritize research of monitoring and conservation efforts, develop and test monitoring methods by mutually verifying methods such as in-situ monitoring and remote sensing, and to incorporate monitoring of ecosystem functions and services and drivers of change into monitoring schemes. Furthermore, since not everything can be monitored, an increased interaction with field experiments and model development will be sought that will help fill the knowledge gaps left by incomplete monitoring. Finally, the expert group will work on how results from long-term monitoring need to be analysed and presented so as to be useful to data users. Value judgments going into summary and interpretation need to be clarified and explicitly stated. This is especially important for the development of global biodiversity indices as they will be one of the main products to transport information to decision-makers and the general public. For this reason, monitoring results should be interpreted in an ecosystem context, i.e. relate monitoring results to the overall state and potential of the respective ecosystem.

Meanwhile, the World Data Center for Biodiversity and Ecology (WDCBE) has addressed the data and information requirements of some of the world's global biodiversity and ecological issues. It is building the framework and partnerships for housing integrated, updated, and accessible global biodiversity, ecology, and geophysical data for use by the scientific and conservation community. Its work towards the GEO Biodiversity Observation Network includes: 1) distribution of data and results from the Millennium Ecosystem Assessment, 2) development of web-enabled capabilities (tools) to improve the efficiency of digital data input and resulting accuracies, 3) acquisition, integration and accessibility of key global data sets (e.g. protected areas, Global Amphibian Assessment, Important Bird Areas, Global Biodiversity Information Facility specimens, ecosystems, geospatial data [e.g., topography, hydrology, land cover, land cover change, census]), and 4) creation of long-term data sharing and analysis partnerships with leading international biodiversity and ecological informatics and conservation organizations. For this purpose, various global biodiversity and associated geophysical data sets are being created. Combined data sets allow for the creation and analysis of valued added products and analyses. The following tools are being designed, developed, tested, and deployed to fulfill these needs: (1) Global Data Tool Kit (GDT): an operational and easy to use on-line polygon data entry tool to facilitate an organization's ability to engage their network in the entry and/or validation of digital data (e.g., protected areas, species distributions, Important Bird Areas, ecosystems); (2) Rapid Land Cover/Ecosystem Mapping Tool: an on-line technique to manually interpret satellite imagery for mapping land cover; (3) Integrated Taxonomic Information System (ITIS): a taxonomic crosswalk

to operationally compare, integrate, and apply global biodiversity data sets. It also provides the museum community with a methodology and data to validate specimen data, while at the same time provides the greater user community with historical observations to increase the spatial accuracy of their particular species distributions.

Therefore, GEOSS-related activities have helped to improve data access, sharing, and use, and to establish forums for cross-cutting development, interdisciplinary collaboration, and community building within the community, thus advancing biodiversity science and its applications. In the near future, the biodiversity science community, through the GEOSS framework, will increase capacity building, especially in developing nations to fill monitoring gaps; develop more tools for policy making to be used in decision-making, especially in the light of improved resource management of marine, freshwater and terrestrial biodiversity resources and ecosystem services; develop cross-links with other GEOSS "Societal Benefit Areas", e.g. land use change, coastal zones, water management, health, etc.; further integrate monitoring activities and modelling exercises.

Keywords: global biodiversity; long-term monitoring; capacity building; GEOSS

Change of soil microbial diversity with landuse alteration from paddy field to vegetable land

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A diverse soil microbial community is an important measure of sustainable land use. The characterization of microbiology characteristics inside the soil, especially the diversity, is essential to gain a better understanding of the effects and contributions of biological activities. However, there is little information on the structure and diversity of soil microorganisms in managed long term cultivated soils. In this study, the composition of bacteria communities was examined by three different methods. The aim of this study was to investigate if and how the change of cultivation management with the landuse alteration affects the soil microbial community.

To evaluate the long term impact of landuse alteration on soil microbiological characteristics, three fields with an area large than 1 ha (the distance among them is less than 100m) in the same area were selected for sampling. Research area is located in Yichen town, Yixing county, Jiangsu province, China. (N 31°23', E 119°58'). The average temperature is 15.7° C and the average rainfall is 1128.0 mm. The first is a paddy field which has been used for more than 100 years as intensive paddy field under conventional tillage (Paddy). The second is a vegetable field which has been altered from the paddy field for ten years (NV, new vegetable land). The third one is an old vegetable field which has been altered from paddy field for more than 100 years (OV, old vegetable). In each field, more than ten sites were choose for sample by auger and mixed. Three replicate was done.

To compare with different level of microbial diversity, three methods were used: soil microbial biomass carbon, total bacterial counting by plate methods, and RFLP analysis. Soil microbial community DNA was extracted, PCR-amplified and the bacterial composition and diversity were examined using molecular data based on 16S rRNA gene clone sequences. The 16S rDNA sequences were compared with sequences from the BLAST database. Genomic DNA was extracted from soil samples and amplified using universal bacteria 16S rDNA primers.

By plate methods, the NV had the highest number of total bacteria (8.6×10^7 cfu g⁻¹), while there was no significantly difference between Paddy and OV. However, there was lower microbial biomass carbon amount in the OV (193 µg g⁻¹), while there was no significantly difference between Paddy and NV. By RFLP analysis, the ratio of RFLP type to clone number was the lowest (0.36) in OV, compared with 0.95 in Paddy and 0.84 in NV. Part of the reason maybe that OV land has reached an equilibrium state regarding competition between species and can thus contain less species than others. When using two enzymes, the RFLP type was different. Part of the reason why the results from Hha I differed from Rsa I may be that different enzymes have different recognition sites, but it showed the importance of using more than one restriction enzyme when evaluating microbial community profiles from environmental samples.

The 16S rDNA sequences obtained form the different clones were subject to phylogenetic analysis.

The sequenced clones were affiliated to major lineages of the domain Bacteria; the alpha Proteobacteria, and delta Proteobacteria, and the Acidobacteria bacterium. Both the RFLP and sequencing results showed there were differences in the three kinds of soils.

Some species are not included because of the heterogeneity of the distribution of fungi in the soil. Although we tried to eliminate the heterogeneity by taking more than 15 soil cores from each plot and mix these into composite samples, there is only a subset of the species actually present in the soil was analyzed.

Different level methods give different point of view, while the link and the discrepancy between different level analysis methods, were to be explored by further researches.

Generally, the change of landuse from paddy field to vegetable land decrease the soil microbial diversity. And soil microbial diversity decreased with the time for this alteration.

Key words: microbial diversity; long-term cultivated soil; 16 S rDNA; Yangtze Delta area

Spatial and time scales of biodiversity trends –the role of LTER to understanding interactions between land use and species distribution

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In Europe, most landscapes have been affected by human activities since millennia. Time lags between species distribution and land use changes can be observed at a variety of time scales; and land use systems and practices at any time, especially nowadays, are a blend of inherited knowledge and innovations. Response to innovation varies among people according to their cultural background, social and economical status. Observations relating biodiversity to land use/ landscape patterns done at a given time assume that 1) the two set of variables are in some kind of equilibrium or, at best 2) take into consideration information on past land cover and landscape structure. Several examples illustrate that the latter improved our understanding of the relationships. In none of the two cases, one can relate the dynamics of the different sets of variables, their scale and rate of variations or give a measure of the time lags between variations. A major advance with long term studies is that they permit to observe the dynamics of interacting variables in an independent manner. The French LTER network main question is the relationship between land use/ climate changes and biodiversity. The different sites focus on different biological groups and land use practices, but have data that are consistent with the need to develop research and monitoring over the long term. In the LTER Valleys and Hills of Gascony, bird species are surveyed every ten years on a 500m square grid by count points (1981, 1991, 2001). The general trend observed (-16% of the total abundance) is consistent with the decline of bird abundances observed in other parts of Europe. The analysis of the relationships between bird communities and land cover changes shows that the global pattern of the bird community was slightly modified through the 20 years period: the same main factors, linked to woodland cover, determined the species distribution; but this global stability encompassed higher local variabilities showing that species-habitat relationships were changing. Sites of higher variability are located mostly in the valleys where conversion of pastures to arable land is frequent. The results underlined also the impact of two extreme winters (1985 & 1987) on the spatial distribution of several species in 1991 which is narrower than in 1981 and 2001, probably because individuals in sub-optimal habitats have been eliminated.

In the LTER Pleine-Fougères, carabids beetles are, with flora, the focal group. Some species (e.g. *Abax parallelipedus*) leave only in stable wooded habitats (woods, hedgerows). We show that the distribution of this species is better explained by the landscape structure 40 years before the

sampling than by current structure. Past structure explains colonization processes impossible nowadays. This single sampling cannot provide any insight on the relative rate of changes of suitable habitat vs. landscape structure. On a shorter time span, we analyzed the cumulative effects of field margin management on carabids communities. While the management practices the year of sampling account for 10% of the variance, the practices over the last 6 years explain 15% of the variance. The current monitoring design enables us to follow both management practices and species distribution. As samples are collected in three landscapes (landscape diversity accounts for 7% of the variance), we can evaluate the effects of both local (management) and landscape factors.

In the two Alps LTER sites, the focus is on the dynamics of grassland alpine and sub-alpine vegetation under different grazing regimes. For more than 25 years, the development of the vegetation of a vast sub-alpine pasture (1500-2000 m asl) which has been partially abandoned since the 1950's is studied in the Oisans, part of the French LTER site "Alps". In the 1980's, cattle and sheep were re-introduced and we started to follow the effect of domestic animals on the vegetation. In 2000, an assessment of the actual state identified the regression of monopolist species with a low fodder quality (e.g. *Brachypodium pinnatum*, *Festuca paniculata*), and an increase in the species diversity, due to grazing pressure after several years. However, in this vegetation type with *Festuca paniculata* the stocking density was adjusted after a first period of high cattle density to a stabilized rate of 1-1.3 heifer/ha during 100 days. Our long-term data thus help us to disentangle the effects of grazing domestic animals and climate on the vegetation and the feedback on the grazing regime. In the Vercors Nature Reserve, diminishing agricultural and forest uses lead to an increase in the wooded surface threatening the high biodiversity. Shortly after the creation of the nature reserve in 1985, permanent plots were set-up to monitor the herbaceous and the woody vegetation. After 20 years, grazing by sheep did not significantly modify the herbaceous vegetation. However, sheep grazing helped to slow down the regeneration of Mountain Pine which spread and increased in density during the 20th century. Exclosures (non grazed plots) are paired with the grazed plots, permitting to set apart the effects of climate changes those of grazing. In each site, consideration of several spatial scales (local management/ landscape structure) and time periods allows a better understanding of factors driving species distribution. The understanding of those relationships between various aspects of biodiversity and land use practices is a key point to managing resources and ecosystem services. Modern societies develop policies to foster sustainable uses of resources and protection of biodiversity. From the ecological standpoint, the two main questions are: 1) The rate at which policies designed at high levels in societies (e.g. international conventions, EU directives for Europe) are translated at landscape scale level for action, and 2) the time it takes to ecological systems to react to management changes linked to those policies. An analysis of the implementation of EU policies concerning the protection of biodiversity reveals that more than 10 years may be necessary before any action begins. Meanwhile the practices causing losses of species continue, afterwards changes in those practices may take some more years. Long term, site based research on socio-ecological systems permit to fully address research and applied questions like responses of societies to environmental problems by changes in policies and the response of ecological systems to novel drivers.

keywords: biodiversity; land use; France; agriculture; vegetation; birds; carabids

Population structure and dynamics of *Neobalanocarpus heimii* (Chengal) in a lowland dipterocarp forest

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Sustainable utilization of commercial species has received great deal attention in the international negotiation such as Convention on Biological Diversity (CBD) and CITES. To ensure sustainable harvest of a species requires the understanding of its population structure and dynamics. Basic demographic information on population abundance, growth increment, mortality and recruitment based on sufficient data is required to support the sustainable utilization of the species. In 1985, a 50 ha plot was established in a lowland dipterocarp forest of Peninsular Malaysia for the purpose of gathering this information. Since then, three more censuses have been completed in 1990, 1995, 2000 and 2005 for all trees 1 cm dbh and above measured. A total of 814 species with 335,400 individuals was recorded during the first census. The plot provides substantial database on demographic patterns on some of the important commercial species. This paper presented the population structure and dynamics of a highly commercial heavy hardwood tropical timber species, *Neobalanocarpus heimii* in the 50 ha plot. The timber is suitable for all forms of heavy constructional works, bridges, railway sleepers, power-line poles, heavy duty flooring and furniture, a favourite timber used for boat building and carving for Malay traditional house.

Study site

The study site is located at Pasoh Forest Reserve in Peninsular Malaysia). All free-standing trees greater than 10 mm dbh were measured at 1.3 m above ground and identified to species level. We used the first two census data to describe the population structure and dynamics. The advantage of large plots is that sufficient individual is obtainable in almost all size class. The plot is part of the long-term ecological research network of the Center for Tropical Forest Science.

We calculated the population abundance and change, growth rate, mortality rate and recruitment of *Neobalanocarpus heimii* by dbh limits and dbh class. The individual growth rates are presented as absolute and relative value. The absolute growth rates is the difference of diameter between the two census divided by mean interval time of the quadrants. The relative growth rate is the annual increment divided by the natural logarithm of initial dbh. Abundance of trees for both censuses was taken as number of all surviving trees at each census. Mortality is taken as trees that died in the 2nd census. Annual recruitment rates were calculated similar to mortality rates. It required two complete datasets, one per census with date for every individual of trees in the first and second census. Recruitments were define as the as the trees found in the minimum dbh limits of the second census but absent in the first census. The date of census in each 20x20m quadrant of the plot was used to calculate the mean interval time between censuses.

The program code to run the analysis was developed in R freeware by the CTFS scientists lead by Dr. Richard Condit, Dr. Pamela Hall and Suzzane Lao.

Results

Abundance and population change

Neobalanocarpus heimii constitute 0.98 % of the total population of trees in the 50 ha plot with 3290 individuals in the first census of all trees greater than 10 mm dbh. The stem density decreases by 98 individual in the second census and representing similar density of 0.99 % of the total population (Table 1, Table 2). The proportion of trees greater than 100 mm increases from 4.8 % to 5.3 % in the first and second census, respectively (Table 1). Most of the trees are at the sapling stage below 40 mm dbh with 79 % fall into this category in the first census. The rate of population change differs with minimum dbh used. The 10mm dbh limit showed a negative rate but larger minimum dbh limit of 50 mm and 100 mm showed rate of above 2.0 % (Table 1). The trend in population change showed similar pattern with total population of trees in the 50 ha plot, with -1.2 %, 1.28 % and 1.45 % for 10 mm, 50 mm and 100 mm dbh limit, respectively.

Growth

The growth of trees differs by the size classes with a general trend of increasing growth rates associated with the initial size of trees (Table 2). The relative growth rates showed the opposite trend. Smallest size trees exhibited the highest relative growth rates and subsequently decline sharply until stabilize at 100 mm.

Mortality

The annual mortality rate above 10mm was 1.02%. The 50 mm and 100 mm dbh limit also showed a lower rate with less than 0.7 % per year. (Table 1). The rate is lower when compared with mortality of all trees (1.17%). No mortality was recorded for 320-640 mm (N=30) and 640 mm and above (N=43). Highest mortality rate was recorded for 160-320 mm dbh at 2.75 % (Table 2).

Recruitment

The overall recruitment rates for tree above 10 mm is 0.87 % with 88 trees recorded in the second census (Table 1). Higher dbh limit showed a higher value of recruitment rates at 3.93% and 3.02 % for dbh minimum limit of 50 mm and 100 mm respectively. The low recruitment rate for 10 mm dbh could have been due to low fruiting during the period. The recruitment rate of *Neobalanocarpus heimi*, however was higher than the plot average for all trees (0.59 %).

Almost all recruits fall in the lowest size class 10-20 mm dbh which probably relates to the slow growing characteristics of *Neobalanocarpus heimii*. Only two saplings move to the 20-30 mm dbh (Table 2).

Conclusion

The high number of *Neobalanocarpus heimii* individual in the 50 ha demography plot, allow us to assess the dynamics of its populations in relation to different size limits and classes. The results had shown that population abundance and absolute growth rates differs with increasing size classes. Mortality rate, however did not show any trend by size classes. Recruitment rate was higher as compared to the mortality rates. The mortality rate was lower and and recruitment rate is higher than the all trees in the plot.

Table 1: Population abundance change, mortality and recruitment by minimum dbh limits of *Neobalanocarpus heimii*

Minimum dbh (mm)	N1	N2	Population change (%)	Mortality		Recruitment	
				N	Rate (%)	N	Rate (%)
10	3290	3192	-0.97	103	1.02	88	0.87
50	491	537	2.96	10	0.68	542	3.94
100	159	170	2.20	3	0.63	15	3.03

Table2: Population abundance change, mortality and recruitment by minimum dbh limits of all trees

Minimum dbh (mm)	N1	N2	Population change (%)	Mortality		Recruitment	
				N	Rate (%)	N	Rate (%)
10	335352	323237	-1.25	11237	1.17	5709	0.60
50	68762	71390	1.26	2078	1.05	5595	2.76
100	26554	27699	1.40	895	1.18	2283	2.93

Table 3: Population abundance change, growth, mortality and recruitment rates by dbh class of *Neobalanocarpus heimii*

dbh class (mm)	Initial		Growth (mm yr ⁻¹)		Mortality (%)				Recruits (N)	Final (N)
	N	N	Rate	CI	N	Rate	CI	CI		
							Lower	Upper		
10-20	1462	1352	1.33	0.06	60	1.33	1.02	1.67	86	1207
20-30	715	676	1.29	0.07	14	0.63	0.31	1	1	791
30-40	416	391	1.38	0.1	15	1.20	0.63	1.85	1	444
40-80	473	450	1.64	0.13	9	0.64	0.28	1.07	0	511
80-160	126	119	2.12	0.36	3	0.81	0	1.92	0	137
160-320	25	23	4.34	1.19	2	2.75	0	7.35	0	28
320-640	30	28	4.22	1.72	0	0	0	4.08	0	32
640	43	41	5.35	2.39	0	0	0	2.84	0	42
Total	3290	3080	-	-	103	-	-	-	88	3192
Average	-	-	1.5	0.06	-	1.02	0.83	1.22	-	-

CI: Confidence Interval

N: Number of individuals

Long-term changes forest soil mesofauna on the background of climate warming

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Much attention in our days has been paid to the influence of the climate warming on visible, attractive animal species like birds, mammals, amphibians and butterflies. Very few data are available on the cryptobiota - soil invertebrates, represented mainly by microscopic creatures. However, these small animals play an important role in terrestrial ecosystems by soil formation, enhancing of nutrient cycling, decomposition of plant litter, humus formation, and digging activities. This kind of ecological service they provide is of crucial importance for the human society. Changes in species composition of soil fauna due to the climate warming may initiate significant deviations in litter decomposition and soil formation making it vulnerable to degradation and fertility loss. The soil fauna can be regarded not only as an actor of soil formation but also as an early warning bioindicator of changes of soil conditions. Therefore it can be used in soil ecosystem assessment under the influence of the global climate warming.

Until recently most of the studies performed on soil fauna focused on experimentally simulated drought effects (Kennedy, 1994; Briones et al., 1997; Lindberg, 2003). However, the results of model experiments are restricted by small spatial scales and cannot reveal long-term changes of soil ecosystems affected by the climate warming. The real changes can be traced only by the long-term research in natural circumstances. There are very few long-term studies of soil fauna in which at least five-year data are considered (Wolters, 1998; Rusek, 1993).

We performed regular studies of pine forest soil mesofauna (Enchytraeidae, Collembola and Gamasina) as from 1992 in the pine forest sites of the National LTER Network of Latvia in the North Vidzeme Biosphere Reserve. Analysis of the first ten-year data (1992-2002) revealed considerable trends in population numbers and community structure of soil mesofauna. Data from three forest sites represented by young (30-40 years), middle-aged (50-70 years), and old (150-200 years) Scotch pine stands growing on sandy spodosol soils were analysed.

In Latvia, warming of the climate has been documented by statistically significant increase of mean temperatures during the last decades. We used data from the local meteorological station. Statistically significant increase of positive ($\geq +4^{\circ}\text{C}$) temperature sums took place during the study period. No statistically significant trends were found in mean air temperatures and soil moisture.

Sampling of soil mesofauna was performed once a year, on the end of August. Soil microarthropods were collected from series ($n=100$) of soil samples ($5\text{ cm}^2 \times 10\text{ cm}$) by using modified high gradient extractor, and Enchytraeids from series ($n=30$) of soil samples ($23\text{ cm}^2 \times 10\text{ cm}$) by using wet funnel techniques. Non-metric Multidimensional Scaling (NMS) and correlation analysis was used in data analysis.

In total, 67 species of Collembola (total density 1820-28100 ind/m²), 46 species of Gamasina mites (1040-6120 ind/m²) and 7 species of Enchytraeidae (8300-10 700 ind./m²) dominated by

Cognettia sphagnetorum and *Achaeta* spp. were recorded.

NMS of Collembola data yielded two intercorrelated ($r=0.455$, $p<0.05$) axes. Axis 1, explaining 48.6% of data variation had strong correlation with positive temperature sums ($r=0.66$, $p<0.01$), and Axis 2 (38.6%) with soil moisture ($r=-0.62$, $p<0.01$). Temporal trajectory of community along Axis 1 describing climate warming was strongly controlled by the fluctuations in soil moisture. Interactive effects of these factors became apparent as loops in the community trajectory within the NMS axes (Jucevica, Melecis, 2005). The species richness showed statistically significant decrease during the study period from 29-36 to 13-26 species.

NMS of Gamasina data yielded three axes. Axis 3 (35.2%) was correlated with soil moisture ($r=-0.536$, $p<0.01$), Axis 2 (23.7%) with mean air temperatures ($r=-0.496$, $p<0.05$), and Axis 1 (15.7%) with positive temperature sums ($r=-0.531$, $p<0.05$). Therefore, fluctuations in soil moisture played the most important role in formation of community structure. Species richness of mites was declining during the period of study from 13-19 species in 1992 to 9-11 species in 2002 and was correlated with Axis 1 and Axis 2.

Statistically significant correlations with soil moisture were recorded for the total numbers of Enchytraeids ($r=0.593$, $p<0.05$) and *C. sphagnetorum* ($r=0.597$, $p<0.01$). Density of *Achaeta* spp. showed positive correlation with mean air temperatures ($r=0.543$, $p<0.01$).

Our studies demonstrated that the climate warming during the ten-year period negatively affected three ecologically different components of soil mesofauna – springtails, mites and partly enchytraeids. Collembola and enchytraeids are saprophagous and mycetophagous, while Gamasina mites are zoophagous. They prey on soil nematodes, enchytraeids and springtails. Therefore, reduction of Gamasina communities may be at least partly explained by decrease in their food supply. The soil moisture is one of the most important factors responsible for year-to-year population fluctuations of soil mesofauna. However, gradual increase in temperature seems to be the most important factor responsible for long-term trends in the community structure. It is important to note that until now no new species of southern origin have been observed to invade the community. Reduction of soil mesofauna in northern forest ecosystems may result in gradual decrease of humus formation. A shift from animal-grazing litter decomposition to microbial induced decomposition may occur. This may change the structure of the forest humus layer by decreasing porosity and aeration of the soil organic horizon.

Keywords: climate warming; soil mesofauna; pine forests

Global change research on South Africa's plant biodiversity

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The Fourth Assessment Report (AR4) of the Inter-governmental Panel on Climate Change (IPCC) has predicted further increases in temperature and more drought events in Africa and other areas around the world. These changes are as a result of the global increase in atmospheric greenhouse gases by 70% between 1970 and 2004 due to anthropogenic activities. Climate change is already impacting negatively on many physical and biological systems as seen from observations of the almost 30 000 data sets from around the world. Of major concern is that of the almost 30 000 data sets less than 10 observations are in Africa, making Africa even more vulnerable to climate change. Here we report on some of the pioneering work carried out by the South African National Biodiversity Institute (SANBI) and collaborators to understand global change impacts on some key vegetation types (Savannas and Succulent Karoo) of South Africa. We begin by reporting on a climate-driven range shift in *Aloe dichotoma*, a succulent tree of the Namib desert, that suggests that such plants' ranges may become squeezed between rapidly contracting trailing edges and poor dispersal at the leading range. We also present results on the impacts of the rising atmospheric CO₂ since the last ice age and the interaction with fire on South African savannas. Broad and fine-leaved African savanna trees were exposed to a series of CO₂ regimes (180, 260, 375, 450 and 540 ppm) for a period of two and a half years. Carbon uptake of broad leaved species showed a linear increase in contrast to the fine leaved species which exhibited a curvi-linear response. However, carbon uptake of all trees was suppressed under sub-ambient CO₂ and significantly improved under super-ambient conditions. The broad leaved species allocated more carbon above ground contrary to below ground allocation in the fine leaved species. The latter response is argued to be an important adaptation trait that facilitates vigorous re-sprouting following fire or browsing. Our results also indicate that African savanna trees were less defended against herbivory during the last glacial maximum era but this is reversed under current ambient and future atmospheric CO₂ conditions. The latter scenario will impact negatively on herbivores that inhabit African savannas. This study suggests that the increase in atmospheric CO₂ will favour tree recruitment and transform African savannas to dense woodlands and adjacent grasslands to savanna like vegetation type. Finally, we show the impacts of elevated temperatures on endemic species of the Succulent Karoo biome – one of the global hotspots of biodiversity. Clear open top chambers of different heights were used in the field to simulate a series of temperature regimes above ambient. The results showed that even small temperature increases of less than 3°C raise the risk of mortality of endemic Succulent Karoo species.

Keywords: Savanna; temperature; CO₂; Succulent Karoo; climate change; Africa

Biodiversity monitoring in China --on Chinese forest biodiversity monitoring network

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The world is currently experiencing exceptionally high rates of species extinctions, largely because of human activity. Monitoring biodiversity to assess the magnitude and rate of loss are emerging as main topic in conservation biology. Networks of monitoring biodiversity such as Center of Tropical Forest Science (CTFS) network have extended their sites to almost all continents. With one of largest territories, China has its forest cover only accounting for 16.5% of the total area. At the same time, the country is currently experiencing an economic booming. Establishing networks to monitor biodiversity of different habitats is urgently needed in China.

We began to set up the Chinese forest biodiversity monitoring network in 2005. Before that, we have established a number of similar permanent plots for the same purpose, but much smaller with area. Up to now, we have set up 4 plots with the area more than 20 hm² and 5 5-hectar plots. The plots are distributed in different climatic zones. In temperate coniferous and broadleaved mixed forest region, there are 1 25-hectar plot and 1 5-hectar plot; in warm temperate broadleaved forest region, there is 1 5-hectar plot; in subtropical evergreen broadleaved forest, there are 1 24-hectar plot, 1 20-hectar plot and 3 5-hectar plots; in monsoon tropical rain forest region, 1 20-hectar was established. We planned to set up 2 more plots in cold temperate coniferous forest region and western part of subtropical evergreen broadleaved forest respectively. Try to set up a network covering most of the dominant forest ecosystems in China.

Assessment and conservation of biodiversity in Malindang Range, Mindanao, Philippines

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The research attempted to generate comprehensive information on richness, status, and conservation of the biodiversity in Malindang Range Natural Park in Misamis Occidental, Northern Mindanao, Philippines. Inventory of the forest and agroecosystems was carried out in three municipalities of Misamis Occidental, viz., Don Victoriano, Oroquieta City and Lopez Jaena. Nine vegetation types were delineated namely, mossy forest (above 1700 masl), montane forest (1000-1700 masl), dipterocarp forest (700-1400 masl), almaciga forest (1000-1400 masl), two types of mixed-dipterocarp forest (300-400 masl), lowland dipterocarp forest, plantation forest (300-1400 masl) and agroecosystem (300-1400 masl). Each vegetation type was characterized by a specific combination of plant species. The mossy forests has the community of *Ascarina philippinensis* and *Xanthomyrtus diplycossifolium*. The montane forest has the community of *Clethra lancifolia* and *Impatiens montalbanica*. The submontane dipterocarp forests were comprised of Almaciga forest (community of *Almaciga philippinensis* and *Cinnamomum mercadoi*) and the community of *Ficus minahassae* and *Bischofia javanica*. Lowland dipterocarp forest (community of *Ficus variegata* and *Selaginella moellendorffii*) were found at lower altitudes. Two types of mixed dipterocarp forests occurred on steep slopes, namely, community of *Shorea polysperma* and *Shorea palosapis* at relatively high altitude (above 700m) and community of *Diplodiscus paniculatus* and *Lithocarpus* at lower altitude. Plantations and degraded forests were found near Barangays Peniel and Bunga. The agroecosystem was characterized by arable fields with vegetables (*Sechium edule*-*Allium fistulosum*) and cereals (*Oryza sativa*-*Zea mays*). Also agroforestry (*Cocos nucifera*-*Lansium domesticum*), and grass-dominated fallowed areas (*Cyathea* spp.-*Saccharum spontaneum*) have been assigned to this group.

The forests and the agroecosystem vegetation types revealed a total of 1286 species of plants: 873 angiosperms, 20 gymnosperms, 281 pteridophytes, 84 mosses (Bryophytes), and 28 lichen species. It further revealed a total of 278 species of vertebrates (26 amphibians, 51 reptiles, 161 birds, 19 volant mammals and 21 non-volant mammals).

Among the vegetation types, the Almaciga forests appeared to be the most species-rich vegetation type (on average 33 species per plot) with the most number of endemic species, followed by the montane forest and the mossy forest (29 and 31 species per plot, respectively). The lowest species richness and endemism were found in the plantation forest with 11 species per plot only. For fauna, endemism of 59.69% for frogs and toads, 58.33% for skinks, 37.5% for snakes, 40.99% for birds, 47.37% for volant mammals and 66.67% for non-volant mammals were observed.

In general, the forest types (except the plantations) scored high on the species diversity index, with

values from $H=1.92$ to 2.04 . It is expected that this species diversity index may increase when the forest will be protected and properly managed. This can be combined with sustainable use of these ecosystems by the local people of Malindang Range Natural Park. The forest types revealed 56 and 30 endangered and threatened species of plants and animals, respectively.

Mass propagation of endemic, rare and economically important plants in a nursery and green house, as an ex situ conservation strategy, was conducted through the participation of the local community in selecting priority plants, collecting seeds, wildings and seedlings from the forests. When the wildings were potted in various potting media, there was no significant difference as to percentage survival. The hardened outplanted wildings along the roads and trails of the village showed high percentage survival, which is an indication that they could be easily propagated as rainforestation species and to rehabilitate denuded forests. The identification of forest types, their communities and threatened species are vital information for the production of Information, Education and Communication (IEC) materials for immediate dissemination to the decision makers, to the concerned communities and stakeholders. This will enable them to design protection, conservation and management strategies through their annual natural resources management action plan.

Key words: diversity; vegetation types; conservation; Northern Mindanao; Philippines

Dynamics of tree species ecological groups in logged and unlogged tropical forests in the Venezuelan western plains

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The study of tree mortality and recruitment contributes to the understanding of forest dynamics and, at the same time, supplies a baseline to evaluate the impact of human activities. The study site is a moist semi-deciduous forest located in the Caparo Forest Reserve, Barinas state. Tree data were obtained from four 0.25 ha and four 1 ha permanent plots in unlogged and logged stands, respectively. Successive measurements were taken during a 15 years period. Tree species mortality and recruitment was analyzed for individuals with diameter at breast height (dbh) >10 cm. The species were classified according to their shade tolerance (low or intolerant, intermediate and high or tolerant) and the maximum height (hmax) (small <15 m, medium: 15-30 m and large >30 m). Consequently, eight groups were formed because of the absence of shade intolerant species (pioneers) with large size. Palms were considered as a separate group. In the unlogged stands 307 and 274 trees ha⁻¹ were found at the beginning and final time of the monitoring period, respectively. These trees were classified into 55 and 48 species, respectively. Among them predominate *Attalea butyracea*, *Coccoloba padiformis*, *Spondias mombin*, *Fissicalyx fendleri*, *Zanthoxylum culantrillo*, *Pouteria reticulata*, *Pachira quinata*, *Syagrus sancona* and *Terminalia amazonia* with more than 10 individuals ha⁻¹. Most of these species belong to the shade intermediate tolerant and large size group and palms. Similarly, in the logged forest 151 and 115 trees ha⁻¹ were found At this initial and final time of monitoring 59 and 60 trees species were recorded, respectively. Only four species were found with 10 or more individuals ha⁻¹, they are *Attalea butyracea*, *Ochroma pyramidale*, *Cecropia peltata*, *Pouteria reticulata*. The majority of these species belong to the functional group of shade intolerant medium size species, which may be partly explained by forest recovering after selective logging. The correlation analysis showed that tree density in the unlogged stands was not significantly correlated to tree mortality during the period ($r = 0.469$). In the same way, tree recruitment in each one of the plots was not significantly different ($r = 0.5667$). Correlation between tree mortality and recruitment showed a similar result ($r = 0.4904$, $P = 0.2997$). In the logged stands, tree density was not correlated to the number of dead individuals during the monitoring period ($r = 0.4218$); in contrast, a statistically significant difference was found for tree recruitment ($r = 0.9656$, $P = 0.02$). The correlation between tree mortality and recruitment was not significant ($r = 0.5988$, $P = 0.2262$). Moreover, in the logged forest the mean annual rate of tree mortality is 2.57%, a value higher than those reported for this type of forest under undisturbed conditions recently. The lowest mortality rate (1.51%) was obtained for the shade intermediate tolerant medium size species. Similarly, the annual recruitment rate reached 3.30% with the highest value for the shade tolerant small size species, followed by shade intermediate tolerant large size species. In the unlogged forest the mortality rate reached 2.8%, and the highest values corresponded to shade intermediate tolerant and intolerant small size species. This may be related to the absence of recent human activity. The recruitment rate was 1.49%, with the lowest values obtained for the same groups with highest mortality. In the logged stands a significant difference was found among the functional groups for tree mortality rates (Kruskal-Wallis test = 15.64, $P = 0.05$, 8 df.), but not for tree recruitment rates. These results show some effects of ecosystem disturbance in forest dynamics.

Key words: ecosystem disturbance; recruitment; tree mortality; tropical forest

Phylogenetic diversity of nitrogen-fixing bacteria in mangrove sediments assessed by PCR- Denaturing Gradient Gel Electrophoresis

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Nitrogen fixation was considered being the major source of combined nitrogen input in mangrove forest habitats. Culture-independent PCR-denaturing gradient gel electrophoresis (DGGE) was employed to assess the composition of diazotroph species from the sediments of three mangrove ecosystem sites in Sanya, Hainan Island, China. A strategy of removing humic acids prior to DNA extraction was conducted, then total community DNA extracted using the soil DNA kit successfully for *nifH* PCR amplification, which simplifies the current procedure and results in good DGGE banding profiles. The predominant DGGE bands of ten sediments samples grouped into two main groups, which consistent with the cluster analysis of environmental parameters. The results from statistical analysis indicated that organic matter content, especially nitrogen could influence the diazotrophic community structure in mangrove sediments. The predominant DGGE bands were sequenced, yielding 31 different *nifH* sequences, which were used in phylogenetic reconstructions. Most sequences were from Proteobacteria, e.g. α , γ , β , δ -subdivisions, and characterized by sequences of members of genera *Azotobacter*, *Desulfuromonas*, *Sphingomonas*, *Geobacter*, *Pseudomonas*, and *Pelobacter*. This is the first time a direct molecular approach was used to investigate the nitrogen-fixing bacterial composition in mangrove ecosystem. All *nifH* sequences were reported for the first time in mangrove system. Statistical analysis reveals that the environmental status has potential effect on the nitrogen-fixing bacterial population composition of mangrove system.

Keywords: mangrove sediments; nitrogen-fixing bacteria; PCR-DGGE;

Biodiversity research in the cross-border Lithuanian-Belarusian and Lithuanian-Russian LTER sites

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The cross-border site-based ecological research was recently initiated in two Lithuanian LTER sites shared with Belarus (Cepkeliai mire complex and Lake Druksiai) and in one LTER site (Baltic coastal wetlands) shared with Russia. Cepkeliai mire complex (total area – 25,000 ha) stretching in territories of Lithuania and Belarus is one of the largest in Central Europe. The joint Lithuanian – Belarusian research program on biodiversity of this mire ecosystem was initiated in 2001. 18 habitat types of European importance (according to the European Union Habitats Directive) were identified in Cepkeliai mire complex. Particularly valuable habitat types of the site are active raised bogs, deciduous swamp woods, bog woodland and alluvial forests. Large areas covered by old wet forests have never been used for intensive forestry or agriculture. More than 1,230 flora species have been recorded in the site, including 145 species of Algae, 135 – Lichenes, 301 – Fungi, 119 – Bryophyta, 6 – Lycopodiophyta, 6 – Equisetophyta, 14 – Polypodiophyta, 3 – Pinophyta and 595 – Magnoliophyta. The wetland complex hosts numerous rare plant species protected in Belarus, Lithuania and in the European Union. Very high diversity of fauna is characteristic of the Cepkeliai wetland complex. About 2,500 species of invertebrates, 14 – fishes, 10 – amphibians, 6 – reptiles, 183 – birds and 41 – mammals have been recorded in the site. This large natural complex of wetlands is of crucial importance for the maintenance of rare and vulnerable species, included into the Red Data Books of Belarus and Lithuania, and listed in the EU Habitats and Birds Directives. Lake Druksiai is also a cross-border LTER site shared by Lithuania and Belarus. This large lake (total area – 4,480 ha) is used as the water-cooling reservoir of the nuclear power station. The water volume annually used for cooling up to nine times exceeds the natural water volume of the lake and up to 27 times – the natural annual influx of water into the lake. The joint Lithuanian – Belarusian research program in Lake Druksiai initiated since the 1970s is focused on topics related to impacts of thermal and other anthropogenic loads on lake ecosystem. Since the beginning of nuclear power plant exploitation, the trophic status of Lake Druksiai changed from oligo-mesotrophic to eutrophic or hypertrophic. The succession of the cooler's ecosystem is several hundred times more intensive, if compared with a natural process. Stenobiotic species got scarce or extinct, while the abundance of eurybionic species increased dramatically. Changes in ecosystems of the closed-type coolers after the closedown of the nuclear power station are poorly investigated. Since the exploitation of the nuclear power station located at Lake Druksiai will be terminated in 2009, this cross-border LTER site will become a representative model for such investigations. The total area of the Lithuanian coastal LTER site shared with Russia - about 90,000 ha. The site is distinguished by one of the very few natural or moderately changed estuaries, remaining along the coastline of the Baltic Sea and the largest brackish lagoon in the Eastern Baltic region. The joint Lithuanian – Russian research program in

this site was initiated in 2001. It is focused on biodiversity and long-term land cover changes in this cross-border coastal ecosystem. According to the diversity of valuable types of habitats this wetland complex is one of the most important in the Baltic region. Particularly valuable habitat types of the site are estuaries, coastal lagoons, inland dunes, active raised bogs, deciduous swamp woods and alluvial forests. More than 600 vascular plant species were recorded in the site during this research program. The wetland complex is distinguished by rare and protected plant communities, characteristic exclusively of coastal floodplains. This large complex of wetlands supports many rare and vulnerable fauna species listed in the EU Habitats and Birds Directives. The site supports 57 nesting bird species listed in the Annex I of the EU Birds Directive. It is the key stopover site for numerous migratory waterbird species in Europe. Internationally important concentrations of 17 waterbird species were recently recorded in the site. The coastal LTER site is also the key path for migratory fish species. The analysis of land cover changes based on photo-interpretation of satellite images in this cross-border LTER site has revealed that the key habitats remained unchanged there since 1975. The database of transboundary LTER sites was developed in 2005. The database contains detailed data on rare fauna and flora species in each cross-border territory, distribution of all rare species in each territory plotted in maps, multi-species maps and recommendations on conservation and management of rare species and communities. Replicates of the database were forwarded to the regional and local authorities responsible for the land-use and conservation of cross-border LTER sites. The changes that have taken place in Europe during recent years have impacted also the cross-border LTER sites shared by Lithuania – Belarus and Lithuania – Russia. These areas that were formerly far from international borders now are located along the eastern border of the European Union and attract the interest of international and national authorities. Therefore further long-term ecological research of cross-border LTER sites will serve as an important tool for their joint management and protection.

Keywords: long-term cross-border research; biodiversity

Workshop 2 Ecosystem Restoration

Monitoring the recovery of the vegetation in two conservation areas in the Succulent Karoo, South Africa

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Namaqualand is a winter-rainfall desert, located in the northwestern part of South Africa. It is part of the Succulent Karoo Biome, one of only two entirely arid regions to qualify as a hotspot of global significance. Compared with other similar deserts of the world, Namaqualand has an exceptionally high level of endemism and an unrivalled diversity of leaf succulent and geophytic species. This rich plant diversity is vulnerable to land use practices such as pastoralism which is commonly associated with overgrazing, especially in communal land, but also on privately-owned land. In the higher rainfall areas of Namaqualand, the landscape has also been highly transformed by the clearing of land for the cultivation of crops. To most people, Namaqualand is synonymous with mass displays of wild flowers. Ironically, this springtime floral spectacle is often associated with land degradation as it is especially prominent on fallow or abandoned fields and other disturbed or overgrazed sites. These flower displays attract thousands of tourists annually and are a valuable source of income to the region. Conservation authorities are therefore often confronted with the conflicting demands of tourism (associated with high levels of disturbance and low levels of diversity) on the one hand and conservation on the other. Several long-term studies have been undertaken in two conservation areas to monitor the recovery of the vegetation after the cessation of farming practices, i.e. after abandoning cropping and the removal of livestock. In the Namaqua National Park the recovery of the vegetation on abandoned cropland is monitored annually. Four abandoned fields, differing in time since last disturbance were selected in 1993 to monitor changes in species richness and composition. When the first surveys were made the ages of the fields were 3 years, 4 years, 10 years and 40 years respectively. Total species richness increased with time since abandonment. This increase was mainly due to an increase in the perennial component, while the annual component was not yet decreasing after >50 years. Species composition of the perennial species showed a clear directional trend over the monitored years. The annual species did not show a similar directional trend and their composition seemed to be dictated by the timing and amount of seasonal rainfall. Although the richness of the annual species did not diminish with time since abandonment, the abundance of the showy species has decreased. In the Goegap Nature Reserve a long-term monitoring project was initiated in 1974 after the reserve had been fenced and all livestock removed. Initially only two line transects of 1000 descending points were set out. As the reserve was enlarged an additional five transects were added in the 1990s in highly degraded areas and a further 14 transects were added in the 2000s to cover all the different vegetation types. Only the two longest monitored transects show clear trends as yet, indicating the slow rate of recovery of the vegetation. The species composition revealed notable changes over the monitored period with a slight increase in palatable species and decrease in unpalatable ones. Together with an increase in vegetation cover of the perennial species, these changes constitute an improvement in the range condition. The annual component showed no directional trend, but reacted to the timing and amount of seasonal rainfall.

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Keywords: abandoned cropland; biodiversity conservation; disturbance; Succulent Karoo; vegetation recovery

Vegetation restoration of the abandoned cropland in Horqin Sand Land of China

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Cropland is one of important ecosystems in the agro-pastoral transitional area in northern China due to its contribution to grain production, water consumption and invasion into grassland, and desertification. Since implementation of the policy of 'Reversing Cropland into Grassland/Woodland for Land Degradation Control' in 1999 in Horqin Sand Land, which is a typical part of the agro-pastoral transitional area in northern China, large area of cropland was restored into grassland, some even restored into tree-scattered grassland. Considering frequent drought and growing human pressure on the ecosystems, however, the following questions are more frequently asked: How this abandoned cropland successes into grassland? Is the restored grassland sustainable or stable?

With these two questions, researchers from Naiman Desertification Research Station (NDRS), Chinese Ecosystems Research Network (CERN) have carried out a series of monitoring of the changes from two croplands, one irrigated and the other rainfed, to grassland from the very beginning of implementation of this policy. Monitoring found that:

Restoration of abandoned cropland was influenced by residue crop species, surrounding vegetation, and the weeds mixed with crops before restoration. The residue crop species played a key role in vegetation restoration at the beginning, either as a competitor or protector for the newly invaded species. The rainfed cropland was dominated with liquorice (*Glycyrrhiza uralensis*), grasses (*Digitaria ciliaris*, *Setaria viridis*) at first, and then semi-bushes, such as *Artemisia annua*, mixed with millet (*Panicum miliaceum*) in the first three years, and then ruderals. For the irrigated cropland, the succession was dominated with grasses, and then *Artemisia annua* and grasses again. The coverage was increased from less than 10% in the first year up to 60% in the fifth year; and the species increased from five in the first year to 15 in the fifth year. But the species composition was different from each other. Irrigated cropland was restored fast than the rainfed cropland mainly due to water availability and soil characteristics.

Compared to the related research, it is concluded that the restored vegetation is still in a dynamic process, which is frequently disturbed mainly by human activity. It is quite difficult for the vegetation to be restored to a so called regional climax stage, which is dominated with *Ulmus pumila* scattered *Leymus Chinesense* and/or *Stipa grandis* grassland. The policy of 'Reversing Cropland into Grassland/Woodland for Land Degradation Control' is feasible and made positive contribution to restoration of degraded cropland.

Keyword: agro-pastoral transitional area; abandoned cropland; grassland; restoration

Indigenous knowledge in wetland management in Lake Victoria Basin

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This paper addresses how the local community applies the knowledge and skills to actively manage their wetlands for poverty alleviation purposes. In the search for such information, the discussions and participatory rapid appraisal (PRA) activities were widened in scope to investigate the characteristics and functioning of the wider network of wetland use and management information in which farmers play a pivot role. About 96% of interviewed farmers reported that, the use of indigenous knowledge (IK) of Rain-Water Harvesting (RWH) has increased the rice production substantially. The cost and benefit analysis of RWH system, shows that returns to labour for smallholder farmer based on RWH system in all study villages ranges between Tsh 5,000 and 35,000 per manday. As compared to rainfed based rice cultivation with returns to labour ranging between Tsh 500 – 1500 per manday, the indigenous RWH has a higher potential towards poverty alleviation. The study also addresses the IK used for conservation and management of wetland resources. The people of Simiyu basin are practising indigenous natural resource management system called *ngitili* - a Sukuma word meaning enclosure. The *ngitili* system involves the conservation of grazing and fodder lands by encouraging vegetation regeneration and tree planting. With respect to the importance of IK in wetland use and management it is concluded that, the IK has significance importance to the livelihood of the local communities as it is used for improving crop production, household income through utilization of wetland resources. The *ngitili* system has proven to help protect the environment and improve the livelihoods of communities in the region.

Keywords: Rain-water Harvesting; indigenous knowledge; rice cultivation; returns to labour; gross margin; *ngitili* system.

Evaluating vegetation recovery following forest fires in humid subtropical mountain forest ecosystem in central Taiwan using multi-temporal SPOT images

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Fire disturbance plays a dominant role in cold-temperate coniferous forest ecosystems, altering forest succession, biogeochemical cycling, and carbon sequestration. Vegetation recovery from fire has been widely studied at the stand level in many types of terrestrial ecosystems, but few studies have examined factors controlling regeneration at the landscape scale. Over large areas, fire history, climate, topography, and dominant vegetation may affect post-fire response. We used the Normalized Difference Vegetation Index (NDVI) from SPOT sensor to monitor vegetation recovery in a 299 ha area of Yu-shan mountain area in central Taiwan following a fire event in 1993. Post-fire NDVI recovery trajectories were derived for the entire area and for individual vegetation types. Results indicated that the post-fire recovery was rapid in the first five years after the fire. The recovery trajectories of the different vegetation types were similar, and the resistance and resilience of natural conifer forest and hardwood forest was better than mixed forest and plantation. NDVI changes were closely related to topography with higher NDVI decrease at higher elevations than in lower elevation. This is possibly caused by the soil moisture gradients that decrease from lower elevations to higher elevations. The NDVI values for the fire in 2006 (14 years after the fire) were still lower than the pre-fire level.

Keywords: remote sensing; forest fire; recovery; NDVI

Long-term ecological studies and ecosystem rehabilitation on the Loess Plateau of China —challenge and prospective

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The Loess Plateau is well known for its serious soil erosion and ecosystem degradation. This paper analyzes the characteristic of soil erosion and landscape on the Plateau and reviewed ecosystem rehabilitation and management as well as sustainable development in the future. In the last 30 years, the scientists have paid great attention on the integrated ecosystem management and restoration of the Loess Plateau. A regional network of long term ecological field stations has been established under the support of the Chinese Ecosystem Research Network (CERN). The integrated observational system on the environments in the plot, small watershed and regional scale were set up. Chinese scientists presented strategy and conservational eco-agriculture on the Plateau for food security, ecological security and economic sustainability. The long term research found that the driving force for ecosystem succession on the Loess Plateau is the land use pattern, and re-vegetation is the key strategy for rehabilitation. The ecosystem rehabilitation models in different scale have been developed which provide the real case for research and extension in local people. The result showed that after 20 years' continuous rehabilitation management of watershed in the hilly Loess Plateau, soil erosion was controlled and watershed eco-economic system came into fine development track with sustainable development. The further research on the ecosystem rehabilitation should focus on the ecosystem natural rehabilitation, impact of rehabilitation on the environment and integrated assessment as well as the ecosystem stability.

Key words: the Loess plateau; soil and water conservation; ecosystem rehabilitation

Activity report of Shimane University and the future prospects of the nature restoration in Lakes Shinji and Nakaumi, newly registered Ramsar sites in Japan

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Lakes Shinji and Nakaumi, the largest coupled lagoon system in Japan, have undergone extensive changes in the last 40 years due to the big national projects aiming at desalination and reclamation of these lakes. In the year 2000, however, the land reclamation project in Lake Nakaumi was officially discontinued, and shortly thereafter, desalination project was also terminated. In July 2003, the president of Shimane Prefectural Government expressed to designate the lakes for inclusion in the list of wetlands of international importance, and these two lakes designated as Ramsar sites in 2005. This is an opportunity for us to come up with the grand design for these lakes and their watershed, a plan which must establish clear goals for the next 10 years and for the next 50 years. The new national biodiversity strategy of Japan, which was approved in 2002, proposes the promotion of restoration projects in order to actively rehabilitate degraded environments. This long-term strategy, incorporating good management planning practices, such as adaptive management, fits well with the restoration of Lakes Shinji and Nakaumi in which severe alteration occurred in the past.

Shimane University is situated nearby these two brackish lakes Shinji and Nakaumi, and established the Research Center for Coastal Lagoon Environments (ReCCLE) in 1992 to promote basic research aimed at solving environmental and social problems in estuaries and coastal areas. Based on this previous work, ReCCLE was reorganized in 2002 and the project, aiming at developing a new model for the wise use of estuaries and coastal lagoons by conducting interdisciplinary research on complex phenomena relevant for conservation and management of the lagoon system, has been launched in 2004. This project includes two principal work packages, one short-term and the other long-term. Till now, results have been achieved contributing to sustainable and wise use of the lakes. The short-term studies delivered a method for synthesis of hydrotalcite compounds, high performance inorganic materials for water purification, having high selectivity for phosphorus. The technique was successfully promoted as an example of business-academic-public sector cooperation in city area, under the auspices of the Ministry of Education, Science, Sports and Culture. Currently, the utilization of these compounds for the reduction of nutrient loading from both point and non-point sources and thus for the improvement of water environment is discussed. A granulation technique of high performance material for overlaying was also established and a field experiment was done. The long-term studies of the project have begun to develop simple yet scientifically rigorous monitoring techniques, like Seagrass-Watch program, a community-based monitoring program suitable for the nature restoration project in Lakes Shinji and Nakaumi.

ReCCLE has also started a large scale field experiment of lake-littoral restoration in collaboration with the Izumo branch of the Ministry of Infrastructure, Land and Transport (MILT), since shallow areas of these two lakes have been diminished due to reclamation, restoration or rehabilitation of shallow littoral zone is one of the most important objectives in the lake. As a practical fishery promotion measure, Shimane Prefectural government mentioned a guideline of the creation of shallow area as well as the protection of waters threatened by anoxia. By creating shallow areas, quantitative recovery of macrophytes may be assured, and we may regain the fertile lake.

Keywords: coastal lagoon; restoration; wise use

Evolution characteristics of the restoration desert ecosystem and its influence on infiltration patterns in the Tengger Desert, Northern China

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Precipitation is often the sole source of water replenishment in arid and semiarid areas and thus plays a pertinent role in sustaining desert ecosystems. The rainfed sand-binding vegetation for stabilizing the migrating desert dunes in the Shapotou area at the southeastern edge of the Tengger Desert, initiated in 1956, using shrubs consisting predominantly of *Caragana korshinskii*, *Hedysarum scoparium* and *Artemisia ordosica*, has established a desert shrub ecosystem with a dwarf-shrub and biological soil crust cover on the stabilized sand dunes. Since 1956 the success of this effort has not only insured the smooth operation of the Baotou-Lanzhou railway in the sand dune section but has also played an important role in the restoration of the local eco-environment; therefore, it is viewed as a successful model for desertification control and ecological restoration along the transport line in the arid desert region of China. Some of the effects of recovery from desertification and ecological restoration on soil properties are manifested by the increase of distribution of fine soil particle size, organic matter and nutrients. The physical surface structure of the stabilized sand dunes, and inorganic soil crusts formed by atmospheric dust has also gradually formed biological soil crusts. Sand dune stabilization is associated with: 1) decreased soil particle size, 2) increased total N, 3) increased thickness of biological crusts, 4) increased thickness of subsoil, 5) increase in volumetric soil moisture in the near surface environment, and, 6) influence the infiltration processes under natural rainfall events.

The redistribution of infiltrated moisture through percolation, root extraction, evapotranspiration pathways indicates that the infiltration varied greatly from 7.5 to more than 45 cm depending upon rainfall quantity and soil surface conditions. In the shrub community area without biological soil crust cover, infiltration increased due to preferential flow associated with root tunnels. The biological soil crust cover had a significant negative influence on the infiltration for small rainfall events (~10 mm), it restricted the infiltration depth to less than 20 cm, and increased soil moisture content just beneath the soil profile of 10 cm, while it was not as strong or clear for larger rainfall events (~60 mm). For small rainfall events, the wetting front depth for the three kinds of surface cover was as follows: shrub community without biological soil crust > bare area > shrub community with biological soil crust. In contrast, for large rainfall events, infiltration was similar in shrub communities with and without biological soil crust cover, but significantly higher than measured in the bare area. Soil water extraction by roots associated with evapotranspiration restricted the wetting front penetration after one to three hours of rainfall.

After 17 years of dune stabilization, both the shrub numbers and community biomass decreased.

The number of microbes, vegetation cover and plant species all attained a maximum degree after the dunes stabilized for 40 years. There is a significant positive correlation between fractal dimension of soil particle size distribution and the clay content of the shallow soil profile in the desert shrub ecosystem, the longer the dune being stabilized, the greater the soil clay content in the shallow soil profiles (0-3 cm), and the greater the fractal dimension of soil particle size distribution. This reflects the fact that during the re-vegetation processes, the soil structure is better developed especially in the upper profile. Hence, the migrating sand dune becomes more stabilized. Therefore, the fractal model can be used to describe the texture and fertility, and, along with the degree of stability of the previously migrating sand dunes, can be used as an integrated quantitative index to evaluate the re-vegetation practice in the sand dune areas and their stabilization.

Keywords: desert ecosystem; infiltration; biological soil crust; dwarf-shrub stabilized sand dune; Shapotou

Long-term cyanobacteria dominance in a polymictic nutrient-poor tropical lake (Gambazinho Lake, South-East Brazil)

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Although cyanobacteria have been reported occurring in a broad trophic scale, their exceptional growth, known to contribute to the decline of biodiversity and water quality, is commonly related to very eutrophic systems. Gambazinho lake is located within the State Park of Rio Doce (Southeast Brazil), being a nutrient poor, polymictic, and natural ecosystem. Despite this, its phytoplankton is remarkably cyanobacteria dominated. This study focused on phytoplankton changes searching for the ecological conditions that determine the cyanobacteria supremacy and if it characterizes as a steady-state. Monthly samples of phytoplankton, zooplankton, nutrients and abiotic data were taken during 2002 to 2004. Within an explicit alternation between warm and cold mixing periods, low levels of inorganic nutrients suggested fast cycling and resources limitation. Zygnemaphyceae and Chlorophyceae were the richest classes, following the pattern of other lakes in the region. However, two cyanobacteria species co-dominated (*Pseudanabaena galeata* and *Planktolyngbya limnetica*), contributing to at least 85% of total biovolume during all sampled months and depths. Seeing that steady-states are defined when the persistent species remain unchanged for at least two weeks, we indicated that the phytoplankton community in Gambazinho lake seems to be in an everlasting steady-state, probably as a result of resource restricted conditions.

Key words: cyanobacteria dominance; poor tropical lake, *Planktolyngbya limnetica*; *Pseudanabaena galeata*; steady-states

Workshop 3 Carbon, Nitrogen and Water Cycling of Ecosystems

Processes controlling the increasing trends of dissolved organic carbon concentrations in the surface waters of a boreal catchment

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1. Background

Lakes and streams across substantial parts of the glaciated landscapes of eastern North America and northern and central Europe have become increasingly coloured over the past two decades due to an increase in the concentration of dissolved organic carbon (DOC). This has increased the cost of water treatment and, in the absence of widespread reductions in the hydrologic flux, has raised concerns that terrestrial carbon stores may be becoming unstable, with unpredictable consequences for the global carbon cycle. To date there has been little agreement as to underlying causes, but most hypotheses imply a response to an unprecedented shift in drivers, such as changes in atmospheric CO₂ concentration, surface air temperatures, precipitation patterns, land-use, or atmospheric deposition.

Freshwater DOC concentrations are controlled by aquatic and terrestrial processes. The majority of freshwater DOC is produced from the breakdown of plant and microbial material in catchment soils. This terrestrially-derived material can play an important role in the food webs of humic lakes. Changing DOC concentrations in soils and surface waters will also affect the rate of recovery from acidification. A range of different techniques and datasets is needed to understand the reasons for the observed changes in DOC. This presentation will show examples from both detailed data compilation and modelling studies carried out at the Finnish Lammi LTER-site as well as results from large-scale regional monitoring programmes.

2. Materials and Methods

The small headwater catchment Valkea-Kotinen of the Finnish Lammi LTER-site (www.environment.fi/syke/lter) was the main site studied. This intensively studied catchment is situated in a remote, unmanaged forested area in southern Finland. The catchment is in a protected conservation area and only receives background levels of air pollution. The catchment has an area of 30 ha and the lake elevation is 156m above sea level. Typical of glaciated boreal, the catchment contains areas of forested mineral soil (higher elevations), peatland (lower elevations and adjacent to the lakes and streams) and a discharge lake with stream. The mineral soils in the catchments are predominately Podzols developed in shallow glacial drift (till) deposits. The forest cover consists mainly of old-growth mixed stands of Norway spruce and deciduous species (birch and aspen) with large individuals of Scots pine present. The lake in the Valkea-Kotinen catchment has a mean depth of 3m and a single discharge. The water in the lake and the outlet stream are humic (average [DOC] 17mg L⁻¹) and have low pH (4.5-5).

We have used both statistically based artificial neural network (ANN) modelling (Holmberg *et al.* 2006) and INCA-C, a process-based model of carbon biogeochemistry (Futter *et al.* 2007), to

explore the controls of [DOC] at Valkea-Kotinen. Climate change predictions were made using the calibrated ANN model version. We have also analysed data from national surface water monitoring programmes to investigate the large-scale patterns (Vuorenmaa *et al.* 2006, Monteith *et al.* 2007).

3 . Key results

A statistically significant increase was observed in both measured and INCA-C modelled annual average [DOC] in the lake (Fig. 1). In general, “black box” ANN models were able to provide a better fit to observed data. ANN modelling showed that the high change climate scenario gave an increase of approximately 26% of annual DOC, N_{tot} and P_{tot} fluxes. INCA-C modelling indicated that both production in the catchment and mineralization in the lake controlled [DOC] in the lake. Concentrations in the catchment outflow were controlled by rates of DOC production in the surrounding organic soils. This suggests that some of the observed increase in surface water [DOC] is caused by climate-related processes operating in the lake and catchment. The results from the regional monitoring programmes demonstrated that [DOC] have increased in proportion to reductions in atmospherically deposited anthropogenic sulphur and, in some areas, seasalt. Our results suggest that a full understanding of surface water [DOC] dynamics can only come from catchment-scale process-based models linking the effects of changing climate and deposition on aquatic and terrestrial environments.

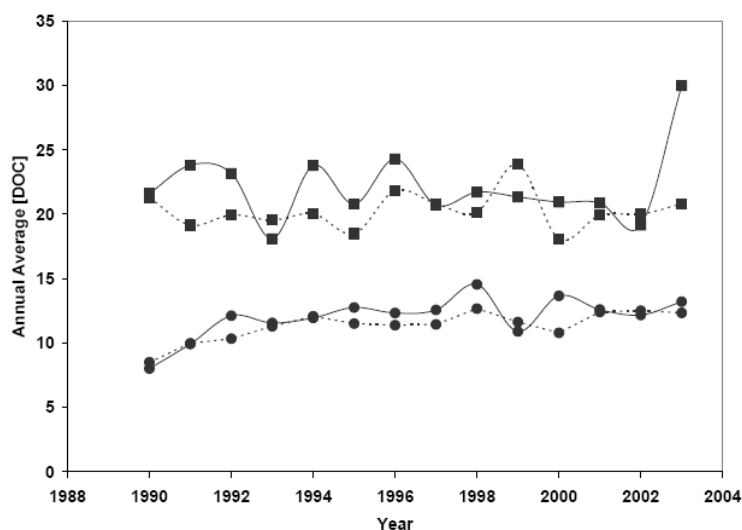


Figure 1. Annual average measured (dashed lines) and modelled [DOC] (solid lines) in lake (circles) and catchment outflow (squares) at Valkea-Kotinen. Annual averages are calculated using dates on which observations were made. Mann-Kendall statistics revealed a significant increase in observed and modelled [DOC] in the lake ($p < 0.01$) (Futter *et al.* 2007).

Recent progress and future directions of ChinaFLUX

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The eddy covariance technique has emerged as an important tool to directly measure carbon dioxide, water vapor and heat fluxes between terrestrial ecosystem and atmosphere after a long history of fundamental research and technological developments. With the successful anticipation of regional networks of flux measurements in North American, European, Asia, Brazil, Australia and Africa, a global-scale network of micrometeorological flux measurement (FLUXNET) was established in 1998. FLUXNET has made great progresses in investigating the environmental controlling mechanism on carbon and water cycles, quantifying its spatial- temporal patterns of carbon budget and seeking the “missing carbon sink” in global terrestrial ecosystems in past ten years. The global-scale flux measurement also built a platform for international communication in the fields of resource, ecology and environment sciences. With the continuous development of flux research, FLUXNET will introduce and explore new techniques to extend the application fields of flux measurement, and to answer questions in the fields of bio-geography, eco-hydrology, meteorology, climate change, remote sensing and modeling with eddy covariance flux data. As an important part of FLUXNET, ChinaFLUX has made significant progresses in past three years on methodology and technique of eddy covariance flux measurement, on the responses of CO₂ and H₂O exchange between terrestrial ecosystem and atmosphere to environment change, and on flux modeling development. Results showed that the major forests on the North-South Transect of Eastern China (NSTEC) were all carbon sink during 2003 to 2005, and the alpine meadows on Tibet Plateau were also small carbon sink. However, the reserved natural grassland, *Leymus chinensis* steppe in Inner Mongolia, was a carbon source. On regional scale, temperature and precipitation are the primary climate factors that determined the carbon balance in major terrestrial ecosystems in China. Finally, the current research emphasis and future directions of ChinaFLUX were presented. By combining flux network and terrestrial transect, ChinaFLUX will develop integrated researches with multi-sales, multi-processes, multi-subjects observations, laying emphasis on the mechanism and coupling relationships between water, carbon and nitrogen cycles in terrestrial ecosystems.

Key Words: eddy covariance, flux measurement, carbon budget, terrestrial ecosystem, ChinaFLUX

Dissolved organic carbon and nitrogen in precipitation, throughfall, soil solution, and stream water in the subtropics of the Fushan Forest

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The concentration and flux of dissolved organic carbon (DOC) and nitrogen (DON) were measured in precipitation, throughfall, soil solution (15, 30, 60 cm), and stream water in subtropics of the Fushan (mountain) forest, northeast (NE) Taiwan from May 2001 to December 2004. The mean DOC and DON concentration in precipitation was 2.57 and 0.89 mg L⁻¹, respectively. However in the rain passing through the tree canopies as throughfall, the mean concentrations were 6.05 and 0.87 mg L⁻¹, respectively. Mean DOC and DON concentrations in soil solution were 3.62 and 1.76 mg L⁻¹ at 15 cm, respectively, and decreased with depth of soil profiles. The seasonal variations of DOC and DON concentrations in throughfall showed increase in the beginning of growing season of April. No clear seasonal variations in soil solution DOC and DON concentrations were found in our study. DOC and DON concentrations in the stream draining the watershed were higher in spring and in winter.

Key words: DOC; DON; throughfall; soil solution; stream water; subtropical forest

Carbon density and storage of bamboo forest in China

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Abstract: Bamboo forest is an important part in forest ecosystem. So far, forest area is decreasing all over the world. However, area of bamboo forest is increasing by 3% every year because its special asexual reproduction. So it can accumulate more and more carbon. China is one of the country which is rich in bamboo species all over the world, and its area, volume and wood are all rank first throughout the world. Therefore, it is necessary and pressing to study carbon density and storage of bamboo forest ecosystem in China. The sixth forest inventory materials and data from the forest ecosystem research stations in China, and documents related to bamboo forest are used to study it. Living conditions had great effects on bamboo organic carbon density, and species had obvious effects on bamboo organic carbon density in the same conditions too. The belowground carbon density of Bamboo was larger than aboveground. Influenced by geographic distribution of bamboos, bamboo forest carbon storage were Fujian > Jiangxi > Zhejiang > Hunan, the carbon storage of them took up 63.76 percent. However, the carbon density were Zhejiang > Jiangxi > Hunan > Fujian. It could fix 5.25t C.hm⁻² every year. The total carbon storage was 7.54 billion tons. Compared with total carbon storage of forest ecosystem in China, it was about 2.63 percent.

Tab 1 Carbon storage of bamboo forest in China

Province	Carbon storage					
	Trees	shrubs	herbs	Litter	Soil	Ecosystem
Shanxi(R)	4.35	0.33	0.1	0.76	44.55	0.01
Shanxi(L)	126.14	9.21	2.79	21.01	400.5	0.06
Shanghai	17.04	0.88	0.08	0.74	29.34	0
Sichuan	1630.81	121.86	11.43	64.71	3928.65	0.58
Yunnan	445.82	28.17	2.64	4.66	896.4	0.14
Zhejiang	4004.07	243.68	22.85	148.93	12557.39	1.7
Chongqing	604.24	38.17	3.58	64.85	2606.3	0.33
Hainan	45.16	5.87	0.55	0.97	206.76	0.03
Guizhou	581.77	31.33	2.94	24.99	1166.04	0.18
Guangxi	1352.94	100.21	9.4	48.05	1649.23	0.32
Guangdong	1646.94	121.99	11.44	20.16	3569.84	0.54
Fujian	2292.82	288.57	27.06	47.7	6328.04	0.9
Anhui	746.59	87.95	8.25	42.17	2485.17	0.34
Hubei	409.66	44.86	4.21	21.51	1666.63	0.21
Hunan	1678.05	170.17	15.96	81.6	6383.92	0.83
Jiangsu	81.63	12.16	1.14	5.83	381.78	0.05
Henan	49.26	3.94	1.19	8.99	155.8	0.02
Jiangxi	2537.47	262.95	24.66	126.08	10275.31	1.32
			Vegetation	Litter	Soil	Ecosystem
	Total			×10 ⁴ t		×10 ⁸ t
			19977.31	733.72	54731.67	7.54

Tab 2 Carbon density of bamboo forest in China

Province	Carbon density/t .hm ⁻²					
	Trees	shrubs	herbs	Litter	Soil	Ecosystem
Shanxi(R)	29.00	2.21	0.67	10.63	5.05	297.03
Shanxi(L)	30.32	2.21	0.67	11.07	5.05	96.27
Shanghai	63.12	3.26	0.31	22.23	2.73	108.66
Sichuan	43.63	3.26	0.31	15.73	1.73	105.10
Yunnan	51.60	3.26	0.31	18.39	0.54	103.75
Zhejiang	53.57	3.26	0.31	19.04	1.99	167.99
Chongqing	51.60	3.26	0.31	18.39	5.54	222.57
Hainan	25.09	3.26	0.31	9.55	0.54	114.87
Guizhou	60.54	3.26	0.31	21.37	2.60	121.34
Guangxi	44.01	3.26	0.31	15.86	1.56	53.65
Guangdong	44.01	3.26	0.31	15.86	0.54	95.40
Fujian	25.90	3.26	0.31	9.82	0.54	71.49
Anhui	27.67	3.26	0.31	10.41	1.56	92.11
Hubei	29.77	3.26	0.31	11.11	1.56	121.12
Hunan	32.15	3.26	0.31	11.90	1.56	122.30
Jiangsu	21.88	3.26	0.31	8.48	1.56	102.35
Henan	27.67	2.21	0.67	10.19	5.05	87.53
Jiangxi	31.46	3.26	0.31	11.67	1.56	127.39

Key words:China,Bamboo forest,carbon storage,carbon density

Analysis on the impacts of various factors on leaf litter decomposition from an intersite decomposition experiment across China

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The study was carried out and based on the Long-Term Intersite Decomposition Experiment in China (hereafter referred to as LTIDE-China) from the southmost to the northmost and the southeast to the southwest reflecting a wide variety of natural and managed ecosystems and climates. 12 forest types (8 regional broadleaf forests, 3 needle-leaf plantations and 1 broadleaf plantation) in 8 sites were involved in. The mixed leaf litter from south subtropical evergreen broadleaf forest in Dinghushan (hereafter referred to as DHS sample) was translocated to all the 12 forest types. And the leaf litter from each of other 11 forest types was kept in original forest. The experiment had been done for 30 months, collecting litterbags once in three months. Several key results as follows emerged from the study. Fitted k -values ranged from 0.169 to 1.454. The differences in fraction of mass remaining between DHS and local broadleaved samples during all decomposition processes were resulted in less than 0.5 years. There is significant difference in initial %C, %N, N/P and C/N ratios between broadleaved and needle leaf litters. Initial N/P ratio reduced with increase in latitudes of communities. Mean annual temperature and precipitation are dominant and subordinate climatic factors of controlling decomposition rates. Excepting initial C/N ratio, initial N/P ratio was also demonstrated to be an important factor of regulating litter decomposition rate. We suppose that litter decomposition rates are sensitive to temperature changes not only because of the direct impacts of mean annual precipitation, but also because of the acclimation of decomposer community to substrate. Reducing or enhancing temperature would result in, respectively, bigger decrease or bigger increase in decomposition rate of substrate.

Keywords: Long-Term Intersite Decomposition; plant litter; interregional climate; substrate quality; exponential decay

Spatial and temporal pattern of dissolved carbon and nitrogen in stream water with topographical gradient in forested basins in Northern Japan.

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Exports of carbon and nitrogen as a solute in forest stream are composed as a result of biogeochemical and hydrological cycling of the vegetation-soil-microbe ecosystem in the basin. Energy and nutrient supplies from terrestrial watershed are very important for aquatic ecosystem. The characteristics of the basin topography cause various features of the hydrological processes including water flow-pass, water retention time, distribution of soil moisture, resulting to create spatial variability of stream chemistry in the watershed and landscape scales. We investigated the stream chemistry in eleven sub-catchments with different basin topography in a forested basin located in northern Japan to clarify the topographic control on formation mechanism of dissolved carbon and nitrogen chemistry in stream water.

The study site is located in Dorokawa experimental watershed in Uryu experimental forest of a part of North Hokkaido Experimental Forest (one of the core-site of Japan Long-Term Ecological Research Network; JaLTER). Dominant bedrock is Andesite and major soil type is Cambisols. Dominant vegetation is cool-temperate natural mixed forest with dense Sasa dwarf bamboo as understory vegetation. Annual mean precipitation is about 140 cm, and about half of the precipitation is supplied as snowfall from December to April. We investigated the concentration of dissolved inorganic nitrogen (nitrate), dissolved organic nitrogen (DON) and dissolved organic carbon (DOC) in stream water. We also analyzed the content of stable isotope of hydrogen and oxygen of water as well. Samples were collected once a month basically, while once a week during snowmelt period (late March to May). Basin topographies are analyzed using Digital Elevation Model (50 m mesh) and GIS techniques.

The concentration of most solutes largely fluctuated during snowmelt period with large increase of stream discharge. The mean concentration of nitrate and DOC in stream water was significantly ($P < 0.01$) correlated with mean slope of the watershed (negatively for nitrate, positively for DOC). The DOC and DON ratio (DOC/DON) also significantly correlated to the basin slope (negative, $p < 0.01$). The spatial pattern of stable isotopic characteristics in stream water was also influenced by the difference of the basin topography. The stream water from the basin with the gentle slope tended to have heavy stable isotope (both hydrogen and oxygen) and large seasonal fluctuation of

them, while that with steep basin tended to have light stable isotope and small seasonal change. These results indicated that the differences of the basin topography cause different hydrological regimes in the sub-catchments. It was suggested that the retention of nitrate (mostly biological reaction) and leaching of dissolved organic solutes were enhanced in the basin with gentle slope due to the larger water retention, deeper water flow-pass in the ground and broad riparian zone. On the other hands, the basin with steeper slope would enhance the flush of the nitrate from the surface soil due to the shorter retention time of water and the shallow water flow-pass with narrow riparian zone. The understandings of these linkages between stream chemistry and basin topography would be important to describe the fundamental characteristics of the biogeochemical processes for the further long-term prediction including the response of the ecosystems against the various natural and anthropogenic disturbances.

CO₂ flux in a tropical seasonal rain forest in Xishuangbanna, Southwest China

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CO₂ flux has been measured since 2003 by the eddy covariance method over a tropical seasonal rain forest in Xishuangbanna, which is one of the ChinaFlux forest sites. Soil respiration under the forest has also been observed since then with static opaque chamber and gas chromatography technique. Compared with the measurements of photosynthesis of dominant tree species and seedlings, stem respiration, leaf area index, litter production and decomposing rate, fine root biomass and turnover, temperature and moisture, solar radiation and photosynthetic photon flux density, we estimated CO₂ flux in this forest ecosystem. Soil respiration changed seasonally in accordance with the fluctuation of temperature and precipitation, but no significant diurnal change was found, probably due to little diurnal change in soil temperature. Q_{10} values of soil respiration ranged from 2.03 to 2.36, close to those reported in other tropics. CO₂ flux over the forest canopy demonstrated diurnal variation. The forest served as a carbon sink in daytime, but a carbon source at night. CO₂ flux over the forest canopy also presented significant seasonal variation, negative in dry season (Nov. – Apr.) and slightly positive in rainy season (May – Oct.). All the factors, such as photosynthesis, respiration, litter fall and decomposition, made contribution to carbon flux. The patterns of CO₂ flux were regulated by different factors at different time scale. However, our preliminary study showed that this forest functioned as a carbon sink at the yearly scale.

Keywords: CO₂ flux; eddy covariance; soil respiration; Q_{10} ; tropical rain forest

Stable carbon isotope variation in plants and their indicating significances along the inland Heihe River basin of Northwestern China

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The inland Heihe River basin of Chinese northwest arid region is composed by three great landscapes of the mountain, the oasis and the desert. The upper reaches mountain is an environmental variation sensitive region, which is subjected to human interference little; in the middle and lower reaches, the oases and deserts are ecological fragile regions, and their environmental transition is the focus that people pay attention to. Plant is an indicator of environmental variation, and the photosynthetic organ is more sensitive to the environmental variation, as its characteristics can manifest the influence of the environment factor change or the adaptation plant to the environment.

Along the Heihe River basin, from the water source collection area to the water source vanishing area, leaves or assimilation shoots of plants were collected and determined the stable carbon isotope ratio. The results showed that stable carbon isotope ratio ($\delta^{13}\text{C}$) of the plants on the mountain regions were between -23‰ to -29‰, with the mean value of -26.3‰; the $\delta^{13}\text{C}$ of the plants in oases were between -26‰ to -30‰, with the mean value of -27.2‰; while the $\delta^{13}\text{C}$ of the plants in deserts were among -23‰ to -28‰ and -12‰ to -15‰, with the mean values of -26.0‰ and -13.8‰, respectively. The $\delta^{13}\text{C}$ was higher in the harsher environments. For the same species under different habitats, it showed that the $\delta^{13}\text{C}$ was higher when the habitat was harsher. For *Populus euphratica*, tree species of desert riparian forest, the $\delta^{13}\text{C}$ of its willow leaves were lower than that of its poplar leaves. Either in the mountain region or in the desert, along the increasing altitude, stable carbon isotope discriminations (Δ) of some plants reduced, while some were not obvious. The Δ of *Picea crassifolia* significantly linearly decreased with the increasing altitude ($r^2=0.98$, $P<0.001$), reflecting the sensitivity to variation of the temperature and the CO_2 concentration.

It can be concluded that *P. crassifolia* may be used as an important indicator plant to the environmental variation of the mountain region of the upper reaches of Heihe River. Among the trees in the Qilian Mountain region, the water use efficiency (WUE) of the evergreen *P. crassifolia* is highest, the high WUE may be the reason that *P. crassifolia* is the dominant species in the Qilian Mountain region. The C_4 plants occupy certain proportion in the desert vegetations; WUE of the C_3 plants in the harsh habitat was higher than in suitable habitat. For *P. euphratica*, WUE of its linear leaves was lowest, and that of the orbicular leaves was highest among the different leaf morphologies; WUE rose as the willow leaves in seedling period grew to poplar leaves. Exorbitant $\delta^{13}\text{C}$ of the same species indicates the fading of the plant and the severe stress of the habitat. Plant adapting environment is along the direction helping to improve the water use efficiency.

Keywords Inland Heihe River; $\delta^{13}\text{C}$; C_4 plant; water use efficiency; environment

Fog and precipitation chemistry at a mid-land humid forest in central Taiwan

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Fog forests make up a considerable proportion of the forest ecosystems in Taiwan. Yet, to date the role of fog deposition on forest nutrient cycling has only been examined at Yuan-yang Lake ecosystem in northeastern Taiwan. We analyzed fog and bulk precipitation chemistry at a fog forest at Chi-tou Tract of the Experimental Forest of National Taiwan University, in central Taiwan where mountain agriculture activities are most active. There were 320 foggy days (visibility < 1000 m) recorded during the sampling year, May 2005 to April 2006. Fog was most frequent between May and July (153/153 days) and least frequent in January (21/31 days). The mean daily duration of fog ranged from 2.6 hours in August to 18.4 hours in April. The total fog periods were 2415 hours which represented 28% of the sampling period. Compared to bulk precipitation, fog was disproportionally enriched in acidic anions relative to base cations resulting in higher acidity (median pH = 4.88) in fog than in bulk precipitation (median and mean pH = 5.48). The very high input of NH_4^+ , $66 \text{ kg ha}^{-1} \text{ yr}^{-1}$, through bulk precipitation and likely fog suggests that the use of fertilizer (ammonium sulfate and animal manure) associated with mountain agriculture has a major impact on atmospheric deposition at the surrounding forest ecosystems. The input of inorganic N reached $77 \text{ kg ha}^{-1} \text{ yr}^{-1}$ and likely exceeded the biological demand of the forest ecosystem. Thus, the impact of mountain agriculture to the nutrient cycling and health of the surrounding ecosystems should be taken into consideration in land use planning. SO_4^{2-} is the most abundant anion in fog at Chi-tou as well as in precipitation at various forests throughout Taiwan, suggesting that the emission and transport of large quantities of SO_2 , the precursor of SO_4^{2-} , is an island-wide environmental issue.

Key Words: ammonium; bulk precipitation; fog forest; long-range transport; mountain agriculture

Nitrogen fertilization enhances soil water deficit and results in accumulation of nitrate in a semiarid soil profile.

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Yields of dryland crops are often limited by low precipitation and nutrient in the Loess Plateau. Increased productivity following fertilization can improve water use efficiency, but increased yields can result in water stress which in turn restricts soil residual nitrate-N transport and resulted in nitrate-N accumulation in soil profiles. It is therefore important to quantify the effect of increased fertilizer application in dryland farming on soil productivity, soil-water, and nitrate-N level. This study assessed the effects of long-term fertilization on the relationships between yield increase, water movement and nitrate-N level over 17 years of continuous winter wheat cropping under dryland conditions on the Loess Plateau of China. The experiment consisted of six fertilization treatments: (i) unfertilized (U); (ii) N fertilizer (N); (iii) N and P fertilizer (NP); (iv) farm yard manure (M); (v) N fertilizer and farm yard manure (NM); and (vi) N, P fertilizer and farm yard manure (NPM). N, P, and M fertilizer rates were 120 kg N ha⁻¹ a⁻¹, 29 kg P ha⁻¹ a⁻¹, and 75 t ha⁻¹ a⁻¹ respectively. The increased productivity in the NP, NM, and NPM treatments led to a subsoil (200-300 cm) water deficit. There was a significant negative correlation between the average winter wheat yield over 17 yrs and soil water storage from 200 to 300 cm. Fertilizer N use efficiency ranged from 18% to 48% among treatments. In the N treatment, 1012 kg nitrate-N ha⁻¹ accumulated in the soil profile from 0 to 300 cm. For NP, NPM, and NM treatments, nitrate-N accumulated closer to the surface, and was 200, 450, and 480 kg ha⁻¹ from 0 to 180 cm, respectively. The quantity of residual N fertilizer accumulated as nitrate-N in the subsoil was related to the magnitude of subsoil water deficit in high yielding treatments. Fertilization significantly enhanced crop yield, but resulted in a subsoil water deficit, which retarded nitrate-N movement down the profile and lead to accumulation within the soil profiles. Therefore, fertilization strategies require modification to ensure optimal use of fertilizer N and soil water in the Loess plateau.

Keywords: Loess Plateau; China; soil; nitrate; fertilizer; water deficit.

Effects of long-term cycling of organic nutrient on soil nitrogen supplying capacity in a red soil paddy ecosystem

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Soil nitrogen supplying capacity played an important role in growth and yield of rice. In order to obtain efficient nitrogen and organic nutrient utilization and reduce the possible environmental effects, it is essential to determine the fertilization model which is based on the soil nitrogen supplying capacity. A long-term field experiment was carried out to simulate fertilization model (Use of organic and inorganic sources in a systems approach) on a reddish paddy soil in Taoyuan agro-ecology station, Hunan, during 1990-2007, it included 8 treatments (CK, N, NP, NPK, C, N+C, NP+C, NPK+C) and 3 replications. Levels of fertilization were N 182.3kg/ hm², P 39.3kg/ hm², K 197.0 kg/ hm² after 1997 (N 262.5kg/ hm², P 39.3kg/ hm², K 137.0 kg/ hm² pre 1997). For some treatments in which there were cycling of crop nutrients, the way was that rice straw was fully returned to the field after harvesting, 80% of full grains (50% after 1995) and all of the empty or blighted grains were fed to pigs, and the pig manure subsequently was spread in the field, and the last step was that the Chinese milk vetch (green manure) was cultivated in winter and then ploughed into the field before spring plowing.

The growth and yield of rice in the long term experiment are not suitable parameters for assessing soil nitrogen supplying capacity because the contributions of soil nitrogen can not be separated from the contributions of added organic and inorganic nutrients to crop growth. In addition, multiple and different factors affect crop performance and the nutrient limitations among the treatments. Measures of soil organic matter fractions, soil nutrient contents, fractions of soil nutrients, and nutrient turnover in soil are not functionally related to rice growth and yield in the long term experiment. Functional relationships can be developed between soil nutrient pools or soil nutrient supplying capacity, as assessed from plant uptake of a nutrient, when P and K nutrients are not limiting plant growth.

A pot experiment was conducted with soil collected from each of the plots from 8 treatments within the long-term experiment (8 treatments x 3 reps = 24 plots). The pot experiment was carried out in Taoyuan (2004). The objective is to determine the effect of treatments on soil parameters for assessing the supply of N and the relationship between the soil parameters and nitrogen supplying capacity of the soil. Soil total nitrogen, soil organic carbon, mineralizable nitrogen, microbial biomass nitrogen and carbon content, nitrogen uptake by rice were measured.

The results indicated that, there was a significant positive relationship among soil organic carbon, total N, amount of mineralizable N, the microbial biomass N and N uptake of rice, and they were good index to soil nitrogen supplied capacity. The cycling application of organic nutrient or application combined with N fertilizer significantly increased soil organic carbon content, total nitrogen content and amount of net N mineralization (6 weeks) by 20.1% ~ 40.9%, 0.46 g/kg ~ 0.60 g/kg and 55.0%, respectively; And it obviously increased soil MB-N content by 70.3%. Whereas, there was less effects of chemical fertilizer application on the content of soil

nitrogen, soil carbon and mineralizable N. The pot experiment indicated that, compared with zero application of fertilizer, there were significantly effects of long-term cycling application of organic nutrient on the soil nitrogen supplied capacity, and the amount of nitrogen uptake by rice increased by 33.7%~89.0%,while there was less effects of application of chemical fertilizer N and NPK, it only increased by 2.1% and 6.2%.Additionally, with the combination degree between the cycling application of organic nutrient and fertilizer NPK enhancing, the soil nitrogen supplying capacity showed a ascending trend.

Key word: reddish paddy soil; cycling of organic nutrient; soil nitrogen supplying capacities

Influence of nitrate amendment on the fate of nonylphenol under anoxic conditions in submerged paddy soils

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Nonylphenol (NP) is receiving increasing public concern, because of its ubiquitous, persistent, endocrine disrupting effect, and toxicity. NP is usually found in many arable soils as the degradation product of the widely-used surfactant nonylphenolpolyethoxylates, which belongs to the formulation of many pesticides. Recently, alkylphenols have been detected in paddy soil as well as in surface water, drinking water, aquatic food and sediments in China. Rice (*Oryza sativa* L.), as a staple food source, is widely cultivated in China, which represents by far the largest agricultural crop production of China. The rice growing area of China in 2004 amounted to 29.4 million ha, accounting for 19% of the world's area. Preserving suitable area of rice production is important for the food security and ecosystem integrity of China. Until now, there is no report that could definitely demonstrate the biodegradability of nonylphenol under anoxic and anaerobic conditions. This fact is of primary importance since the water-submersion of paddy soil, agricultural practice for the rice cultivation, is leading to important chemical changes such as depletion of oxygen, decrease of redox potential, the reduction of Fe^{3+} , Mn^{4+} , NO_3^- and SO_4^{2-} , etc. In lowland rice production, the dominant system in many parts of China, rice fields are kept continuously flooded with a water layer of 5-10 cm throughout the growing season. Using a ^{14}C -labeled isomer of NP, i.e. the 4-[1-ethyl-1, 3-dimethylpentyl] phenol, the fate of NP was studied in two flooded typical paddy soils under anoxic conditions (gleyic hydragric anthrosol, derived from a silt loam deposit and quaternary red clay, respectively). Additionally, some soil/water systems were amended with 20 mM of nitrate in order to investigate one of the possible effects of fertilization on the degradation, sorption and formation of bound-residues of NP. After 75 days of incubation under non aerated conditions in hermetically closed systems, sequential extractions were carried out with organic solvents and 0.1 M NaOH and the radioactivity contained in the various extracts was analyzed by means of liquid scintillation counting and HPLC-diode array detector coupled to a radiodetector. Radioactivity remaining in the solid matrix was determined by means of combustion with oxidizer. Although, no radioactive methane and only traces of $^{14}\text{CO}_2$ could be detected, degradation of NP under anoxic conditions could be definitively demonstrated for the first time by the detection of polar metabolites of NP in all the non-sterilized systems. Some differences in the fate of NP could be detected between the two soils. More precisely, higher amount of NP remained none degraded in gleyic hydragric anthrosol derived from quaternary red clay than in the other soil. High amount of bound-residues were found when the extent of degradation of NP was significant. Comparatively to the quaternary red clay, higher mineralization and formation of non-extractable residues was observed in the soil derived from silt loam deposit. As almost no bound residues were detected in the irradiated soil controls, it suggests that bound residues result from the covalent binding of degradation products. The addition of nitrate presented the advantage of increasing significantly the degradation in both soils, especially in gleyic hydragric anthrosol derived from silt loam deposit, which contained high amounts of organic matter.

Keywords: endocrine disrupting compounds; nonylphenol; submerged paddy soils; anoxic condition; nitrate

Characteristics of nitrate leaching loss from slope cropland of purple soil

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Nitrogen is the most important essential nutrient for terrestrial ecosystem. However, excessive nitrogen loads to the environment results in severe non-point-source pollution which would exacerbate water quality. The excess nitrate in both surface water and ground water also draws much attention due to its harm to human health.

Nitrate leaching loss from slope cropland of purple soil were studied through orientation observation and analyses of nitrate accumulation at soil profile. Orientation observation was conducted from 2003~2006 in self-designed and constructed runoff plot with function of subsurface flow monitoring. Results showed, nitrate accumulated at dry season and moved at raining season in the slope cropland of purple soil. Subsurface flow is the main pathway of nitrate leaching loss at raining season. Soil accumulated nitrate moved through subsurface flow owing to shallow soil layer (60 cm), low water-infiltrate parent rock beneath soil and heavy rainfall at summer. Average discharge of subsurface flow from 2003 to 2006 was 139.7mm, and amounted to 52.42% of total runoff at raining season. The content of NO_3^- -N was persistently high with average content of $14.92 \text{ mg}\cdot\text{L}^{-1}$ within 2003~2006. Annual average loss flux of NO_3^- -N through subsurface flow was $27.98 \text{ kg}\cdot\text{hm}^{-2}$, and accounted for 10.02% of total fertilizer nitrogen applied within a year. NO_3^- -N loss fluxes through subsurface flow changed with seasonal patterns and yearly differences, and it reached at peak through jointing to stamen-growing stage, which accounted for 69.6% of annual loss flux. Nitrate leaching flux was dominated influenced by discharge of subsurface flow.

Nitrate loss through subsurface flow results in not only in situ groundwater pollution, but also off site pollution by long-distant travel of soluble nitrate, and would throw threat to water environment in the region of Three Gorges Reservoir.

Key words: nitrate leaching loss; subsurface flow; loss flux; slope land; purple soil.

Study on the relationship between the soil organic matter content and soil productivity

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It is now widely recognized that soil organic matter (SOM) plays an important role in soil biological, chemical and physical properties. These properties, along with SOM, are considered critical indicators for the health and quality of the soil. One of the key issues on the black soil in Northeast China is that the SOM has decreased to no more than 40 g kg^{-1} , about one third of that before reclamation, which greatly threatened local sustainable agricultural development. We have known some ways to improve the SOM content in the black soil, but we do not know how much the appropriate value it should be. Many researches have concentrated on the relationship between the SOM and soil productivity. And some results have been given on some specific soils or areas, but all did not eliminate the effect of the climate factors on soil productivity from their results.

The SOM differed widely from $10\text{-}50 \text{ g kg}^{-1}$ to $70\text{-}150 \text{ g kg}^{-1}$ with increase in latitude in the black soil region in Northeast China. This provided a good condition for evaluate the relationship between the SOM and soil productivity.

Present studies were conducted both in Heilongjiang and Jilin provinces through soil removal method aiming to determine the relationship between the SOM and soil productivity. Soils were collected from five sites in the black soil belt (Nenjiang, 49° , 53.6 g kg^{-1} ; Bei'an, 48° , 103.9 g kg^{-1} ; Hailun, 47° , 54.6 g kg^{-1} ; Dehui, 44° , 31.1 g kg^{-1} ; Lishu, 43° , 18.1 g kg^{-1}) in northeast China to develop the field experiments both in Hailun county, Heilongjiang province and Dehui county, Jilin province; and other two soils were also collected from Fengqiu (Henan province, 35° , Chao soil, 8 g kg^{-1}) and Yingtan (Jiangxi province, 28° , red earth, 37 g kg^{-1}) to create an assistant experiment in Heilongjiang province only. We tested the soil physical and chemical properties and some basic parameters of crop as the result of the effect of variation in SOM for two years from 2005 to 2006.

The results showed that: 1) The soil with higher SOM, have a higher soil water content and lower bulk density under Hailun's climate conditions. 2) The soil with 60 g kg^{-1} -SOM, but not 110 g kg^{-1} had the highest soil Temperature in day time and the highest natural soil productivity under Hailun's and Dehui's climate conditions. 3) There was a higher yield increase rate from chemical fertilizer application in warm location (Dehui) than that in cold location (Hailun) despite of the variation in SOM. 4) The black soil is of the highest potential productivity compared with red earth and Chao soil under Hailun's climate conditions. 5) There is not significant difference between the SOM content and corn yield under the same fertilization rate under both Hailun and Dehui conditions, which means that SOM alone have limited effect on corn yield increase, 6) Chemical fertilizer applying can increase the corn yield from 12.3% to 64.1% for soils with different SOM content, and this increase is large in the low latitude area than the high latitude area, which indicated that the fertilizer application should not be ignored especially for the soil with a relatively higher SOM content in low latitude region in the black soil area. 7) SOM content can not change the yield-composing biological characters of corn, but fertilization does.

We concluded from this study that the relationship between soil organic matter and soil productivity is much more complex than people considered. Further studies are needed.

Key words: soil removal; SOM; black soil; corn; productivity

Longterm study on the nutrient cycling and soil organic matter dynamics and its implications to the sustainable management of Chinese fir plantations

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Based on our long term study of Chinese fir plantation over 34 years, the characteristics of nutrient cycling of Chinese fir plantation in different stages of a permanent experimental plot and soil organic matter dynamics in chronosequence were examined. The experimental plots was located at 26°45'N,109°30'E, in Huitong Experimental Station of Forest Ecology, Chinese Academy of Sciences (HTF). The plantation stand was planted in 1960 and harvested in 1994, the data were collected all over developing stages, young stand (from age 1 to 2),.The growth of tree height and the diameter at breast height was measured at different stages from young stage, fast growing stages, stem exclusion stages and mature stages. Starting form the canopy closure, the litterfall was collected by using the litter traps of $1 \times 1 \times 0.1 \text{m}^3$. The concentrations of N, P, K, Ca and Mg in different organs and different types of litter were analyzed by using the common methods. The soil samples were taken from the same plots as those taken 30 years ago and analyzed by the same methods. The results showed that the concentration of N, P, K, Ca and Mg generally decreased in the order of young stage, fast-growing stage (from age 4 to 15),stem exclusion stage (from age 16 to 25), mature stage (old than age 26). The percentage of nutrient content in photosynthetic organs decreased all the way down from young stand stage to mature stage, indicating that the nutrient accumulation rate decreased with the stand growth. The stand productivity increased from young stage to mature stage, indicating that the nutrient use efficiency was lower at the early stages and higher at later stage. The nutrient cycling dynamics measured as the ratio of nutrient return to nutrient uptake showed that Chinese fir plantation stand depleted the soil nutrient pool during the whole development stage, but the returned nutrient to soil increased from the early stage to mature stage. The analysis of the soil sample showed that the concentration of N, P and K decreased significantly compared with the results analyzed 30 years ago for the former rotation, indicating that the soil nutrient pool was depleted during the period of cutting and logging of the former rotation and establishment of the current rotation.

In order to measure the dynamics of soil organic matter,3 sample plots were selected from the first, the second, the third, and the fourth rotation of Chinese fir plantation forest in the region surrounding HTF, and 3 sample plots were selected from evergreen broadleaved forest as control. The ages of these forest stands are generally similar, about 20 years old. The soils are hydric hapludult, except for the fourth rotation of Chinese fir plantation. We used soil drill to take soil cores from 0-10cm and 10-20cm, each sample was taken from the mixture of cores of the same layer from 10 different points randomly selected from the sample plot. Before air dry the soil sample, the larger pieces were broken into smaller, and sieve the samples through screen with 2mm mesh size after air dry. The soil samples were fractionated using polytungstate at density of 1.7g/ml. The carbon and nitrogen concentration of each soil fraction were analyzed by using NC

2100 Soil at University of California at Berkeley. The ^{14}C abundance was analysed at Lawrence Livermore National Laboratory by using Accelerate Mass Spectrum (AMS), HVEC Model FN. The results show that total soil organic carbon (TOC) in Chinese fir plantation forest did not change significantly between rotations of Chinese fir plantation, significant degradation of soil organic matter mainly occurred in the period of conversion of broadleaved forest to plantation forest. According to the abundance of ^{14}C in the soil fraction, fLF and oLF contained more new carbon and less carbon than HF, indicating that fLF and oLF turnover fast than the HF; Modern carbon increased in the order of BF<1st<2nd<3rd<4th and the order of 0-10cm<10-20cm, indicating that the management practices caused the incorporation of ^{14}C into the soil and the abundance of ^{14}C could be used as a parameter of human disturbance to the soil.

In short, development of Chinese fir plantation forest depleted the soil nutrient pool by accumulating more from and returning less to the soil. As the major source of nutrient, the total soil organic matter did not change significantly from different rotations indicating that the quality of Chinese fir plantation soil declined significantly. In terms of sustainable management, the long term soil productivity of Chinese fir plantation was controlled by both the quantity and quality of the soil organic matter. The implications to sustainable management practices for the Chinese fir plantation forest were also discussed.

Carbon and nitrogen coupling processes and responses to climate change in forest ecosystem along North-South Transect of Eastern China (NSTEC)

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Terrestrial transect method is thought as a bridge to couple and transform C & N cycle processes at different ecosystem scale, and has been broadly applied to study their responses to climate change. North-South transect of Eastern China (NSTEC) has a temperature-driven gradient and is set up by IGBP as the fifteenth standard transect. The objective of this paper is to study the pattern of C & N storage, efflux from soil and natural isotopes along NSTEC based on field control experiments, remote sensing and ecosystem models. The results showed that:

(a) Under current conditions, NPP varies from 1 to 50 t ha⁻¹ yr⁻¹ along the transect. Under a scenario of 1°C warmer, the estimated NPP of the transect increased 1-5% in south China, 3-8% in central China, 2-15% in north China, and 15-30% in north-east China. Under a scenario of 20% increased precipitation, mean NPP would increase 8-24% with very pronounced regional differences.

(b) The release efflux of CO₂ and N₂O from forest soils in summer is less than that in winter, and vice versa for CH₄ absorption. Moreover, the range of CO₂ and CH₄ efflux in cold temperate zone is higher than that in sub-tropical forest ecosystem. Forest soils are the source of CO₂ and N₂O and the sink of CH₄. Nitrogen deposition decreases CO₂ release and CH₄ absorption in rich N ecosystem, but increases N₂O release from forest soils.

(c) The wet nitrogen deposition ranges from 5 to 75 kg ha⁻¹ yr⁻¹ along NSTEC, and has a descending trend from south to north. Based on a long-term control experiment, nitrogen addition increases N content and δ¹⁵N of plant foliage, but decreases its C/N. Meanwhile, nitrogen addition restrains carbon turnover and accelerates C sequestration in forest soils with poor N, and vice versa for forest ecosystem with rich N.

In summary, carbon and nitrogen cycle processes in forest ecosystems are influenced by climate change such as air temperature, precipitation and nitrogen deposition. Based on terrestrial transect method, we could distinctly understand the processes and patterns of C & N cycle in forest ecosystem.

Key Words: climate change; C & N Coupling cycle; C & N isotopes; forest ecosystem; North-South transect of Eastern China (NSTEC)

Development of a distributed eco-hydrological model for water management in irrigation districts of the Yellow River Basin, China

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This paper presents the development of a distributed eco-hydrological simulator (DEHYDROS) for the irrigation districts of the Yellow River Basin (YRB), China, and briefly introduces its application in Hetao Irrigation District (HID) in the upper stream of YRB, Inner Mongolia, China. DEHYDROS was developed from the watershed hydrological model SWAT2000 (Soil Water Assessment Tool), the groundwater model MODFLOW96 (A Modular Three-Dimensional Finite-Difference Groundwater Flow Model), the surface/groundwater modeling package SWATMOD99, and the wheat and maize models of CERES (Crop Environment Resource Synthesis) model family. The hydrological component ASWAT of DEHYDROS was based on SWAT2000. However, significant modifications were made and quite several new capacities were developed to meet with requirements of the irrigation districts. The biological components of the CERES crop models were integrated into the ASWAT to enhance vegetation/crop growth simulation. Along with the evapotranspiration approaches in SWAT2000, Shuttleworth-Wallace equations were also employed in ASWAT to calculate evaporation and transpiration under conditions of sparse vegetation cover, multi-story canopy, mulching, and etc. An irrigation canal transmission module was developed to simulate irrigation canal hydrology, which is common in the irrigation districts of the basin. DEHYDROS was also designed for conjunctive use of multi-source water in the irrigation districts. The groundwater components were developed from the groundwater modules of SWAT2000 and MODFLOW model. This provided two options for dealing with groundwater simulation in the coupled ecological - surface water - groundwater system. One is the shallow aquifer storage – groundwater height curve (S-H) method. With this method, HRU (Hydrological Response Unit) column contains the unsaturated soil profile and the shallow and deep aquifers. The shallow aquifer storage was modeled by a water balance approach; the groundwater height was derived from its storage with the S-H curve. Water extraction from the storage of one HRU column was allocated among storage of HRUs within the same subbasin by ad hoc weighing HRU area and groundwater height. Another component MFX96 was developed from the MODFLOW96. This component simulates groundwater flow in a grid domain of finer resolution. For the S-H method, unsaturated and saturated flows were coupled at the HRU scale. For the MODFLOW method, the two-way coupling unsaturated - saturated flow and the surface water / groundwater were realized through an association map of the subbasin to the grid domain at the subbasin scale. The boundaries of the subbasins are adopted to fit to the grid flow domain. In either case, the unsaturated soil profile was interconnected to the oscillating water table and the groundwater evaporation was formulated based on evaporative demand, vegetation/crop, soil water, and water table. The application of DEHYDROS in HID provided a detailed simulation of seasonal groundwater table fluctuation, recharge to and evaporation from the shallow groundwater, and the annual water budget over the entire district. These results indicate the necessity of two-way coupling of the unsaturated-saturated processes when groundwater level is shallow, and the feasibility of making comprehensive use of surface, soil and ground water information in providing a more physically-based assessment of regional hydrological dynamics.

Key words: hydrological model; irrigation, irrigation district; surface water; groundwater

Soil water and nutrients use and balance and their environmental effects in the rainfed cropland eco-systems: a long-term experiment study on the loess plateau

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The tableland-gully landscape is one of the main topographic-ecological types on the Loess Plateau, which includes two geomorphic units: tableland and dissected land. The loess tableland-gully region traverses Shanxi, Shaanxi and Gansu provinces of China with the altitude of 900m-1300m, and dryland farming is conducted in most parts. The Changwu tableland is located in the middle of the tableland-gully region of the Loess Plateau, and is climatically sub-humid and subject to drought.

In 1984, researchers in the Changwu Station set up a long-term rotation experiment, in which there were 36 treatments with 108 plots and 66.7m² of area for each plot, the rotation systems included grain-grain rotation, grain-grazing rotation, and monoculture; fertilization systems included N application only, P application only, organic manure (M) only, and mixed application. The experiment has generated a large amount of experimental data in last twenty years and over 100 academic publications, and lots of significant results were turned out.

This article reviewed the published research papers, analyzed the experimental data of last two years, and discussed the balance and utilization of soil water and nutrients of cropland eco-systems and their environmental effects. It was found that the mixed application of N, P and M had a better effect than the individual application of each fertilizer alone, viz., NPM>NP>N or P or M. Three yield levels (high, middle, and low) corresponded to the three levels of nutrients supply. As the yield increased the soil layer of water consumption deepened. At the same yield level, the soil layer of water consumption was deepened as the duration of continuous wheat without rotation increased. After 15 years of continuous wheat without rotation, the soil layer of water consumption was deeper than 500cm in the high yield plots, just to 500cm in the middle yield plots, and relatively shallow in the low yield plots. The minimal wetting depth of rainwater was in the high yield plots. The deep soil layer of water consumption with small depth of rainwater infiltration resulted in more serious desiccation of soil in the high yield plots. Yield fluctuation took place in both high yield level and low yield level plots during the experiment. The desiccation of soil was the direct cause of the fluctuation in the high yield plots; however the lower water absorption capacity of crop and insufficient use of soil water storage was the cause in the low yield plots.

The formation of the long-lasting desiccated soil layer diminished the passage of rainwater infiltrating to underground water, and therefore strengthened the water cycle through SPAC in a small scale. Long-term high fertilizer input or the unbalanced application resulted in the NO₃-N accumulation in the deep layer between 100cm and 180cm, with the maximum accumulation over 40% of N application. Rational application of P fertilizer could reduce the NO₃-N

accumulation effectively, but P is fixed more easily by soil. Nutrient accumulation in the deep layer lead to waste of nutrient resources and potential ecological environment problems. In the long-term continuous alfalfa plots, soil depth of water consumption exceeded 1000cm, while the content of NO₃-N was lower in the deeper soil.

The total precipitation in 2003 was 959 mm, which was 64.6% higher than long-term average of 578 mm and was a record high since 1957. In 2003, rainwater infiltrated to the 4.5-m to 5-m depth on the fertilized wheat plots in both monoculture and rotation, and deeper than 6-m depth on the unfertilized wheat plot and bare fallow plot; however only 3.5-m depth on the long-term continuous alfalfa plot, in which the desiccated soil layer shrinked, but has not been eliminated. Although cropping systems had a significant impact on subsoil moisture restoration, the long-lasting desiccated soil layer between the 2- to 3-m depth in croplands, resulting from years of high productivity of crop and intensive water consumption, was fully replenished in the wet year like 2003.

Analyzing series of data of the long-term rotation experiment at the Changwu Station is significant to clarify the cycle and use of water and nutrients of regional agro-eco systems and their environmental effects, and to promote the sustainable development of agricultural systems.

Key words: long-term experiment; cropland eco-systems; soil moisture; environmental effect; the loess plateau

Growth, biomass production, water-use efficiency and leaf anatomy of two leguminous shrubs in response to water stress

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In the context of climate change, an increased frequency of drought stress might occur at a regional scale in the dry valleys of the Hengduan Mountain Systems. The selection of appropriate planting stock for vegetation restoration in regard to environments is an important issue for the sustainable development in this area at present and predicted global change. *Sophora davidii* and *Bauhinia faberi* var. *microphylla* are xerophytic leguminous shrubs, natively distributed in the dry valley of Minjiang River. They are often predominant on eroded slopes and play a vital role in retaining ecological stability. To assess their differentiations in drought tolerance, two-month old seedlings of the two species were grown under five water supplies in greenhouse at the Maoxian Station for Ecosystem Research, CAS. The seedlings were watered to 100%, 80%, 60%, 40% and 20% water field capacity (FC), respectively. Plant height and leaf number were recorded monthly over a 4-month period, while biomass production, water-use efficiency (WUE), leaf relative water content (RWC) and leaf anatomical characteristics were measured at the end of the experiment. The both species exhibited the greatest height, leaf number and size, biomass production, WUE and RWC when water supply was at 100% FC, and slightly declined at 80% FC. These parameters were greatly decreased by 60 to 40% FC and were strongly retarded by 20% FC.

Our results suggested that the two species could tolerate water stress. However, the parallel reduction of biomass production and WUE under drought conditions indicated that the seedlings employed a prodigal water-use strategy. Hence, they did not produce significant biomass under severe or prolonged drought stress. In particular, significant differentiations in drought tolerance were confirmed between *S. davidii* and *B. faberi* var. *microphylla*. *B. faberi* var. *microphylla* was more susceptible to water stress than *S. davidii*, which can be explained by its leaf senescence and pronounced reduction of biomass, WUE, RWC and mesophyll cell thickness under moderate and severe water stress. Seedlings establishment of *B. faberi* var. *microphylla* was strongly favored by a relative wet soil condition, whereas *S. davidii* seedlings were more resistant to drought conditions. These results might provide insights into limitations and opportunities of seedlings establishment and selection of planting stock for vegetation restoration in different water supply areas.

Keywords: drought tolerance; leguminous; seedling establishment; water-use strategy

Sustainable water management in irrigation regions: understanding the impact of precipitation trend on crop productivity in the North China Plain

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Precipitation is one of most important limited factors restricted the crop growth. However, in order to obtain high grain yield in the North China Plain (NCP) farmers pumped groundwater excessively. How to establish the optimal irrigation scheduling according to the crop water requirements (CWR) and precipitation is the key factor to achieve the rational water use. Precipitation data collected from 1960 to 2005 was analysed to find the trend and weather data from 1984 to 2005 to estimate the CWR and irrigation water requirements (IWR). Field experiments were performed at the Luancheng Agro-ecology Experimental Station from 1996 to 2005 to calculate the soil water consumption at three irrigation levels. The precipitation trend was reduction especially during the summer maize growing periods. The CWR of winter wheat and summer maize was similar, however the IWR had significant difference because the IWR of winter wheat was higher 2 times than that of summer maize. So in the future, facing the water resources shortage becoming more and more serious, how we can keep the agricultural sustainable development water-saving agriculture is imperative under the situation.

Keywords: sustainable water management; precipitation trend; crop productivity; irrigation regions; North China Plain

Impact of fog on the energy budget of a subtropical cypress forest in Taiwan

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Results of energy balance measurements during an 11-d period under clear weather, and a 5-d period under foggy conditions are presented. The single most important factor discriminating the 2 periods was the intensity of solar radiation. With fog, a reduction in the incoming shortwave radiation of up to 95% was found. Using the eddy covariance method, turbulent fluxes of CO₂, latent heat (E), and sensible heat (H), were measured. The energy balance (EB) was positive (26 W m⁻²) under clear conditions, resulting in a gain of energy for the ecosystem. In contrast, during the presence of fog, EB was negative (-15 W m⁻²) indicating a loss of energy. In both situations, the EB was not completely closed. Possible reasons for this finding are discussed. The ratio of available energy and the sum of turbulent fluxes in E, H and soil heat flux (S) during the clear and foggy periods were examined for daytime and nighttime conditions. The CO₂ flux exhibited a diurnal cycle with negative fluxes in the daytime associated with CO₂ uptake by vegetation. The average CO₂ fluxes of -7.8 μmol m⁻² s⁻¹ during clear conditions and -3.2 μmol m⁻² s⁻¹ during foggy conditions indicate that the ecosystem benefits from clear weather conditions.

Key words: eddy covariance; energy balance; fog; forest ecosystem; radiation balance; cypress forest

Nutrient budget of irrigation-drainage system of paddy field in the Yangtse Delta region

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Nutrient load management is an important environmental issue because nutrient loads from farmlands degrade surface waters as a result of anthropogenic eutrophication. However, the effect of paddy field on irrigation-drainage system N and P budgets has not yet been clearly assessed. A field experiment using large monolith lysimeters which included control (no fertilizer), low fertilization(F1), medium fertilization(F2), high fertilization (F3) as well as low fertilization with pig manure (F1+M) and medium fertilization with straw treatments, was conducted from 2005 to 2006 at Changshu Agroecological Experiment Station of central Yangtse Delta. N and P of leachate, irrigation and raining water were measured and balance of N and P in irrigation-drainage system was calculated for the rice growing season. In wheat season (from November 2005 to May 2006), N and P leaching rate increased with fertilizer applied. Nitrate concentration was high to 14.21~ 32.99 mg N. L⁻¹ in the first leachate, exceeding 10 mg.L⁻¹ drinking water standard and the amount of F1, F2 and F3 treatment leaching was 12.19, 14.01 and 16.42 kg.hm⁻², respectively. The total amount of NH₄⁺-N, NO₃⁻-N and T-P (total phosphorus) leaching was 0.41~0.64, 10.86~16.42 and 0.09~0.19 kg.ha⁻¹, respectively, accounting for 0.2%~0.4%, 4.8%~8.1% and 0.1%~0.3% of fertilizer applied. In rice season(2005-2006), the amount of leaching was 0.36~1.04, 1.55~3.01 and 0.26~1.17 kg.ha⁻¹, respectively, accounting for 0.2%~0.4%, 0.6%~1.7% and 0.4%~3.9% of applied fertilizer. Compared with using fertilizer only, fertilizer combined with manure (F1+M) can increase the nutrient leaching for both wheat and rice seasons, especially for phosphorus, while fertilizer combined with straw (F2+M) reduce the nitrogen leaching during the wheat season. The paddy field ecosystem, during the rice growing period, consumed 890~1320 mm irrigation water, the net absorbing 10.7~12.3, 6.8~9.2 and -1.2~2.0 kg.ha⁻¹ of NH₄⁺-N, NO₃⁻-N and T-P, respectively in all fertilization treatment, regardless of fertilizer application rate. Although nutrient leaching rate increased with the fertilization rate, the net nutrient purifying rate did not seem to be closely related to it. Because of rice of high fertilization used much irrigation water and nutrients than of low fertilization. Application of straw (F2+S) had a little effect on purifying nutrient rate, while application of pig manure (F1+M) weakened the purifying function significantly, and could even be deemed as a “source” of phosphorus in surrounding water. During the rice growing period, paddy field played the role of purifying the N and P of irrigation water, except for in the treatment of pig manure added. NO₃⁻-N, however, was liable to leach in the period of puddling the paddy soil and basal fertilization. These results demonstrate that paddy field system mainly functions as water purifier by absorbing nutrients from irrigation water regardless of runoff and leaching of nitrate in wheat growing season has the risk of environment.

Keywords: paddy field; irrigation-drainage system; N and P budget; nutrient leaching

Impact of temperature and moisture on soil respiration: deconvolution analysis of field data in subtropical forests in southern China

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Evaluation of the relative influence of temperature and moisture on soil respiration is critical for making reliable predictions of soil carbon (C) cycle, and for refining process based soil C models. Past studies have encountered considerable difficulty in separating temperature and moisture impact on soil respiration on the basis of field data because these two factors are confounded in forest ecosystems. In this study, we adopted a deconvolution analysis to distinguish relative influence of temperature from that moisture on soil respiration based on regression models. Site specific models were developed at daily and monthly time steps respectively. Soil temperature and moisture were employed as predicators in the daily soil-driven models, while air temperature and precipitation are predicators in the monthly climate-driven models. Intersite models then developed by adding site index into the site-specific models. The performance of intersite models is similar which suggested that each of them can be used to evaluation soil respiration with the respect of the easiness of measuring site variables and the land disturbance history. Sensitivities of soil respiration to temperature and moisture were compared across sites based on site-specific monthly models. The intersite difference of temperature sensitivity was not pronounced in the cool-dry season (October – March) while it became prominently in the hot-humid season (April – September). The moisture sensitivity increased asymptotically with the increase of precipitation. Deconvolution analysis indicated that soil respiration in DNR forests affected more by precipitation than by temperature, especially in the cool-dry seasons. Extremely low precipitation impact values in the winter suggested that the scarcity of rainfall restricted soil CO₂ efflux. With the respect of climate change, soil respiration in DNR forests will be less sensitive to temperature change than to precipitation change.

Key words: deconvolution analysis; soil CO₂ efflux; soil water storage; impacts of soil temperature and soil moisture; Dinghushan Nature Reserve

Soil water dynamics as influenced by land use changes in Karst Mountainous Region in Northwest Guangxi

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Soil water plays a key role in vegetation rehabilitation and eco-environmental construction in karst mountainous region. This region is ecologically fragile with the basic characteristics of scarce soil-water resources and low vegetation coverage, which has been aggravated due to high population pressure and irrational land use. In order to decrease man-environment conflict and improve local eco-environment, ecological migration has been carried out since 1990s in some karst mountainous regions. This project would no doubt lead to land use changes, and result in the change of soil water dynamics in the emigrant area to some extent.

In this paper, the dynamic change of soil water, the distribution of soil water along hillslope, and the spatial variability of soil water were discussed in a typical peak-cluster depression area of Guzhou Village, Huanjiang County in Northwest Guangxi of China. In this village, some farmers were migrated outside and their cultivated slope lands were abandoned in 1996. Thereafter, forage grass (Guimu-1 hybrid *Pennisetum purpureum*), chestnut (*Castanea mollissima* Bl.) and pigeonpea (*Cajanus cajan* (L.) Millsp.) were gradually planted in 2002. In order to study the dynamic change of soil water, five land use types on hillslope and two in the depression were selected in 2004 and 2006. In order to analyze the distribution of soil water along hillslope, two land use structures in 2004 and five in 2006 were chosen, respectively. Soil water was measured with oven drying method. There were ten to fifteen replications in the 0-20 cm soil layer on hillslope, and five replications in the 0-100 cm layer in the depression. Furthermore, the spatial variability of soil water in the depression and on hillslope was investigated with grid and line sampling methods in 2004 and 2005, respectively.

Soil water in the top 0-20 cm layer on hillslope was moderate variation, but had some differences among various land use types. Original shrub, abandoned and cultivated lands had higher water contents and anti-disturbance abilities than those economic forestland planted with chestnut and pigeonpea. The latter needed some water-conserving measures during their early growth period. As a result, natural restoration was better than artificial rehabilitation from the viewpoint of soil-water conservation. Soil water in the depression increased averagely with the increase of soil depth in the 0-100 cm soil layer. However, the coefficient of variance of soil water decreased in the soil profile, and its vertical change could be divided into two or three layers. Compared with the coefficient of variance, slope land was easier to be disturbed by environmental conditions than the depression.

Soil water movement on hillslope was complex, and its distribution along hillslope was controlled mostly by land use type. When land use was the same along hillslope, slope positions had small

effects on its distribution. Soil water in chestnut land had the increasing trend from top to bottom, but there was not obvious difference in various slope positions. However, soil water in corn and abandoned lands was obviously higher in the top position than that in the middle and bottom positions. This kind of phenomenon might result from the higher vegetation and rock coverage in the upper slope, which increased land runoff and lateral water movement. When land use was different along hillslope, the distribution of soil water had a close relationship with land use type but not slope position.

Surface soil water (0-5 and 5-10 cm) in a rectangular plot (150 m in length and 50 m in width) had a simple pattern of periodic variations in drought season. The patches with the same spatial autocorrelation character corresponded to soil continuum and rock distribution in area. The semi-variograms had an anisotropy character in the whole sampling plot. However, it showed different structure characters in different patches. The soil continuum patch had a low sill and a long range (about 60 m), whereas the rock-distributed patch had a high sill and a short range (about 8.5 m). Such soil water patterns could be explained by the effect of local bare rock distribution and the topography. Furthermore, the range of soil water increased with the sample spacing. This implied that when the spatial pattern was controlled by plural factors of different scales, sample spacing should be decided by the aim and precision of the research. When mean soil water increased, its spatial variability would decrease in a rectangular plot (90 m in length and 40 m in width). The range was about 55 m under moist condition and 9.35 m under arid condition. In addition, the variability of soil water along horizontal direction was greater than that along longitudinal direction. This resulted from the special soil and topography conditions in horizontal direction. Land use type and slope gradient were the key factors that affected the distribution and variability of surface soil water on hillslope.

Key words: soil water; spatial variability; land use change; Karst Mountainous Region

Workshop 4 Environmental Changes and their Impacts to Ecosystems

Climate change and grazing impacts at the Mongolian long-term ecological research network site, Lake Hovsgol, Mongolia

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Lake Hovsgol occupies a tectonic basin at the southern end of the Baikal Rift System and formed during the neo-Baikalian period about 4-5 Ma. Lake Hovsgol was the focus of a twenty year (1970-1990) joint research expedition organized by scientists of The National University of Mongolia and Irkutsk State University, Russia. This research extensively characterized the lake and its watershed and resulted in numerous Russian and Mongolian publications. From 1995 to 1997 the research continued with support from NSF joined by scientists from the USA and Japan. A book on this research was published in 2006 in English that also summarized some of the earlier research. The lake and its watershed were established as an ILTER network site in 1998.

In 2002, a five year study of nomadic pastoralism and climate change impacts on steppe and forested habitats in six eastern shore stream valleys was initiated with funding from the Global Environment Facility (GEF). The region is significant because Lake Hovsgol is located in the forest/steppe boundary zone between the Siberian taiga forest and the vast steppe of Central and East Asia, an excellent location for studies of climate change. The six valleys also form a gradient of livestock grazing, most intense in the north near the Russian border, and with less grazing to the south farther from the border. The watersheds consist of forested ridge tops between each valley that extend downward on north-facing slopes; whereas, south-facing slopes and riparian zones are primarily steppe, dominated by a mix of grasses, sedges and/or forbs and shrubs, depending on the intensity of grazing. The Hovsgol GEF project included capacity building for 23 young Mongolian researchers who performed the research following training in a series of workshops presented by several international scientists.

Major findings of the research include the following: Climate change—long-term meteorological station data sets from four locations near Lake Hovsgol (40-70 year records) indicate that the area's annual average temperature has warmed by almost 2° C. With the warming, there has been a significant reduction in extremely cold days and in the number of frost days, and a significant increase in extremely hot days (> 25° C). There has been no substantial change in annual precipitation levels (ca. 300 mm/year), but this may be difficult to detect because seasonal rains are highly variable among years. Northern Mongolia is also the boundary of continuous permafrost in Asia though our study area has discontinuous permafrost; temperature monitoring of boreholes indicate that permafrost temperatures are warming and active layer depths are increasing. However, permafrost depth is also related to the loss of vegetation cover due to livestock grazing.

Steppe plant biomass for each year is highly dependent upon soil moisture from summer rains. The forest is dominated by *Larix sibirica*; successful seed germination is also dependent upon adequate soil moisture. Stream biota in the watershed streams appears to be determined by stream water chemistry. Conservation of soil moisture appears to be key to making the habitats more sustainable and this depends upon soil plant cover, whether of living green tissue or of dead plant litter. To better understand the relationships between temperature and precipitation changes, soil moisture and plant growth and the impacts of livestock grazing and climate change on the vegetation, the project is developing an Ecosystem model.

Oil spill in panay island: its effects and need for post-marine biodiversity assessment

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Guimaras Province in Panay Island, Central Philippines was the area where the disastrous oil spill took place in August 2006. Central Philippines, includes the three Visayan Regions, identified as a biodiversity-rich marine habitat. This is attested by the rich seaweed species I and other Filipino Biologists, have studied/reported for the past three decades. The seaweed resources in Guimaras contain both biologically important and commercially abundant species like Caulerpa, Gracilaria, Gelidiella, Eucheuma, and Kappaphycus. The latter two species constitute the Philippines' principal seaweed exports as dried item (3rd in the world), and as processed natural grade Carrageenan (1st in the world). The so-called Solar I oil spill (named after the ill-fated bunker oil carrier) in Guimaras Province, was a nightmare to the benthonic organism, specifically the seaweed, seagrass, mangrove, mollusk and coral populations. It wrecked-havoc to the marine ecosystem, both biologically and economically, as shown by the statistics: damage to 107 hectares of seaweed farms, 28 hectares of seagrasses, 688 hectares of mangrove, 100 hectares of corals, and 974 hectares of fishponds.

Socio-economically dislocated were 50,000 plus fish vendors and traders as well as affected the livelihood of Guimaras Province's 150,000-155,000 fisherfolks population. Also, were revenues lost by beach/vacation resort establishments and the risks caused on the people's health and their nutrition. The Philippine Government and PETRON Corporation, owner of spilled bunker oil, including both national and foreign NGO's, have tried to alleviate the situation in Guimaras province and its population, by extending technical and financial assistance. The snail-paced program to resurrect the marine organisms ecology and population have reached an alarming level. This has urged me to advocate for a prompt post-oil spill marine biodiversity assessment program designed to document the extent of the damage to the marine vegetation, particularly on seaweeds. The strategy includes cross-checking the "surviving" species against base-line pre-oil spill data and to identify which taxa need rehabilitation or re-introduction in Guimaras Province and vicinity.

The 3-year project proposal is already with the Philippine Government and hopes to get a slice of the budget for R & D which is expected to reach P5.522 Billion in 2008.

Keywords: oil spill; panay island; biodiversity assessment

Long term dynamics of biophysical structure and bioeconomy of the Lower Danube River System (LDRS)

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The proposed presentation is aiming to deliver a comprehensive overview on the long term structural and functional changes and their impact on resources and services flows, of the LDRS which extends over more than 9000 km², along lower stretch (840 km) of the second largest river in Europe. The system consists in four major land-waterscapes: i) Coastal Danube Delta (CDD) (4420 km²); ii) downstream floodplain (701 km²); iii) Inland Danube Delta (IDD – 2413) and; iv) up stream linear floodplain (between 350-840 km) (1500 km²). These type of biophysical units belong to a range of local and sub-regional socio-ecological systems, playing a major role as services provider to the respective socio-economic subsystems. The analysis and synthesis are based on a large amount of empirical data derived from long term (40 years) field measurements and experiments, carried out by a network of expert teams and laboratories belonging to the University of Bucharest, the Romanian Academy and other national research institutes. The analysis allowed for the identification and description of major structural (e.g. 48.4% of the total floodplain conversion into crop production or intensive fishery systems) and functional (e.g. energy and mass transfer, water storage capacity; production, regulation and support functions) changes under different pressures and driving forces, active within the entire river catchment. There is also briefly described the impact of such changes upon the range and density of resource and service flows. The major findings allow to conclude that by the end of 1970^s the engineered structural changes exceeded the threshold of 30 per cent of the converted floodplain into polders and, reached by the end of 1980^s the level of 48.4 per cent. Such changes within the structural configuration of the LDRS has been accompanied by a shift in the functional regime of the remained natural and semi-natural components which became less resilient against external and internal driving forces (in particular hydrological river pulse; nutrient input; climate change).

Detecting the impacts of anthropogenic and climatic changes on water, carbon and nitrogen cycling of ecosystems in Eastern Asia

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For sound management and decision making of sustainable water and material use under the condition of global warming, the ecosystem assessment, emphasizing biophysical and biogeochemical processes and human interactions, is a key task. For this task, an integrated ecosystem model has been modified to estimate the spatial and temporal distributions of the water, carbon and nutrient cycles over large regional scales. Many models have been developed to simulate the terrestrial processes, in which the BIOME-BGC is a model originally developed to simulate the development of carbon and nitrogen pools over time (Running and Coughlan, 1988). The model is driven by routinely available daily climate data and the definition of several key climate, vegetation, soil and site conditions.

In this study, we try to improve and explore the ability of the BIOME-BGC to estimate the H₂O and CO₂ dynamics of various ecosystems. We start with an evaluation of the uncertainty in the model estimates associated with different initializations (carbon and nitrogen state variables), and then analyze the effect of changes in both environmental conditions (air temperature, atmospheric CO₂ concentration and nitrogen application) and human activities (irrigation and fertilizer application). By using the model, the future changes in water, carbon and nitrogen cycles can be predicted based on scenarios, such as the degradation of vegetation due to water shortage, and the increase in air temperature and CO₂ concentration, as well as the land use/cover changes.

The model has been applied to the total ecosystems in China by using MODIS satellite data products, such as leaf area index (LAI), vegetation index (VI) and land surface temperature (LST). The model inputs include the data of land cover, soil properties as well as meteorological data, such as maximum and minimum daily air temperature, T_a (°C), precipitation, P (cm), total daily mean solar radiation, Q (W m⁻²) and day-length, D_L (s). The model outputs include gross primary production, G_{PP} (kg C m⁻²), net primary production, N_{PP} (kg C m⁻²), net ecosystem production, N_{EP} (kg C m⁻²), maintenance respiration, R_m (kg C m⁻²), growth respiration, R_g (kg C m⁻²) and heterotrophic soil respiration, R_h (kg C m⁻²), as well as the net ecosystem CO₂ and N exchanges, F_c (kg C m⁻²) and F_N (kg C m⁻²). Hydrologic variables estimated by the model include evapotranspiration, E (mm), soil moisture S_M (mm) and runoff, R_O (mm).

In order to validate the model after modified its parameterization, we compared the simulated results of daily ET and NEE with the observed flux data. The APEIS Project, launched in 2001 by the Ministry of the Environment of Japan, has established 5 flux-tower sites, so-called APEIS-FLUX (Wang and Watanabe, 2005) that covers a variety of ecosystems, including grassland, irrigated agricultural field, paddy field, forest and semi-arid desert, to measure water vapor, energy exchange and carbon dioxide over a long term. The Biome-BGC model requires three types of information: site parameters, meteorological data, and vegetation data, which were intensively observed at these sites that allow a reliable parameterization of this model. To estimate the effects of anthropogenic forcing on the carbon sequestration capacity, the model simulations were executed with two scenarios: undisturbed and disturbed.

In the real world, ecosystems are often disturbed intensively by anthropogenic and environmental change forces, such as irrigation, fertilizer application and the increase of CO₂ concentration, thus first we compared the estimated daily ET and F_c under the disturbed scenario with the observed data of APEIS-FLUX. Linear regression analysis between modeled and observed daily average ET and F_c showed a close relation. These results suggest that the improved model is quite useful for simulated H₂O and CO₂ fluxes under the consideration of anthropogenic forcing after modifying

its eco-physiological parameters.

Simulation under the undisturbed scenarios is an important way to understand the potential plant growth as well as water, carbon and nitrogen exchanges without the impacts of human activities. Both ET and F_c simulated under the undisturbed scenario were lower than those simulated under the disturbed scenario and observed values because the crop growth under undisturbed natural conditions is limited by carbon and especially nitrogen availability. These results showed that enhanced atmospheric CO₂ concentrations and especially increased nitrogen application had a marked effect on the simulated water and carbon sequestration capacity and played a prominent role in increasing this capacity.

Comparing the simulated results with ground observations suggested that the model can also predict both crop growth (LAI, NPP) and daily CO₂ and N fluxes reasonably under the consideration of the effects of anthropogenic forcing, such as increasing atmospheric and soil nitrogen application and CO₂ concentrations. For different ecosystems, we found that in the case of NPP, Corn > Rice > Wheat > Grass > Desert, soil respiration, Rice > Grass > Wheat > Corn > Desert, and finally NEP, Corn > Wheat > Grass > Rice > Desert. Compared with the undisturbed scenario, the simulated water vapor flux and net CO₂ ecosystem exchange are much higher in the disturbed scenario than those in the undisturbed scenario. This result suggests that enhanced atmospheric CO₂ concentrations and especially increased nitrogen application in soil due to fertilizer application had an apparent effect on the water and carbon fluxes and sequestration capacity. Finally, both 8-day and annual carbon fixation by vegetation in Eastern Asia has been estimated with a resolution of 1km by using the modified model and MODIS data inputs as shown in Fig. 1.

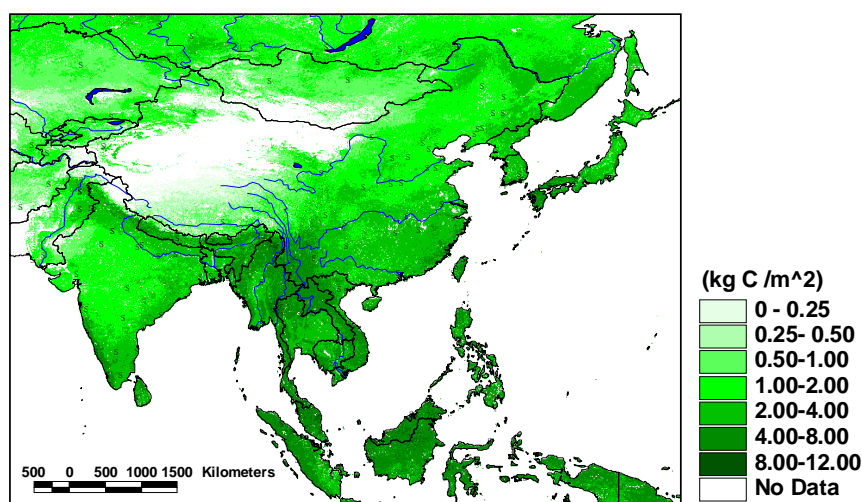


Fig.1 Annual carbon fixation by vegetation in Eastern Asia estimated by the integrated model

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Keywords: water and carbon cycles; anthropogenic impact; climatic changes; ecosystem; Eastern Asia

Climate change and its ecological impacts—The evidences from the field experiments on northeastern Tibetan plateau

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A series field experiments include open top chambers (OTCs), the eddy covariance method and transects, were conducted at the Haibei Alpine Ecosystem Research Station, Chinese Academy of Sciences to investigate the impacts of global warming on plant species diversity, vegetation production and forage quality, ecosystem carbon budget of alpine ecosystems.

Within each of OTC's experimental plots, a complete factorial experimental design was established where warming was simulated using fiberglass OTC's, and the effects of defoliation from grazing were simulated through clipping. Simulated warming decreased total species richness by five to 14 species (depending on the habitat and the grazing history) in 1999, and by 9 to 15 species in 2001. This represents a 16-30% decline in species richness in 1999 and a 26-39% decline in species richness by 2001. The large absolute and relative declines in the overall richness of species occurred at the high grazing meadow and light grazing shrub-land sites. Averaged across all sites, warming decreased the Shannon diversity index by four species (34%) in 2001. The overall effects of experimental warming on species diversity were large and robust across all sites, while the effects of simulated grazing, and of combined simulated warming and grazing, exhibited more site-specific heterogeneity. Simulated grazing had no effect on species richness at any of the sites in 1999. By 2000 and 2001, most sites exhibited an increase of two to four species with clipping; this represents a 5–14% increase in species richness. For example, clipping increased species richness by four species at the light grazing meadow site in 2001. By contrast, clipping never showed any effects on species richness at the light grazing shrub-land site. In 2000, clipping increased the Shannon index by three species at most sites. However, it had no effects in 2001. The experimental results of simulated warming and grazing suggest that grazing management can be used to mitigate some of the losses of species incurred as a result of warming. This is a preliminary study to explicitly examine the independent and combined effects of experimental warming and grazing on the rangelands of the Qinghai-Tibetan Plateau, and its results suggest that the future of species diversity in this region will depend on both climate change and grazing management.

Warming decreased total ANPP by $40\text{gm}^{-2}\text{yr}^{-1}$ at the meadow habitats also reduced rangeland quality. Grazing maintained or improved rangeland quality by increasing total ANPP by $20\text{-}40\text{gm}^{-2}\text{yr}^{-1}$ with no effect on palatable ANPP. Four sites with differing temperatures were selected at different altitudes of Daban Mountain to investigate the potential effect of climate warming on alpine herbage nutrient content. Five species of herbage, i.e., *Festuca ovina*, *Poa annua*, *Koeleria cristata*, *Kobresia humilis*, *Carex atrofusca* were selected for the purpose of determining soluble contents and structured carbohydrates, such as crude protein (CP) and ADF (acid detergent fiber) and ADL (acid detergent lignin). Temperatures showed a clear downward

trend with increases in altitude. Correlation analysis indicated significant negative correlation coefficients between altitudes and temperatures. Therefore, differences in herbage CP, ADF, and ADL contents were primarily influenced by temperature, and the warming trends seen in the climate of the Tibetan Plateau over the last 40 years would enhance herbage respiration. This is especially true of increases in nighttime temperatures. This tends to work against the accumulation of some soluble matters such as protein, ether extract, and nitrogen free extract, and is better suited to the accumulation of insoluble lignin. This is the first reported empirical evidence that climate warming could cause declines in plant species diversity and productive in high elevation ecosystems over short time frames and supports model predictions of large species losses with anthropogenic climate change.

Flux of CO₂ measurement for 3-4 years at three different vegetations showed that seasonal trends of annual total biomass and NEE followed closely the change in air temperature. Integrated NEE were $-78.5 \sim -192.5 \text{ gCm}^{-2}\text{yr}^{-1}$ and $-58.5 \sim -75.5 \text{ gCm}^{-2}\text{yr}^{-1}$ carbon sink for meadow and shrubland ecosystem respectively, well as swamp ecosystem was carbon source ($16.10 \sim 76.73 \text{ gCm}^{-2}\text{yr}^{-1}$) for atmosphere. The current CO₂ sink strength seems small and is comparable with many other subalpine ecosystems reported so far. This dependence seemed to be related to the accumulated biological effects that resulted from previous temperatures, that is, cumulative temperature and consequent plant growth. The annual NEE in the alpine meadow was comprehensively controlled by the temperature environment, including its effect on biomass growth; the timing of rain events had more impact than the total amount of precipitation on ecosystem Reco and NEE. The carbon cycle of the Qinghai-Tibetan plateau is controlled by the following two approaches, short-term control including day and night difference in temperature, precipitation, season length and leaf area and long-term control including biota, time and human functional on temporal scale; it is controlled by the following two approaches top-down climate factor (temperature and precipitation) and down-top biology factor (leaf area and grazing) on spatial scale. In general, increase air temperature has negative effect on carbon sink for three different ecosystems. Large Q₁₀ for swamp and shrubland ecosystems indicated ecosystem respiration was more sensitive to temperature change. Ecosystem carbon budget behavior also depended closely to soil carbon density.

Keywords: experiment warming; species diversity; herbage quality; NEE

LTER for adaptation to global warming in Veracruz, Mexico

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Global Climate Change has now established as a first line environmental issue in the world's agenda. The LTER research platform is naturally call to be a significant contributor of both data an understanding of processes that are relevant to human well being. At a local scale, the LTER national programs should allow for pinpointing particular aspects of the Global Climate Change impacts and mitigation strategies that should be monitored as well as devising adaptation strategies that make sense locally. At the same time, and providing that the ILTER policies can be strengthen, the worldwide deployed capacities make and ideal structure for the coherent scaling of local data to global coverage. At Veracruz, Mexico we are involved on the development of the "Action Plan of the Estate for Climate Change", we shall present some of the challenges that this endeavor entails and the advantages that we feels it has to link such an strategy with the MEX-LTER and ILTER initiatives.

The state of Veracruz is located on the Gulf of Mexico shoreline. It has the largest coastal contact with the Gulf of Mexico in the country. It is a rather narrow stripe of land some 60 km wide which spans over a very wide coastal flatland which contrasts inland with its contacts with very high topographic features, like the main volcanic axis where Mexico City is located at approximately 2,200 m above sea level. Also the largest volcano in the country is located in this region (Citlaltepetl: 5747 m elevation). The state of Veracruz is third on biodiversity within Mexico, which is in turn a megadiverse country.

On a preliminary basis, we hypothesize the main ecosystem structure of this region will be transform towards a drier condition, but some area will receive quite a bit more rainfall than they do now. Many species of tropical humid affinity will struggle to survive in this new habitat. Small portions currently with semiarid vegetation might disappear altogether. We are also analyzing the opening of habitat condition for some dangerous fauna, especially vectors of diseases like malaria and dengue fever. Biodiversity monitoring is to us a very important issue in Mexico and in relation with climate change it should be added to the strategies of adaptation because human well being is based to a great extent on the environmental services provided by it. Therefore, as Ahmed Djoghlaif (Executive Secretary of the Convention on Biological Diversity at UNEP) suggested recently, together with the climate change preparedness the reduction on biodiversity is undertaken we should have much better tools to mitigate climate change impacts, especially for the world population living under poverty conditions.

Veracruz estate has already an LTER site located on tropical rain forest conditions at Los Tuxtlas. It has a biological station operated by the National University (UNAM) with a long scientific tradition. Research groups of several institutions have converged along the station history. There are other two spots in the estate that we are currently analyzing to incorporate into the LTER network: "La Mancha" (the Instituto de Ecología, AC has a coastal station there) and "La Cortadura" (Coatepec Municipality has an ecological reserve there for environmental services

assurance). With these three points we believed we should have a very nice coverage of the most important ecological conditions in the region: tropical humid, sea side and tropical mountain ecosystems. In all of them the biodiversity base line is quite well documented now. We are now incorporating monitoring capacities of physical variable on coastal environments and on the La Cortadura site. With the information available we have some preliminary indication that the “condensation floor” (currently cloud forest environment) is displaced a little bit higher. At the same time, authorities at Coatepec Municipality have put in place an important program on Payment for Environmental Services that we trust can get substantial feedback from long term ecological research.

Keywords: climate change; vegetation monitoring; fauna monitoring; biodiversity; mitigation; preparedness

Monitoring of natural processes in Doñana at landscape scale

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Introduction

Established in 1968, Doñana National Park (537 km²) is both a Biosphere Reserve and Ramsar Site. It contains the largest wetland in Europe, a complex matrix of marshlands (273 km²), phreatic lagoons, a 25 km-long dune ecosystem and representative Mediterranean terrestrial plant communities. Conservation objectives include the preservation of critically endangered species (Iberian Lynx, Imperial Eagle), of the abundance of waterfowl, and of Mediterranean wetlands and terrestrial ecosystems. Doñana is both a critical stopover site for Palearctic birds migrating to Africa and an important overwintering site for waterfowl.

Methods

Remote sensing technology started to be used as a monitoring tool for Doñana ecosystems at a landscape scale since 2002. Periodic remote sensing images are the best tool for detecting not only local but also regional changes. More specifically, remote sensing is being used to monitor:

- Shoreline dynamics
- Dune system dynamics
- Sedimentation processes in the marshland
- Dynamics of terrestrial plant communities
- Dynamics of marshland plant communities
- Temporal patterns of marsh inundation and water turbidity
- Ecological restoration of transformed marsh
- Land use and land cover changes in the immediate surroundings of Doñana National Park

We have acquired a time series of Landsat satellites images (MSS, TM and ETM+) from 1975 up to 2007. Images are co-registered, radiometrically corrected and normalized in order to make them comparable. The time series is regularly updated through a Landsat 5 TM subscription and many Landsat 7 ETM+ slc-off scenes.

Results

For shoreline, dune system and sedimentation processes we apply a segmentation algorithm to band 7 which ultimately helps us discriminate sand from other land covers, such as water and pine forests. By comparing scenes from the last 23 years, we observe that the most active dunes are advancing around 6 meters per year on average, and that shoreline progradation, at the South of the Park, is occurring at rates up to 18 meters per year as an average (not lineal increase). On the other hand, sedimentation processes have increased in the main basin of the marsh in the last decade, even after reiterated efforts to avoid sand transportation by tributary rivers. Fortunately, current marsh restoration initiatives are reducing this trend.

We used supervised classification techniques to map both shrublands and helophytic (marshland) vegetation and observed dramatic changes over the last decades due to anthropogenic conversion, overgrazing and changes in inundation patterns. Several sampling plots have been established and used as training areas which are also revealing forest and shrublands stand structure. During a recent episode of severe drought we were able to assess mortality rates associated with this recurrent phenomenon.

Focused research on discriminating inundation levels, turbidity and depth using multi- and hyperspectral imagery has enabled us to reconstruct a historical profile of the inundation regime of Doñana marshes. Hydroperiod (the time during which a wetland is covered with water) values for every pixel have been calculated from inundation maps generated through simple thresholding TM and ETM+ bands 5 (MSS band 4) as the best indicator of water level in such shallow wetlands (Díaz-Delgado et al., 2006a). Hydroperiod turns out to be a very valuable ecological variable explaining plant presence and abundance, as well as inundation trends that may be human or naturally induced (Díaz-Delgado et al., 2006b).

A large restoration project called “Doñana 2005” was initiated after a toxic spill from a local mine in April 1998 which severely compromised water quantity and quality entering Doñana marshes (Pain et al., 1998). Multispectral images together with airborne campaigns of the Airborne Hyperspectral Scanner (AHS) track the effectiveness of restoration measures in supporting natural recovery processes and community species assemblage. Every monitored process here reported is conveniently validated against ground-truth data.

All information generated from remote sensing--including spatially interpolated maps--is accessible through an IDE (Spatial Data Infrastructure) allowing easy access and use of monitoring results. Two websites are available to visualize and download data:

<http://www-rbd.ebd.csic.es/Seguimiento/seguimiento.htm>: available results for all monitoring topics and methodological protocols.

<http://mercurio.ebd.csic.es/seguimiento/>: web map server showing the location of all the ground sampling plots and providing results in a spatial context.

Limitations

The remote sensing applications usually show limitations related to spectral, spatial and temporal resolution. For all the monitoring applications that we are developing, temporal resolution, i.e. revisit time, is far enough since, Landsat platform revisits our study area every 16 days (among ETM and TM sensors 7 days of delay), what allow to efficiently monitor any of the studied natural processes. However, Landsat spectral bands are not enough for many of the ecosystems. It is the case of shrublands, which are the dominant plant community over stabilized sand dunes. Shrubs are mainly composed by 8 species that are co-dominant. Species abundance changes subtly along a gradient highly dependent of aquifer proximity. This aspect has lead to introduce the use of hyperspectral airborne sensors which are helping to yield dominant plant abundance maps through Spectral Unmixing Analysis with very satisfactory results (Jiménez et al. 2007). On the other hand, pixel size has always been mentioned as one of the main constraints for certain research studies. However, in our case, 30m-pixels are substantially informative for every one of the natural

processes monitored, since landscape scale and landscape diversity are the targets of the monitoring program.

Finally, it is worth to say that marsh vegetation and inundation are highly dynamic, not only in terms of annual hydrological cycles but also among cycles, since dominant plants may dramatically change from year to year according to rainfall and fluvial inputs. At this level, the technical protocols to map marshland vegetation are focused on mapping dominant helophytic species as an indicator of temporal changes. Nonetheless, aquatic plant communities are also composed by submerged and floating species that are currently not monitored due to their inconspicuous signal under emergent vegetation. So far, we are investigating new approaches by the use of hyperspectral airborne and satellite sensors to deal with this typical ‘mixed pixel’ problem.

Keywords: monitoring; remote sensing; time series of images; Landsat.

Toward an understanding of typhoon effects on soil nutrient dynamics of a subtropical forest ecosystem

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Typhoon is one of the natural disturbances that may cause ecosystem perturbations of different magnitude. Based on long-term monitoring of meteorological parameters and aboveground litterfall, the drastically increased precipitation and fresh aboveground litter are the most well known phenomena accompanying typhoons. In this study we tested the hypothesis that the high leaf litter input to the soil may result in nutrient losses with seepage water under the warm and moist climatic condition in subtropical forests. The study was conducted at the Chi-Lan Mountain (CLM) site located in northern Taiwan at an altitude of 1400 to 1800 m a.s.l. The dominant tree species of the site is *Chamaecyparis obtusa* var. *formosana*. The meteorological parameters and the biogeochemical fluxes of the CLM site have been measured since 2002.

The approach of this study was an in situ litter manipulation experiment, in which 3-fold and 1-fold of annual leaf litterfall were applied to soil surface. The forest floor leachates and seepage water were analyzed biweekly for a period four months before and 15 months after the manipulation. Water samples were analyzed for pH, electric conductivity, major ions, dissolved organic nitrogen (DON), and dissolved organic carbon (DOC). The water fluxes with forest floor leachates and seepage were calculated using soil water balance between throughfall input and transpiration output. To characterize the dynamics of nutrient release during leaf decomposition, litterbag experiment was conducted in the field at the same period. Mass loss and element composition in the remaining litter were analyzed in 7 dates over 16 months. The remaining litter was further extracted with water for exploring the capacity of nutrient leaching. The properties of extracted DOC were analyzed by fluorescence spectra and their stability was tested against microbial decomposition.

The addition of 3-fold litter, as a simulation of disastrous result of typhoon event, significantly increased the concentration of K and Mg in forest floor percolates and K, DON, and DOC in the seepage (Figure 1). The total element fluxes during the 15-month period showed an increased fluxes of K, Mg, Ca, NH₄ and DON in forest floor percolates as compared to the 1-fold treatment, while for seepage the enhancement of flux was only significant for K, NO₃, DON, and DOC (Table 1). When looking back to the sources of the nutrients, as evidenced by the litterbag decomposition experiment, the mass loss of K and Mg reached 86% and 60% of the initial amount during 16 months, respectively. The results suggest that the decomposition of large amounts of fresh leaf litter may cause K loss from the ecosystem via seepage, whereas the probability for N and DOC losses is moderate. For Ca and Mg, additional losses seem to be rather unlikely.

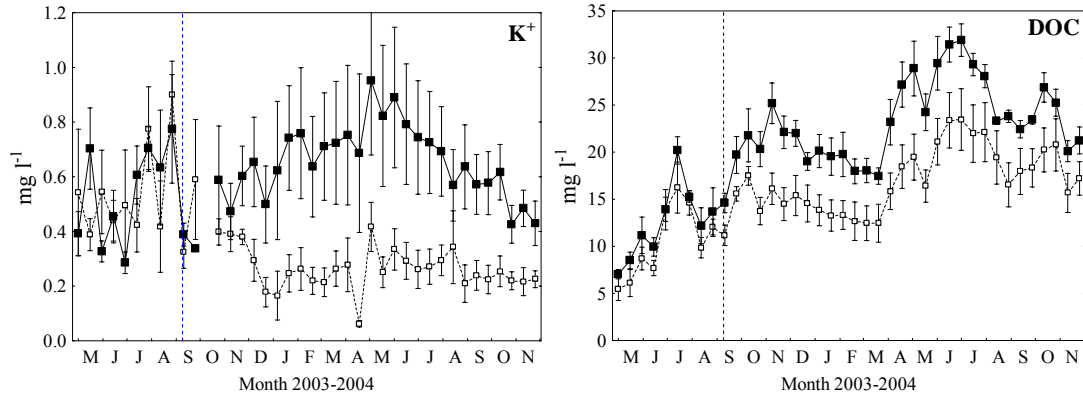


Figure 1: Dynamics of K^+ and DOC concentrations in seepage. Vertical line indicates the date of litter manipulations with 3-fold (filled square) and 1-fold (open square) fresh leaf litter. Error bars represent standard error of mean ($n=4$).

Table 1: Water and element fluxes in throughfall, forest floor leachates and seepage from September 2003 to November 2004 (water fluxes: [$\text{mm } 15 \text{ month}^{-1}$]; for element fluxes: [$\text{kg ha}^{-1} 15 \text{ month}^{-1}$]). Significant difference ($p<0.05$) between 3-fold and 1-fold litter treatments is represented by *.

	H ₂ O	Na	K	Ca	Mg	NH ₄ -N	NO ₃ -N	DON	DOC
Throughfall	4088	8.8±0.1	13.6±0.5	10.4±0.2	2.6±0.1	3.1±0.7	1.9±0.4	3.0±0.6	189±9
Forest floor leachate	4016								
3-fold litter		15.2±1.7	29.7±3.9*	26.8±4.3*	5.3±1.3*	5.4±0.2*	6.9±3.2	21.9±1.8*	1965±277
1-fold litter		13.4±0.8	16.0±2.1	12.5±2.4	7.4±1.4	3.2±0.2	4.2±1.7	16.3±1.4	1422±168
Seepage	3876								
3-fold litter		13.4±1.4	24.4±5.0*	7.6±1.0	4.6±0.5	0.8±0.0	2.4±0.4*	6.8±0.4*	886±37*
1-fold litter		15.7±2.0	12.0±0.9	7.9±0.5	4.0±0.6	0.7±0.1	1.0±0.2	4.6±0.5	653±76

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Keywords: *Chamaecyparis obtusa* var. *formosana*; dissolved organic matter; litterfall; soil solution; typhoon

Climate change from 1980 to 2005 in the Ailao Mountains, Southwest China

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Significance of the study. The question of whether climate has changed significantly is of substantial interest and requires a better understanding of climate behavior and climate impact problems associated with ecological, economic and social matters. Having sufficient information about climatic change in the recent past is necessary to improve the certainty and accuracy of estimates about the future and the role of this information is particularly important in assessments of regional climate change. The climate of a specific location cannot be considered constant environmental factor. Regional climate change has regional peculiarities that are often not consistent with global patterns. Ailao mountains is boundary between the western Longitudinal Range-Gorge Region and eastern altiplano of Yunnan province, southwest china. For this reason investigation of climate change in this region may be very appropriate for understanding such differences.

Objectives. Our objectives of this study were: (1) to investigate long-term trends in annual and seasonal mean temperatures and precipitation series of a field station on the mountaintop (2) to find out what's the difference of climate change in a relative small region, just as the western slope, the eastern slope and the mountaintop

Methods. Monthly air temperature and precipitation data were obtained from the archives of the National Meteorological Service and Ailaoshan Station for Subtropical Forest Ecosystem Studies of Xishuangbanna Tropical Botanical Garden. Long-term trends in annual and seasonal mean temperatures and precipitation series were analysed. Changes in these series were measured by correlating them with linear trends.

Results. Being differ from the average level of china that the minimum mean monthly air temperature presents to January and the maximum presents to July, the maximum mean monthly air temperature in the region of Ailao mountains presents to June. Primarily owing to the monsoon from the Indian Ocean, a major feature of the region of Ailao mountains is the clear-cut changes between the two seasons: the dry season (November-April) and the rainy season (May-October). Precipitation of the rainy season makes more than eighty-five percent of the whole year and the maximum precipitation presents to July. Annual air temperature increased remarkably at all the stations and the statistically significant upward trends are 0.0179°C/yr, 0.0417°C/yr and 0.0419°C/yr when it comes to Jindong, Xujiaba and Chuxiong. There was also a remarkable increase of air temperature in dry season and rainy season. The incremental speed is very different in monthly, seasonal and annual scale and it is the biggest in the dry season, moderate for the whole year and the least in the rainy season. The incremental speed in the hottest month is faster than that in the coldest month. Precipitation tended more or less to increase owing to the increase in the rainy

season. Comparing to the western slope of Ailao mountains, the eastern slope is experiencing a more hotter period then it comes to the mountaintop.

Conclusion. As our research on the climate change of a field station on the mountaintop, air temperature also increased remarkably. Although all the stations lie in the same region, the climate change is not consistent with each other. Ailao mountains lie in the southwestern-monsoon climatic zone and range from northwest to southeast. As it makes a vertical angle between the direction of Ailao mountains and the direction of southwestern-monsoon comes from the Indian Ocean, the incremental speed of air temperature of the eastern slope is much faster than the western slope due to the foehn effect and that of the mountaintop is moderate.

Keywords: climate change; mountain climate; climate characteristics; regional variation; Ailao Mountains

Applicability assessment and improvement of CLIGEN non-precipitation parameters on the Loess Plateau

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Physically based soil erosion and crop simulation models are often used to assess the potential impact of climate variations. Most simulation models require daily weather data, which are frequently synthesized using stochastic daily weather generators. The objective of this study was to evaluate and improve the ability of the CLImate GENerator (CLIGEN) to generate non-precipitation parameters, including daily temperatures, solar radiation, and wind velocity at twelve standard Meteorological Stations on the Loess Plateau. We evaluated the newest version (CLIGEN v5.22564), and modified the solar radiation and wind velocity in this model because they were simulated very poorly. The results demonstrate that CLIGEN (v5.22564) reproduced daily maximum and minimum temperature reasonably well. In addition, means and distributions of daily dew point temperature also reproduced very well. In comparison, standard deviations of daily dew point temperature were less well reproduced, probably because the model used the standard deviation of minimum temperature to compute dew point temperature. The means and standard deviations of daily solar radiation were well produced by the modified model, but the distributions were less well reproduced. Daily wind velocity was also reproduced very well by the modified model. Means of the same-day temperature range ($T_{max1}-T_{min1}$) and one-day lag temperature ranges for both $T_{max1}-T_{min2}$ and $T_{max2}-T_{min1}$ of the CLIGEN-generated data were consistently reproduced very well. However, the standard deviations of $T_{max1}-T_{min1}$ were consistently underestimated compared with the measured data, and the standard deviations of $T_{max1}-T_{min2}$ and $T_{max2}-T_{min1}$ were consistently overestimated with the measured data on all sites. There were very small differences between those generated without (I0) and with Fourier interpolation (I2). Meanwhile, seasonal serial correlations of solar radiation and cross correlation between temperature and solar radiation were well reproduced by the modified model. But, there were no day-to-day correlations for CLIGEN-generated data, including solar radiation, maximum and minimum temperature. Temperatures and solar radiation change gradually and continuously in natural systems, CLIGEN generated data did not reproduced this attribute, and exhibited jumps between months. However, the data generated with Fourier interpolation (I2) have improved this situation. The changes of temperature and solar radiation were more gradual and continuous. Compared to CLIGEN (v5.111), minimum and maximum temperature were improved significantly in CLIGEN (v5.22564), as well as the means of $T_{max1}-T_{min2}$ and $T_{max2}-T_{min1}$, but standard deviations of $T_{max1}-T_{min1}$ were less well produced. Standard deviations of $T_{max1}-T_{min2}$ and $T_{max2}-T_{min1}$ generated by CLIGEN (v5.111) and CLIGEN (v5.22564) were similar. Furthermore, both the means and standard deviations of solar radiation were improved significantly when the standard deviations of measured radiation were used in the model. Consequently, seasonal serial correlations of solar radiation and cross correlation between temperatures and solar radiation were also improved. The distributions of solar radiation were improved slightly, but the prediction of the all-time maximum solar radiation somewhat worsened. In addition, means, standard deviations and distributions of wind velocity were improved significantly by correcting a unit conversion error (change from mile per hour to meter per second) in the model. These results indicate that the modified model considerably improved predictions of the non-precipitation parameters.

Keywords: CLIGEN; non-precipitation parameter; Loess Plateau; applicability assessment; improvement

Energy partitioning and evapotranspiration from a typical freshwater marsh in the Sanjiang Plain, northeast China

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Water loss by evapotranspiration (ET) is a principle component of the hydrological cycle in wetlands. At present, the Sanjiang Plain is the largest concentrative distribution area for freshwater marshes in China. Using eddy covariance technique for the period May to October 2006, we measured evapotranspiration as its energy equivalent, the latent heat flux, from a typical freshwater marsh in the Sanjiang Plain, northeast China. In addition, data were collected on the other surface energy balance fluxes (sensible heat flux and net radiation). Parallel to the flux measurement, ancillary meteorological data such as wind speed and direction, temperature, pressure, relative humidity, precipitation and water depth were collected.

The energy balance terms showed obvious seasonal variation during the measurement period. The storage heat flux was stable from May to August and decreased significantly since September. The average proportions of latent heat flux to net radiation kept increasing from 31.6% in May to 55.5% in September, while the average proportions of sensible heat flux to net radiations decreased from 38.2% in May to 18.7% in August and increased again to 25.8% in September. In October, with the storage heat flux turning into negative, the storage heat flux and net radiation were both consumed by latent heat and sensible heat fluxes. Overall, latent heat flux dissipated 45% of the net radiation, sensible heat flux 28% and storage heat flux 27%. Latent heat flux was the largest energy consumer of the incoming energy in the marsh. The total ET was 311 mm and the daily ET rate ranged from 0.26 to 3.44 mm d⁻¹ with an average of 1.80 mm d⁻¹ during the measurement period. The ET rate showed obvious seasonal variation with the seasonal variation of meteorological factors and the development of marsh vegetation. We separated ET into evaporation from water surface (E_w) and transpiration from canopy (E_c) by extrapolating the stepwise regression equation to estimate E_w and then calculated E_c as the result of ET minus E_w. During the growing season (May to September), the E_w/ET ratios decreased on average from 85.4% in May to 62.4% in August and then increased again to 70% in September. E_w (on average 1.36 mm d⁻¹), contributed about 70% of total ET and E_c (on average 0.58 mm d⁻¹) contributed about 30% during the growing season. Overall, evaporation from water surface was the main contributor for marsh evapotranspiration.

Key words: energy partitioning; evapotranspiration; evaporation; transpiration; freshwater marsh

Long-term variations of nutrients and its structure and ecological responses in Jiaozhou Bay, China

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Based on the observing data from 1962 to 2004, the long-term variations of nutrients and its structure and ecological responses in Jiaozhou Bay, China are discussed. During the last 40 years, nutrient concentrations have increased 3.1 times for PO₄-P, and 8.1 times for DIN. The mole ratio of DIN/PO₄-P increased significantly from 15.9 ± 6.3 in 1960s, to 36.5 ± 11.6 in 2000s which was much more than Redfield value (16). SiO₃-Si concentration remained at a very low level before 1990s and the ratios of SiO₃-Si / PO₄-P (7.6 ± 8.9) and SiO₃-Si/ DIN (0.19 ± 0.15) were far lower than Redfield value (16 and 1). The increasing in the concentrations of N and P are the direct result of human influences, such as the discharges of industrial waste and residential sewage and rapid development of sea farming. Low concentration of SiO₃-Si was relative to building irrigation in rivers. High concentrations of N and P and low SiO₃-Si, and high DIN/PO₄-P ratio and vary low SiO₃-Si / PO₄-P and SiO₃-Si/ DIN ratios show that SiO₃-Si was main limiting factor of phytoplankton growth. The changes in nutrient structure have led to decrease of large diatoms and a shift of phytoplankton species composition. It was obviously relative to SiO₃-Si limiting. Of late years, due to rapid development of city construction, SiO₃-Si concentration in the seawater increased notably in Jiaozhou Bay and the ratios of SiO₃-Si / PO₄-P and SiO₃-Si/ DIN also increased. The increasing of SiO₃-Si concentration and its molar ratios broken the quondam balance between nutrients and accelerated eutrophication in Jiaozhou Bay waters, and red tide occurred frequently. In February, 2004, winter red tide was first found in Jiaozhou Bay. After autumn, nutrients concentrations increased rapidly, especially SiO₃-Si and DIN, led to red tide of *Lauderia annulata* Cleve in winter. When the peak of red tide, nutrients were heavy consumed, and SiO₃-Si was almost exhausted ($0.49 \mu\text{mol/L}$) and SiO₃-Si/DIN and SiO₃-Si/PO₄-P ratios rapidly dropped down to 0.01 and 1.04 respectively. SiO₃-Si became limiting factor of phytoplankton growth and the red tide was finally controlled. Primary study show that the variation in SiO₃-Si concentration is one of major factor controlling waters eutrophication in Jiaozhou Bay.

Key words: Jiaozhou Bay; mineral nutrients; long-term variation; ecological response

A province-scale long-term forest ecosystem monitoring in Zhejiang——Proposal of the establishment and development of ecological station in major public-welfare forest in Zhejiang

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1. Introduction to the forests of Zhejiang province

Zhejiang is a coastal province in east China, and it located in subtropical zone. In the total land area of 100 thousand km², hills and mountains occupy nearly 70 percent. These areas are the main areas where forests distribute. The forest coverage of Zhejiang province is up to 60.5 percent. The total production of Zhejiang forestry in the year 2006 is 121.8 billion, which is 7.78 percent of GDP(gross domestic product) in Zhejiang.

Zhejiang is located the subtropics monsoon climatic region ,with the temperate and moist climate and distinct seasons, 8~9 month none frost period, annual mean temperature of 17°C, and annual mean precipitation of 1319.7mm. Two obvious different thermal zones distribute across the province. The southern zone appears warmer and the northern one cooler. In the point of provincial topography, the southwest regions are higher, and the northeast lower. The coastal and river valley plain distribute below the elevation of 50m. And hilly Farming-Forest ecotones appear mainly in the areas with elevation between 50~350m. Those regions with elevation above 350m are usually covered by mountainous forests. Zhejiang possesses the largest number of coastal islands in China, and more than 2000 islands distribute in eastern part of the province.

2. The Vegetation and Flora

According to the regionalization in 'the Chinese Vegetation', the Zhejiang province entirely lies in the subtropical ever-green broad-leaved forest region, and the ever-green broad-leaved forest is the local forest type in Zhejiang. The vegetation flora is rich. There are about 4000 vascular plant species in the province, among which approximately 1300 specieses are woody plants, belonging to 109 families, and 423 generas respecting; lospecis are the gymnosperm plants belonging to 8 famillies and 25 generas, the woody angiosperm plants have 1260 species belonging to 398 generas and 101 families, including many unique species in our country. Zhejiang Province conserves 12 national protected species (level 1)such as *Fokienia hodginsii*, *Ginkgo biloba*, *Abies beshanzuensis* M.H.Wu and so on; And 38 national (level 2) species such as *Pseudolarix amabilis*, *Torreya grandis*, *Cercidiphyllum japonicum*, *Liriodendron chinense* and so on.

3. The major public-welfare forest in Zhejiang

The major public-welfare forest is defined as forests grow in the areas, where ecological communities are important or ecological situation is weak, with the important benefits to guarantee soil ecological safety, biodiversity conservation and society economy sustainable development. These forests are managed mainly for forest ecological services and social services. There are 1,971,500 hectares of major public welfare forest in Zhejiang, which accounts for

19.10% of land area and 30.10% of forestland. They distribute mainly the headstreams, large-scale reservoirs, natural reservation areas, forest parks, the coastal areas in East Ocean, along roadsides and water and soil erosion damaged areas.

4. curent situation of the development of forest station:

Since 1999, Zhejiang province forestry system has set the aim of establishing 11 to 15 Forest stations in the eleventh five-year development plan. Till now 6 Forest stations have been established in the Qiantang river watershed, in order to resolve the management problem of public welfare forest in watershed scale; In Hangzhou, the capital city of Zhejiang, we are planning to establish an urban forest healthy assessment station, which is aimed to study the important role of urban forest in improving the residents health. Each station is equipped with automation climatological station (made by COMPBELL company) and built 9 different slop runoff plots in each station.

Study fields can be classified as the followings:

Regular study: All the station conducts a serials of regular reseach field in long term including the quality and the function of the forest eco-system, the constitution and structure of forest, energy, moisture and nutrient cycling in forests, and as well as the environment protection affects.

Special study: Special plans are also been prepared for each stations according to its site characteristics. Take the QianTang river watershed for example, we carried our a study of ‘forest in purifying precipitation’ in KaiHua Station, which locates in headstream of QianTang River, and in West Lake district, an urban forest healthy assessment station is under building to study the effect of urban forests on human health.

Furthermore, the ZheJiang public-welfare forest stations should also include the following studies: such as growth rate, soil situation and biomass research in the 469 sample fields in the 23 experimental units since 2000.

5 Developing prospect and difficulties

We should strengthen the study of fundamental theory, understanding deeply succession law of subtropical evergreen broad-leaved forest and the forest carbon sequestration function. Researches are also needed on material flow, energy flow, information flow in forest ecosystem and so on.

the applied research of monitor achievements should be enhanced. In 2006, we evaluated the value of the Zhejiang Province’s major public welfare forest displayed ecological benefit in 2005. We synthesized the localization station’s monitor achievements and the formerly research results. we draw the conclusion that the ecological benefit value of the Zhejiang Province’s major public welfare forest in 2005 is 72.266 billion Chinese Yuan. Next step, we will apply the monitor achievement on the instruction and the region forest management by further criterion transformation, geographic information system and so on..

The forest ecological station establishment in major public welfare forest in Zhejiang has achieved great progress, but we are also faced with such problems as deficiency of funds and equipments. The study levels are still relatively low and there are aslo many difficulties in data sharing and personal training. But we are confident that the future of forest ecological station establishment in Zhejiang will be glorious. We are looking forward to your visit and good advice.

Keywords: Zhejiang; forest station; subtropical region; ever-green broad-leaved forest; major public welfare forest

Spatio-temporal characteristics of Ultraviolet radiation and Photosynthetically Active Radiation derived from the ground-based measurements taken in CERN

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Ultraviolet (UV) radiation and broadband solar radiation (R_s) measured from January 2005 to June 2006 at 31 stations in Chinese Ecosystem Research Network (CERN) were used to investigate the spatio-temporal characteristics of UV radiation and UV fraction (the ratio of UV radiation to R_s) in China. Results indicated that the seasonal variations of UV radiation and R_s were consistent with the solar activities, which reached their lower values during winter period, and increased throughout the spring, peaking in June or July, in most sites. The Meiyu weather system and Southwest Monsoon produced different variation characteristics of UV radiation and R_s in subtropical and tropical regions. The UV fraction values showed a similar seasonal trend as that of UV radiation, which was mainly determined by the seasonal change of the aerosol optical depth (AOD) and water vapor content in atmosphere. The seasonal variations of UV fraction were much smoother in southern China due to high water vapor content over the whole year.

The UV radiation showed an increasing trend from east to west in China. In the western area, a simple increasing trend was observed from north to south, with the largest annual mean daily UV value 0.91MJm^{-2} appearing in the Qinghai-Tibet Plateau area. In east China there was a low center that appeared in the subtropical region due to high aerosol burden, with the lowest value 0.41MJm^{-2} observed in Yanting site. Two high centers were located in the tropics with higher solar altitudes and the north desert region with low atmospheric attenuation. The largest values of UV fraction appeared in the tropical and subtropical regions due to higher relative humidity (RH) in these areas. However, the smallest value did not appear in the north desert region where the RH was the lowest, they were found at the Luancheng site which featured relatively low humidity and abundant fine aerosols. The variations in the UV fraction were not such distinctive as those of the UV radiation in China due to the more complex influences of aerosol and water vapor.

Photosynthetically active radiation (PAR) plays an important part in climate change and ecological processes. Few PAR measurements are usually available, especially in China. Thus, it is important and significant to investigate the spatio-temporal characteristics of PAR in China for radiation budget and ecosystem studies. In order to study the spatio-temporal characteristics of PAR, photosynthetic photon flux density (Q_p) and broadband solar radiation (R_s) measurement data were analyzed for the period of January 2005 to June 2006. Q_p increases gradually from spring and reaches its maximum and minimum in summer and winter, respectively. The highest value of annual mean daily Q_p ($40.9 \pm 4.1 \text{ mol m}^{-2} \text{ d}^{-1}$) appears in the Qinghai-Tibet Plateau region, along with higher atmospheric transmission; and the lowest value ($17.4 \pm 9.03 \text{ mol m}^{-2} \text{ d}^{-1}$) is found in the north subtropics, along with the largest aerosol optical depth (AOD) and a lower water vapor content. PAR fraction shows a similar seasonal trend as that of Q_p at all sites except for some near to lakes and sea. The annual mean daily value of PAR fraction varies from 1.75 ± 0.12 to $2.3 \pm$

0.15 mol MJ⁻¹ over China. The largest value appears in tropical regions due to higher relative humidity (RH). The lowest value is observed at the Luancheng site, which features low humidity and an abundance of fine aerosols, instead of sites in China's driest north desert region. The variability of PAR fraction is mainly controlled by the selective scattering of aerosol particles and absorption of water vapor. Two different diurnal trends of PAR fraction are observed in China. In most sites, PAR fraction tends to peak during sunrise or sunset, and reaches its lowest value around noon. However, it exhibits an opposite trend in the north desert area due to the distinctive diurnal variation of water vapor in this region. Further analysis of annual mean hourly PAR fraction shows that the national average is 1.82 ± 0.11 and 2.00 ± 0.08 $\mu\text{mol J}^{-1}$ for clear and cloudy days, respectively. The cloudy day's ratio is therefore 10% higher than that for clear days. The altitude dependency of PAR fraction is very weak below 1500 m due to uneven distributions of water vapor, clouds and aerosols. Above 1500 m, PAR fraction increases gradually with altitude on both cloudy and clear days, attributed to the weaker extinction of Q_p at higher altitude sites. The distribution pattern of annual mean daily PAR fraction is similar to that of the hourly value. Its magnitude is medial to the hourly values on cloudy and clear days. These results are helpful for understanding the climatic, agricultural, and ecological processes over China, and useful for primary productivity estimation and ecosystem-atmosphere CO₂ exchange study in China.

Keywords: Chinese Ecosystem Research Network (CERN); photosynthetically active radiation; PAR fraction

Influences of human activities and global climate change on the Jiaozhou Bay Ecosystem

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The Jiaozhou Bay is a semi-closed fan-shaped sea bay, connecting the Yellow Sea with a narrow channel. It covers an area of 390 km², and is surrounded by the Qingdao city. During the recent several decades, both human activities and global climate change has brought heavy stress to this temperate ecosystem.

According to high resolution records, annual average air temperature in the Jiaozhou Bay region was increasing in the past 30 years. Before 1980s, annual average temperature was lower than long-term average, while that since 1990s was higher than average of the past 30 years. Average temperature in February, May, August and November was found also increasing during this period. Temperature increased most rapidly in winter, i.e. February, and least in summer, i.e. August. Long-term change of air temperature in this region is similar to that of Pacific Decadal Oscillation (PDO).

According to data collected during 81 cruises from 1960s to 1990s, concentrations of inorganic N and P have increased 1-4 times. Study shows that the nutrient structure of Jiaozhou Bay has changed from relatively balanced to unbalance during the last 40 years and SiO₃-Si possibly becoming the main limiting factor of phytoplankton growth.

Phytoplankton abundance tends to increase in the past 50 years, and number of species was found fluctuated. These are regarded as signs of marine ecosystem alternation. Since middle 1990s, frequency of red tides keeps increasing. Besides the original red tide species *Mesodinium rubrum*, six diatom and one flagellate species were recognized as HAB species in the Jiaozhou Bay. In 2004, red tide was observed in winter for the first time.

High primary production in the Jiaozhou Bay supports a high shellfish yield of more than 300,000 t per year. Taken aquaculture into consideration, the total shellfish production keeps increasing before 2006, when this area was bursting with starfish *Asterias amurensis*. The starfish destroyed half of shellfish production. This was recognized as a kind of regime shift of the local ecosystem under pressure of eutrophication and climate change.

Key words: marine ecosystem; human activity; climate change; regime shift

Comparative studies on different determining methods of underground biomass in grassland ecosystems

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Atmospheric CO₂ concentration has increased from approximate 280 μmol·mol⁻¹ before the onset of the Industrial Revolution to around 380 μmol·mol⁻¹ today, and is projected to 650 ~ 970 μmol·mol⁻¹ by 2100 yr. At the last ten years, atmospheric CO₂ concentration was rising at about 1.8 μmol·mol⁻¹·yr⁻¹, but now the annual increase rate is sharply raised to 3 μmol·mol⁻¹·yr⁻¹ (Houghton (IPCC) <http://www.aip.org>). As CO₂ is an essential resource for photosynthesis and product of respiration, this increase of atmospheric CO₂ concentration along with other climate factors is expected to deeply impact the structure and function of entire ecosystem.

It is reported that different functional types of plant species response differently to elevated CO₂, which leading to changes in composition of ecosystem (Lüscher et al. 2002). Generally, legume plants, with symbiotic N₂ fixation, are found to benefit much more from CO₂ enrichment than other plants. Recently, several authors have proposed that the increase of atmospheric CO₂ concentration would enhance the expansion of woody plant (Idso 1992; Polley 1997; Polley et al. 1997, 2002).

Caragana microphylla Lam is a dominant species in bush land in Xilin River Basin and its distribution increased rapidly during recent 20 years. *Caragana microphylla* Lam belongs to leguminous woody plant. How climate change, such as CO₂ enrichment and water condition affected and will affect *Caragana microphylla* Lam and its distribution? To answer this question, a group of CO₂ enrichment experiments was commenced in 2006 in Inner Mongolia Grassland Ecosystem Research Station (IMGERS) (43°26'-48°08'N, 116°04'-117°05'E).

The authors studied the effect of CO₂ enrichment on two functional types: *Leymus Chinensis* (C3 grass), the dominance species of typical temperate grassland in Inner Mongolia, and *Caragana microphylla* Lam (leguminous woody plant), with six open-top chambers, three of which with current CO₂ concentrations (370 μmol·mol⁻¹) and the other three Controlled with elevated CO₂ concentrations (780 μmol·mol⁻¹). Each species was sowed in 36 pots (φ 30cm×30cm) which were filled with universal native soil. Each plant species was subjected with 24 treatments: 3 CO₂ conditions (unchambered, chambered with ambient CO₂ concentrations, chambered with elevated CO₂ concentrations) × 2 soil water levels (normal precipitation, 50% normal precipitation added) × 2 N levels (unfertilized, 17.5g/m² N fertilization). Each treatment has three replicates.

Photosynthetic and respiratory rates were measured using Li-cor 6400 photosynthesis system in growth season. Aboveground plants were harvested at the time of peak standing biomass. C and N contents in plant and soil materials were analyzed with standard method. The first year's results and conclusions are as follows:

At high level of N fertilization, the CO₂-induced increase in the dry weight of *C. microphylla* was 22%, in *L. Chinensis* was 47.4%. In low N level, no significant differences were observed in dry

weight between two CO₂ treatments. N fertilization caused a significant increase of *L. Chinensis* by 41.69%, but no significant change in *C. microphylla*. Two species showed significant differences between two soil moisture levels and *C. microphylla* has higher water use efficiency.

Under the elevated CO₂, leaf N concentration in *L. Chinensis* was decreased by 25.8% at low N level, and increased 58.6% at the high N level. However, leaf N concentration in *C. microphylla* showed no significant changes between different CO₂ and N treatments. Water treatment has no significant influence on leaf N concentration in two species.

Elevated CO₂ reduced soil valuable N in both species. Based on calculation, it was found that the N loss in soil was less than N increase in plant biomass.

Based on above results, it is hypothesized: 1) responses of *L. Chinensis* to elevated CO₂ were N-limited, but not for *C. microphylla*. So, elevated CO₂ may play a positive role in expansion of *C. microphylla* bush. 2) symbiotic N₂ fixation in *C. microphylla* is activated by elevated CO₂; 3) elevated CO₂ may promote the N denitrification and N immobilization to reduce the soil valuable N. This experiment is continued to explore the long-term effects of CO₂ enrichment and to test above hypothesis.

Key Words: *Caragana microphylla* lam; CO₂ concentration; global change; *Leymus Chinensis*

‘Fertile island’ effect of *Tamarix* and *Haloxylon ammodendron* shrubs in the south Gurbantunggut desert, Xinjiang, China

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Vegetation in arid ecosystems is discontinuous, often with a cover less than 60%. For the Gurbantunggut desert, the vastest temperate desert in the world, it is less than 30%. Due to that, arid ecosystems are often characterized by a two-phase mosaic structure of high- and low-cover or bared patches. Associated with the heterogeneous vegetation, soil resources, including soil water, nutrients, etc, are distributed heterogeneously. One of the typical phenomenon of such heterogeneity in arid and semiarid regions is that soil resources are enriched under shrub canopies by a combination of biotic and abiotic processes, thus forming a gradient of resources from the canopied areas toward the interspaces between shrubs, the so-called ‘fertile island’.

Ecosystems undergo environmental changes (such as climate, human activities) at different space and time scale. Though such changes are gradual, sudden catastrophic change might occur in the structure and function of ecosystems. Such catastrophic change is mostly possible in arid and semiarid ecosystems, due to the existence of two attracting states, i.e., plant patch or bared patch. Positive feedback between plants and soil resources is considered to be the main mechanisms for such catastrophic shifts in arid and semiarid ecosystems. Therefore, the shrub ‘fertile island’ in desert ecosystems is of great interests in ecology, since it is resulted from the interactions between plants and the environments, and it greatly influences the structure and function of the arid ecosystems.

Previous studies showed that the soil resource enrichment under shrub canopies were not only species-dependent, but also related to the given environment. Thus, the present study is to explore the shrub species effect on the ‘fertile island’ development by two dominant shrub species (i.e., *Tamarix* spp. and *Haloxylon ammodendron*) with different above-ground appearance in south margin of Gurbantunggut desert, Xinjiang, China.

To examine the species effect on the shrub ‘fertile island’, soils were sampled from canopied area, vertically projected limit of crown margin and interspaces between shrubs in *Tamarix* spp. and *H. ammodendron* communities for physical and chemical analyses, including soil texture, pH, electric conductivity (EC), soil organic matter (SOM), total nitrogen (TN), available nitrogen (AN) and C_aCO_3 . The results indicate that 1) ‘fertile islands’ develop both under *Tamarix* and *H. ammodendron* shrubs, with the differences of soil properties between ‘islands’ and interspaces decreasing with depth; 2) there are gradients in biologically-limiting nutrients from ‘islands’ toward interspaces, whereas the biologically-unlimited elements are more or less or equally distributed in ‘islands’ relative to interspaces; 3) in terms of the spatial scale, ‘islands’ of *Tamarix* spp. may extend out of the canopied area while ‘islands’ of *H. ammodendron* are relatively smaller and more shallow than that of *Tamarix* spp.; 4) Soil texture patterns surrounding the shrubs of the two species are even more different, with more coarse particles under the *Tamarix* spp. canopies compared to the interspace between shrubs but fewer under the *H. ammodendron* canopies

compared to the interspaces; 5) spatial sizes of the ‘islands’ for different soil indices vary even for the same shrub species. In conclusion, *Tamarix* ‘islands’ have more nutrients enriched, larger area and greater depth in comparison to that of *H. ammodendron*.

These differences are greatly due to the different morphologies of the two species, with the hemispheroidal crowns of *Tamarix* spp. more efficiently capturing and maintaining litter than the Y-shaped *H. ammodendron* crown. As a result, the positive feedbacks among higher litter input, soil structure and nutrient storage make the accelerated biogeochemical cycling reach a wider spatial extent under *Tamarix* shrubs.

Key words: desert; heterogeneity; microhabitat; soil nutrient

An overview of long-term hydro-meteorological researches during forest restoration in small watersheds underlain by weathered granite in warm-temperate mountainous area in the Central Japan

Hirofumi Shibano

A mountainous area surrounding the Nobi Plain including Nagoya City had been denuded by excessive exploitation of fuel woods and organic matters used as farm-land fertilizer until 1950s. Since the foundation in 1922 of University Forest in Aichi, the University of Tokyo, observation of hydro-meteorology has been carried out in three experimental watersheds preserved for strict management without disturbance until now. The damaged forest restored gradually its coverage during 85 years' history of the University Forest. Forest tree composition of the watersheds has been changing from initial artificially-planted species to naturally-regenerated species now dominant and to ever-green species partially emerging.

Various analyses of long-term research concerning water balance, rainfall-discharge response, sediment discharge and elements observed at weather stations have been reported. An overview of these kinds of researches leads us understanding of the watershed ecological dynamics having influenced environments until now and influencing for the future.

Water balance showed unexpected trend of water loss decreasing on the process of forest restoration until 1990 and rapidly increasing for recent 15 years. If water loss means evapo-transpiration, the value should have increased in accordance with the forest restoration process. Therefore, the result seems to be mysterious. Until 1990, meteorological elements observed at weather stations showed also unexpected decreasing trend of average temperature in the hottest month, evaporation from free water surface and wind velocity and, to the contrary, an increasing trend of relative humidity.

The year-by-year sediment discharge has been modified effectively by the forest restoration. And water discharge response to the heavy rainfall event also turned to be modified effectively. It can be attributed to extension of the forest floor coverage. In addition to these trends, the present soil loss from forest floor turned to be very small in comparison with the result at an experiment carried out in the denuded plot near the University Forest.

Though it seems a difficult task because of various unfixed aspects of environmental change globally and locally, some kind of future perspective on hydro-meteorological phenomena in this site will be discussed based on the findings of above-mentioned results in this study

Hydrochemical responses of two debris-torrent impacted watersheds to the 2005 typhoon Talim event--a case study in the Chitou Experimental Forest, Central Taiwan

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In order to understand the responses of two debris-torrent impacted watersheds to typhoon disturbances, rainwater and streamwater collecting system was set up to study hydrochemical changes in precipitation and streamwater in the Chitou Experimental Forest, central Taiwan during the 2005 Typhoon Talim event. Total rainfall of 382 mm (comprised of two distinctive 184-mm and 198-mm peak rainfall) was recorded in Chitou experimental watershed from 2005/08/31~2005/09/05. Bulk precipitation was acidic (pH4.21~5.40) with low conductivity (1.2~22.6 $\mu\text{S}/\text{cm}$), and with low concentration for most anions and cations, yet higher concentrations of Na^+ , Cl^- and SO_4^{2-} in the first peak rainfall could be from the sea salt spray. Heavy rainfall brought by typhoon induced twin-peak stormflow in both Giant-Rock Creek and the Big-Tree Creek. Conductivity, pH, Ca^{2+} , Mg^{2+} , Na^+ , Cl^- , NO_3^- , SO_4^{2-} and HCO_3^- in both creeks exhibited decreases in concentration with increasing streamflow. Among these constituents, diluting NO_3^- in this study showed different trend to other studies in Taiwan. Whether or not the NO_3^- pools in both watersheds were adequately replenished from previous leaching caused by antecedent precipitation, needs further study. While suspended solids, and K^+ showed increases with increasing streamflow. Extreme increase in suspended solids in the Big-Tree Creek was caused by the cumulative effects from Talim typhoon storm flow, the last debris torrent from typhoon Toraji in 2001 and the 7.3 magnitude earthquake in 1999. These solute behaviors suggested that typhoon Talim could bring heavy amount of rainfall input to the Chitou watersheds, yet stormwater chemistry could be controlled by the distinctive disturbance history for Giant-Rock Creek and Big-Tree Creek respectively. In addition, this study also showed that previous rehabilitation constructions could not efficiently stabilized the suspended solids, thus impaired the water quality in the Big-Tree Creek. Considering Giant-Rock Creek to be the reference stream, further rehabilitation strategies could design suitable alternatives to restore riparian vegetation, to carefully remove deposited fluvial sediments, to increase roughness and filtration mechanisms in the Big-Tree Creek.

Keywords: hydrochemical responses; debris-torrent impacted watersheds; typhoon Talim event

Comparative study of the dynamics of simulated daily soil moisture content at Mt. Namsan, Seoul, Korea and Hubbard Brook Experimental Forest, New Hampshire, USA for the last 50 years

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As the key and central medium to determine ecosystem parameters, various aspects of soil moisture content are extensively studied around the world. To understand the dynamics of soil moisture content at different forest ecosystems, daily soil moisture content has been simulated using the hydrological model, BROOK, developed at Hubbard Brook Experimental Forest, New Hampshire, USA with the daily inputs of mean temperature and precipitation for the last 50 years. The dynamics of simulated daily soil moisture content at Hubbard Brook Experimental Forest have been compared to those at Mt. Namsan, Seoul, Korea for the same period. While there is a not significant seasonal trend in precipitation, soil moisture content was shown to have a significant seasonal trend at Hubbard Brook Experimental Forest. At Mt. Namsan, located in the region of northeast Asia, where monsoon prevails with the distinct seasonal trends in precipitation and temperature, soil moisture content was also shown to have a significant seasonal trend. Using the patterns of simulated soil moisture content on daily basis, the length, severity, and frequency of droughts could have been clearly defined under different levels of soil moisture content at the two forests. On the issues related to the climate change in the regions represented by the two forests, annual amounts of simulated soil moisture content did not show any significant change at two forests; meanwhile mean annual temperature was shown to have significantly increasing trends at the two forests, especially faster in recent years. Interpretation and discussion have been extended to the growth response of tree species affected by the changes of soil moisture content at the forests and the potentials in applicability of the simulated daily soil moisture content to various impacts to the ecosystem processes.

Influence of ecological restoration on forest soil carbon turnover rate influence of ecological restoration on forest soil carbon turnover rate

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To better know the influence of ecological restoration on SOC storage in south China plantation forest. We investigated SOC and its stable C isotope composition in 3 forests at Qian Yanzhou Ecological Experimental Station.

Compared to the nature forest, the plantation forest has lower SOC content and more potential to store more organic carbon. Plant forest is good for store more C in soil as the forest input more C to the lower layer of soil though the SOC content is still low in Qian Yanzhou plantation forest. Like the vertical distribution of SOC in nature forest soil profile, SOC concentration follows an exponentially decreasing function with depth. The land type before afforestation has influence on the SOC vertical distribution. The grassland has left more SOC in the upper soil layer. The SOC stable isotope (^{13}C) composition of plantation forest is mainly affected by the biomass ^{13}C isotope composition derived from afforestation. The profile which has photosynthetic pathway change has a more complex ^{13}C isotope composition distribution. The fractionation of ^{13}C isotopes occurs during maturation of soil organic matter. It makes the lower soil layer to have higher $\delta^{13}\text{C}$ value. The SOC derived from afforestation has a big ratio in upper soil layer in plantation forest. The ratio ranges from 60% to 80%. The SOC derived from forest litter has a little ratio as the forest litter is decomposition more completely. The model from Jonathan can explain the relationship between soil organic carbon content and its $\delta^{13}\text{C}$ value well. In the further study, this model needs to be improved and the characteristic of SOC cycle needs to be simulated with the model.

Effects of plant organs on root hydraulic traits in American elm (*Ulmus americana* L.) and red oak seedlings (*Quercus rubra* L.) chang in elevated CO₂

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Aims How plant organ development and root hydraulic traits synergistically change in the acclimation of plant to elevated CO₂, and how various size roots of seedling develop are not well known. The study attempted to answer what relationships between plant organs and root hydraulic traits were, whether elevated CO₂ changed the relationships, and how root biomass was allocated to different roots of a seedling.

Methods American elm (*Ulmus americana* L.) and red oak (*Quercus rubra* L.) seedlings grew in 71 and 77 days in ambient 360 and 540 (± 7.95) ppm CO₂ in the greenhouse. After the treatment, total plant biomass, total root biomass, coarse root biomass, fine root biomass, stem biomass, leaf biomass, leaf area, height, base diameter, root hydraulic conductance (Lp), root specific biomass hydraulic conductance (Lp₁), and root specific leaf area hydraulic conductance (Lp₂) were measured.

Results: In the treatment, coarse root biomass increased, and root specific leaf area decreased in red oak; only height in American elm responded to elevated CO₂. In American elm, Lp had a relationship with leaf area at both CO₂ levels. Lp₁ was associated with total root biomass and leaf biomass in ambient CO₂, while with total root biomass only in elevated CO₂. Lp₂ had a relationship with total root biomass in ambient CO₂, but with leaf biomass in elevated CO₂. In red oak, Lp was related to coarse root biomass in ambient CO₂, while to height in elevated CO₂. Lp₁ was associated with stem biomass and total plant biomass in ambient CO₂, but with leaf biomass and stem biomass in elevated CO₂. Lp₂ had a relationship with only total plant biomass at both CO₂ levels. In the root development of seedling, root biomass was primarily allocated to coarse roots rather than fine roots. **Conclusions** The study states plant development responds to elevated CO₂ earlier than root hydraulic traits in both species, and the changes in root hydraulic traits depend on the development of both species. Plant organs have different effects on the hydraulic traits. The effects change with elevated CO₂. That suggest the changes may be one of important means in plant acclimation. In the development of seedling roots, root biomass is primarily allocated to coarse roots rather than fine roots. Many previous results that the fine root biomass in seedlings principally increases have been reported need to be reevaluated.

Key words: American elm; elevated CO₂; modeling; plant biomass; red oak; Root hydraulic traits

Workshop 6 Information Management

Research advance of data management, Chinese Ecosystem Research Network (CERN)

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Recently, great progress and development have been made in CERN data management. As to management, CERN has established data management regulations (policies) and make a systematically and scientifically classification to data and user. As to data classification, data are divided into monitoring data and research data, and monitoring data are developed in national different ecosystem types according to monitoring specifications and standards. As to data management flow, CERN has realized three level data management flow with "Stations—Subcenters—Synthesis Center" and integration of standard from "Top to Bottom" and data from " Bottom to Top". As to construction of information system, ecology metadata national standards have been established , according to CERN actual situations, metadata and data management system are developed based on EXCEL and SQL SERVER software, which have been extended to 53 stations. The transformation of file data management to database management system (DBMS) are realized through making a integration of metadata standard ,database construction and data sharing. On the basis of this transformation , CERN realized the conversion of centralize data information system to distributed data information system ,unified User Management ,Single Sign-On , operation monitoring of field stations and remote automatic harvestry of metadata through using WEB SERVICE technique. CERN distributed data information system is established, containing many nodes and one general node. Data management has been an important component of CERN, which also is the foundation of CERN data sharing and CERN research ability improving

Keywords: data management; data information system; CERN

Metadata management with Ecological Metadata Language (EML)

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Traditionally, ecologists in Taiwan and throughout the world, use a variety of methods to collect field data. Most of these methods are time and manpower intensive. The development of sensor networks, however, allows sensors to gather data in the field and deliver them to the laboratory automatically. Already a variety of ecologically important data such as generic meteorological measurements, soil and water temperatures and acoustical records are being collected by sensor networks. But the shift toward this data collection paradigm in turn creates new challenges for data management problems which include documenting, quality checking, navigating, and analyzing data. When large data transmit into laboratory during a very short time period, these data are gathered to support the research question of interests. In order to be useful, these data must provide relevant information which usually means that it is documented and quality assurance checked. Data of unknown quality are essentially useless, and useless data can potentially make a bias conclusion in the research process. Therefore, incorporating a quality component into information management system is necessary for generating useful data. Unfortunately, standard mechanisms for analysis and quality assurance checking of sensor collected data are lacking. Therefore, an automated data quality checking and analyzing system is an essential component for information management system and has tremendous advantages for ecologists when they use sensor collected data.

To address the management and quality assurance problem of sensor data, we have developed a tool based on the Ecological Metadata Language (EML). This tool allows researchers to automate basic quality assurance processes and correct the mistakes checked from the system.

Abstracts for Poster Presentation

Long-term effects of air pollution on selected forest ecosystems in the Bucegi Natural Park, Romania

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In Central Europe, since the late 1980s, levels of pollutants have been considerably declining; the photochemical pollution, especially the ozone (O₃) and other phytotoxic agents (SO₂, NO₂, NH₃) registered an important increase with damaging effects upon forests. In the same time the climate factors exert a permanent influence, temporal and spatial fluctuant, but determinant upon forest ecosystem status at global, regional and local scale. Simultaneous with photochemical pollution intensifying process and phenomenon produced by climate changes, at global, regional and local level there were initiated long-term multidisciplinary researches on effects of this phenomenon upon forest ecosystems.

The general objective of the project is to characterise the air pollution and its potential effects upon forest ecosystems status and biodiversity in Bucegi Natural Park, in close connection with climate changes.

The specific objectives are to characterize spatial and temporal distribution of the ozone (O₃) and other phytotoxic agents (SO₂, NO₂ and NH₃) and to evaluate the influence and intensity of their concentrations and of climate changes upon forest health status, forest growth, state of forest soils, plant nutrition and forest ecosystem's biodiversity.

Preliminary scientific results obtained in the framework of the project show the air pollution, as initiating and influencing (predisposing) factor of the climate changes plays a decisive role on the occurrence of the negative effects upon forest ecosystems' status. As a result, with reference to the health status during the year 2006, about 30.7% is the share of damaged trees (defoliation classes 2-4). For the main species, the share of damaged trees was 23.9% for *Fagus sylvatica*, 33.3% for *Abies alba*, and 30.7% for *Picea abies*. Registered volume growth losses for all species is 2.59%, and for the main species is 4.28% for *Fagus sylvatica*, 5.1% for *Abies alba* and 5.99% for *Picea abies*. With regard to bulk deposition, soil solution, ozone (O₃) and other potential phytotoxic agents, in the year 2006, have registered normal levels of concentrations, between critical levels (ozone < 55ppb, NO₂ < 0.6ppb), with the exception of NH₃, for which were registered high values, above 1.0 ppb threshold, in some locations.

In addition, the forest vegetation biodiversity indicator is specific and in accordance with forest composition and climatic and pollution conditions of the Bucegi Natural Park, with genuine flora elements, unchanged compared to previous research results achieved over 20-30 years ago. Also within the normal levels are the leaves/needles microelements contents (nitrogen, phosphorous, magnesium, calcium, natrium), without any major influences on the metabolic processes of the trees. For *Abies alba*, the needles' chemical elements is 10% for nitrogen, 46% for calcium and 56% manganese. For *Picea abies* and *Pinus sylvestris*, the nitrogen levels reached 9%.

For the Bucegi Natural Park, based upon the 2005 ortophotoplans have been obtained state of the art topographical plans (1:5000 scale), which have been updated with cartographical elements of the management planning activity, in this way obtaining a comprehensive geographical database in order to establish the link with the relational database, both building the Geographical Information System of the research area.

These preliminary results will be completed and based on scientific information that will be acquired in the following stages of the project, in this manner, building up the scientific foundation for continuing the researches on long term bases in the national , European and global research programmes.

Key words: forest ecosystem; long-term multidisciplinary researches; air pollution; climate change; forest biodiversity

Biomass and nutritive elements accumulation, distribution of *Rodgersia aesculifolia Bata* in different soil and vegetation types

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Rodgersia aesculifolia Bata is a kind of medicinal plant which was developed in recent years. At present, medicinal substances extracting is the main research aspect, while the less focus was given on growth habit. This study contrasted the characters of wild *Rodgersia aesculifolia Bata* biomass and nutritive elements accumulation, distribution in the different soil and vegetation type, in order to provide some theories to the introduction, domestication and the further utilization. The experiment site was in plots A and B of MaoXian field ecological station, MaoXian. Plot A is artificial needle mixed forest on cinnamon soil, the canopy cover of this forest is 0.9, the pH value is 5.17. Plot b is secondary bush on brown soil, the pH value is 5.25. Various nutritive elements contents of soil in plot A are higher than that in plot B. The assay showed that (1) the biomass of *Rodgersia aesculifolia Bata* in plot A was 341.30 kg/hm², and 1300 kg/hm² in plot B; (2) Various nutritive elements contents of plants in plot A were N3.95 kg/hm², P0.41 kg/hm², K4.55 kg/hm², Ca3.78 kg/hm², Mg0.71 kg/hm², S0.67 kg/hm², and N10.64 kg/hm², P0.10 kg/hm², K18.96 kg/hm², Ca17.64 kg/hm², Mg 3.19 kg/hm², S3.09 kg/hm² in plot B; (3) Various nutritive elements content of *Rodgersia aesculifolia Bata* in plot A were higher than that in plot B. The experiment results indicate that *Rodgersia aesculifolia Bata* is not a shade-tolerance plant, the lack of illumination is a disadvantage to it. So, the elements contents and accumulation of *Rodgersia aesculifolia Bata* in plot B which had a better light condition were higher than that in plot A; the nutritive elements absorption of *Rodgersia aesculifolia Bata* was effected by the nutritive elements contents in soil, but the nutritive elements contents in soil was not the restrictive condition of growth.

Key words: *Rodgersia aesculifolia Bata*; biomass; nutritive elements accumulation

Positive linear relationship between productivity and diversity: evidence from the Eurasian Steppe

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Understanding the productivity-diversity relationship (PDR) is a key issue in biodiversity-ecosystem functioning research, and has important implications for ecosystem management. Most studies have supported the predominance of a hump-shaped form of PDR in which species richness peaks at an intermediate level of productivity. However, this view has been recently challenged on several grounds. Based on data from 854 field sites across the Inner Mongolia region of the Eurasian Steppe, we tested the form of PDR at different organisational levels (association type, vegetation type, and biome) and multiple spatial scales (local, landscape, and regional). Our results showed that a positive linear, rather than hump-shaped, form was ubiquitous across all organisational levels and spatial scales examined. On the regional scale, this monotonic PDR pattern corresponded closely with the gradient in mean annual precipitation (MAP) and soil nitrogen. Increasing species dissimilarity with productivity could also contribute to the positive linear form of PDR. Our results also indicated that grazing decreased both primary productivity and species richness but, intriguingly, not the form of PDR. This study provides the first direct test of the productivity-diversity relationship for the world's largest contiguous terrestrial biome – the Eurasian Steppe. The predominance of a positive linear relationship in this region defies the commonly-held view that a unimodal form of PDR dominates terrestrial ecosystems, supported mainly by studies in Africa, Europe, and North America. It suggests that precipitation has a greater control on the productivity-diversity relationship in the Eurasian Steppe than grasslands elsewhere. Also, the positive linear relationship is surprisingly robust to grazing. Our results provide new insight into the productivity-diversity relationship, and have several implications for restoring degraded lands and understanding ecological consequences of climate change in the Eurasian Steppe.

Keywords: Eurasian steppe; Inner Mongolia grassland; productivity-diversity relationship; spatial scale; species dissimilarity; grazing land; precipitation gradient; ecosystem management

The role of NH₄⁺ toxicity in the decline of the submersed macrophyte, *Vallisneria natans*, in lakes of the Yangtze River basin, China

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Experimental and field studies were conducted to evaluate the effects of NH₄⁺ enrichment on growth and distribution of the submersed macrophyte, *Vallisneria natans* L, in lakes of the Yangtze River in China, based on the balance between free amino acids (FAA) and soluble carbohydrate (SC) in the plant tissue. Increase of NH₄⁺ rather than NO₃⁻ concentrations in the water column caused FAA accumulation and SC depletion of the plant. The plant showed a unimodal pattern of biomass distribution along both FAA/SC ratios and external NH₄⁺ concentrations, indicating that a moderate NH₄-N concentration (< 0.3 mg L⁻¹) benefited the plant, while the high NH₄-N concentration (> 0.56 mg L⁻¹) eliminated the plant completely. Therefore, 0.56 mg NH₄-N mg L⁻¹ in water column was taken as the upper limit for *V. natans* in lakes of the Yangtze River basin. The mesocosm experiment showed that at a high external NH₄-N (0.81 mg L⁻¹), *V. natans* failed to propagate with a loss of half SC content (5 mg g⁻¹DW) in the rhizomes, indicating that the consumption of carbohydrate for detoxification of excess NH₄⁺ into nontoxic FAA significantly diminished carbohydrate supply to the rhizomes. This might consequently inhibit the vegetative reproduction of the plant, and also might be an important cause for the decline and disappearance of the plant with eutrophication. The present study for the first time reports substantial ecophysiological evidences for NH₄⁺ stress to submersed macrophytes, and indicates that NH₄⁺ toxicity arising from eutrophication probably plays a key role in the deterioration of submersed macrophytes like *V. natans*.

Keywords: *Vallisneria natans*; ammonium toxicity; FAA/SC ratio; propagation.

16S rRNA gene analyses of bacterial community structures in the soils of evergreen broad-leaved forests in Southwest China

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Significance of the study. Microorganism is one of an important constituents in the ecosystem, which is among the most complex and diverse assemblages of organisms in nature. Carbon and nutrient transformation cycles are recognized to be greatly driven and influenced by bacteria. However, the overall microbial community structure is up to date still poorly understood. It has been estimated that only 1% of the microorganisms has ever been isolated, which arises from the limitation of traditional cultivation methods. Via characterization of ribosomal RNA gene, a new perspective of the biosphere has been introduced. Advanced molecular approach provides a means to assess the overall microbial community composition enabling us to understand and monitor distribution and population dynamics of microorganisms in response to environmental conditions as well as human disturbances.

Objectives. Our objectives of this study were: (1) to retrieve the major components of the overall bacterial community in the soils of evergreen broad-leaved forests in Yunnan province, southwest China, and (2) to assess if there is correlation between the bacterial community structure and the soil organic carbon and nutrients contents.

Methods. Sequence analysis and terminal restriction fragment length polymorphism (T-RFLP) analysis of 16S rRNA genes were used to examine the bacterial community structure in humus and mineral soils of evergreen broad-leaved forests in Ailaoshan and Xishuangbanna, southwest China. Soil chemical properties, including pH, water content, total organic carbon content, total N, hydrolysable N, extractable NH_4^+ -N and NO_3^- -N, total P, extractable PO_4^- -P, and cation exchange capacity were analyzed.

Results. Two clone libraries consisted of 72 and 69 nearly full-length 16S rRNA gene sequences were obtained, respectively, from the humus and mineral soil layers of the forest at Ailaoshan; and 78 rRNA gene clones were retrieved from the mixed soil sample at Xishuangbanna. Over half of the clone sequences were affiliated to *Acidobacteria* in both forest soils, which were further divided into 5 clusters. *Acidobacteria* is a recently identified bacterial group that covers a broad phylogenetic spectrum and inhabits in a wide range of environment. Other major bacterial phyla were *Proteobacteria*, *Planctomycete* and *Verrucomicrobia*. Bacterial communities in humus and mineral soils of the two forests were well-differentiated based on 16S rRNA phylogeny. Significant correlations were found between the bacterial T-RFLP community patterns and the organic carbon and nutrient contents (notably total N, hydrolyzable N, extractable NH_4^+ -N and total P) of the soil samples.

Conclusion. This is the first study establishing a 16S rRNA gene clone library for the soil of evergreen broad-leaved forest. Our data demonstrated the retrieval of a recently identified phylum, *Acidobacteria*, as predominant bacterial group in evergreen broad-leaved forest soils in southwest China. The bacterial community structure was found to be correlated to soil carbon and nutrient contents.

Keywords: 16S rRNA gene; bacterial community structure; carbon and nutrient contents; forest soil

A study of ecological characteristics of eremophytes in Minqin

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The Minqin County is a serious desertification region where environment change has undergone large area of water to halophytic meadow by Han dynasty to that late of the time and desert of now. At present, ecological environment will be degrading that large natural vegetation and artificial shrubbery of fixed sand, which was planted in 1960s to 1970s, are largely withered, thin and died. The major types of vegetation are choose to study location vegetation and its action by characteristic of phytocoehosium and that of relationship with environment, niche of the major constructive species, healthiness of dominant species and plant phonological.

(1) The climate belongs to the typical desert in Minqin where shrubs are the major roles of desert vegetation with coverage of only 5% ~15%. It is obvious that canopy of vegetation and itself change and has been degenerating with fluctuant cause of annual precipitation in Minqin. In common years, upside of the shrubs, such as *Nitraria tangutorum*, *Haloxylon ammodendron*, *Artemisia arenaria* etc., must be died away; or died all of them in years of that annual precipitation distributing is exceptional. Therefore, it positively decreases that of the canopy of vegetation and height of shrubs in some years. It is obvious different that the different communities distributed in state of landform and soil. The *Nitraria tangutorum* existed on mound of *Nitraria*, with soil moisture content of 1.4~2.0% at layer of 0~30cm. The *Ephedra przewalskii* distributes only at flat with gravels and far fewer soil moisture content of 0.8% at layer of 0~30cm of soil. The *Artemisia arenaria* distributes at semi-fixed dunes, shifting dunes and the flat which was covered by moving sands and with the soil moisture content of 0.9~1.7% at 0~30cm. The plants answer the precipitation on change of soil moisture content, which is affected by the dimension of granule of soil, and fine sand sensitively answers precipitation. It is positive relation that height of dominant plants respond precipitation during the last ten-days of July to the last ten-days of September. There is positive relation with the average canopy of herbage and the precipitation in the last ten-day of May to the last ten-days of July. The annual precipitation affected the total canopy of community. Its effect is more obvious that the precipitation in the last ten-day of May to the last ten-day of July compared with annual precipitation.

(2) There is a great difference of breadth of ecological niche amount structure plants, and similar proportion of niche is quite small among plants, which is enslaved aroused by desert habitat, also one of the major characteristics of thin desert vegetation in arid environment. The current niche breadth closely associated annual precipitation, and the soil moisture is the key role among influencing factors, such as landform, soil granule, soil moisture and soil nutrient etc. When underground water table reaches to about 20m depth, plants can not use it, which shows water is the major competition item of resource among plants. A larger niche breadth of the same species of plant in different communities, the competition differences plants in varied communities are resulted in niche, relative steady landform, soil conditions and various annual precipitation.

(3) An analyzed result of healthy sequence of domination plant shows the healthiness of the

same community is better on semi-fixed dune and shift dune than that of on fixed dune. The healthiness condition of community is obviously affected by healthiness of domination plant. The analysis of sensitive degree of healthy sequence is not only used to check security of analyzed conclusion, but also it opens out the action and conditions of roles that are shown by distinguish indexes in community. It is capable to shown out affected factors that the distinguish index is divided into index of dominant species and auxiliary species, which is more proper to natural characteristics of community, meanwhile the healthiness condition will be studied by first grade analysis standard on the healthy of dominant species and companion species. The analyzed result of weight as sensitive degree of domination plant and auxiliary species for showing the weight communities of *Nitraria tangutorum* and *Artemisia arenaria* is more than 0.65, 0.60 of *Tamarix ramosissima*, and 0.50 of *Haloxylon ammodendron*, but the healthy sequence is not changed.

(4) The 48 participations of plants, which are representations in Minqin region, are selected and comparing with to study phonological characteristic. The first step that 9 phonological types of 48 plants are analyzed by system clustered on phonological data from 1985 to 2004; as well the result is classified by mesophyte, xerophyte, psammophyte. The studying result shows rank changing of many years of the some phonological time increased scope in sequent rank from mesophyte, xerophyte to psammophyte; the rank from mesophyte to xerophyte is bigger than that of mesophyte to psammophyte, and phonological time puts up gradually delaying direction. The winter is far longer, as well as a number of days of summer, whereas the autumn is the shortest in location. It is more days that frequency is distributed in the number of phonology in spring and autumn, and with few acting relatively days for plant.

Key words: desert vegetation; living condition; niche breadth; similar proportion of niche; healthy sequence; sensitivity analysis; phenology; Minqin

Effects of long-term cycling of organic nutrient on soil phosphorus supplying capacity in a red soil paddy ecosystem in China

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The purpose of this study is to understand the effect of long-term cycling of organic nutrient on soil phosphorus supplying capacity. The study was based on the uptake of phosphorus by rice when N, K nutrient are not limiting rice growth in pot experiment and the content of soil total P, organic P, inorganic P, Olsen-P and MB-P. The soils of pot experiment came from a long-term field experiment. The field experiment was carried out in Taoyuan station, Hunan province, during 1990-2007, it included 8 treatments (CK, N, NP, NPK, C, N+C, NP+C, NPK+C) and 3 replications. Levels of fertilization were N 182.3 kg/hm², P 39.3 kg/hm², K 197.0 kg/hm² after 1997 (N 262.5 kg/hm², P 39.3 kg/hm², K 137.0 kg/hm² pre 1997). For some treatments in which there were cycling of crop nutrients, the way was that rice straw was fully returned to the field after harvesting, 80% of full grains (50% after 1995) and all of the empty or blighted grains were fed to pigs, and the pig manure subsequently was spread in the field, and the last step was that the Chinese milk vetch (green manure) was cultivated in winter and then ploughed into the field before spring plowing. The results indicated that, long-term application of chemical P fertilizer obviously increased the soil phosphorus supplying capacities, compared with application of chemical fertilizer P, the amount of P uptake by rice application chemical fertilizer P combine with cycling of organic nutrient increased by 45.7%. Compared with no fertilizer application, it decreased by 23.4% in the way of long-term application N, but it increased by 60.2% averagely in the way of application organic nutrient. Cycling of organic nutrient obviously increased the amount of soil MB-P, it combined with chemical fertilizer P significantly increased the content of total P, organic P, Olsen-P and MB-P ($p < 0.05$). There was a significant positive relationship among soil total P, organic P, Olsen-P, MB-P and P uptake of rice. It was a key that the conversion of inorganic P into extractable P was accomplished by microorganisms in paddy soils. Cycling of organic nutrient combine with the chemical P fertilizer is a good fertilizer application mode which obviously increase the soil P supplying capacity.

Key words: reddish paddy soil; cycling of organic nutrient; soil phosphorus supplying capacity

Effects of long-term organic nutrient recycling on soil fertility and productivity in rice cropping system of red soil region of China

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Nutrients cycle is one of the most essential functions in an ecosystem. The amount of nutrients cycle is indicator of the primary characteristics of metabolism in farming ecosystem. Researches on the effects of fertilization systems and nutrient recycling are useful for understanding changes in soil fertility and grain yield, and also helpful for making reasonably utilizing of organic matter and fertilization strategies. The experiment based on the long-term experiment-the effects of different fertilization systems on soil productivity and environments in rice cropping system of red soil region of South China at Taoyuan of Agro-ecology Station Research, during 1990-2004. The field experiment included 8 treatments(CK,N, NP, NPK, C, N+C, NP+C, NPK+C) and 3 replications. Levels of fertilization were N 182.3kg/ hm²,P 39.3kg/ hm², k 197.0 kg/ hm² after 1997 (N 262.5kg/ hm²,P 39.3kg/ hm², k137.0 kg/hm² pre 1997) .For some treatments in which there were cycling of crop nutrients, the way was that rice straw was fully returned to the field after harvesting, 80% of full grains(50% after 1995) and all of the empty or blighted grains were fed to pigs, and the pig manure subsequently was spread in the field, and the last step was that the Chinese milk vetch(green manure) was cultivated in winter and then ploughed into the field before spring plowing. The main results were as follows:

In the past 14 years, soil bulk density in paddy soil with no fertilizer and recycling use of organic nutrients decreased by 12.0% and 12.8% (in average) ,respectively, while the recycling use of organic nutrients had a significant effect on the soil bulk density, which decreased 25.6%.

The most amount of annual self-returned organic carbon is up to 2192 kg hm⁻², the average is 1811 kg hm⁻² in rice cropping system of red soil. Little declining of soil organic carbon content was found with no fertilization application for 15 years ,under only depended on organic material self-returned, the increase range of soil organic matter is narrower and it rang from 0 to 1.8 g kg⁻¹ under only chemical fertilizer applied. The most annual self-returned organic carbon is up to 8436 kg hm⁻², the average is 7480 kg hm⁻² in rice cropping system of red soil. The recycling use of organic nutrients significantly increases soil organic carbon. The increase range of soil organic carbon is from 3.4 g kg⁻¹ to 6.3 g kg⁻¹ and the increase rate is from 22.1% to 40.9% under organic material cycling. Total N,P and available nutrients had a slightly increase or decrease under no fertilizers or application of inorganic fertilizers. The recycling use of organic nutrients significantly increased the soil total N、P, Olsen-p and available K. Without chemical P fertilizer, soil Olsen-P was less than 10 mg/kg soil, while application of organic fertilizer has little effects on the Olsen-P and total P.

Microbial biomass C, N and P (811.0~1524.7, 81.4~158.1, 17.3~36.2 mg/kg soil,respectively) in paddy soil were generally larger than those in upland arable soil, as indicated in previous

publications, which suggests that paddy soil has relatively strong ability to maintain the microbial biomass. The amounts of microbial biomass C, N in the soil were not significantly affected by the long-term application of fertilizer N, NP or NPK, while the amount of MB-C was significantly increased by the organic nutrient recycling use in the rice ecosystem. Under the application of fertilizer NP or NPK, the amount of microbial biomass N were significantly improved with the recycling of organic nutrient. However, microbial biomass N were not significantly increased by the recycling use of organic nutrient based on zero fertilizer or application of fertilizer N alone. Microbial biomass C, N and P in the soils accounted in average, for 5.6%, 5.5% and 3.6% of total organic C, N and P, these percentages were little affected by the application of inorganic fertilizers, while increased by application of organic nutrient recycling (7.1%, 5.8% and 4.6% respectively). There was a very strong relationship between the amount of organic carbon input and the concentration of soil MB-C. Moreover, the microbial biomass C、 N had a significant relationship with soil total C and N, respectively. Therefore, the recycling use of organic nutrient improved the rate of soil MB-C to soil total C and MB-N to total N, and also enhanced the fixation of microbial to N nutrients.

The rice yield is increased 62.5% due to chemical fertilizer application, the rice yield is heightened 80.1% under inorganic–organic fertilizer incorporation. The recycling use of Organic nutrients increased grain yield, which will be reduced with increasing the combinative degree of fertilizer N, P and K application (55.4%、 44.2%、 18.2% and 9.6%,respectively).

Keywords: paddy soil; soil fertility; grain yield; organic nutrient recycling

Responses of microbial biomass P to the changes of organic C and P in paddy soils of long-term fertilization systems

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Responses of microbial biomass P (MB-P) to organic C and P in reddish paddy soils of different fertilization systems were investigated based on a fifteen-year field experiment of double-rice cropping of Subtropical China. The field experiment was carried out in Taoyuan station, Hunan province, during 1990-2007, it included 8 treatments (CK, N, NP, NPK, C, N+C, NP+C, NPK+C) and 3 replications. Levels of fertilization were N 182.3 kg/hm², P 39.3 kg/hm², K 197.0 kg/hm² after 1997 (N 262.5 kg/hm², P 39.3 kg/hm², K 137.0 kg/hm² pre 1997). For some treatments in which there were cycling of crop nutrients, the way was that rice straw was fully returned to the field after harvesting, 80% of full grains (50% after 1995) and all of the empty or blighted grains were fed to pigs, and the pig manure subsequently was spread in the field, and the last step was that the Chinese milk vetch (green manure) was cultivated in winter and then ploughed into the field before spring plowing.

Results indicated that the paddy soil has a strong ability on maintaining a high level of the microbial biomass (> 800 mg kg⁻¹) because of the rising soil organic carbon and long term return of organic carbon, the high level of the microbial biomass is the main reason of MB-P increasing. Compared with 1990, there were significantly decreased of long-term zero chemical P fertilizer application on the soil total P, but soil organic P increased by 29.3% averagely, it showed that the main shortcoming shape of total P is inorganic P (Al-P, Fe-P, Ca-P and O-P), however, the content of soil MB-P was more than 16.0 mg·kg⁻¹ when the content of Olsen-P is very low (<7.0 mg·kg⁻¹), which all indicated it was a possible key that the conversion of Al-P, Fe-P, Ca-P and O-P into extractable P was accomplished by soil microorganisms in paddy soils. Chemical P fertilizer application combined with cycling of organic nutrient is a better fertilizer application model which not only increased soil total P pool but also the P availability.

Key word: reddish paddy soil; microbial biomass P; soil organic P, soil inorganic P

Response of crop yield, water productivity and water balance to agricultural water management under variable climate in the North China Plain

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In the North China Plain (NCP), one of the largest agricultural production areas in China, excessive groundwater pumping for irrigation has significantly lowered water table. Efforts to meet the high water demand of the dominant wheat-maize double cropping system under the variable climate will inevitably lead to depletion of groundwater resources. Sustainable agricultural water management requires understanding of how crop yield, water productivity and water balance being affected by climate variability and management practices. Agricultural systems' modeling is a useful means to analyze the performance of farming systems and to modify management practices for agricultural sustainability under long term historical climate variations. In this study, the Agricultural Production System Simulator (APSIM) was calibrated and validated against three years (1998~2001) of experimental data of wheat-maize rotations at Luancheng in the NCP. The validated model could reproduce observed crop LAI, biomass, grain yield (GY) and water balance components with acceptable accuracy, thus was used to simulate crop production and water balance in response to historical (1961~2000) climate variations and water management strategies. Under rainfed conditions, the simulated GY of wheat ranged from 0 to 4500 kg ha⁻¹ (mean 1400 kg ha⁻¹), and of maize from 0 to 5000 kg ha⁻¹ (mean 3100 kg ha⁻¹). Applying one-, two-, three- and four irrigations based on soil water status could increase the mean wheat yield to 2900, 4000, 4800 and 5200 kg ha⁻¹, respectively. Applying one- or two irrigations could increase the mean maize yield to 4600 and 5800 kg ha⁻¹. Crop yield increased disproportionately with irrigation water supply. The irrigation water requirement for both wheat and maize depends greatly on climate conditions in cropping season, and varies significantly from year to year. Results showed that one-, two-, and three irrigations (i.e., 65, 150 and 200 mm year⁻¹) based on soil water status are recommend for wheat to achieve the maximum WP in wet, medium and dry season types, respectively. For maize, no irrigation should be applied in wet years, while one- or two irrigations (i.e., 40 and 90 mm year⁻¹) in medium and dry years. With such irrigation scheduling, 2800 m³ ha⁻¹ of water could be saved for a crop rotation year with only 7.8 % crop yield decrease, compared with traditional irrigation to fully met crop water demand. Under the double cropping system, there is little chance for water to pass the crop root zone to become deep drainage, unless in extreme wet years during the maize season. High level of irrigations as specified in this paper could lead to up to 2m year⁻¹ decline in groundwater table.

Key words: crop yield, water productivity; water balance; climate variability; APSIM; simulation; North China Plain

Establishment of long term ecological research for agricultural ecosystem in taiwan and its application

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A long term ecological research (LTER) for ecosystem has launched after similar research for natural ecosystem conducted in 2006, as is promoted by Dr. Hen-Biau King and have cooperated visit with Kellogg biological station (KBS), USA. The project overall is aimed at verifying the general hypothesis that agricultural management based on ecological concepts can effectively substitute for reliance on chemical subsidies in major cropping systems in subtropical region. It will focus on the sustenance mechanism of productivity of agricultural ecosystem and its impact on environments – involved with level cropping systems; patterns, microbial phase, plant and insect diversity in agricultural system. During the first five years of the LTER, the initial goal is to seek the optimal agricultural practice best sustaining agricultural ecosystem in subtropics with complete realization of the mechanism of productivity, biodiversity and its impact on environment.

Major cropping systems representative of agricultural ecosystem in Taiwan will be studied in detail. Three sites are selected based on elements concerned for LTER as follows. They are: (1) Yuin-Lin branch station, for rotation cropping of sweet potato and peanut and rotation of rice and sweet potato. The soil is classified Fluventic Dystrudepts with pH around 4 to 6.5 and texture of sandy loam. (2) Chi-Ko branch farm, for two rice cropping and rotation of rice and sweet potato. The soil is classified Fluventic Dystrudepts with pH 6 to 7.5 and silty clay loam. (3) Chia-Yi branch of Agricultural Research Institute, litchi orchard for both natural and managed orchard ecosystem already established more than 10 years. The soil is classified Typic Kandiodults and Typic Kanhapludults, with pH is 4 to 5 sand surface soil of loam and subsoil of silty clay loam. Experimental designs will be decided based on the soil mapping. For field crops ecosystem, treatments cover both conventional agoecosystem (CA) with high chemical input as well as sustainable agoecosystem (SA) with low chemical input in different rotation systems. The area of treatment is large (more than 0.3 ha) enough to prevent interaction between treatments. Each treatment plot set 5 permanent sampling stations to perform soil and crop sampling. As various experiment conducted on the sites for years, soil fertilities on the farms are not uniform. Hence, two cropping of rice without fertilization have conducted from autumn, 2005 to summer, 2006 and one cropping of rice and sweet potato for various treatments with recommended fertilization also conducted since autumn, 2006. The two treatments in various cropping system have started to conduct on spring, 2007.

For better understanding the agricultural ecosystem, important ecological functions of three communities in row-crop ecosystem are evaluated: soil microbial communities influencing organic matter dynamics and biogeochemical processes related to crop growth; communities of aboveground consumers –pathogens and insects operating at several different trophic levels - severely influencing primary productivity in outbreak years; and plant communities, which largely

drive nutrient dynamics and both belowground and insect community structure. The consequences of complexity changes will be expressed at the ecosystem level as changes in primary productivity and nutrient cycling.

This study not only involve water balance and nutrient cycling but also monitoring the qualities of irrigation water and precipitation monthly. The economical analysis is to be carried out in each rotation with different managements. Data collected will be filed with EML (Ecological metadata language) for sharing and exchange. Morpho-Metacat software is used as the tool for information management. The meteorological data of three sites is already put into the meteorological database of the ClimDB, affiliated to the long-term ecological research network in the U.S.A.

As the LTER for agricultural ecosystem requires more human activities and resource investment and is more complicated than those for natural ecosystem. It would be of remarkable value and significance if a LTER site could be well assembled up and operate constantly for a very long term in Taiwan. Some ecological parameters based on long-term data collection could be present to compare with those from others worldwide for policy-making of optimal agricultural managements best sustaining the agricultural ecosystem and minimize environmental impacts rendered by human activity.

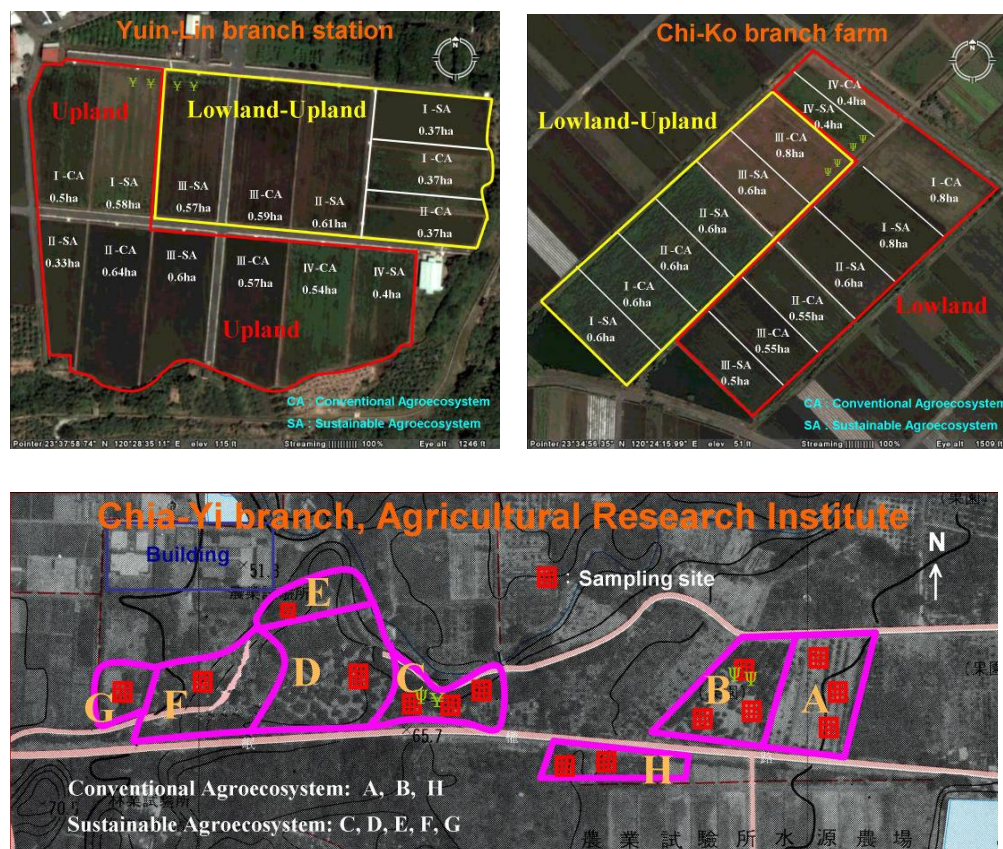


Fig.1. Ecological study of field crop rotation and orchard are carried out on three sites.

Keywords: long term ecological research; agricultural ecosystem; subtropics

Reproductive allocation, seed dispersal and germination of *Myricaria laxiflora*, an endangered species in the Three Gorges reservoir area

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Myricaria laxiflora is an endangered plant that grows in the flood zone along the Yangtze River in the Three Gorges area from 70 to 155 m above sea level. To understand the spatial distribution patterns of the species and provide information for developing conservation strategies, we used field surveys to study its seed reproduction and dispersion and used growth chambers to study seed germination. Results showed that *M. laxiflora* produced many flowering branches, inflorescences and seeds. Seeds were very small and output was high although biomass allocation to reproduction was low (~ 4%). Reproductive allocation was strongly correlated with the biomass of stems and leaves. Seeds were dispersed either by the wind or the river current. Wind-dispersed seeds usually settled within 25 m from parent plants leading to a clumped distribution of individuals in populations. Water-dispersed seeds often landed and established on strands of firth where the flow velocity was slow. Seedlings that emerged from water-dispersed seeds were distributed along the water flood line.

The life-span of *M. laxiflora* seeds was about 7 days. Seeds could germinate within 24 hours when they absorbed adequate amounts of water. Soil water content was a key factor limiting the establishment ability of *M. laxiflora*. Experiments showed that the minimum soil water content for germination to occur was 10% on sand or 17% on sandy soil substrates, and the optimal conditions were on saturated soils. The water content of sandy soils on the riverbank was lower than 10% in autumn, the dry season, and seeds were able to germinate only on sandy beaches that were intermittently inundated by the fluctuating river current. These characteristics of seed dispersal and germination limit the ability for *M. laxiflora* to expand its distribution. These results provide information essential for the conservation and reintroduction of this endangered species.

Key Words: soil water content; biomass; riverbank; distribution; Three Gorges area

Effect of ration on growth, faecal production, nitrogenous excretion and energy budget of Juvenile ovate pampano (Trachinotus ovatus L.)

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Growth, faecal production, nitrogenous excretion and energy budget of juvenile ovate pampano (initial body weight 7.7g or so) at various ration levels (starvation, 1, 2 and 4% of initial body weight per day, and satiation) were investigated in this study. Faecal production (f , $\text{mg g}^{-1} \text{d}^{-1}$) and nitrogenous excretion (u , $\text{mg g}^{-1} \text{d}^{-1}$) increased linearly with increased ration level (RL, % per day), described as $f=0.3937\text{RL}+0.0033$ and $u=0.2687\text{RL}+0.3111$, respectively. Feed absorption efficiency (FAE, %) appreciably increased as ration level increased but had no significant difference between ration levels. Relationships between specific growth rate in wet weight (SGR_w , % per day), dry weight (SGR_d , % per day), protein (SGR_p , % per day), energy (SGR_e , % per day) and ration level (RL, % per day) were linear, described as $\text{SGR}_w=0.9873\text{RL}-3.3630$, $\text{SGR}_d=1.1370\text{RL}-3.5448$, $\text{SGR}_p=1.2721\text{RL}-4.2564$ and $\text{SGR}_e=1.5159\text{RL}-5.0075$, respectively. Accordingly, feed conversion efficiency in wet weight (FCE_w , %), dry weight (FCE_d , %), protein (FCE_p , %) and energy (FCE_e , %) all also increased as ration increased and maximized at ad libitum ration level. Energy budgets of juvenile ovate pampano at satiation ration was $100C=3F+4U+76R+17G$ or $100A=82R+18G$, where C is food energy, A is assimilated energy, F is faeces energy, U is excretion energy, R is metabolism energy and G is growth energy.

Keywords: juvenile ovate pampano (Trachinotus ovatus L.); ration; growth; faecal production; nitrogenous excretion; energy budget

In situ studies on the distribution patterns and dynamics of microcystins in a biomanipulation fish—bighead carp (*Aristichthys nobilis*)

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The distribution and dynamics of microcystins in various organs of the phytoplanktivorous bighead carp were studied monthly in Lake Taihu, nwhich is dominated by toxic cyanobacteria. There was a good agreement between LC-MS and HPLC-UV determinations. Average recoveries of spiked fish samples were 63% for MC-RR and 71% for MC-LR. The highest MC contents in intestine, liver, kidney and spleen were 85.67, 2.83, 1.70 and 1.57 mg g₋₁ DW, respectively. MCs were much higher in mid-gut walls (1.22 mg g₋₁ DW) than in hind- and fore-gut walls (0.31 and 0.18 mg g₋₁ DW, respectively), suggesting the importance of mid-gut wall as major site for MC absorption. A cysteine conjugate of MC-LR was detected frequently in kidney. Among the muscle samples analyzed, 25% were above the provisional tolerable daily intake level by WHO. Bighead is strongly resistant to microcystins and can be used as biomanipulation fish to counteract cyanotoxin contamination in eutrophic waters.

Keywords: microcystin accumulation; bighead carp; organs; seasonal dynamics; MC-LR-Cys; TDI; Lake Taihu

Natural succession and carbon accumulation of sub-alpine forest in the east Tibet Plateau

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The community structure of primary forests and forest successional processes are studied in Gongga mountain. In a primitive and undisturbed environment, trees compete for light, water and nutrients. Disaster disturbance in mountain is a very important driving factor for regeneration of tree plants. Repeated destruction of forests by glacier movement or debris flow generated additional forest gaps that allow young plants to grow. Tree species and size between glacier shrinking area and debris-flow fan in Hailuogou valley are compared. The pioneer species that settle in debris-flow fan and glacier shrinking area are *Salix spp.* and *Populus purdomii*. *Abies fabri* and *Picea brachytyla* are the climax tree species, respectively. The primary vegetation successional process in Hailuogou (2700-3200m) can be classified into four stages:

Slash surface (20-200a)→ *Salix*-*Populus* seeding community (10-30a)→*Populus*-*Salix* sapling community (30-100a)→*Populus*-*Abies* mixed community (50-100a)→*Abies*-*Picea* climax.

In this study the Gongga Forest Succession Model (GFSM) was developed for simulation of forest community successional processes in different scales in Gongga Mountain. A soil succession module was added into the GFSM model to simulate soil formation and chemical element change of woodland. In order to represent major features of forests in Southwestern China, many field works have been done to identify ecological parameters of various trees in the sub-alpine region. On the basis of simulation of tree's life history, the GFSM combines forest succession with soil change in both material components and nutrition content. The Monte-Carlo method was applied to simulate random weather fluctuation and the uncertainty of tree death. These modeled processes agreed with the field investigation results in this region. The modeling approach reflects well the succession dynamics of primary forests in Southwestern China. These results are very useful for improving the management polices and prediction technology for restoration and conservation of primary forests in Southwestern China. Based on the biomass investigation, and succession model of sub-alpine forest, the C storage, absorption and release for several typical wood land in sub-alpine zones have been discussed. For *Abies fabri* forest of 3000m above sea level, the C storage amount is 177.4t/hm² for plant above ground surface and 143.2t/hm² for soil. The annual gross C fixed by vegetation photosynthesis is 20-24 t/hm². The C release by canopy respiration is 3.0-5.5t/hm² for arbors and 10-19t/hm² for soil and roots. Total annual net C fixed of forest ecosystem is about 6.0-7.1 t/hm². At lower position, the woods land release C amount is higher than that of woods at higher place.

Key words:Gongga Mountain, forest succession, forest gap model, carbon accumulation

Soil characteristics and nutrient budget in three agricultural long term ecological research sites in Taiwan: first year report

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In order to understand the effects of different cultivation system on the biodiversity, mechanism of maintaining soil productivity, and environmental impacts, we want to study the available soil nutrient contents under different cultivation system, including the interaction among soil nitrogen, organic matter contents, and microbial population and activities, and the effects of microbial population on the soil nutrient cycling and nutrient budget. The objectives of first year project are to establish and monitor the changes of soil characteristics, crop quality, and nutrient budget of three experimental sites under different cultivation systems. These three sites include Shee-Ko Experimental Station of TARI (Taiwan Agricultural Research Institute), Cha-Yee Branch Station of TARI, Yun-Lin Branch Experimental Station of Tainan District Agricultural Experimental and Extension Station (TDAEES). The soil and crop sampling programs will be considered based on the variations of site characteristics, cultivation programs, and soil characteristics. The monitoring items of soil characteristics will include soil pH, bulk density, soil electric conductivity (EC), soil organic carbon (SOC) contents, exchangeable bases, cation exchange capacity (CEC), base saturation percentage, soil nutrition concentration (total and bioavailability types of N, P, K, and other ions in the soil). The concentration of N, P, K, Ca, Mg, S, and other elements in the rain, irrigation water, and leaves, stems, and roots of different crops are all determined. All the data will be collected from this ecosystem and it can be collected into the Morph (client)-Metacat (Server) system of knowledge network for biocomplexity. We also want to establish a Nutrient Budget Model (NBM) to validate the nutrient budget of soil and crop cultivation system under agricultural long term ecological system of different crop systems in Taiwan.

Key Words: agricultural long term ecological research site; cultivation system; soil characteristics; crop quality; nutrient budget model (NBM); Morph (client)- Metacat (Server) system.

Data management in a collaborative GIS

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The South African Environmental Observation Network (SAEON) has recently implemented a data portal with a collaborative Geographical Information System (CoGIS) as the core. Due to the diversity of data and information, both spatial and tabular, a system needs to be devised whereby the data can be managed. SAEON is in a unique situation where our nodes are being established and developed. Hence there is limited data output from the nodes themselves. However, there are historical datasets sitting with various individuals and organisations which SAEON aims to collect and collate. This necessitates a complex management system and policies to cater for diverse needs. This is currently work in progress and is being developed in conjunction with the technical development of the portal.

Effect of intercropping with medicinal plants on microbial communities and peanut yield in a long continuous peanuts cropping system

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Changes in soil microbial communities were widely supposed a main factor for decreasing in peanut yield. With pot experiment, the changes in soil microbial communities and yield of peanuts after intercropped with Chinese traditional medicinal plants in a red soil from a long continuous peanuts cropping system were studied.

Five kinds of Chinese traditional medicinal plants, *Atractylodes lancea*, *Dioscorea zingiberensis*, *Euphorbia peginensis*, *Ophiopogon platyphyllum* and *Pinellia ternate*, were intercropped with peanuts, respectively. Compared with peanut alone system, the peanut yields were increased significantly ($P < 0.01$) in the *E. peginensis* and *A. lancea* intercropping system. Soil microbial diversity in early spring, flowering-pegging stage and pod-filling stage of peanut were improved in intercropping systems, especially for *A. lancea* and *P. ternate* on bacterial and *E. peginensis* and *O. platyphyllum* on fungi.

No familiar pathogens were found in the *A. lancea*, *E. peginensis* and *Dioscorea zingiberensis* intercropping systems. DGGE analysis of 16S-rDNA and 18S-rDNA from whole soil communities DNA showed obvious transferring of bacteria and fungi between intercropping system and peanut alone system. Cluster analysis of different communities profiles showed fungi species in *A. lancea*, *E. peginensis* and *Dioscorea zingiberensis* had relatively high comparability. Furthermore, soil enzymes assays and activities of antioxidant enzymes SOD, CAT and POD also revealed positive impacts in *A. lancea* and *E. peginensis* intercropping systems. These results suggest that intercropped with Chinese traditional medicinal plants, particularly for *A. lancea* and *E. peginensis*, are potential measures to improve soil microbial communities, physiology condition and yield of peanuts in a long continuous peanuts cropping system.

Key words: peanut; intercrop; medicinal plants; soil microbial diversity; yield

In situ determination of NH₃ volatilization in the field after different application of fertilizer

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A semi-open chamber is often used to measure N gaseous losses from soils, which permitted exchange with the atmosphere via diffusion and allowed continuous measurement of NH₃ volatilization. Since this methodology uses a static trap for ammonia, the amount of ammonia volatilization would be expected to be lower than that determined with Micrometeorological methods in which the air exchange rates at the soil surface induced by commonly prevailing ambient wind speeds. Therefore, a semi-open system method for determining ammonia (NH₃) volatilization in the field was calibrated by comparison with simultaneous measurements in natural condition from ammonium solution. The result found that the flux of NH₃ emission measured by the semi-open chamber (NH₃ Flux_M) was underestimated about 10-40 percent as compared to the natural emission (NH₃ Flux_N), which can be calibrated by the variety of the concentration of the ammonium solution. A calibration equation was calculated by multiple linear regression ($R^2=0.90$) which included NH₃ flux data and wind speed values (2 m above soil surface).

Seven field experiments were conducted following fertilization on summer maize and winter wheat plots (2002 - 2003) at Luancheng Experimental Station, north China. The object of field experiments was to evaluate ammonia emission from urea in different dosage (N rate=0, 200,400,600kg N ha⁻¹a⁻¹) and the mixtures of urea and superphosphate as well as potassium chloride. As local practice, the urea was applied three times in annual: the basal and jointing season of wheat as well as the jointing season of corn, while superphosphate potassium chloride in the basal season of wheat only. The total loss of ammonia volatilization in wheat and summer corn is about 0.2-18.7% of applied urea and the ratio will be different with the change of fertilizing methods and the weather conditions in very period. The high temperature and surface broadcast give rise to volatilization greatly in corn season, accounting to 90% of whole loss of rotation cycle. In basal season of wheat, ammonia volatilization would decrease to 40% in the soil amending urea with calcium superphosphate by reason of lower pH compare to amending urea only, and the effect still is on work in jointing season and corn season. Reversely, ammonia volatilization will increase if the soil was fertilized potassium chloride on addition calcium superphosphate though the extent little.

Spatial and seasonal variations of cyanobacteria and their nitrogen fixation rates in Sanya Bay, South China Sea

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New nitrogen fixed by cyanobacteria contributes significantly to oceanic productivity and the carbon cycle. In this study the nitrogen fixation rates of phytoplankton and intertidal benthic cyanobacteria were investigated in Sanya Bay from 2003 to 2005. *Trichodesmium thiebautii* was the dominant specie of phytoplankton cyanobacteria during our investigation. High *Trichodesmium* abundance was promoted by the intermonsoon periods and peak abundance occurred in outer bay stations. Its average abundance was 273×10^3 trichomes m^{-2} in surface water, Maximum and minimum abundance was 2060×10^3 and 1.14×10^3 trichomes m^{-2} respectively. Average nitrogen fixation rate of *T. thiebautii* was $0.53 \text{ nmol C}_2\text{H}_4 \text{ h}^{-1} \text{ col}^{-1}$ and there was no obviously seasonal variation on a per colony nitrogen fixation rate. It is estimated that the amount of new nitrogen introduced by *Trichodesmium* contribute from 0-2.10% of the total primary production in the bay, and contribute up to 15% new production of the outer bay. Large seasonal variations of nitrogen fixation rate were found in the intertidal zone. All populations studied had the highest nitrogen activity in summer and the lowest in winter. The highest nitrogen fixation rate was found in microbial mats and the lowest in reef and rocky sediments. Climate factors such as temperature and salinity are the important effects on the abundance and nitrogen fixation rates of benthic cyanobacteria. The main predominant benthic species identified as members of genera *Anabaena*, *Calothrix*, *Lyngbya*, *Nostoc* and *Oscillatoria*. The results indicated that phytoplankton nitrogen fixation cyanobacteria are the important contributor of new nitrogen in outer bay area, whereas in intertidal zone the benthic cyanobacteria take important role.

Keywords: *Trichodesmium*; phytoplankton; nitrogen fixation; cyanobacteria; Sanya Bay;

Variation of water sources for the four dominant species on the Tibetan Plateau

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δD and $\delta^{18}O$ values of xylem water for four dominant species (*Q. aquifolioides*, *P. tabulaeformis*, *S. rehderiana* and *N. tangutorum*) in three vegetations on the Tibetan Plateau were measured in the summer of 2005. At the same time, δD and $\delta^{18}O$ values of the precipitation, river water and soil water were analyzed to determine plant water sources using two- or three compartment linear mixing models. Stable isotope composition of summer precipitations presented variation in spatial and temporal scales. The water source for all the plants come from both precipitation and soil water. Water used by plants switched rapidly among different water sources when environmental water conditions changed. Rainwater had different contributions to the plants, which was influenced by precipitation. The percentage of plant xylem water derived from rainwater increased with increase of precipitation. Water sources for broad-leaved and coniferous species were different although they grown in the same plot. For broad-leaved species *Q. aquifolioides*, they used the most of the water from deep soil, while for coniferous species *P. tabulaeformis*, 92.5% of xylem water was from rainwater during the growth season.

Key words: Tibetan Plateau; $\delta D/\delta^{18}O$; plant water sources; precipitation; soil water; river water

Water sources of dominant species in three alpine ecosystems on the Tibetan Plateau, China

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Plant water sources were estimated by two or three compartment linear mixing models using δD and $\delta^{18}O$ values of different components such as plant xylem water, precipitation and river water as well as soil water on the Tibetan Plateau in the summer of 2005. Four dominant species (*Quercus aquifolioides*, *Pinus tabulaeformis*, *Salix rehderiana* and *Nitraria tangutorum*) in three typical ecosystems (forest, shrub and desert ecosystems) were investigated in this study. Stable isotope ratios of the summer precipitations and the soil water presented variations in spatial and temporal scales. $\delta^{18}O$ values of *N. tangutorum* xylem water were constant in the whole growth season and very similar to those of deep soil water. Water sources for all the plants came from both precipitations and soil water. Plants switched rapidly among different water sources when environmental water conditions changed. Rainwater had different contributions to the plants, which was influenced by amounts of precipitation. The percentage of plant xylem water derived from rainwater raised with an increase of precipitation. Water sources for broad-leaved and coniferous species were different although they grew in the same environment conditions. For example, the broad-leaved species *Q. aquifolioides* used mainly the water from deep soil, while 92.5% of xylem water of the coniferous species *P. tabulaeformis* was derived from rainwater during the growth season. The study will be helpful for us to fully understand responses of species on the Tibetan Plateau to changes in precipitation patterns, and to assess accurately changes of vegetation distribution in the future.

Key words: δD ; $\delta^{18}O$; precipitation; river water; soil water; Tibetan Plateau

Impacts of exotic species of *Acacia mearnsii* De Wilde on species diversity of undergrowth plants

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Invasion by alien plants is widely recognized as a major threats on biodiversity. Research is needed to evaluate how and to what extent alien plants affect biodiversity. *Acacia mearnsii* De Wilde, growing naturally in Australia, is a multipurpose tree species for its wood and high tannin-yielding bark. It has been introduced into many countries and became invasive. In South China, it has been widely planted, but little is known on its impacts on local ecosystem. The species diversity, richness and evenness of 6 types of *Acacia mearnsii* plantations were investigated. Following results were found: i) The species richness was 28, 29, 19, 15, 4, 24 in communities of *Acacia mearnsii*×*Eucalyptus globus*, *Acacia mearnsii*×*Acacia dealbata*, *Acacia mearnsii*×*Pinus yunnanensis*×*Keleleeria evelyniana*, *Acacia mearnsii*×*Camellia oleifera*, pure *Acacia mearnsii* plantation and *Acacia mearnsii* of natural regenerated forest, respectively. Shannon-wiener index varied from 1.0939 to 2.7578, which was in accordance with the species richness. Simpson index varied in an opposite way to Shannon-wiener index. ii) The evenness based on Shannon-wiener index and Simpson index varied from 0.6882 to 0.8190 and 0.8084 to 0.9457, respectively, among which the highest was in community of *Acacia mearnsii*×*Eucalyptus globus* and the lowest was in *Acacia mearnsii*×*Camellia oleifera*. iii) The species abundance and diversity in bush layer were negatively correlated with those in grass layer, which was supposed to be caused by the impact of tree layer and human activities. iv) The species diversity in all *Acacia mearnsii* forests but pure forest and *Acacia mearnsii*×*Camellia oleifera* was higher than that in local *Pinus yunnanensis* forests, indicating that *Acacia mearnsii* forests mixed with local plant species have not resulted in reduction of understory species diversity.

Keywords: *Acacia mearnsii*; *Acacia dealbata*; species diversity; plantation; biological invasion

Artificial rubber forest ecosystem hydrological process: mechanism of runoff response to complex factors

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Xishuangbanna region is located at the northern edge of tropical Asia, locates south of Yunnan province, SW China, among 21° 09' ~22° 36' N, 99° 58' ~101° 50' E, with an area of 19,120km². The climate is typical influenced by strongly seasonal alternating within year-round, rainy season (May to October), the tropical Southwest Monsoon from the Indian Ocean contributes over 80% of the annual rainfall, whereas the dry season (November to April), the dry and cold air of the southern edges of the subtropical jet streams dominates the regional climate-environment. Xishuangbanna region has mountain-valley topography with the Hengduan Mountains running north-south, and about 95% of the region is mountainous. The Mekong River flows through the center of the region, resulting in many driver valleys and small basins. A large proportion of the forest in this region is tropical seasonal rainforest, which is primarily formed in wet valleys, lowlands and on low hills (less than 1000 m a.s.l).

Since after the rubber plantation beginning in 1950s, the plantation area of rubber forest has increased in a surprising rate, the demography information shows that the area of artificial rubber forest occupies over 29% of the total forest area in the Xishuangbanna region. It means that the artificial rubber forest ecosystem will play significant ecological roles in the future. Many scientific investigations have been conducted during the past half-century with the hard working by the researchers from the Xishuangbanna Tropical Botanical Garden, CAS and other institutes or organizations. Special highlights on the hydrological process researching work carried out with the light of Chinese Ecosystem Research Network (CERN) will be reported in this paper. The authors try to explain the mechanism of runoff response to the complex factors in the artificial rubber forest ecosystem catchments.

Depending on the long-term monitoring hydrological data generated from the artificial rubber forest ecosystem catchments managed by the Xishuangbanna Tropical Forest Ecosystem Station, the pertinent hydrological period from 1993 to 2004 is selected as the research subjects. The volumes of runoff in daily, monthly and yearly are calculated according to the special formula $Q=a \cdot H^b \cdot t$ (a and b are the constant, in m³), the runoff depth in monthly and yearly is calculated on this formula $H=Q \cdot A^{-1} \times 10^3$ (mm). The final results indicate that during the research period, runoff response to the rainfall, topography, LAI, soil texture, biomass keeping, litter decomposition rate and human activities factors in this artificial rubber forest catchments. The complex interaction mechanism needs to be interpreted with additional survey and investigation.

Keywords: artificial rubber forest ecosystem; runoff; soil texture; biomass; decomposition

A leaf litter decomposition experiment of typical forest ecosystems across China

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In order to explore the effects of litter quality and climate on litter decomposition rates across regions, we carried out the Long-Term Intersite Decomposition Experiment (LTIDE-China) in China from the southmost to the northmost and from southeast to southwest reflecting a wide variety of natural and managed ecosystems and climate. 12 forest types (including 8 regional broadleaf forests, 3 needle-leaf plantations and 1 broadleaf plantation) in 8 sites were involved in. The experiment had been done for 30 months, collecting litterbags once in three months. Several key results as follows emerged from the study:

Estimated k-values or the initial decomposition rate ranged from 0.169 to 1.454, fractions of mass remaining in 2.5 years from 0.026 to 0.655, and the decomposition rate in 2.5 years from 0.038 to 0.147. From tropical zone, subtropical zone to temperate zone, litter decomposition rate of forest ecosystems declined.

The factors of interregional climate, substrate quality and the acclimation of decomposer community to decomposing substrates were successfully tested to control decomposition processes. For the factor of interregional climate, MAT is dominant and MAP is subordinate. Excepting testing the importance of initial C%, N% and C/N ratio on the contribution of decomposition rate, we suppose that initial concentrations of other elements, such as K, may also plays an important role in controlling the decomposition rate of prophase. Initial N%, C/N, N/P ratio were good indicators of decomposition rates.

Key Words: LTIDE; decomposition rate; interregional climate; substrate quality

Use of silver and bighead carps to control cyanobacteria blooms: a case study

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Silver carp (*Hypophthalmichthys molitrix*) and bighead carp (*Aristichthys nobilis*) were used as a new biomanipulation technique to control algal blooms in Meiliang Bay of Lake Taihu, with large pen culture covering a surface area of 1.036 km² in 2005. In order to evaluate the capacity of two biomanipulation fishes to decrease the algal biomass during seasons with algal blooms, diel feeding samplings were carried out in May (without algal blooms) and September (with algal blooms) in 2005. The results showed that both silver carp and bighead carp continued to feed, but with different peak feeding times in May and then a similar tendency in September. Based on estimated food consumption following the Elliott-Persson model, silver carp increased daily consumption from 2.071 g dry weight of plankton per 100 g of body weight in May to 4.975 g dry weight of plankton per 100 g of body weight in September as algal blooms broke. No obvious variations of food consumed by bighead carp were observed during the study periods, when they consumed 1.880 and 1.542 g dry weight of plankton per 100 g of body weight in May and September, respectively. However, silver carp had an approximately higher feeding capacity of plankton than bighead carp. Biotic factors, i.e. fish size and conspecific competition with natural species in the lake, may affect the feeding behaviors of both carps as many seasonal variation of plankton communities in the pen. Based on daily consumption of the carps, we suggest that silver carp and bighead carps can be used for control of algal biomass in eutrophic lakes with outbreak of blooms.

Keywords: food consumption; silver carp; bighead carp; pen culture; biomanipulation

Impact of wetlands reclamation on water resources of the Sanjiang Plain

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Wetlands in the Sanjiang Plain went through extensive reclamation during the past half century, and more than 70 percentage of wetlands in lower plain has been exploited into plowland, which exerted profound impact on both surface and sub-ground water resources through disturbing the normal hydrological regime and agricultural utilization processes. This report explores the interaction between wetlands' reclamation and the dynamics of water resources by analyzing regional hydrological data and monitoring results in typical places in detail. Although the fluctuation of the total runoff of the main rivers seems no remarkable trend, the contrast between the sharp increase of runoff generation coefficient in summer and the decrease in spring indicates the destroy of distribution balance, and hence the utilization implications of surface water resources through the years. The alteration of soil hydrological characters after reclamation is the essential reason, and most typical natural hydrological processes, such as freeze thawing, are affected intensively. The continuous decline of groundwater level is the most dangerous symbol for the utilization potential of groundwater resources, and wetlands left seems no obvious benefits for the inter-replenishment between surface and groundwater. Paddy irrigation accounts for most part of declined groundwater reserves, and plans for further wetland reclamation must be circumspect to optimize groundwater utilization, and an appropriate policy should be formulated for long-term water utilization.

Key words: wetland reclamation; hydrological processes; water resources

CO₂ emission from a black soil as influenced by land use and management

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Land use change and soil management play a vital role in influencing losses of C by respiration. The aim of the experiment was to examine the impact of natural vegetation restoration or long-term fertilization management on the seasonal pattern of soil respiration and accumulative CO₂ emissions from black soil of northeast China. The research was carried out at the National Field Research Station of Agro-ecosystem of Chinese Academy of Science in Hailun County, Heilongjiang Province, China. Both gas and soil samples were collected from the following sites: (i) grassland (GL), it was formerly cultivated and cropped, but allowed for natural vegetation restoration since 1985; (ii) bareland (BL), just as the grassland, but the grasses were manually removed periodically during the growth seasons so that there is limited vegetation cover on this site; (iii) cropland (CL) (started in 1985), crop rotation of maize-soybean-wheat was established in 1990. Three treatments for croplands were: 1) no fertilizer applied (CK), 2) application of nitrogen, phosphorus and potassium fertilizers (NPK), and 3) NPK fertilizers amended together with organic manure (OM). The results show that soil CO₂ emission was significantly affected by natural vegetation restoration and long-term application of organic manure. Soil respiration rate fluctuated sharply during the grass growth for GL, ranging from 92.6 mg CO₂ m⁻² h⁻¹ to 343.4 mg CO₂ m⁻² h⁻¹ with an average of 202.4 mg CO₂ m⁻² h⁻¹. By contrast, soil CO₂ emission did not significantly increase or decline in BL. For cropland, soil CO₂ emission gradually increased with the growth of maize after seedling under different fertilizer applications, and differed for the three different treatments with an increase in an order: CK<NPK<OM. A highly significant exponential correlation was observed between soil temperature and soil CO₂ efflux for GL with Q₁₀=1.99, which accounted for approximately 35% of flux variability. In addition, a strong exponential correlation between CO₂ emission and soil temperature was found at the later growth stage for cropland with Q₁₀ values as 2.28, 2.50 and 2.83 for CK, NPK and OM, respectively. Seasonal CO₂ emission from soil rhizosphere changed in line with overall soil respiration, which averaged 91.3, 135.5 and 194.7 mg CO₂ m⁻² h⁻¹, arriving at peaks of 204.6, 421.6 and 592.1 mg CO₂ m⁻² h⁻¹ for CK, NPK and OM, respectively, then declining sharply thereafter. The SOM-derived CO₂ emission, including basal soil respiration and plant residue derived microbial decomposition, averaged 44.1, 43.9 and 45.3 mg CO₂ m⁻² h⁻¹, showing no difference for the three cropland treatments. Cumulative soil CO₂ emissions decreased in the order: OM>GL>NPK>CK>BL. The cumulated rhizosphere-derived CO₂ emissions at growth stages of maize in cropland accounted for 67.2, 73.7 and 79.6% of overall CO₂ emissions for CK, NPK and OM, respectively. Cumulative CO₂ emissions was found to significantly correlate with SOC stocks ($r=0.92$, $n=5$, $P<0.05$) as well as with SOC concentration ($r=0.97$, $n=5$, $P<0.01$). In sum, long-term application and vegetation restoration increased both soil organic carbon stocks and soil CO₂ emission, these measures are of great significance to properly manage black soil as the large carbon pool in arable land of northeast China.

Keywords: CO₂ flux; land use; long-term fertilization; temperature; rhizosphere respiration; black soil

Long-term monitoring of the coastal environment in the Seto Inland Sea, Japan using macro-algal biodiversities, and the selection of Awaji Island as a long-term monitoring site.

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Marine diversity of the enclosed coastal sea is especially vulnerable to pollution and environmental damage caused by economic activities. Long-term monitoring of coastal ecosystems is essential for conserving these exceptionally sensitive environments. Through the studies of macro-algal biodiversity in the Osaka Bay and Seto Inland Sea area, macro-algal biodiversity has revealed to be an excellent index for evaluating the environmental condition of the area. In addition, the macro-alga community itself has an essential role as the basis of the ecosystem and also stabilizing the water quality.

Seto Inland Sea is located in the western part of Japan and is the largest enclosed coastal sea in Japan. Our marine station belonging to KURCIS (Kobe University Research Center for Inland Seas) is located at the eastern end of the Seto Inland Sea, facing Osaka Bay. Based on the station, we have been investigating the biodiversity of macro-algae in the Seto Inland Sea for more than 40 years, and compiled the macro-algal exsiccatae of the Seto Inland Sea: From 1983 to 1995, under the initiative of Prof. S. Enomoto (former director of the marine station), the macro-algal specimens were collected from 102 localities in the Seto Inland Sea, and 150 sets of exsiccatae including 188 species (collection of voucher specimens) were compiled. They were distributed to major herbaria, museums, and research institutes in the world, and are used for reference collection to identify the macro-algal species in the area.

Furthermore, more intensive biodiversity study in the Osaka Bay area revealed a very clear correlation between the number of macro-algal species and the environmental gradient in the area such as water quality and artificial changes of the coastal lines associated with economic development. Total number of macro-algal species in the Osaka Bay ranged from 118 to 7 from the mouth of the Bay and the innermost part of the Bay. Furthermore, perennial species did not occur in the inner part of the bay reflecting the very low transparency and occurrence of anaerobic water during the summer.

Considering these features, we consider that Awaji Island is a suitable site for monitoring the long-term changes of the coastal environment, and proposed to use the marine station as a core site of the JaLTEL project.

Keywords: Macro-algae; monitoring; Osaka Bay; species diversity; Seto Inland Sea

Study on traits evolution of wheat in Wei-bei Dryland

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In this paper the wheat traits evolution in different period were studied. The results indicated that the leaf was wider and shorter, the plant height was shorter than before; there were not difference on spike length and number of spike let; the 1000-grains weight, yield and harvest index number were increased with the variety evolution; The leaf width was negative related to the grain number per spike and positively correlation to the number of spike、1000-grains weight and yield at extremely significant level. The length of the node and plant was negative correlation to the number of spike、1000-grains weight and yield at extremely significant level; the path analysis indicated that the effect order was 1000-grains weight > number of spike > grain number per spike in three yield construction factor and the harvest index > biomass yield ; the leaf width were larger and length of the node and plant were shorter were benefited to increasing yield. the increased yield attributed to the increasing of 1000-grains weight and harvest index.

Key words: wheat; traits evolution; Weibei Dryland

Forest diversity and dynamics plot network of China: broad-leaved Korean pine mixed forest plot in Changbai Mountain

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A 25 ha (500 m × 500 m) broad-leaved Korean pine (*Pinus koraiensis*) mixed forest plot, namely CBS plot, was established in the summer of 2004 in the core zone of Changbai Mountain Natural Reserve, Northeastern China, to monitor long-term dynamics in a primary temperate forest. All free-standing trees at least one centimeter in diameter at breast height (DBH) were mapped and identified to species, and their geographic coordinates were recorded following a standard field protocol (Condit, 1998). In CBS plot, the terrain is relatively gentle. The elevation ranges from 791.8 m to 809.5 m, with a mean elevation of 801.5 m. The total number of living individuals in the first census of 2004 was 38,902, belonging to 52 species, 32 genus, 18 families. Unlike tropical rain forests without obvious dominant species, 3 species comprise 60% of all individuals and 14 species comprise 95% of all individuals, whereas other 38 species only account for fewer than 5% of all individuals. Species abundances ranged from 1, as found in 3 species to 7381 individuals of hazel (*Corylus mandshurica*), the most abundant species in CBS plot. By virtue of the criterion that species with ≤ 1 individual per ha was considered as rare species, there were 18 rare species, accounting for 34.6% of the total number of species in the plot. Mean stand density was 1556 living trees ha⁻¹, and mean basal area was 43.2 m² ha⁻¹. The clumping index analyses of different growth stages showed that intra-species competition increased with plant growing. Spatial pattern analyses of 46 species with at least 4 individuals suggested that 43 species were aggregated distribution, 3 species were random distribution, and no species showed regular distribution. The analyses combined with elevation and slope suggested that no significant topography dependence was found in the plot.

Species diversity (species richness, abundance and Shannon diversity) in CBS plot has also been studied from the point of view of its spatial organization in order to investigate the observed spatial patterns. Three groups of questions have been addressed: 1) changes in the three diversity variables (species richness, abundance and Shannon diversity) were studied using a range of sampling area and sampling designs. The species–area relationship described the tendency for species richness to increase with sampling area; a relationship whose slope declines (but remains positive) as sampling area increased. When the sampling area increased to 4 ha, there was about 40 species in all sampling designs, approximately 77% of the total number of species in CBS plot. And then, the curve slowed and asymptotic or leveled off. Species abundance and sampling area form a linear relationship, whereas the Shannon diversity-area curves are well fitted by a parabolic model. Different sampling designs had no significant effect on the diversity variable-area curves. 2) Variograms were used to examine the spatial structure of species diversity and showed that the spatial structure of species diversity in the CBS temperate forest was weakly anisotropic. 3)

Partitioning the variation of species diversity into spatial and environmental factors indicated that the spatial pattern of the forest community was only partly explained.

In addition, spatial patterns of four dominant tree species (*P. koraiensis*, *Tilia amurensis*, *Quercus mongolica*, *Fraxinus mandshurica*) were analyzed at different vertical layers and spatial associations of these species among different layers in order to get insights on the processes driving regeneration and succession of the forest. We found that: (1) *P. koraiensis* is a discontinuous regeneration population, *T. amurensis* and *Q. mongolica* are continuously regenerating populations, and *F. mandshurica* may be a declining population. (2) Generally, higher layers tended to random or regular distribution at almost all scales, lower layers tended to aggregated distribution at smaller scales, and the aggregation degree decreases with canopy height. (3) Spatial associations of intra- and interspecies varied with species, layers and scales: positive association or spatial dependence of *P. koraiensis* and *T. amurensis* to most species at upper layer at almost all scales indicated that they have broad niche and grow well under the canopy of other species, *Q. mongolica* showed spatial independence at smaller scales and negative association at larger scales to non-conspecific adults, suggesting that spatial heterogeneity may be important, and *F. mandshurica* was negatively associated with non-conspecific adults, suggesting that its shade-intolerant character. (4) Scale is an important factor for pattern generation, and spatial patterns of different species changed differently with scaling up.

Key words: broad-leaved Korean pine mixed forest; species composition; size class; species distribution pattern

Storage and dynamics of carbon and nitrogen in soil following grazing exclusion in *Leymus chinensis* grassland of northern China

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Land-use change can lead to changes in soil carbon (C) and nitrogen (N) storage. The study aimed to determine the impact of long-term grazing exclusion on the soil organic C (SOC) and total N stores in the *L. chinensis* grassland of northern China and to estimate the dynamics of recovery after grazing exclusion. We investigated the aboveground biomass and SOC and TN stores in 6 contiguous plots along a grazing exclusion chronosequence, which included free grazing (FG), 3-year grazing exclusion (GE3), 8-year grazing exclusion (GE8), 20-year grazing exclusion (GE20), 24-year grazing exclusion (GE24), and 28-year grazing exclusion (GE28). We found that grazing exclusion on at 2-decade scales could increase the soil C and N by 35.7 % and 14.6 %, respectively, in the 0–40 cm soil layer. The aboveground net primary productivity (ANPP) and soil C and N stores were highest and lowest in the GE24 and FG, respectively. The stores increased logarithmically with the duration of grazing exclusion, after an initial rapid increase following the introduction of grazing exclusion, the stores attained a relative equilibrium at GE24. A logarithmic regression analysis revealed 86.8% and 87.1% variation in the soil C stores in the 0–10 cm, and 0–40 cm soil layers, and 74.2% and 80.7% variation in the soil N stores in the 0–10 cm, and 0–40 cm soil layers; this result was statistically significant. Based on the results, we presume that 2 decades of grazing exclusion would restore the *L. chinensis* grassland from light degradation to a stable condition from the view of aboveground productivity and soil C and N stores. Our results demonstrated that by implementing grazing exclusion, the temperate grasslands of northern China could act as significant C and N store on a decade scales in the context of mitigating global climate change.

Key Words: grassland; grazing exclusion; land use; restoration; soil organic carbon; soil organic matter; total nitrogen

Climatic dynamics of middle-mountain areas of upper reaches of Minjiang River

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Upper reaches of Minjiang river situated in North segment gorge of Hengduan mountains region, east edge of Qinghai-Tibet Plateau. It is an important ecological defence to Chengdu plain and Middle and Lower Reaches of Changjiang River. Maoxian Mountain Ecosystem Research Station is a eco-environmental monitoring station of Chinese Academy of Sciences in the upper reaches of Mingjiang River. Climate of the areas has changed silently along with Global climatic change in the past years. Based on the meteorological data recorded by Maoxian Mountain Ecosystem Research Station, some climatic factors, including radiation factor, thermal factor, moisture factor, wind velocity and wind direction were analyzed in the areas. This paper provided mean values of climatic factors and the dynamics characteristics during 16 years (from 1989 to 2004).

Some mean values of climatic factors in the area during 16 years (from 1989 to 2004) have been got or corrected as follows: annual sun shine hours 1373.8 hours, annual sunshine percentage 31%, annual mean temperature 9.3°C, annual extreme highest temperature 30.9°C, annual extreme lowest temperature -13.5°C, mean coldest monthly (January) temperature -0.9°C, the mean hottest monthly (July) temperature 18.6°C, $\geq 10^{\circ}\text{C}$ annual accumulated temperature 2579.1°C, $\geq 10^{\circ}\text{C}$ annual total active temperature 954.1°C, frost-free period 215 days, annual precipitation 825.2mm, annual evaporation 968.7mm, annual mean relative humidity 81.1%, annual maximum depth of snow 19cm, annual maximum depth of frozen soil 65cm, annual mean wind velocity 1.5m/s, maximum wind velocity 10m/s, most wind comes from southeast. Analyzing results of dynamics of some climatic factors during 16 years show that: the values of annual mean temperature, monthly mean temperature of January, monthly mean temperature of July and annual evaporation have trend upwards as time goes along. On the contrary, the values of annual sunshine hours, annual sun shine percentage and annual precipitation have a trend of decline during the same time. Precipitation of the area has obviously seasonal characteristics, 82% precipitation of a whole year arises in 7 months (from April to October). So we divide the whole year into two season according to precipitation, namely rainy season (from April to October) and dry season (from November to next March). Summer drought is severe in some year due to the imbalance distribution of precipitation during the 16 years. The annual mean relative humidity puts up complex changing trend during these years, declined obviously from 1989 year to 1996 year and moved up evidently from 1996 to 2004.

Keywords: Minjiang River; climatic dynamics; climatic factors

Composition and organic carbon distribution of organo-mineral complex in black soil under different land use

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The composition and organic carbon distribution of organo-mineral complexes in a black soil under different land use were studied by means of ultrasonic dispersion and particle assortment method on the base of long-term site experiment. Soil sampling was performed from the following sites: grassland (GL), fallowed in 1985; bareland (BL), the grasses were eliminated periodically during the plant growth stage, fallowed in 1985; cropland, no fertilizer applied (NF); nitrogen and phosphorus fertilizer applied (NP), and NP fertilizer amended with organic materials (NPM), established in 1993. The results showed that the fine sand-size complex was dominant under different land use. Silt-size and fine sand-size complexes were increased in NP and NPM treatment, and clay-size complexes were decreased. The content of <20 μ m size complex in GL was less than in BL, and >20 μ m complex had the opposite direction. The silt-size complex content was increased with the increasing of SOM. Distinguished negative relation was found between the clay-size complexes content and SOM content under different land use. Soil has different dynamics in sequestering C under different land use, <20 μ m size complex in GL was more than in NP and NPM, because that SOM stored in <20 μ m size fractions was more stable than in soil and other complexes, GL has more ability in sequestering C than tilled soil. Fertilization and vegetation restoration made the OC content of all size of complexes increased, clay-size complex in GL had the highest OC concentration, and next was NPM and NP. Fertilization and vegetation restoration also made the proportion of OC in >20 μ m size complexes increase, which showed that OC in sand size complex increased with SOM content.

Key words: organo-mineral complex; land use; SOM; carbon sequestration

Dynamics of groundwater resources in the region irrigated using groundwater in North China Plain: Its ecological effects and strategies for conservation

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Over fifty percent of irrigated area in the North China Plain is irrigated using groundwater. The dramatic decline of groundwater table has been limited the sustainability of agriculture and caused a series ecological problems since 1970's. Our objectives were to identify main factors contributing to groundwater table decline in North China Plain, ecological effects and comprehensive strategies of water saving practices for reducing consumptive use and stabilize the groundwater table.

Based on more than 30 years monitoring data of groundwater table in the region irrigated using groundwater in the North China Plain, we found that groundwater levels has been dropping at a rate of 0.8 m y^{-1} ($P < 0.001$) during the time of significantly lower precipitation that explained about 91% of the groundwater depletion rate ($P < 0.001$) in shallow groundwater area. The drop in groundwater levels was also correlated with the increased area planted to wheat ($P < 0.001$). Lateral recharge of groundwater from mountain area has been decreased since 1980's. At this current rate of groundwater use the resource will be depleted within three decades.

Field irrigation experiments (1989-2004) showed that irrigation scheduling based on wheat stage of growth can significantly increase WUE when we target the application of two key 60 mm irrigation events at the jointing and heading stages of growth when compared to traditional farmer practices that use four irrigation events (240 mm) ($P < 0.05$). Straw mulching reduced soil evaporation by 40 mm for winter wheat and 43 mm for maize. WUE was improved by over 10%. Difference of WUE among different Wheat and corn cultivars were up to 20%. Our studies from 1989 to 2004 suggest that there is potential to use integration water saving agricultural practices including irrigation schedule, straw mulching, crop cultivars with higher WUE, modern irrigation ways of sprinkler, drop and pipe irrigation to cut water use by nearly thirty percent without significantly reducing grain yield in North China Plain.

Vegetation productivity along China Grassland Transect

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Preliminary information on spatiotemporal dynamics of ecosystem productivity on China Grassland Transect (CGT) has been yield. CGT is a transect with ca. 4500 km in length and ca. 500 km in width, which consists of main grassland types of north China and Tibetan Plateau. Precipitation and temperature are the driving factors across CGT. Along the precipitation gradient on the east half of CGT, vegetation aboveground productivity (ANPP) increased exponentially with the increase of mean annual precipitation, indicating higher precipitation-use efficiency in wet climate. Inter-annual variation in ANPP gets greater with the increase of aridity, such trend, however, is not correlated with the inter-annual variation in annual precipitation. Across CGT, both the *in site* eddy covariance measurements and field sampling data indicate that vegetation plays important role in determining the spatiotemporal dynamics of ecosystem water-use efficiency and precipitation-use efficiency.

Key words: China grassland; aboveground productivity; water use efficiency; precipitation use efficiency

Population structure and dynamics of *Neobalanocarpus heimii* in Pasoh

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Sustainable utilization of commercial species has received attention and great deal attention in the international discussion such as Convention on Biological Diversity (CBD). To ensure sustainable harvest of a species requires the understanding of its population structure and dynamics. Basic demographic information on population abundance, growth increment, mortality and recruitment based on sufficient data is required to support the sustainable utilization of the species. In 1985, a 50 ha plot was established in a lowland dipterocarp forest of Peninsular Malaysia for the purpose of gathering this information. Since then, four more censuses have been completed in 1990, 1995, 2000 and 2005 for all trees 1 cm dbh and above measured. The plot provides substantial data base on demographic patterns on some of the important commercial species. This paper presents the population structure and dynamics of *Neobalanocarpus heimii* or commercially known as Chengal a highly valued timber for heavy construction, and use for higher-end homes and resort buildings.

Long-term ecological research on food web structure in a temperate paddy field using stable isotope ratio analysis

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The crux of sustainable agriculture is integrated pest management (IPM) which considers biological control as a core component. For a successful IPM it is very important to understand the target ecosystem, which we concern for sustainable agriculture. The ecosystem can be understood by delving into the food web structures, species composition and their interactions within the system. These may be changed by season, region, year, and human activities. Human activity is one of the most important factor affecting species composition and their interactions, especially in the agroecosystem. To explain the seasonal, annual and regional variations of the food web structures, long-term ecological researches must be conducted. Once all possible prey-predator and/or resource-consumer linkage was made, flows of matter and energy between the species can be studied. Various methods such as direct observations both in a field and laboratory, gut content analysis, radiolabelling, and immunoassay have been used to study on the food web. However, these methods often require professional knowledge and skills, and are expensive and somewhat dangerous to both the ecosystem and the researcher in case of radiolabelling. Since late 1960s, stable isotopes have been used to study ecological processes such as migration, an exotic species invasion, trophic interactions. This method is easy and relatively convenient to prepare samples. In general, ^{13}C and ^{15}N are applied to reveal food sources and trophic levels, respectively because they show certain increases along trophic levels. We surveyed three rice fields which were practiced under different cultivation methods (divided by use of chemical insecticides, herbicides and fertilizers as site 1 (-, +,-), site 2 (+, +, +), and site 3 (-, -, +)). From May 23 to September 27, 2005, and from May 26 to September 29, 2006, samples were collected using sweeping nets and battery-powered sucking devices. Soil and rice plants were dried at 60°C for 5 days and then powdered for homogenization. Arthropod samples were identified species level if possible, then were dried at 60°C for 3 days and then powdered. The $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values were analyzed using these powdered samples. Arthropod and plant samples from 2006 were not analyzed yet. In 2005, 51, 41 and 34 insect species and 20, 41 and 34 spider species were collected in the Site 1, 2 and 3, respectively. Tomoceridae, Chironomidae, Delphacidae consisted over 80% of total individuals in the three sites. For spiders, *Pirata subpiraticus* (Lycosidae) dominated all sites. For soil, the value of $\delta^{13}\text{C}$ displayed little seasonal variations in both years and all sites but there were significant differences between sites. The $\delta^{13}\text{C}$ was enriched more in the site 1 than in other sites. The $\delta^{15}\text{N}$ showed significant seasonal variations in all sites in 2005 and in the site 1 in 2006. The $\delta^{15}\text{N}$ was enriched more by 2~3‰ in the site 3 than in other sites. Rice plants showed a similar pattern with the soil. Both $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ significantly differed between seasons (early, middle, and late) and sites in 2005. Especially, $\delta^{15}\text{N}$ was enriched more by about 3‰ in the site 3 than in other sites after late June. These tendencies were reflected in the stable isotope ratios of insects and spiders. Among sites, there were significant differences in values of $\delta^{15}\text{N}$ of Delphacidae and Collembola

($p < 0.0001$), and in values of both $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ of *Pirata subpiraticus* ($p = 0.037$ and $p < 0.0001$, respectively). The values of $\delta^{15}\text{N}$ and $\delta^{13}\text{C}$ of these arthropods in the site 3 were more enriched by 3~5.7‰ and 3‰, respectively than in other sites. Although there were some variations as described above, the stable isotope ratio structure of the functional groups (guilds) showed similar differential relative positions in all sites in the order of herbivorous insects (pests), detritivores and predators (mainly spiders). In the early season, pests and detritivores were showed similar $\delta^{15}\text{N}$ values but differed in $\delta^{13}\text{C}$ values. Spiders showed higher $\delta^{15}\text{N}$ values than pests and detritivores, and values of $\delta^{13}\text{C}$ of spiders were between those of herbivores and detritivores. In the mid-season, values of $\delta^{13}\text{C}$ of pests and detritivores were close to each other, and in the late season they were merged and thus, showed similar $\delta^{13}\text{C}$ values.

Keywords: LTER; food web; paddy field; stable isotope; $\delta^{13}\text{C}$, $\delta^{15}\text{N}$

Major activities and achievements of the international Long Term Ecological Research (ILTER) from 2003 to 2006

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The International Long Term Ecological Research Network (ILTERN) (<http://www.internet.edu>) was established in 1993 as an outgrowth of US-LTER network which was established in 1980. The Major supporter of the ILTERN was US National Science Foundation (NSF) until 2003. After the 10th anniversary of its establishment in 2003, the NSF gradually diminishes its funding support and the ILTERN has to be increasingly relied on and operated by all its member networks. For the last three years, from September 2003 till now, memberships have increased from 26 in 2003 to 34 in September 2006. To strengthen continuously the network as a site-based, multi-disciplinary, and long term research network, a few significant activities have been carried out in order to stabilize the organization, finance independently, research on the core areas set by the network, and handle effectively and collect data more efficiently, and handle data more effectively. The Bylaws, was not in existence before, was drafted in 2003 and was approved by the Coordinating Committee in the General Annual Meeting (AGM) held in Brazil in 2004. A strategic plan, supported financially by the NSF, was completed in 2005 and was approved in the AGM in Namibia in 2006. Three subcommittees were formed following the recommendations of the strategic plan. The Science and Program Committee promotes science development and international collaborations. The fundraising committee improves funding situation. The Legalize Entity works on legalization of the network as an official international organization. The Eco-informatics Committee develops information management systems and builds infrastructures for the network. Additional suites officer were elected to help conducting the newly established subcommittees. Each subcommittee has a chair and a vice-chair, a treasurer, and general secretary were identified. The 2007 AGM will review the progresses of these subcommittees.

Activity report of shimane university and the future prospects of the nature restoration in lakes Shinji and Nakaumi, newly registered Ramsar sites in Japan

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Lakes Shinji and Nakaumi, the largest coupled lagoon system in Japan, have undergone extensive changes in the last 40 years due to the big national projects aiming at desalination and reclamation of these lakes. In the year 2000, however, the land reclamation project in Lake Nakaumi was officially discontinued, and shortly thereafter, desalination project was also terminated. In July 2003, the president of Shimane Prefectural Government expressed to designate the lakes for inclusion in the list of wetlands of international importance, and these two lakes designated as Ramsar sites in 2005. This is an opportunity for us to come up with the grand design for these lakes and their watershed, a plan which must establish clear goals for the next 10 years and for the next 50 years. The new national biodiversity strategy of Japan, which was approved in 2002, proposes the promotion of restoration projects in order to actively rehabilitate degraded environments. This long-term strategy, incorporating good management planning practices, such as adaptive management, fits well with the restoration of Lakes Shinji and Nakaumi in which severe alteration occurred in the past.

Shimane University is situated nearby these two brackish lakes Shinji and Nakaumi, and established the Research Center for Coastal Lagoon Environments (ReCCLE) in 1992 to promote basic research aimed at solving environmental and social problems in estuaries and coastal areas. Based on this previous work, ReCCLE was reorganized in 2002 and the project, aiming at developing a new model for the wise use of estuaries and coastal lagoons by conducting interdisciplinary research on complex phenomena relevant for conservation and management of the lagoon system, has been launched in 2004. This project includes two principal work packages, one short-term and the other long-term. Till now, results have been achieved contributing to sustainable and wise use of the lakes. The short-term studies delivered a method for synthesis of hydrotalcite compounds, high performance inorganic materials for water purification, having high selectivity for phosphorus. The technique was successfully promoted as an example of business-academic-public sector cooperation in city area, under the auspices of the Ministry of Education, Science, Sports and Culture. Currently, the utilization of these compounds for the reduction of nutrient loading from both point and non-point sources and thus for the improvement of water environment is discussed. A granulation technique of high performance material for overlaying was also established and a field experiment was done. The long-term studies of the project have begun to develop simple yet scientifically rigorous monitoring techniques, like Seagrass-Watch program, a community-based monitoring program suitable for the nature restoration project in Lakes Shinji and Nakaumi.

ReCCLE has also started a large scale field experiment of lake-littoral restoration in collaboration with the Izumo branch of the Ministry of Infrastructure, Land and Transport (MILT), since shallow areas of these two lakes have been diminished due to reclamation, restoration or rehabilitation of shallow littoral zone is one of the most important objectives in the lake. As a practical fishery promotion measure, Shimane Prefectural government mentioned a guideline of the creation of shallow area as well as the protection of waters threatened by anoxia. By creating shallow areas, quantitative recovery of macrophytes may be assured, and we may regain the fertile lake.

Keywords: coastal lagoon; restoration; wise use

National long-term ecological research and Monitoring in Coastal Ecosystem of Korea

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Coastal ecosystem is emerging important ecosystems due to the highest productivity among various ecosystems in the world, because organic and inorganic materials in coastal ecosystem are supplied from both terrestrial and marine environments. However, physical environment changes owing to global warming, environmental pollution including human impact are influence to biological diversity and biomass of various organisms (benthic diatoms, benthic invertebrates, algae, halophytes). National long-term ecological research is to monitor the changes of biological and physical environments, and to examine the structure and function of coastal ecosystem in Hapgyung Bay. It also can be supported to simulation model and management strategy for coastal ecosystem in global environmental change.

As a result of the 1st stage(2004-2006), an effective long-term monitoring methodology on coastal ecosystem was established. Moreover, it is meaningful that this stage was established a system for basic biological and environmental data. Physical and environmental changes were examined through analysis of the accumulated climate, water quality and soil data in Hapgyung Bay, where is the LTER center of coastal ecosystem in Korea. In addition, biological diversity and biomass of various organisms (benthic diatoms, benthic invertebrates, algae, halophytes) were investigated and indicator species and its habitats were examined. Spatial data such as NDVI, land cover map, climate distribution map, DEM, and shadow effect map was established using satellite image and geographic information system.

Biological data, environmental data and spatial data had supported to construct the basic environmental information in global change and to establish the integrated coastal management strategy in Korea.

Recent development of Taiwan Ecological Research Network (TERN)

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The Taiwan Long Term Ecological Research Network (TERN) was established in 1992 with a principal objective of understanding long-term ecological phenomena and processes within Taiwan's dominant ecosystem. Six LTER sites have been established in Taiwan since 1992, including Fushan, Yuan-Yang Lake, Guan-dau-shi, Tatachia, Nan-jen-shan, and Kenting coral reef.

In addition to monitoring and studying how natural and anthropogenic factors impact Taiwan's ecosystems at various LTER sites in Taiwan, TERN scientists also collaborate with scientists and institutions of the ILTER network and conduct inter-regional comparison on topics such as decomposition, impact of typhoon/hurricane on forest dynamics and invertebrate community, lake chemistry, coral reef, etc.

In the end of 2005, a new agriculture LTER program and a new forest management research program joined TERN. The agriculture program focuses on studies of the relationships between soil ecology and crop productivity, and environmental impacts of various cultivation strategies. The forest management program focuses on studies of how various management strategies may affect timber production and biodiversity of forest plantation

To improve the information management system of TERN, a special IM working group of TERN was set up in 2004, with strong support of the Taiwan Forestry Research Institute. By working closely with the IM and IT experts of the US LTER network, members of the IM working groups were able to learn the detailed practice of information management and train TERN scientists in getting the basic concept and tools of information management. TERN scientists are beginning to apply the knowledge into managing their scientific data, which will greatly facilitate data analysis and integration in the future. TERN's IM working group is also helping IM in the ILTER - East Asia Pacific region by co-hosting IM workshops and sharing its experience with scientists of the region. For more information on activities of TERN and TERN's IM working group, please check the website of TERN at <http://www.lter-tern.org/>.

Research of dendroclimatology of subtropical region in China

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Dendroclimatology can relative mark the long climate change, it has being used more fields to recur or revert the history environment process. Now only a little research has been done in subtropical regions. Choose the *Castanopsis fargesil Franch* tree-rings width to revert the climate history of Jiangxi Province. The results show that ring width series of *Castanopsis fargesil Franch* was sensitive to climate variance in the past 30 years. The climate response models were established with mean monthly temperature and total monthly precipitation from the preceding October to the current September. It was found that ring width has a significant positive response to precipitation and a significant negative response to temperature from October to February.

Key words: *Castanopsis fargesil Franch*; ring width; subtropical region; climate variance; response

Effect of temperature and salinity on germination of two Halophytes (Chenopodiaceae) in Northwest of China

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Seed germination is an important stage in life cycle of plants, especially growing in saline environment, because it determines the soil conditions to which later stages of the life cycle will be exposed ^[1] and influences the distribution pattern of plant species. The effects of temperature and NaCl on germination of two stem-succulent halophytes *Halocnemum strobilaceum* and *Halostachys caspica* (Chenopodiaceae), which were mainly distributed in salt desert or salt pan in Northwest of China, were tested. Growth chamber studies revealed that there was a significant difference in optimum temperature range for seed germination of the two species. For *Halocnemum strobilaceum*, the optimum temperature range was between 25~35 °C. The germination percentage of *Halostachys caspica* was higher at alternating temperature. The final germination percentage and germination rate of the both species decreased as NaCl concentration increased. *Halostachys caspica* was slightly less tolerant to salinity than *Halocnemum strobilaceum*. Hypersaline conditions could induce dormancy. The percentage of germination recovery for the both species by NaCl treatments was not significantly different from the controls and the germination rate was enhanced when salinity stress was alleviated. Although *Halostachys caspica* only germinated at less than 400 mmol/L NaCl concentration and *Halocnemum strobilaceum* at less than 500 mmol/L, which were lower than some other halophytes such as *Salicornia europaea et. al* did at, the both species seemed to be highly tolerant to salinity stress due to their germination characteristics.

Key words: germination; germination recovery; *Halocnemum strobilaceum*; *Halostachys caspica*; halophyte

Switzerland: are critical values for atmospheric deposition and ozone in forests exceeded?

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Air pollution affects forest ecosystem functioning through atmospheric deposition of acidic and nitrogen compounds and elevated levels of tropospheric ozone (O_3). The emissions of sulphur dioxide (SO_2), nitrogen oxides (NO_x) and ammonia (NH_3) have rapidly increased since the industrial revolution (Percy and Ferretti 2004) and contribute as precursors to elevated levels of tropospheric ozone.

In the 1980's, a monitoring network was established worldwide and various research efforts have since been undertaken to define critical values of major atmospheric pollutants. We measured atmospheric deposition of acidity, nitrogen and ambient O_3 levels on 12, 13, and 14 Swiss LWF-plots (Long-Term Forest Ecosystem Research LWF; Fig. 1), respectively, from 1995 to 2002. These plots are part of the International Long Term Ecological Research Network (ILTER). The critical loads of acidity and nitrogen were determined by applying the steady state mass balance approach (Sverdrup 1994). The critical O_3 levels were calculated based on the AOT40 statistics (i.e. Accumulated O_3 Over the Threshold of 40 ppb) (Waldner et al. 2007).

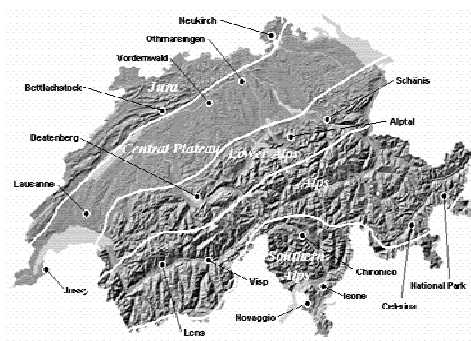


Fig. 1. Location of the Swiss ILTER/LWF-plots. Note: the 2 plots in the Jura region are located at 600 and 1200 m a.s.l., respectively, the 4 plots in the Central Plateau between 500 and 800 m, the 3 plots in the Lower Alps between 700 and 1500 m, the 4 plots in the Alps between 700 and 1900 m, and the 3 plots in the Southern

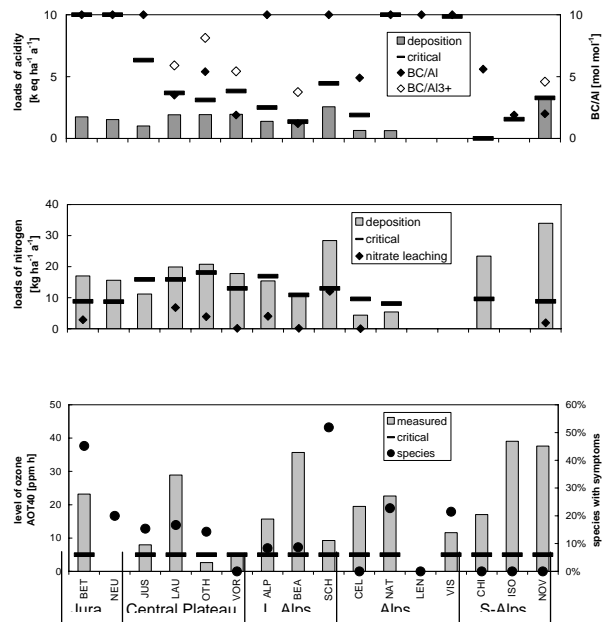


Fig. 2. Atmospheric deposition and ozone-induced visible injury in the Swiss ILTER/LWF-plots. (a): Atmospheric deposition, critical loads for acidity and the lowest median for Bc/Al and Bc/Al³⁺ ratio in soil solution at 15, 50, or 80

Alps between 950 and 1350 m (for more information in detail see <http://www.lwf.ch/>) cm soil depth. (b): Atmospheric deposition and critical loads for nitrogen and nitrate leaching at 80 cm depth. (c): Measured and critical levels for O₃ and percentage of species with ozone-induced visible injury estimated in 2002.

The acid deposition ranged from 0.63 to 3.29 keq ha⁻¹ a⁻¹ (Fig. 2). The deposition of acidity exceeded the critical loads on 2 plots and approached them on 4 plots (Fig. 2). The lowest Bc/Al ratio in the soil profile was close to the critical value of 1 (Fig. 2). The median of the measured molar ratio of base nutrient cations to total dissolved aluminium (Bc/Al) in the soil solution was higher than the critical value of 1 for all depths, and also at the plots with an exceedance of the critical load of acidity (Figures 2 and 3). The N-deposition ranged from 4.4 to 34 kg N ha⁻¹ a⁻¹ (Fig. 2), and the critical loads for nitrogen were within the range from 8 to 20 kg N ha⁻¹ a⁻¹ (Fig. 2). The critical loads were exceeded on 8 plots and deposition is likely to be a long-term ecological risk on 3 to 10 plots (Fig. 2). For O₃, actual AOT40 levels ranged from 2.6 to 39 ppm h in 2002 (Fig. 2), and the critical AOT40 level of 5 ppm h was exceeded on 12 out of 14 plots (Fig. 2), leading to the development of typical O₃-induced visible injury on trees and shrubs (Fig. 3).

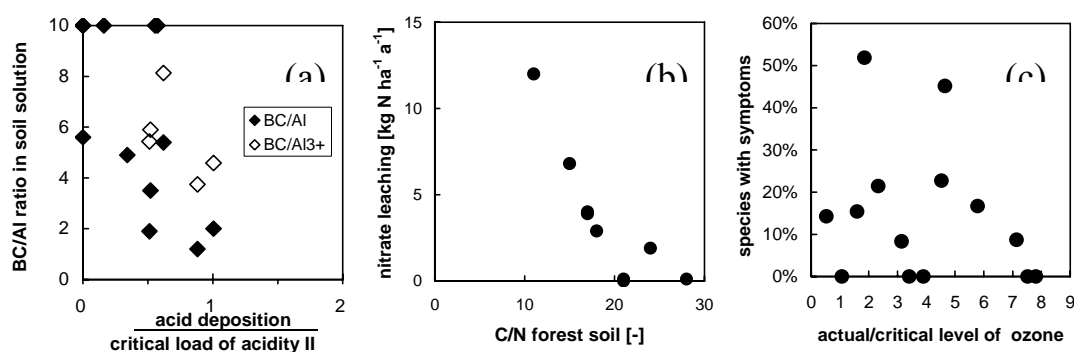


Fig. 3. (a): Lowest of the median Bc/Al and Bc/Al³⁺ ratio in soil solution at 15, 50 or 80 cm soil depth plotted against the ratio of atmospheric deposition to critical loads for acidity estimated based on the soil profile examinations. Bc/Al<1 indicates aluminium toxicity. (b): Nitrate leaching at 80 cm depth plotted against the C/N ratio of the forest floor. (c): Percentage of species assessed at the nearby forest edge with ozone-induced visible injury vs. ratio of actual ozone level over critical ozone level.

The critical loads for nitrogen were clearly exceeded in the Swiss LWF-plots located in the Lower and the Southern Alps due to the proximity of the industrialized and densely populated Po Plain, whereas they were not exceeded at the plots in sparsely populated areas in the Alps. In the Jura and the Central Plateau, the critical loads were lower but were still exceeded at 5 out of 6 plots. Nitrate leaching already occurred on plots with C/N ratios below the value of about 20. Critical levels of O₃ were exceeded on 12 out of 14 Swiss LWF-plots. The quota of the plant species showing ozone-induced visible injury does not correspond with the exceedances of the AOT40 critical level of 5 ppm h O₃. Partly, this lack of correlation may be due to (1) the site specific composition of O₃ sensitive and tolerant plant species, and (2) the influence of microclimatic site

conditions on the stomatal behavior, i.e., O₃ uptake.

In conclusion, the highest risk for harmful effects of atmospheric deposition is expected on Swiss forests in the lowlands if the quantity and concentration of pollutants in the atmospheric emissions are not tightly controlled. Such exceedances may, in the long-term, lead to increasing tree growth, decreased stress tolerance of trees, nutrient imbalances, changes in species composition (species shift and losses), and increased nitrate leaching into ground water.

Keywords: acid deposition; critical levels; long-term forest research; nitrogen deposition; tropospheric ozone

Effects of groundwater depth on distribution and growth of dominant perennials at southern margin of the Taklamakan desert

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At the extremely arid southern margin of the Taklamakan desert in Xinjiang, NW China, mean annual precipitation is less than 50 mm throughout the region. In the foreland of river oases at this region, indigenous vegetation is dominated by a few perennial phreatophytes, since water shifted to the oasis agriculture flooding reached rarely in the foreland, groundwater must have played a key role for plant survival. The hypothesis that distribution and growth of dominant species, *Tamarix ramosissima* Ledeb., *Populus euphratica* Oliv., *Alhagi sparsifolia* Shap. on the foreland of a typical river oases depend on depth to ground water table was tested. Soil water content and salinity were inversely correlated with groundwater depth (GD) of 2 to 15 m. Moreover, salinity of soil and groundwater were directly correlated with variable GD. With GD decreased, plant composition, cover of communities and community diversity increased, at the same time, dominant species in communities varied significantly from *Alhagi* to *Tamarix*, *Populus* etc. On the contrary, communities cover declined and plant composition tended to singleness with GD increased, especially GD above 15 m. Variety of GD affect growth mainly exhibited at two aspects: moisture and salinity. Above-ground biomass generally increases with decreasing depth to groundwater, however, while the DG decreased more, higher salinity of soil and groundwater counteracted the growth benefit that caused by higher soil moisture and restrained the growth. In dominant species, the highest distribution occurred in *Alhagi sparsifolia* from 15 to 2 m of DG. Impact of salinity to growth was more severe in *Populus euphratica* and distributed at small spatial scales only in 4 to 6 m of GD. As a halophyte, *Tamarix ramosissima* indicated high adaptability to salinity and distributed more than other species from 12-2 m of DG.

Key Words: groundwater depth; perennial plants; Taklamakan Desert.

Effects of controlled irrigation on nitrate accumulation in North China Plain

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As one loss of nitrogen, nitrate leaching from the tillage layer results in nitrate accumulation in the deeper soil layers, and in many cases pollutes the groundwater. The fertilizer nitrogen input to the winter wheat-corn double cropping system in north china plain were always more than the plant needed, which caused the nitrate left in soil profile. The amount of water input to the field affected the nitrate accumulation and distribution in the soil profile.

The objectives of this study were to quantify the distribution and accumulation of NO_3^- -N in the soil profile of winter wheat-corn double cropping system under different irrigation practice in North China Plain. On the long-term different irrigation experiment, we select three different irrigation treatments: One is the controlled irrigation which means there was no irrigation during the wheat season, only once irrigation during corn season to insure the germination. Another is the not enough irrigation means there were 2-3 irrigation during the wheat season, during corn season we irrigated the crop according to the plant needed. The other is the enough irrigation which means we irrigated the wheat and corn according to the crop needed. We studied the grain yields and crop harvest nitrogen under the three irrigation treatments from year 2003 to 2005, the result showed there was no yields diversity between treatments ($p=0.05$). We also calculated the nitrate accumulation in 0-4 meter soil profile and nitrate distribution, results showed the nitrate accumulated in the soil profile were most under the controlled irrigation treatment, and it had the nitrate accumulation layers in soil profile. From year 2003-2005 the increased nitrate in the 0-4m soil profile were different: controlled irrigation had 23% fertilizer nitrogen left in the soil and the not enough irrigation treatments had 22% fertilizer nitrogen left in the soil, while enough irrigation had 47 % fertilizer nitrogen left in the soil.

Keyword: nitrate-nitrogen; soil profile; North China Plain; controlled irrigation

Long-term recovery of topsoil physicochemical properties in revegetated sites in the sand-burial ecosystems of the Tengger Desert, northern China

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Sand burial is a major cause of environmental damage in the arid wind-eroded environments of China, resulting from the conversion of steppe to sandy desert. In recent centuries, large areas of desert steppe have been covered by mobile dunes on the south fringe of the Tengger Desert in northern China due to the southward extension of sand dunes. Recovery in soil properties and processes after sand burial in the Tengger Desert, northern China, was documented at five different-aged revegetation sites (1956, 1964, 1973, 1982, and 1991) and at a reference native vegetation site, which had never been damaged by sand burial and was enclosed for grazing. This chronosequence of recovery sites covering a period of 50 years and adjacent enclosed native vegetation sites in the Shapotou–Hongwei region of the Tengger Desert allowed us to study the pattern of soil restoration because monitoring the same site through time is normally considered the most reliable way of measuring change.

The proportions of silt and clay, depth of topsoil and biological soil crusts, and concentrations of soil organic C, total N, total P, and K increased with the age of sites since revegetation. Most topsoil (0–5 cm) characteristics had recovered to 60% of those measured at the reference site by 50 years after sand-binding vegetation had been established. Exceptions were contents of sand, silt, CaCO₃, and organic C and EC, which recovered to 20–40% of the values at the reference site. The difference in annual recovery rates of soil properties between the two most recently revegetated sites (0–14 years) was greater than the difference between the two oldest revegetated sites (43–50 years). Best-fit asymptote models showed that the estimated times for the 50-year-old site to reach the same levels as the non-sand-burial site (i.e. an undisturbed, native steppified desert ecosystem) would be between 23 and 245 years, but for some properties even maximum recovery after >50 years still fell significantly short of the level at the reference site. These results suggest that soil recovery is a slow process in an extremely arid desert environment, and therefore the conservation of soil habitat is a crucial issue for land managers.

Keywords: revegetation; soil nutrients; sand burial; desert ecosystems; chronosequence; restoration

Long-term fertilization response of corn-wheat system in North China Plain

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The North China Plain (NCP), one of the most important grain production areas in China, has rapidly shifted to chemical fertilizer inputs since 1990s. However, long-term improper fertilizer input will affect crop production and soil properties, thereby inhibits the land productivity and agricultural sustainable development. A long-term (1990-2006) field experiment was conducted under a wheat (*Triticum aestivum*)-corn (*Zea mays*) rotation system at the Yucheng Comprehensive Experimental Station, located at the hinterland of NCP, to determine the N, P, and K chemical fertilizers effects on crop yield, plant height, LAI, and soil available nutrient concentrations. The study had 5 treatments receiving N, P, and K at the same rates if it was applied, which was no fertilization as control, NK, NP, PK, and NPK. On average, over 16 years (1991-2006), both wheat and maize yields were the highest and the most stable in the NPK treatments. Unbalanced inorganic fertilization without K (NP) was not sustainable for achieving high yields.

Both wheat and corn growth parameters exhibited a synergistic effect of combining the individual nutrients. For wheat, the synergism appeared to be largely an N-P combination. The soil nutrient supply capacity (SNSC) indicated that wheat yields were most sensitive to phosphorus applications instead of to potassium application in the first years of the study. However, the reduction of available K in the 0-20 cm topsoil and a decline in the SNSC for no-potassium during the later years suggested that K could become a limiting factor for crop growth if not supplied over a long period in this area. These results showed that in order to maintain high yields in Corn-Wheat Double Cropping System, it is necessary to apply N and P annually and it is important to apply K periodically even if full of K in the field soils in NCP.

Keywords: long-term experiment; fertilizer-yield response; soil nutrient; crop yield;

The cropping system in solar greenhouse for sustainable vegetable productivity

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Based on long term field experiment in solar greenhouse, this paper researched system productivity, nutrition quality, safe quality and soil environment in rotation system of cucumber (*Cucumis sativus* L.) with other different crops. The results shown that planting different crops after winter-spring season cucumber harvest, the system productivity and soil characteristic changed significantly in different cropping system. The highest yield productivity and economic productivity was cucumber rotation with greengrocery or cowpea, the second was cucumber rotation with maize for green manure, and with kidney bean. Tomato as the former crop could increase the cucumber soluble sugar content, kidney bean and maize for green manure could increase the cucumber Vc content. Cucumber rotation with black bean for green manure, cowpea and rape could significantly decrease the cucumber nitrate amount. The highest cucumber soil respiration was cowpea as the former crop, the second were maize for green manure, kidney bean, black bean for green manure and control, and the lowest were tomato and greengrocery. That was the best way to reduce soil bacteria and epiphyte amount to follow lasting three or four months during summer season after cucumber harvest, or plant cowpea and other leguminous crops. The research suggested that the effective way to prevent and control continuous cropping obstacle were cucumber rotation with maize for green manure, cowpea and black bean for green manure.

Key words: cucumber; cropping system; solar greenhouse; vegetable productivity; sustainable

A metadata-based framework for multilingual ecological information management

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Herein, we introduce a framework of an ecological information management prototype of tools based on a metadata standard. The framework was developed by the Ecological Informatics Working Group of the Taiwan Forestry Research Institute (TFRI) to aid with editing, storing, and using documents in the multiple languages of Asian cultures that comprise the East-Asia Pacific International Long-Term Ecological Research (EAP-ILTER) Network.

The conceptual framework of the system can be divided into three tiers. The first tier deals with datasets and related information. The second tier relates to information management. Once datasets and other related information have been described, they are stored in a schema-independent database. The third tier is comprised of the full web-based interfaces that allow easy access to the second tier.

Results of the application of this framework consist of an Ecological Metadata Language (EML) document database module, a data analysis function module, and a collection of 58 EML documents.

Key words: ecology; ecological informatics; metadata; information management; corresponding

Edge effects on forest understory vegetation and soil seed banks

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Human-induced forest edges are expanding in worldwide forest landscapes. Their ecological consequences have attracted many attentions from ecologists and conservationists. This study is focused on determining changes in species composition in understory vegetation and soil seed banks at human-induced forest edges and quantifying human disturbance and forest edge ecosystem degradation. The understory vegetation and soil seed banks were sampled at three forest edges from a continuous mid-mountain moist evergreen broad-leaved forest on the northern crest of the Ailao mountains, and at three edges from three tropical seasonal rain forest fragments in the Bubeng area of Xishuangbanna, Southwest China.

The pattern of species composition in understory vegetation along an edge- interior gradient revealed the presence of the three ecological species groups. For the *Lithocarpus xylocarpus* forest, the degree (abundance, richness, diversity, relative abundance and relative richness) of invasion by nonconstituent species and intrusion by secondary species was relatively high at the immediate edge (0-15 m) and decreased sharply in the interior (>15 m) till these species disappeared. The abundance of primary species decreased along the edge to interior gradient, while the richness and diversity did not vary significantly. Thus, there existed three areas with distinct species assemblage which could be quantitatively detected (0-15 m, 15-30 m, 30-60 m). For the *Shorea wantianshuae* forest, the degree of invasion by nonconstituent species was low. The degree of intrusion by secondary species decreased significantly at the immediate edge (0-10 m) and kept relatively stable at the succedent edge. The degree (abundance, richness and diversity) of existence of primary species was high and did not vary significantly along the edge-interior gradient. Thus, there did not exist distinct species assemblage that could be quantitatively detected at the edge zone (0-50 m).

The species composition in soil seed banks at the edges was relatively homogeneous whether in *Lithocarpus xylocarpus* forest or in *Shorea wantianshuae* forest. The dominance pattern of the three ecological groups did not vary significantly along the edge-interior gradient. Secondary species was always the most dominant ecological species group. The invasion of nonconstituent species in understory vegetation lagged behind that in soil seed banks for both penetration depth and occurrence period. We concluded that there was not a lack of propagule pressure for invasion by nonconstituent species at forest edges. The indicators of nonconstituent species in soil seed banks could provide early warning signals for the invasion. We constructed a framework model for predicting and warning the invasion of nonconstituent species in forest ecosystems.

The edge responses of understory vegetation and soil seed banks reflected a strong damage in forest edge ecosystems. Although the degree of damage varied with forest ecosystems, the degradation of forest edge ecosystems was prevalent. The result of quantitative diagnosis showed that, the degradation did not exceed the threshold of ecosystem security and was reversible through the natural restoration in forest edge ecosystems. We constructed an innovative conceptualized model of the dynamic processes of forest edges.

Combining ecological attributes with edge preference, we identified 5 functional response groups for human disturbance: invading, flourishing, proliferating, degrading and indifferent functional response groups in understory vegetation at forest edges. They might be applicable for other forest ecosystems.

28 indicators based on 7 indicator species groups selected from ecological species groups, edge response species groups and functional response groups, were used in principal component analysis (PCA) to ordinate the plots of understory vegetation at forest edges. The integrating indices derived from the principal components showed that there were three orders of disturbance intensity from intense to light along the edge to interior gradient, which coincided with the suitability of our methodology for quantifying human disturbance. We strongly suggest that quantitative assessment of human disturbance in terms of species responses is essential and feasible in forest management.

Keywords: functional response group; nonconstituent species; invasion; propagule pressure; quantitative assessment

Effects of exogenous nitrogen supply on photosynthetic characteristics and carbon sequestration potential of *Calamagrostis angustifolia* in Sanjiang plain Marshes

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Sanjiang Plain mire, one of the largest freshwater marshes in China, experienced an intensive cultivation over the past 50 years. More and more marshes are being drained for conversion to agricultural production, whereas the still undrained marshes receive more exogenous nitrogen from agricultural activities, atmospheric deposition and other approaches, which may influence the ecosystem carbon cycle and the evolutionary process of wetland. Therefore, study the effects of nitrogen on the carbon assimilation capacity and accumulation processes is very important. So we selected *Calamagrostis angustifolia* (typical plant grown in seasonal inundated mire) to study the effects of exogenous nitrogen on growth, photosynthetic characteristics and discussed its carbon sequestration potential after nitrogen supply.

The field cultivate experiment was conducted at the Sanjiang Mire Wetland Experimental Station, Chinese Academy of Sciences (47°35'N, 133°31'E), in Sanjiang Plain Northeast of China, which contributed to a larger evaluation program of wetland management systems. Three controlled nitrogen fertilization levels were added as ammonium nitrate (NH_4NO_3) solution on seedlings of *Calamagrostis angustifolia* every 10 days, and the total nitrogen levels in the entire growing season were as follows: control (N0)、6 (N6)、12 (N12) and 24 (N24) $\text{g N m}^{-2} \cdot \text{a}^{-1}$. The results showed that the height, leaf area and plant number (per pot) increased obviously with enhanced N treatments. As a result, its above ground biomass enhanced significantly, N6、N12 and N24 were about 58.79%、133.11% and 190.55% higher than control at the end of the growing season, respectively. Meanwhile, the foliar N, chlorophyll, soluble protein and free amino acids contents also increased compared to the control treatment, and the net photosynthetic rates under the N treatments (N6、N12 and N24) were 20.70%、26.69% and 53.54% higher than control ($7.58 \mu \text{mol CO}_2 \text{ m}^{-2} \cdot \text{s}^{-1}$), respectively. The results indicated that the increase of exogenous nitrogen supply could cause greater capacity of carbon assimilation in freshwater marshes. Thus, from our short-term field cultivate experiment, we concluded that appropriate even higher ($24 \text{g N m}^{-2} \cdot \text{a}^{-1}$) exogenous nitrogen supply would sequester more CO_2 by photosynthesis. Nevertheless, the respiration of plants and the mire soil which may have strong response to nitrogen inputs and will need further research.

Key words: *Calamagrostis angustifolia*; N supply; photosynthesis; carbon sequestration; mire

Distributed Hydrology Model for Tianranwenyan Agricultural Basin of North China Plain

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A physically-based distributed hydrology model (DHM-ABHC) was built for hydrological cycle of Tianranwenyanqu basin (2514 km²), North China Plain in which the Experimental Station of Agro-Ecosystem in Fengqiu is located. The model advantages in theory include:

(1) An infiltration model (GALS) based on the Green-Ampt methods for layered soil under unsteady rainfall infiltration event was derived. In the GALS, infiltration capacity, ponding time and cumulative infiltration were calculated. The soil profile was subdivided into several layers according to soil texture and initial soil moisture distribution. Comparisons of the developed model with an infiltration model named Gampt and a rainfall-infiltration experiment were conducted and good agreements were achieved.

(2) A kinematic wave overland flow model based on a digital drainage network was developed and it uses topography and land use data to simulate runoff and overland flow routing. The Xinanjiang model was used to simulate the runoff yielding in each grid cell, and the kinematic wave approach was then applied to a ranked raster system defined according to flow vectors computed by the D-8 algorithm for overland flow routing. The calibration and validation results showed that this model worked well.

(3) a new approach, using multiple map information such as river, lake, dam or watershed boundary network as input in addition to the DEM, was developed. The map was digitized and stored by a raster matrix in this method. Two elevation-distance functions was used to adjust the DEM according to the raster map information. This new approach allows for an accurate fit between the map and the modeled drainage structure.

The most of parameters in DHM-ABHC model are physically measurable in the field or derived from their physical meaning, at least in principle. The model is able to simulate hydrological processes, which include: (1) evaporation and evapotranspiration from vegetation, water and naked soil surface, (2) layered soil infiltration and soil water redistribution, (3) surface runoff include overland flow and channel flow, (4) groundwater flow, (5) interface recharge between unsaturated soil, channel and groundwater. In the model, the basin was discrete into raster system to represent the spatial heterogeneity of the studied basin. In horizontal, a ranked digital drainage network was subdivided according to topography and multiple information. The raster was divided into hillslope and river. In vertical, subsurface aquifer was divided into multi-layer column system in terms of soil texture and rock lithology.

The DHM-ABHC model was applied into Tianranwenyanqu basin with an area 2514 km² lies to north bank of Yellow River in Henan province, where the water balance is not only affected by meteorology factors as precipitation but also influenced by recharge and water diversion from Yellow River. The variable head method was used to measure hydraulic conductivity of channel bed sediment. The model simulated hydrological cycle for Tianranwenyanqu basin. One year long

was spent for model warm-up and parameters calibration to reduce the effect by the arbitrary initial conditions. The results showed that the model was capable of simulating all hydrological processes especially with high efficiency at routing surface water and the efficiency coefficients exceed 0.85 and the forecasted runoff errors are all limited by about $\pm 10\%$.

Key words: water resources; interface recharge; green-ampt infiltration theory; kinematic wave model; digital drainage network; distributed hydrology model

Uncertainty analysis of ecosystem photosynthesis and its parameters

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When we fill gaps in the flux record or extract parameters of physiological models, researchers need to fit models to measured data. However, there is no consensus on the best model choosing or ideal optimization criteria. Given our estimates of the distribution of stochastic error of flux measurements at Qianyanzhou (Jiangxi, China) ChinaFlux site, it is incorrect to fit ecosystem daytime NEE models using ordinary least square (OLS). Results indicate that the flux uncertainty follows a double-exponential(Laplace) distribution rather than normal(Gaussian) distribution, and increasing as a function of wind speed. These characteristic violate OLS assumptions. We make use of maximum likelihood method (MLE) to fit daytime NEE models to measured data, which based on minimizing the sum of absolute deviations. We computed ecosystem photosynthesis at different time scales and quantified uncertainty of results through using Monte Carlo simulations. We also can obtain a 90% confidence interval and several statistics of interest for parameters of physical models. We found that using the absolute deviation criterion reduces the estimated photosynthesis compared to OLS. The results indicate that NEE depending on chooses of model, optimization criterion to some extent, and optimization criterion is more important that model choosing.

Keywords: eddy covariance technique; carbon flux; uncertainty; maximum likelihood; monte carlo method; ecosystem respiration

Monsoonal temperate glaciers as a sensitive climate proxy: variation characteristic of Hailuogou Glacier, Gongga Mountain

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Fluctuation of glaciers in mountain areas have been systematically observed for more than a century in various parts of the world and are considered to be highly reliable indications of worldwide warming trends. Monsoonal temperate glaciers, which are mainly distributed over the southeast part of the Tibet Plateau in China, are more sensitive to climate change.

Glaciers in Gongga Mountain strongly retreated since LIA (Little Ice Age) and seem recession quickly in recent 100 yrs. In this study, we collection all evidences for retreat history of Hailuogou glacier, a typical monsoonal temperate glacier on the eastern slope of Gongga Mt., which length is 13.1 km with an area of 25.7 km² and ranges from 7556 to 2980 m. Glacier relics since LGM (Last Glacial Maximum) reflect the variation of the glacier and show several advance and retreat events. Recent 100 years investigation records show a continuous recession from 1930 to 2004. The glacier had retreated 1150 m between 1930 and 1966 (-32 m/yr), 117.8 m between 1966 and 1981 (-12.7 m/yr), 225 m between 1981 and 1996 (-17 m/yr), 55 m between 1996 and 1998 (-18.3 m/yr), 274 m between 1996 and 2004 (-19.6 m/yr). Recent rate of retreat was confirmed by field observations of the glacier terminus in October 2004. Based on the daily data observed of 3000 m Meteorological Station close to terminus of the glacier, increase of annual average temperature was about 0.39°C between 1988 and 2006. The mass balance change of the glacier between 1991 and 2004 which is calculated from glacier discharge shows a big mass loss recently from 1998 balance year.

Key words: monsoonal temperate glacier; climate change; glacier variation; retreat; mass balance

Fog drip and its sources in a tropical seasonal rain forest of Xishuangbanna, SW China

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Fog precipitation (fog drip or fog interception) has long been recognized as an important hydrological and chemical input for forest ecosystems in many mountainous environments. Fog contributes directly to water and nutrient input, but its effect is also indirect by affecting transpiration, photosynthesis, respiration and other physiological processes of the plants. The tropical seasonal rain forest in Xishuangbanna, SW China has a high floristic diversity and is closely related to Malaysian rain forests in flora. This forest would not normally be established in such a climatic region as Xishuangbanna (less precipitation and lower air temperature) compared to those of the lowland moist tropics. The mean annual rainfall in this area is 1487 mm (between 1959 and 2002), which is considerably lower than rain forest in other parts of the world. It is believed that the frequent occurrence of radiation fog might play an important role in the water relations of plants and in the hydrological cycle of this type of rain forest. However, the multiple hydrological and ecological effects of radiation fog are not well understood.

In this study, fog drip and related microclimatic factors were measured between January 1999 and December 2002 at a tropical seasonal rain forest in Xishuangbanna (dominated by *Pometia tomentosa* and *Terminalia myriocarpa*; 21°55'39"N, 101°15'55"E; 750 m *a.s.l.*), SW China. In addition, in order to identify the possible sources of fog drip, samples of rainfall, fog drip, throughfall, stemflow, stream water, river water, pond water and shallow soil water in this site were also collected for three years (2002–2004) for stable isotopic analysis. During the study period, the annual average fog drip was 89.4 ± 13.5 mm (mean \pm 1SD). Fog drip contributes an estimated 5% of the annual rainfall, with 86% of the fog drip occurring in the dry season (November–April). Annual fog drip was negatively correlated with annual rainfall. Monthly variation in fog drip was also negatively correlated with monthly rainfall, and daily fog drip was negatively correlated with minimum air temperature and positively correlated with mean above-canopy wind speed.

Stable isotope composition data for the collected water samples showed that the fog drip, as compared with the other waters, was consistently more enriched, and yielded a higher deuterium excess value, indicating that the radiation fog is produced mainly through evaporation from pond, river, and soil, and through forest evapotranspiration. The analyses suggest that evaporation from the stream is limited. In addition, radiation fog produced during the dry season (low absolute humidity) contained more terrestrially recycled water than fog produced during the rainy season (high absolute humidity; May–October). Forest evapotranspiration appears to be the largest fraction, but a more intense sampling scheme will be needed to assign the relative contribution of the different sources of fog.

These results suggest that fog drip is an important additional input of water to this seasonal rain forest during the dry season, and that the dense rain forest plays not only as an important source of its own moisture but also triggers the fog producing process dynamically since it continues to transpire throughout the year and transpiration is most likely the largest component of evapotranspirative flux.

Keywords: fog drip; stable isotopes; evapotranspiration; moisture recycling; tropical seasonal rain forest

Seasonal Dynamics of CO₂ Fluxes over a Sub-tropical Coniferous Forest Ecosystem

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Global climatic changing has been a focus for a long time in many fields, the increasing CO₂ concentration in atmosphere was considered as one main driving force for global warming. The carbon uptake by planted forest was approbated in Kyoto Protocol. Meanwhile, the forestation and reforestation could be calculated in the country's CO₂ budgets from 1990. To accurately understand the carbon absorbing ability of the terrestrial ecosystem, long term continuous observation for the ecosystem carbon flux is obviously needed. For this reason, we measured the carbon fluxes over a subtropical planted coniferous forest at Qianyanzhou Station using eddy covariance method since 2002. In this study, the diurnal and seasonal dynamics of net ecosystem exchange (NEE), ecosystem respiration (RE) and gross ecosystem exchange (GEE) between the coniferous ecosystem and atmosphere in 2003 and 2004 was analyzed. The carbon fluxes showed obvious diurnal variation with a strong carbon sink in daytime and a small carbon source at the night (Fig. 1). The NEE, RE and GEE greatly varied seasonally with lower values in winter and drought season but with higher values in summer (Fig. 2), and all these fluxes are correlated each other. Light, temperature and soil water content are the main factors determining NEE; air temperature and water vapor pressure deficit (VPD) influence NEE with stronger influence from VPD. Under the proper light condition, drought stress could decrease the temperature range for carbon capture in planted coniferous, air temperature and precipitation controlled RE. The NEE, RE, and GEE for planted coniferous forest in Qianyanzhou are $-387.2 \text{ g C}\cdot\text{m}^{-2} \text{ y}^{-1}$, $1223.3 \text{ g C}\cdot\text{m}^{-2} \text{ y}^{-1}$, $-1610.4 \text{ g C}\cdot\text{m}^{-2} \text{ y}^{-1}$ in 2003 and $-423.8 \text{ g C}\cdot\text{m}^{-2} \text{ y}^{-1}$, $1442.0 \text{ g C}\cdot\text{m}^{-2} \text{ y}^{-1}$, $-1865.8 \text{ g C}\cdot\text{m}^{-2} \text{ y}^{-1}$ in 2004, respectively, which suggest the intensive ability of coniferous forest on carbon absorbing in Qianyanzhou.

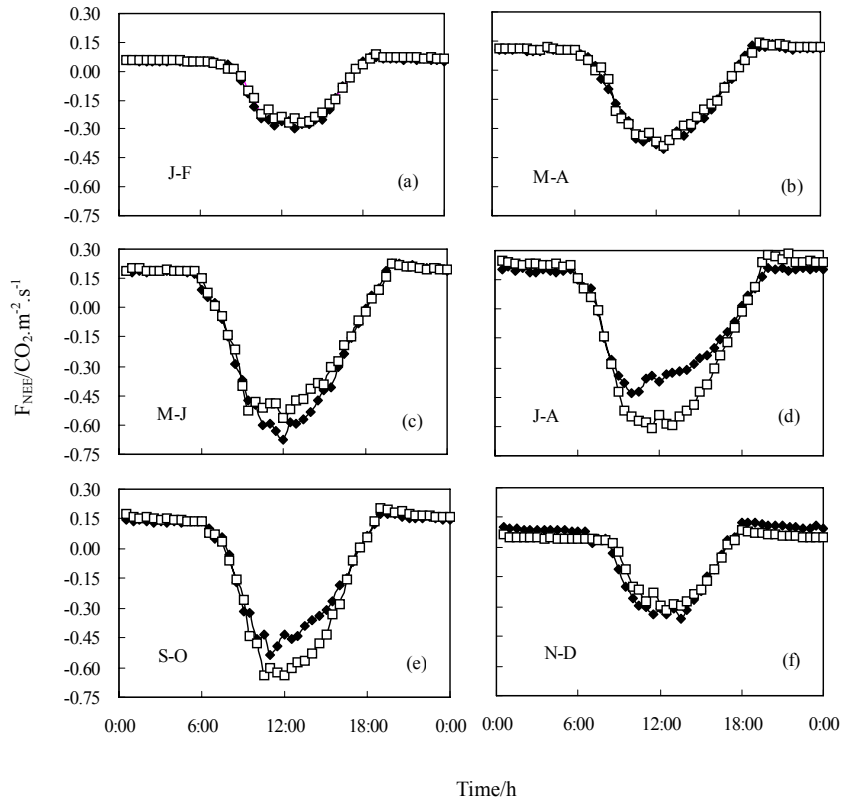


Figure 1. The monthly diurnal variation of F_{NEE} for planted forest in 2003 and 2004 (Solid square stands for the observation in 2003, open square stands for 2004)

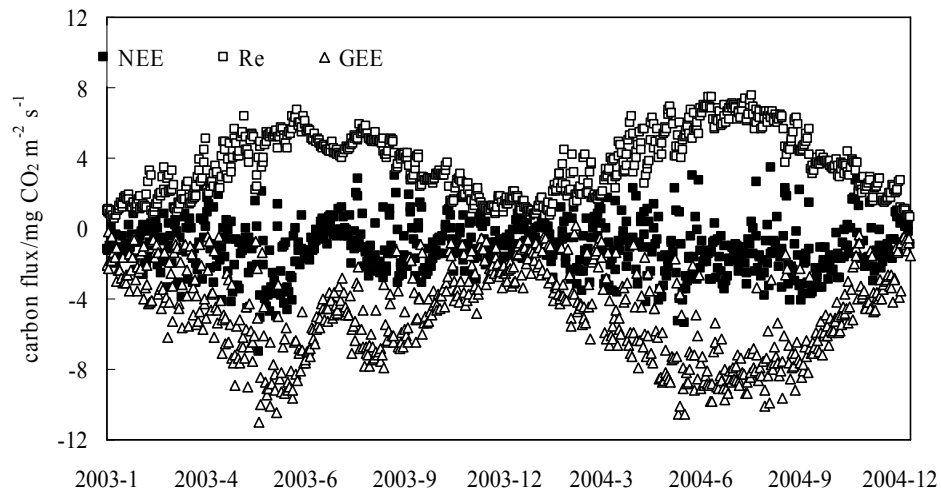


Figure 2 Seasonal variation of NEE, RE and GEE for 2003 and 2004

Effect of different utilization pattern and fertilizer management on soil active aluminum forms and mechanism research

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Aluminum is the most abundant metal that makes up 7% of the earth's crust and occurs in a number of different forms in soil. It is occurred as harmless oxides and aluminosilicates. Nevertheless, if soil pH <5 or even 5.5, as is now the case on 40% of the arable lands in the world, Al is solubilised into toxic forms, generally referred to Al³⁺, which is a primary factor limiting plant growth have been attributed to several physiological pathways. Calorization is an important characteristic in soil formation in tropical and subtropical area in China. Knowing active aluminum actions in the soil is the precondition to alleviate aluminum toxicity and to improve the productivity in acid soil. Take the upland soil of South China as study area, long-term location experiment, pot experiment and incubation experiment were combined together to study dynamic changes of active aluminum forms and its mechanism with the help of lab and field analysis. Long term experiment in upland soil with different utilization patterns was used to study the changes of soil physical and chemical properties and active aluminums in different planting systems. The dynamic changes of ExAl, HyAl and OrAl were analyzed in acid red soil incorporation with organic fertilizer and outside aluminum, and the impacts of these dynamic changes to the growing of maize and maize biomass were also discussed. How their interactions changed soil pH and impacted the actions of active aluminum in the soil were studied by adding acid chemical fertilizer and outside aluminum to soil, and how these changes and impacts can be represented by the growing of maize and maize biomass, so that we can further understand the relationship and the change laws of active aluminum and soil characters, and give scientific proof to these changes impacted on the crop.

With all the studies, the conclusions are as follows:

(1) 4 utilization patterns are in the long-term location experiments, these are, natural recuperation treatment, farming field, planted tea forest and planted orange forest. In comparison of the natural recuperation forest land, the planted tea forest and planted orange forest have low pH and high concentration of ExAl over years. While the farming field has high concentration of nutrients, high pH, low concentration of ExAl, and high concentration of HyAl and OrAl with organic material recycle. For the impacts of litter and acid rain in forest land, soil pH and soil ExAl concentrations of the surface layer were lower than that of the under layer, while the concentration of organic matter and OrAl were higher than that of the under layer. Soil pH and the concentrations of organic matter in downhill were both higher than that of the uphill position because soil corrosion piles up in the downhill position, as a result the toxicity of the aluminum was decreased in the lower part. The surface layer of the soil differentiated greater than the under layer, because it was more affected by human activity and the outside environments.

(2) Active aluminum forms changed remarkably in farming field because of soil tillage and organic material recycle. Dissolved organic matter, soil pH and active aluminum forms in soil changed rapidly within the first 30 days after straw incorporation in acid arable soil, soil pH improved rapidly within 10 days, and then it decreased to the balanced level in the next 20 days. The dissolved organic matter got its maximum value in the first day when incorporated with straw, and then it decreased quickly, and changed very slowly after 30 days. Under the influence of these, the ExAl decreased first and then rose, the more the straw was employed, the greater impacts would be on the ExAl. The changes of HyAl were very complicated and were affected by many factors, but the rapid change characteristics were still concentrated within 30 days. The OrAl rose first and then decreased; and appeared dynamic balance after 30 days. In the first stage of the straw decomposition, the dissolved organic matter, and soil pH were both have great impacts on the changes of active aluminum forms in the soil; but in the later period of the experiment, soil pH was the major factor.

(3) Because of short period of straw function, soil organic matter could not be well accumulated, which could not be well complexed with aluminum, as a result the OrAl wasn't steady and was easy to decompose when outside environment changed. As to maize, HyAl is another kind of aluminum compound with high toxicity only next to ExAl. When the aluminum toxicity was alleviated, soil nutrients absorbability improved obviously, and the root of the corn would also elongate.

(4) Added outside aluminum to red soil could decrease soil pH, while soil pH would rise under influence of the outside aluminum interacted with chemical fertilizer, included urea. But the added aluminum ions could increase the concentrations of the active aluminum, the nutrient absorbability was decreased, as a result both the aboveground and the underground dry matter of the crop would decrease.

Two sides existed if chemical fertilizer was added to acid red soil. Firstly, it could increase the nutrients concentration in the soil; secondly it could also decrease the soil pH and induce more aluminosilicates to dissolve; therefore chemical fertilizer had no obvious impacts on the growing of the crop and the biomass, and couldn't eradicate the toxicity of the aluminum radically. In order to do so, organic fertilizer must be incorporated continuously, and optimal amount of chemical fertilizer was also needed at the same time, so that the nutrients concentrations in the soil and soil pH could both be improved.

Keywords: exchangeable aluminum; hydroxy aluminum; organically complexed aluminum; aluminum toxicity; alleviation

Adsorption on soil of dissolved organic carbon and nitrogen from cattle manure: a preliminary study

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Dissolved organic matter (DOM) is an important constituent of soil solution that plays a role in many chemical and biological processes in soils. Dissolved organic carbon (DOC) and dissolved organic nitrogen (DON) take part in carbon and nitrogen cycle in soil, respectively. Therefore, release and retention of DOM affects the filter function and nutrient cycle processes of soils. However, more study was focusing on the sorption dynamics of DOC, especially in forest ecosystem, very few study was made about sorption processes of the added DOC and DON (e.g., manure) in agricultural soil. Thus, the objective of this study was to establish the sorption isotherms of DOC and DON in batch approaches and to evaluate how two different soil-to-solution ratios may affect the sorption of DOC and DON.

DOM was extracted from cattle manure. The extraction was passed through 0.45- μm polysulfone membrane filters and the DOM stock solution was prepared. Soil sample (silt sand loam) was taken from the topsoil (0-30 cm) of agricultural field at Yucheng Comprehensive Station. Initial solutions were containing 17, 34, 6,119,170,255, 340, and 425 mg DOC L⁻¹, and 1.2, 2.4, 4.8, 8.4, 12, 18, 24, and 30 mg DON L⁻¹ by diluting the stock DOM. The ionic strength of all the working solutions was adjusted to the same with NaCl solution and the pH to 8.45 (the same as stock DOM). Two conventional soil-to-solution ratios (3 replicates) were set in this batch sorption experiments, i.e., 1:5, and 1:10. The suspensions were shaken horizontally at 298 K and the shaking time was 24H for the sorption isotherms. As the shaking was finished, the suspensions were filtered through 0.45- μm polysulfone membrane filters. In the filtrate, the concentration of DOC was measured by TOC analyzer. DON was obtained by subtracting inorganic nitrogen from total nitrogen, which was measured by continuous flow colorimetry and the Kjeldahl digestion method, respectively.

Sorption of DOC was analyzed by the initial mass (IM) relationship (Fig. 1). Isotherm approaches such as Langmuir and Freundlich failed to describe DOC data. An IM isotherm was well used because Freundlich or Langmuir isotherms related the amount of DOC adsorbed to equilibrium concentrations and ignored the native DOC. The perfect linearity between sorption of DOC and amount of DOC added was shown that the sorption capacity of soils is not exhausted within the range of added DOC amounts in this study. However, IM relationship, Langmuir and Freundlich all failed to describe DON data (Fig. 2). Sorption of DOC and DON was significantly influenced by soil-to-solution ratio. Sorption capacity of DOC and DON was increasing with the increasing soil-to-solution ratio in this study.

Key words: Dissolved organic carbon (DOC); Dissolved organic nitrogen (DON); sorption isotherm; soil-to-solution ratio

From LTER to LTSER: incorporating the social dimension to the Mexican LTER network

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An important goal of ILTER is “Deliver scientific information to scientist, policymakers, and the public to meet the needs of decision-makers at multiple levels.” Since its beginning, the Mexican Long Term Ecological Research Network (Mex-LTER) has identified “criteria definition for ecosystem management” as one of its seven core research areas. However, large proportion of its science agenda still concentrates on the study of the structure and functioning of natural ecosystem. By recognizing that ecological systems are intermingled with social systems, it is essential to start studying socio-ecological systems as a whole. Therefore, we decided to start moving from “long term Ecological research” to “long term Socio-Ecosystem research”. The process has not been easy.

The Millennium Ecosystem Assessment is providing an excellent framework to link ecological process from natural ecosystems with human well being. It is also an excellent tool to inform stakeholders and decision makers about human dependence on ecosystems and the need for sustainable ecosystem management strategies. Its main virtue is that it allows the integrated analysis of ecological and social aspects of ecosystem management. In this context, it is important to consider that ecosystem management not only require technical interventions (sustainable practices of ecosystem manipulation), but also need institutional interventions (transformations of social interaction rules towards cooperation) as well as communicative interventions (participatory action as well as environmental, civil and political education activities). Therefore, in order to fully participate in ecosystem management research, our LTSER groups should include teams of social and natural scientist working together to be able to design these technical, institutional and communicative interventions.

In our efforts to incorporate the social dimension in to the Mex-LTER network, it was necessary to dissect ecosystem management issues and look for specific approaches for each of its different aspects. Firstly, it was clear the need to incorporate a detailed socio-economic research agenda, extending the monitoring to include socio-economic variables. It was also important to distinguish between doing research on ecosystem management and the actual implementation of management. By analyzing the ecosystem management protocol we have identified in which particular aspects scientist do and should participate. The role of participatory research and monitoring, as well as its relation with environmental education programs, was analyzed. It seems that involving local people of different social sectors in research and monitoring efforts, is an excellent strategy to induce their interest in environmental issues. Finally, it is important to recognize that windows of opportunity for ecosystem management opens and closes at much faster rhythm than science activities. Since non-governmental organizations (NGO) are not constrained by tight academic structures and are relatively free from these time restrictions, they have been identified as potential operational arms of LTSER groups.

Keywords: ecosystem management; participatory research; Millenniums Assessment; NGOs

Detecting scale-dependent processes of environmental heterogeneity and dispersal limitation in a subtropical forest of Gutian Plot, south China

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Understanding the relative contribution of niche processes (such as competition in heterogeneous habitats) and neutral processes (such as dispersal limitation) is crucial in understanding community assembly rules. However, their relative contribution was thought to be a function of scale. In this research, we test this hypothesis with data from Gutian Plot, a 24 ha subtropical forest plot of Chinese Forest Biodiversity Monitoring Networks. We measured the environmental variables: the mean elevation, convexity, slope, aspect and successional stage for subplots of different cell size, and we also calculated principal coordinates of Neighbor Matrices (PCNM) base function as spatial relationships among sampling grid cells. We employed 2D wavelet analysis to decompose axis 1-3 of redundancy analysis into patterns of different scales, subsequently we used variation partitioning to compute the relative contribution of environmental variables and PCNM bases. Our results indicated that with the increasing of extent, the relative contribution of environmental variables decreased and that of PCNM bases increased. On the other hand, we also varied the cell size and computed the relative contribution of environmental variables and PCNM bases at different grain. On the contrary, the relative contribution of environmental variables increased and that of PCNM bases decreased with increasing of grain. Our results suggested that scale-dependent processes of environmental heterogeneity and dispersal limitation have many faces, and both of basic components of scale, grain and extent should be taken into account.

Key words: scale, heterogeneity, dispersal limitation, variation partitioning

Simulating the response of crop productivity and water consumption to climate change for the north and south counties of the Huang-Huai-Hai (3H) Plain based on VIP model*

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The Huang-Huai-Hai Plain (3H) is one of the main areas for food productivity in China. Documented research shows that 3H area has been incurring very obvious climate change with precipitation decreasing and temperature increasing in the last decades. Still unclear is how the crop productivity and water consumption in 3H response to future climate change, which is certainly urged both for national food security and sound integrated water resources management in this area. Based on a vegetation-interface-program (VIP) model (see Mo, et al. 2005), the response of crop productivity and water consumption at a south (Huaiyuan, Anhui Province) and north (Botou, Hebei Province) county of the 3H Plain to climate change is simulated and predicted.

The climate change scenario is set as the 2 °C increase and 15% change of precipitation. It is shown that under the rainfed condition, the water consumption for both winter wheat and summer maize will increase less than 10 % with the 2 °C increase of the temperature. The north county is less sensitive to the change of the temperature than the south county. If besides the temperature increases of 2 °C, the precipitation also increases 15%, then the amplitude of the increase of water consumption will be enlarged up to about 20%. If the precipitation decreases 15% plus the 2 °C increase of the temperature, the water consumption will be reduced significantly by 15%. From this, it looks that the 15% change of precipitation is a more important determinant than the 2 °C change of temperature. The response of water consumption to the 15% increase of precipitation is larger than the response of water consumption to the 15% decrease of precipitation in the south county, while the two responses are almost the same in the north county. In the south county, the response for winter wheat is smaller than the response for summer maize. Oppositely, the response for winter wheat is larger than the response for summer maize in the north county.

Under the rainfed condition, our results show that crop yields are sensitive to the global warming. With the temperature increasing 2 °C, no matter how the precipitation changes, the crop yield will always be decreased to 20%. The increase of the precipitation will mitigate the responding amplitude about 5% of crop yield's reduction caused by air warming. However the tendency of the decrease keeps the same. The decrease of the precipitation may add another 5 % of decrease in

case of air warming.. Generally, the amplitude of the decrease of the crop yield for winter wheat is smaller than that of summer corn. The response for winter wheat is almost the same for both the south and north county. The decrease amplitude for summer maize in the south county is larger than that for the north county.

It is shown that under the irrigation condition, the water consumption also increases (decreases) with the change of climate. Comparing with the rainfed condition, irrigation mitigates the amplitude of change. This is because of the dual mechanism related water consumption to the increase of water demand and the shortening of growing days. The response of water consumption to climate change under irrigation condition is more complicate than that under rainfed condition.

Under the irrigation condition, the response of crop yield is almost the same as that under the rainfed condition. The amplitude of the change of winter wheat's yield is mitigated obviously to less than 15% under the irrigation condition. The amplitude of the decreasing response of the yield to climate change under irrigation condition seems larger than that under rainfed condition.

Key Words: crop yield; water consumption; Huang-Huai-Hai Plain; climate; China

40 years of studies in oak-hornbeam forest in Báb/Slovakia

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The research site Báb has been established in 1967 within the UNESCO supported International Biological Programme. The 1 ha area is situated in a 66 ha large oak-hornbeam (*Quercus cerris* L., *Quercus petraea* Liebl., *Carpinus betulus* L.) natural forest which has not been managed at least since 1850. The forest is situated in the agriculturally utilised area of Slovakia on loessal soil. The species composition, both tree, shrub and herbaceous layers served as basic information for numerous studies on climatic conditions and its dynamics (day, year), primary and secondary production and productivity, biomass (fresh and dry matter) distribution within thickness categories, stem, stump and crown, their distribution in the above-ground production space of the forest. Canopy structure, overlapping the crown and crowns distribution in the production space was also studied. Leaf biomass, leaf area index (LAI), was thoroughly analysed and the LAI distribution in the production space served as the most important scientific information for subsequent studies on light utilisation for photosynthesis. The final step was the evaluation of the energy content in the biomass and in the increment of the biomass. These studies have been accompanied by zoological, entomological, ornitological and micromycetical surveys which have accomplished the scientific informations from the studied ecosystem. Further reinventarisations and reassessments have been done here in the years 1976 and 1985. The scientific information obtained in these years are going to be followed by the data from 2007. From the iterim results it is clear, that due to the climate change and soil pollution , obvious changes can be observed especially in the herbaceous layer composition, intensive reduction of the shrub layer, where only a break of individuals can be found in comparison with 1967. The tree layer composition is also different: the dominant species (*Quercus* sp.) remained in original amount, but other species (*Carpinus betulus* L., *Acer campestre* L, etc.) have been reduced substantially. Other changes could be documented in soil chemistry, ornithological observation results, enthomology (esp. species composition), etc. The results document that the changes in 40 years period are caused not only by natural eldering of determinant part of the ecosystem – trees, but also and mainly by global changes caused by climate warming and air/soil pollution.

GRID- based assessment on eco-environmental sensitivity in Wushen Banner

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Eco-environmental Sensitivity assessment as a new research field on sustainable development is the foundation for establishing early warning systems for ecological safety and environmental management. Many scholars have started to study the national safety and social safety from the ecological point of view till now.

Wushen Banner locates in the transitional depression between Ordos Plateau in Inner-Mongolia and Loess Plateau in the north of Shaanxi Province, and in the middle of Mu Us Dersert with a fragile environment. For regional social and economic sustainable development, strengthening eco-system management is a prerequisite .One of the most effective methods is to identify the critical or sensitive area which is easy to be degraded.and the spatial distribution of eco-system sensitivity and service importance were characterized. From the perspective of regional ecological safety, the regional Eco-environmental Sensitivity assessment index system is established including sensitivity to soil erosion, land desertification, bioinhabitation and human settlements. Based on the GRID module supported by Geographical Information System (GIS), changing the spatial data into the 1km×1km grid, through grid average weight calculation, the Eco-environmental Sensitivity assessment distribution map of Wushen Banner is compiled. This research could provide scientific basis for exploring sustainable development mode of regional resources and environment as well as guiding local development construction and ecological environment service.

The results show that: (1)In the total area of sensitive or more sensitive region, the most sensitive region to soil erosion makes up 42.4% of the total area, mainly in desert region, and the more sensitive region to soil erosion covers 7.6%. The most sensitive region to desertification covers 7.58%, and the more sensitive region to desertification covers 11.35%. (2) The sensitivity distributed regions are the same regions suffering from eco-environmental problems, and these regions should be taken as priority area for ecological protection and construction.

Keywords: Eco-environmental Sensitivity; Wushen Banner; GRID; spatial analysis

Differential nitrogen uptake and allocation patterns among coexisting plant species in a semiarid steppe community

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How co-occurring plant species divide limiting belowground resources is a major unresolved question, though it is of fundamental importance to understanding species coexistence and community organization in plant communities. In arid and semi-arid ecosystems, soil nitrogen is a limiting resource for primary productivity and is mainly available to plants in brief pulses following precipitation events. However, little is known as to how coexisting plant species take up and allocate pulsed nitrogen in a natural plant community. Here we applied ^{15}N -labeled nitrogen as a pulse at the beginning of the rainy season to a semi-arid steppe grassland community of Inner Mongolia in northern China. We studied the nitrogen uptake and allocation patterns of ten coexisting plant species and examined the relationships between nitrogen uptake and allocation traits and plant species abundance. Species showed significantly different responses to the labeled nitrogen pulse. Contrasting patterns were found between dominant species and minor species in both ^{15}N uptake and allocation. In this semi-arid system, dominant species were characterized by lowest specific ^{15}N uptake rates, highest population ^{15}N uptake rates, highest belowground allocations of recovered ^{15}N and biomass, and lowest tissue nitrogen concentrations, while minor species were characterized by a suite of contrasting traits in ^{15}N uptake, ^{15}N and biomass allocation and tissue nitrogen concentration. Subdominant species showed intermediate rates of ^{15}N uptake and allocation of both recovered ^{15}N and biomass. Belowground ^{15}N allocation, belowground biomass allocation and tissue nitrogen concentration were positively correlated to species abundance, while specific ^{15}N uptake rate, aboveground ^{15}N allocation and aboveground biomass allocation were negatively correlated to species abundance. Our study provides a clear view of how coexisting steppe plant species share pulsed belowground resources. Contrasting patterns between dominant and minor species in nitrogen uptake and allocation improve our understanding of the mechanisms responsible for species dominance and community organization in pulse-driven ecosystems. Our findings also have important implications for managing grassland ecosystems in the face of global climate change and anthropogenic disturbances.

Keywords: community organization; species coexistence; pulse-driven system; nutrient uptake; resource allocation; ^{15}N tracer

Leaf nitrogen and phosphorus ecological stoichiometry in temperate forest ecosystem in Northeast China

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Nitrogen (N) and Phosphorus (P) are among the most important limiting nutrients in terrestrial ecosystems, especially in natural ecosystems. The previous studies have greatly advanced our understanding of the leaf N and P in terrestrial vegetation. However, these studies mostly focused on agricultural ecosystem. The studies about natural ecosystem especially forest ecosystem leaf N and P ecological stoichiometry was much less than agricultural ecosystem and mainly focused on sites, so ecological stoichiometry about forest ecosystem should be further studied. We studied the leaf nitrogen (N) and phosphorus (P) ecological stoichiometry, spatial pattern and the relationships with climate factors of 479 samples of 41 dominant species in 61 sites of northeast China. The results shows: leaf N, P and N/P (mass ratio) exhibited large variations in northeast China, ranging from 5.91mg/g to 41.37 mg/g for N, from 0.86 mg/g to 7.67 mg/g and from 1.29 to 16.37 for N/P. Geometric means for N, P and N/P was 18.12mg/g, 2.67mg/g and 6.79, respectively. The leaf N in northeast China was nearly identical to China and global vegetation, but leaf P was significantly higher and N/P was significantly lower than China and global vegetation. Compared with leaf P, the forest ecosystem in northeast China was more limited by N, which was identical to previous studies about N limitation in temperate forest ecosystem. With latitude increasing, annual mean temperature and annual precipitation decreasing, leaf N and P firstly increased and then decreased, which were different to China and global vegetation.

Key Words: N/P; ecological stoichiometry; forest ecosystem; climate factor; leaf nutrient

Monitoring the recovery of the vegetation in two conservation areas in the Succulent Karoo, South Africa

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Namaqualand is a winter-rainfall desert, located in the northwestern part of South Africa. It is part of the Succulent Karoo Biome, one of only two entirely arid regions to qualify as a hotspot of global significance. Compared with other similar deserts of the world, Namaqualand has an exceptionally high level of endemism and an unrivalled diversity of leaf succulent and geophytic species. This rich plant diversity is vulnerable to land use practices such as pastoralism which is commonly associated with overgrazing, especially in communal land, but also on privately-owned land. In the higher rainfall areas of Namaqualand, the landscape has also been highly transformed by the clearing of land for the cultivation of crops.

To most people, Namaqualand is synonymous with mass displays of wild flowers. Ironically, this springtime floral spectacle is often associated with land degradation as it is especially prominent on fallow or abandoned fields and other disturbed or overgrazed sites. These flower displays attract thousands of tourists annually and are a valuable source of income to the region. Conservation authorities are therefore often confronted with the conflicting demands of tourism (associated with high levels of disturbance and low levels of diversity) on the one hand and conservation on the other.

Several long-term studies have been undertaken in two conservation areas to monitor the recovery of the vegetation after the cessation of farming practices, i.e. after abandoning cropping and the removal of livestock.

In the Namaqua National Park the recovery of the vegetation on abandoned cropland is monitored annually. Four abandoned fields, differing in time since last disturbance were selected in 1993 to monitor changes in species richness and composition. When the first surveys were made the ages of the fields were 3 years, 4 years, 10 years and 40 years respectively. Total species richness increased with time since abandonment. This increase was mainly due to an increase in the perennial component, while the annual component was not yet decreasing after >50 years. Species composition of the perennial species showed a clear directional trend over the monitored years. The annual species did not show a similar directional trend and their composition seemed to be dictated by the timing and amount of seasonal rainfall. Although the richness of the annual species did not diminish with time since abandonment, the abundance of the showy species has decreased.

In the Goegap Nature Reserve a long-term monitoring project was initiated in 1974 after the reserve had been fenced and all livestock removed. Initially only two line transects of 1000 descending points were set out. As the reserve was enlarged an additional five transects were

added in the 1990s in highly degraded areas and a further 14 transects were added in the 2000s to cover all the different vegetation types. Only the two longest monitored transects show clear trends as yet, indicating the slow rate of recovery of the vegetation. The species composition revealed notable changes over the monitored period with a slight increase in palatable species and decrease in unpalatable ones. Together with an increase in vegetation cover of the perennial species, these changes constitute an improvement in the range condition. The annual component showed no directional trend, but reacted to the timing and amount of seasonal rainfall.

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Keywords: abandoned cropland; biodiversity conservation; disturbance; Succulent Karoo; vegetation recovery

Designing conservation landscape for Giant pandas in Min Mountains, China.

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Giant panda (*Ailuropoda melanoleuca*), is one of the world's most endangered species. Habitat loss and fragmentation have reduced its numbers, shrunk its distribution and separated the population into isolated sub-populations. Such isolated small populations are in acute danger of extinction due to random demographic factors as well as inbreeding. In this paper, we used 'least-cost' modelling as a systematic approach to incorporate satellite imagery as well as ecological and behavioral parameters of giant panda collected during more than ten years of field research in order to assist in the design of the Min Mountains conservation landscape for giant panda. This study identified eight core habitats, eight potential protected habitats, and four linkage areas for giant pandas in a reserve design process. The core habitats had an average density of 4.9 pandas per 100 km², and contained approximately 76.6% of giant panda population. 45.2% of the core habitats (3245.4 km²) were outside current protected areas. Total estimated core habitat decreased by 30.4- 44.5% after anthropogenic information was incorporated into the analyses. A detailed landscape-based approach is required to plan, implement, and evaluate the phases of biological and social activities, and their effect on giant panda conservation. The conservation landscape design for giant panda in Min Mountains will help to develop a conservation unit with the aim of ensuring habitat retention and connectivity, improving dispersal potential of corridors and maintaining evolutionary potential of Giant panda in face of future environmental changes. The results of our analysis can help in making recommendation for giant panda conservation in other Mountains areas as well as for other animals conservation in many parts of the world.

Conservational status of plant seedlings a tool for biodiversity conservation in Northern Pakistan

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This paper is based on the results of ecological studies in the Northern Pakistan. The research was conducted in Moist Temperate forest of the Northern Pakistan and the targeted area was Ayubia National Park. It lies over an area of 3312 hectares. To conserve the biodiversity is actually to conserve a species. All species continually interact with each other, forming a web of life in which survival of each is dependant upon the presence of others. Species lost is actually diversity lost. We have endangered species at risk in the study area and more and more species are becoming endangered day by day due to over exploitation and over harvesting for different needs of the local people living around the area. To predict such disturbances studies have been conducted to observe conservational status of all of the trees of Ayubia National Park, taking simple parameters of number of seedling and samplings of these plants in selected plots. In this study borderland area has been divided into 12 (twelve) regions. Total 240 quadrates (0.25 x 0.25m) have been laid. On the basis of number of seedlings and saplings each region is specified a category. Except one region all have some sort of disturbances, which hinder the proper growth of seedlings and consequently the relative tree species in that region. It shows that species used as fuel wood like *Quercus dilatata*, *Abies pindrow*, *Taxus wallichiana*, *Aesculus indica* and *Picea smithiana* were in serious threats of extinction based on the number of seedlings and saplings in each region. The major reasons behind this disturbance is mainly the local people who are unaware of the importance of the plant resources and they are destroying these resources for their domestic needs.

Key Words: National Park; conservation; fuel wood; biodiversity; gymnosperm.

Monitoring water and energy fluxes in irrigated agricultural lands of North China Plain

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During the past decades, increasing interest has been focused on energy and water fluxes, i.e., evapotranspiration, from land surface as the key components of water cycle. Because evapotranspiration links between energy partitioning, stomatal conductance, carbon exchange, and water use efficiency in plant communities; and serves as a key regulator of ecosystem processes. Hence, particularly, it is considered also as the interaction of vegetation with the atmosphere from the aspect of global climate change.

In the context of North China Plain (NCP), wheat and maize are the main crops cultivated in rotation, which constitute the major part of the landscape. Their land surface radiation balance, energy partitioning and groundwater table change are therefore crucial for the regional climate and hydrology as well as the attention focused food problems. It is therefore important to quantify the energy balance components, to understand different factors and their influence on these terms, their rhythmic change and the monitoring of the evaporative processes over the region.

Till now, long-term studies of energy and water fluxes have been concerned to indirect methods, e.g., water balance, with low time resolution only. However, in order to improve the understanding of evapotranspiration and energy partitioning processes, high temporal resolution data is essential in many cases.

Since 1994, we have started measuring the water and energy fluxes over agricultural fields at Luancheng Station, which is located in the middle part of the western NCP. In this study we will introduce some achievements of our experimental studies including the characteristics of energy balance over irrigated field, the effects of irrigation activities on energy and water fluxes, importance of soil moisture and vegetation phenology.

Key words: energy balance; evapotranspiration; bowen Ratio; phenology; irrigated land; NCP

Quality evaluating and assessment for soil datasets for long-term monitoring

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The soil datasets of Chinese Ecosystem Research Network (CERN) covers a long-term observation of ecological processes in the terrestrial ecosystem including farmland, forest, grassland, desert and marsh. These soil data sets from the 31 field stations are: soil nutrient; soil exchangeable cation and cation exchange capacity; available middle-element and available micro-element; heavy metal element and microelement; mineral elements; soil texture and mechanical composition, and soil bulk density. In order to obtain high quality soil monitoring data for decision-making, the quality evaluation and assessment for soil monitoring data is made.

Aimed at evaluating the data quality, different measures are used to compare these data sets directly with desired the accuracy, the precision, the logical conformance and the metadata completeness. First, the inter-comparison test on soil analysis among 31 terrestrial sites was held by 2002 and 2005, and the result for soil nutrient presents that average accuracy is about 95% with Z-statistic and the average precision is 95% with K statistic (ISO 5275). Second is the test of logical conformance including the position conformance of long-term sample plot and the name conformance of soil type. The result shows that position conformance for long-term sample plot is 82% since 2000 and 100% since 2002, and the name of soil type is satisfied with Chinese National Standard (GB/T 17296-2000) is 86.4%. In the end, we conduct the assessment of metadata completeness according to LTER metadata and Eml. The result presents that there are the basic metadata documents in terms of the identification information and the geographic coverage information since 2002, and need to address additional recommendations for 4&5 levels Eml.

Key Words: ecoinformatics; soil Dataset; quality evaluation

Carbon sink limitation and tree growth of *Abies faxoniana* at treeline ecotone in eastern Qinghai-Tibetan Plateau

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The alpine treeline formation is likely caused by low temperature-induced growth limitation rather than carbon source limitation as an increase of altitude. Quantifying the content of non-structural mobile carbon bears the answer to the question of carbon source-sink imbalance. To test this hypothesis, we measured the non-structural carbohydrates (NSC), including starch and sugars in needles, branches, stems and roots, and compare tree growth of *Abies faxoniana*, a wide-spread treeline species, along a altitudinal gradient across treeline ecotone in eastern Qinghai-Tibetan Plateau. *Faxoniana* fir is a kind of 'starch' tree with little content of lipid. NSC contents on a dry mass basis presented significant increase in needles and branches, while higher in roots and stems from forest to tree limit across treeline ecotone. This trend is more pronounced when NSC is accounted on a volume basis. Shoot elongation, tree height abruptly reduced at treeline. Therefore, we conclude that *faxioniana* fir treeline is carbon sink limited with performance of sharp reduction of tree growth at which thermal threshold approaches.

Keywords: treeline; carbon balance; altitudinal; gradient; tree growth; low temperature

Comparison of methods for estimating evapotranspiration of a temperate mixed forest: eddy covariance, Bowen ratio energy balance, Priestley-Taylor and Penman-Monteith equation

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Forest evapotranspiration is one of the main components in regional water budget. A multi-year, multi-technique study was conducted to estimate latent heat flux within a temperate mixed forest of broad-leaved and coniferous trees of Changbai Mountains in northeastern China. Four different methods were used, including eddy covariance (EC), Bowen ratio energy balance (BREB), Priestley-Taylor (PT) and Penman-Monteith combined equation (PM), during the growing seasons (May to September) of 2003–2005. These models, relying on more easily obtainable data desirable, are valuable when long-term direct measurements are not available. The objective of this study is to compare the effectivity of these models.

According to the experiments, it is concluded that:

- (1) Eddy covariance measurements above the temperate mixed forest during 2003 to 2005 showed that the energy balance closure of whole day was not as good as daytime. The regression line slopes of $LE+H$ against R_n-G_s-S were 0.689, 0.726 and 0.519 for the whole day and periods of day ($PAR > 5 \text{ mol m}^{-2} \text{ s}^{-1}$) and nighttime ($PAR \leq 5 \text{ mol m}^{-2} \text{ s}^{-1}$), respectively, which ranged in middle level of that in literature reports. Diurnal cycle of latent heat flux LE was similar to that of net radiation R_n and varied seasonally. LE was smaller than sensible heat flux H in the early and late growing seasons, while in the mid growing seasons when leaves had fully grown, LE exceeded H .
- (2) Each of the BREB and PM method gave different correlative latent heat flux with EC measurements when different reference levels were used. More correlative results were obtained if higher reference level(s) was employed. The phenomena could be partially explained by the hypothesis of BREB method and source area of the measurements. The assumption in BREB method of equal eddy diffusivities for heat and water vapor is not always met. In addition, the measurements of lower elevation sensors were affected by the heterogeneity of the canopy surface and less representative than those of higher elevation sensors. We suggest that elevation for measurements both for BREB and PM method is at least eight times of z_0 higher above mean canopy height.
- (3) In order to estimate PT parameter, the data set was divided into two groups: (a) a calibration data set; (b) a validation data set. A constant PT parameter ($\alpha=1.18$), estimated with the calibration data set, was applied to estimated evapotranspiration of validation data set.
- (4) Latent heat fluxes estimated with four methods were approximately coincident with each other during the most days of three growing seasons. Considering simple linear regression between measured and modeled evapotranspiration, PT method was superior to BREB and PM methods.

The regression line slope of PT-EC half-hourly evapotranspiration (=1.07) was closer to one than those of BREB-EC (=0.081) and PM-EC (=1.22) methods. The intercept of PT method (2.17 W m^{-2}) was closer to zero than those of BREB ($=18.5 \text{ W m}^{-2}$) and PM (51.2 W m^{-2}) methods.

PT method, based on the assumption that the effect of turbulence is small compared to the effect of radiation, is the simplest and most effective approach to estimate evapotranspiration, while it is site-dependent. The uncertainty of BREB method lies in the assumption of equal eddy diffusivities for heat and water vapor, conditions which are not always met, and different levels of probes with different footprints (source area), including those of temperature/humidity and net radiation. The inaccuracy of PM method was due to the assumption that all the energy for evaporation is accessible by the plant canopy, and that water first has to diffuse through leaves against a surface resistance before diffusing into the atmosphere against an aerodynamic resistance.

Keywords: evapotranspiration; eddy covariance; bowen ratio; Priestley-Taylor; Penman-Monteith

Modelling fuelwood demand availability in the Northern Sofala province, Mozambique

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Wood biomass is the primer source of energy for household use in Mozambique, while a significant part of industries is also dependent on this source of energy. Estimations indicate an average consumption of about 0.6 ton per capita per year, which means about 19 million cubic meters a year at national level. Although the national forest inventory indicates 70% of the country surface as covered by wood vegetation, and a national deforestation rate of about 0.58 % per year, it has been noted that certain regions are already short of fuelwood and supply can only be done from other districts. Large towns such as Maputo, Beira, and Nampula are characterized as huge vacuum cleaners sucking the neighboring forests (Maputo has a deforestation rate of 1.67% per year). In fact, charcoal production for sale in towns is among the major cause of deforestation, together with slash-and-burn agriculture. As a result, the areas around the towns and along the major roads have high deforestation rate increasing the distance of fuelwood collection and leaving behind entire communities without a secure source of energy. This fact may be even more pronounced in districts located in the river flood plains, where forest vegetation is naturally low.

It was on this base that this research was defined, with the main objective to model the dynamics of fuelwood consumption and availability in the Northern region of the Sofala province of Central Mozambique. The region lays between the Pungue and Zambezi rivers and covers nine administrative districts in about 65000 Km². The topography is typically plain to undulate covered by grasslands, open woodlands and coastal dense forests. Above ground wood biomass varies from a few tons per hectare in the grasslands, to about 100 tons per hectare in the dense forest. In addition, the study had the objective to evaluate different policy scenarios to address the localized shortage of fuelwood.

A model spatial model was designed using the base line data of the year 2000. The base map was established using a 2x2 Km grid with information on forest cover, population, roads, conservation areas, and forest concessions. The model had two main components: (i) the demand component, consisting of the submodel of population growth and fuelwood consumption, and (ii) the supply submodel, consisting of forest biomass growth. A fuelwood search procedure was developed as part of the routine mimicking the observed pattern: (a) urban consumption – charcoal is the main product; charcoal makers collect trees in the forests around the town and along the main roads; (b) rural consumption – fuelwood is the main product, collected around the homestead. The model includes parameters that can be changed by the user to create scenarios. These include alternative sources of energy, charcoal use efficiency, forest plantations, wild fire, change in charcoal price, population growth parameters, among others. Discussions with the user advisory group, composed by policy makers and practitioners involved with the forest resources and energy in the province were used to shape the model and evaluation of the simulation results. A simulation period of 15 years was suggested considering the high uncertainty of policy options and the respective response on the fuelwood use pattern.

The main results of the simulation are presented in maps with the main objective to identify geographically the location of the areas with potential for deficit in fuelwood supply. These maps show that deforestation will increase along the Beira Corridor and the districts of Dondo and Gorongosa, resulting in fuelwood scarcity in these areas under the base line scenario. Evaluation of these results made by the user advisory group confirmed the pattern, giving the strength to the model, under the current circumstances. Projections to 2015 show that the areas indicated above will increase the deforestation and increase the scarcity. The main cause for deforestation is the urban supply rather than the local consumption of fuelwood. Scenarios with small scale, community participation reforestation programs, and reduction on wildfire reduced the rate of deforestation and alleviated the fuelwood demand. Another scenario that reduced the deforestation is the increased availability of alternative sources of energy. These scenarios are provided to help policy makers evaluate options to face deforestation associated with fuelwood use and options to increase fuelwood supply in localities with high deforestation.

At its present version, the model does not perform statistical comparisons, although the output table can be exported to a statistical program for further analysis. It has, however, responded the need to identify localities/districts with high risk of deforestation that can be then guided in view to prepare a strategic response to cope with the short supply of fuelwood for local population. On the base of the model results, district administrators are advised on possible actions that can be possible to address the fuelwood scarcity.

The model does not discriminate the species that will be affected by the process of deforestation, and the resulting consequences, particularly to the local communities dependent on these plant species. The model is also used to drive further research and data collection. Currently, an additional study is underway to identify species reduction or local extinction and the impacts on local community. Another study is underway to develop the numerical analysis submodel to provide the statistical basis for scenario comparison.

Ecosystem photosynthesis and its environmental factors in a tropical seasonal rain forest, Southwest, China

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The environmental controls on the seasonal variations of ecosystem apparent quantum yield (α), maximum photosynthesis rate ($P_{eco,opt}$) and ecosystem respiration ($R_{eco,day}$) were investigated during 2003 to 2006 in a tropical seasonal rain forest ecosystem in southwest China. Interannual differences in the three parameters not apparent, indicating that the forest ecosystem was a continuum during the four years. There were seasonal differences in the three parameters. They were mainly controlled by air temperature (T_a) and vapor pressure deficit (VPD). In the rainy season, the higher ecosystem photosynthesis related to the higher precipitation and warmer air temperature. In the foggy-cool season, fog drip plays an important role in the water relations of plants, so photosynthesis capacity was still higher relatively. In the dry-hot season, ecosystem α and $P_{eco,opt}$ were lower than other seasons. The reason might be response to a hydrologic limitation. Ecosystem α decreased with increasing T_a and VPD. P_{eco} strongly depended on T_a above 20 °C, as well as on VPD above 1KPa.

Keywords: photosynthesis; ecosystem; tropical seasonal rain forest; Xishuangbanna

Long-term effect of fertilizer and manure application on soil carbon sequestration and soil fertility on silt loam soil in northwest China

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Maintenance of soil organic carbon (SOC) is important for the long-term productivity of agroecosystems. An investigation was carried out to study the effects of long-term applications of inorganic fertilizers and farmyard manure (FYM) on soil organic carbon (SOC), N, P and K nutrient contents and water-stable aggregate distribution and aggregate associated C in a field experiment started in 1982 in arid region of northwest China. Application of inorganic fertilizer alone (Treatments N, NP and NPK) did not increase SOC concentrations compared with no fertilizers (CK), but decreased significantly SOC concentration by 18% on an average compared with the initial value at the beginning of the experiment. Especially, imbalanced inorganic fertilizer application (N and NP) resulted in a significant decrease in available P and K nutrients at the 20cm depth. This indicated that long-term applications of inorganic fertilizers were inadequate to maintain the levels of SOC and nutrients under the conventional management associated with no aboveground crop residues returning to the soil. However, long-term application of FYM alone and combined with inorganic fertilizers (Treatments M (FYM), MN, MNPK and MNPK) improved the SOC and total N concentrations from an initial value of 12.1 g kg⁻¹ and 0.76 g kg⁻¹ to 15.46 g kg⁻¹ and 1.28 g kg⁻¹, respectively, on average, and also enhanced available N, P and K concentrations by 47%, 50% and 68%, respectively during 23 years period. The treatments with FYM had a 0.48mm greater averaged mean weight diameter (MWD) of aggregates and a higher percentage of macro-aggregates (>2mm) and small macro-aggregates (2-0.25mm) than the treatments without FYM. The MWD increased with increasing SOC concentration ($R^2=0.75$). The SOC concentration was the highest in small macro-aggregates, intermediate in macro-aggregates and the lowest in micro-aggregates (0.25-0.05mm). 54%-60% of total SOC were stored in micro-aggregates (0.25-0.05mm) and sand+silt fractions (<0.05mm) under the treatments without FYM but 57%-64% of total SOC in macro-aggregates (>0.25mm) under the treatments with FYM. The MNPK treatment showed a greatest effect in improving the levels of SOC and NPK nutrients, and enhancing the formation and stability of macro-aggregates.

Key words: soil organic carbon; aggregates; farmyard manure; inorganic fertilizer; long-term; fertilization experiment

Nitrogen leaching in upland crop system on an acidic soil in subtropical China: lysimeter measurement and simulation

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The effect of rainfall and N input regime on the nitrate leaching in a typical peanut-oil rape rotation on an acidic soil was explored by field lysimeter experiment consisting of twelve 2×2×1.3m drained cells, from 1997 to 2000 in Subtropical China with monsoon climate. Then the nitrate leaching was simulated using the Water and Nitrogen Management Model (WNMM). Annual N losses through leaching were in the range of 21.1-46.3 kg ha⁻¹ for the N input of 0-150 kg N ha⁻¹, which means 9.5–16.8% loss of the input N. The rainfall had an important impact on nitrate leaching. The relative lower NO₃⁻-N concentrations (averaged from 1.95 to 4.33 mg L⁻¹) in the drainage water were caused by low residual soil nitrate which is associated with a low rate of soil nitrification. The total loss of N was higher in the rainy season (March to June) than in the dry season (October to February) because of a greater drainage. Nitrate loss decreased in the dry year (rainfall 17% below average) mainly as a result of reduced drainage. WNMM can predict the inter-monthly variation in drainage and nitrate leaching very well, with a mean r² of 0.924 and 0.906 (n=36) respectively. Predicted annual N losses were only 1 to 7% less than observed. WNMM need to improve the predict on the NO₃-N concentration rise in the dry season by taking into account of the effect of the repeated dry-wet process on nitrogen mineralization. Projection showed a input threshold of 110 kg N ha⁻¹ for preventing excess N leaching in upland crop system in Southern China.

Key words: acidic soil; lysimeter; model; nitrate leaching; peanut-oil rape rotation; subtropical China; WNMM

Dynamic analysis of phytoplankton community characteristics in Daya Bay, China

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Phytoplankton groups in the ocean are the foundation of the marine food chain. The density and component of phytoplankton directly or indirectly determine the primary productivity in the ocean, which are good indicators of changes in their environment. Because of these reasons, the study of phytoplankton is of primary interest to oceanographers and geologists around the world. Daya Bay is a large bay along the southern coast of China. However, the ecological environment of Daya Bay is considerably influenced by human activities. The rapid economic development and the increase in population along the coast have induced that the type of nutrition has changed from oligotrophic level to mesotrophic level and even eutrophic in some parts of Daya Bay; red tide events occurred many times in the waters near the Aotou harbor. Many studies on the phytoplankton involve only a partial ocean area in Daya Bay or only a certain season. To characterize the phytoplankton community, the seasonal spatial-temporal variability of abundance, community structure and diversity of phytoplankton in Daya Bay in 2002 were analyzed. The relationships between phytoplankton and the variation of environmental factors, mainly nutrients, have been discussed.

In the survey, a total of 114 species of phytoplankton were identified including Varietas and Forma. Bacillariophyta (37genera and 84 taxa) were a predominant group. Pyrrophyta was the second most common group with 9 genera and 23 species. Cyanophyceae and Chrysophyta were also recorded within the study area. The density recorded in 2002 ranged from 5.79×10^4 to 5.37×10^6 cells/m³, and the mean was 1.14×10^6 cells/m³. Annual variations of the phytoplankton community in the Daya Bay show a typical one-peak cycle with the highest cell abundance peak being recorded during summer and the lowest recorded during autumn. While diatoms exhibited predominance, dinoflagellates and *Trichodesmium thiebautii* Gom. accounted for more percent of phytoplankton. In 2002, the composition of dominant species was complex in Daya Bay, and there was a succession of species during the season. Compared with the previous data, some dominant species, the sequence of dominance, and cell abundance have changed. The changes in temperature and nutrient concentration may be the primary factors accelerating the progress of the succession of dominant species in Daya Bay. During winter and spring, some oceanic species with large cells, such as *Rhizosolenia calcar-avis* and *Guinardia flaccida*, showed an increase in dominance, whereas during autumn, the dominance of dinoflagellates and *Trichodesmium thiebautii* Gom showed an increase. The spatial distribution of density and community structure of phytoplankton was influenced by the force of monsoon, current, geographical characteristics and human activities. The species diversity in Daya Bay was high; nevertheless, it was lower during summer than that during other seasons, especially the lowest in the area near aquaculture farms in Dapeng Cove. It was revealed that the phytoplankton community was unstable and there was degradation of the ecosystem near the aquaculture farm. It has been demonstrated that the pattern of nutrient (DIN, DIP and N/P) availability and depletion in conjunction with temperature and hydrodynamics affects the composition, abundance, community structure, community succession and diversity of phytoplankton.

Soil Cu and Zn availability and plant uptake as affected by a long-term straw amending with soil

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The availability of micronutrients in the soil can strongly affect the production and quality of crops. As a result of the change of soil basic characteristics, such as pH, organic matter (OM), and nutrients in response to long-term fertilization field experiments, status and behaviors of micronutrients in soil and crop vary with different fertilization practices. This paper investigated the effects of different fertilization treatments on total and DTPA extractable micronutrients in soils and micronutrients in crops after 10 yr amending experiments in Changshu Agroecological Experiment Station, Changshu County, China. The treatments of the long-term study include NPK and different rate of rice and wheat straw. Wheat and Rice were planted annually. Soil micronutrients along with pH, organic matter (OM), total nitrogen (TN), NO_3^- and NH_4^+ , alkaline-decomposable nitrogen (AND), total phosphate (TP), Readily available phosphate (RAP) and total potassium (TK), Readily available potassium (RAK), Slowly available potassium (SAK) were analyzed. Grain yields and above ground biomass of both crops in the final year were harvested and analyzed for Cu, Zn. The results showed that Chemical fertilizer and straw increased wheat and rice grain yield significantly, but there were no significant in the grain yield about the wheat and rice between single and the complex use of chemical fertilizer and straws. Soil Cu, Zn concentrations did not change among the different treatments to a significant level. Cu and Zn concentration in 0-15cm much higher than those in 15-30cm, Cu and Zn did not move in soil profile. The DTPA extractable soil Cu and Zn concentration decreased when chemical fertilizer and straw were used. Soil OM, RAP, RAK, NH_4^+ , and NO_3^- increased, but soil pH decreased when rice and wheat were used as amendment. The regression analysis between DTPA extractable soil Cu, Zn concentrations and Soil OM, RAP, RAK, NH_4^+ , NO_3^- soil pH show that RAP is a very important factor to control Cu and Zn available, increasing RAP decreased soil DTPA extractable soil Cu, Zn concentrations. Dues to the grain yield increased about 3-4 times than that with no amendment. The uptake of Cu and Zn increased significantly, but also there is no different between single and complex amend.

Keywords: long-term fertilization experiment; soil; micronutrient; crop uptake

Background atmosphere monitoring network of CAS

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The background atmosphere monitoring network of CAS observe the greenhouse gas include CH₄, CO₂, N₂O and ozone, research pollution long range transport, acid rain, aerosol and so on. The observed data were provided to scientist to study for that promote our deeply understand the reciprocity between ocean, atmosphere and biosphere, and forecast the future of atmosphere and earth system. All that campaign will make great effect on the environment problems in 21st century.

Form 2003 to 2005, we had made the arduous work in more than two years, (It were delayed and interferenced by the Gulf War and the SARS). All imported instrument and domestic equipment had been integrated, and debugged, calibrated, and the task of the sample central has perfected, including calibrate, regulate and sample analysed and so on, by August 2005. We has already obtained the qualified data from Gongga Mountain for nearly 1.5 years and that from Changbai Mountain for one year, and that from Dinghu Mountain for one year, and that from Xinglong half a year. We have the following phased result already:

1. The concentration of carbon dioxide of the Changbai Mountain is higher than that of the Gongga Mountain in atmosphere overallly, because the average temperature of the whole year of the Gongga Mountain is higher than that of Changbai Mountain, and the artificial emission of CO₂ in Changbai Mountain was stronger than that in Gongga Mountain.
2. The concentration of the methane in the atmosphere in Gongga Mountain is higher than that of Changbai Mountain, because the sunshine time of Gongga Mountain is less than that of Changbai Mountain by nearly one time, and the vegetation type does benefit to detesting oxygen condition even more. The source was stronger, the sink was weaker all that make immediate cause of difference between two areas.
3. The concentration of surface O₃ of the north of China (such as Changbai Mountain, Xinglong, Fukang) were higher than that in south of China (such as Gongga Mountain, Dinghu Mountain) and the highest concentration was in spring in Gongga Mountain, Changbai Mountain and Fukang, in autumn in Dinghu Mountain and in summer in Xinglong.

Key Words: background; atmosphere; monitoring; network

Land use and landscape structure changes at Sakaerat biosphere reserve ILTER

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The Sakaerat Environmental Research Station (SERS) is one of five biosphere reserve in the Thailand. It is located in the northeast of the country, covering approximately 80 km². The goal of this site is to promote long term ecological research (LTER), in addition to demonstrate sustainable forest management and biodiversity conservation according to Man and Biosphere Reserve concept. In the past decade, the government puts a lot of efforts to rehabilitate degraded forest both inside and surrounding the SERS landscape in order to link fragmented forest patches, especially in the core area. However, there is a lack of appropriate methods that allow the measurement of forest fragmentation and predict future changes. The objective of this paper is to quantify land use and landscape structure changes between 1990 and 2002. The study area encompasses the SERS and its buffer zone (420 km²). Land use/land cover maps were visually interpreted into 9 classes using temporal Landsat-TM images. These classes include dry evergreen forest, mixed deciduous forest, dry dipterocarp forest, secondary growth, plantation, grassland, old clearing, agriculture & settlement, and water body. In addition, Geographic Information (GIS) and Fragstats package were used to assess landscape structure and fragmentation indices. The results revealed that dry evergreen forest increased from 115.74 km² in 1990 to 123.05 km² in 2002 (0.51% annually). Dry dipterocarp forest increased from 36.68 km² in 1990 to 41.18 km² in 2002 (0.97% annually). In addition, forest plantation gained roughly three times or increased 193.23% during this period due to significant private and support. If this trend continues, it is expected that dry evergreen forest and forest plantation will be 33.13% and 13.24% of the study area in 2026, respectively. On the other hand, agricultural and settlement areas will decrease from 40.59% to 32.03% (-7.56% in 12 years). However, the highest loss (-75.61%) in the future is old clearing which will be either regenerated to natural forest or rehabilitated for conservation purposes. By comparing landscape structure of three natural forest types, the results of several fragmentation indices derived from Fragstats indicate that the remaining dry evergreen forest are highly aggregated or low fragmentation. The number of patches decreased from 7 to 5 patches and mean patch size increases significantly. However, mixed deciduous forest and dry dipterocarp forest are relatively fragmented but mixed deciduous forest indicates higher fragmentation. Mean patch size area was substantially decreased from 120.48 ha in 1990 to 38.93 ha in 2002 and number of patches increased from 3 patches to 10 patches during 12 years. It is noted that the projection of land use and landscape changes should be improved in next research by integrating socio-economic and biophysical factors that determine the allocation of land use change. These research findings show the benefits of remotely sensed data, GIS and Fragstats for landscape analysis which significantly enhance to effective management of the SERS for sustainable forest management and biodiversity conservation.

Key words: land use; landscape structure; fragstats, Sakaerat Biosphere Reserve

Nitrogen cycling in larch forests on permafrost in central Siberia

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The large organic pools in northern taiga and tundra ecosystems contain about one-third of the world's pool of soil carbon (Oechel and Billings 1992). In these ecosystems, at least 95 % of organically bound plant nutrients are incorporated in the soil pool (Marison et al. 1982). Therefore, plant growth (or NPP) is severely constrained by nutrient availability in high latitude ecosystems; the cold, wet conditions in arctic soils act to slow the release of nutrients (particularly mineral N and P ions) from organic matter and to retard the oxidation of organic carbon to CO₂ (Hobbie et al. 2002). Namely, it resulted that nutrients, including nitrogen, are limiting to plant growth highly critically in these ecosystems (Shaver et al. 1992).

Russian Siberia occupies a large area of arctic and subarctic ecosystems. The total area of Russian Siberia is 13 million km² (Shvidenko and Nilsson 1994) which is about 30% greater than Europe (10 million km² including European Russia, Stanners and Bourdeau 1995) and 12% greater than boreal North America (11.5 million km² of Canada and Alaska). Additionally with 600 vs. 300 million ha of forest, Siberia is much more extensively forested than Europe or boreal North America (500 million ha). It is considered that Russian Siberia is important for the world's pool of soil carbon and plant nutrients are incorporated in the soil pool. Under the global warming it is clearly important to consider C cycling; C stock and vegetative acquisition of C etc., in Russian Siberia. Although it might result in N and/or P limitation for plant growth in the region, there is not enough information about biogeochemistry of forest ecosystems.

The objective of this study is to clarify the N status of Russian Siberia forest. The dominant tree species of central Siberia forest is larch (*Larix gmelinii*) and those larch forests are on the permafrost. In those forest ecosystems soil based plant available N was estimated by in situ measurement of N dynamics, and the annual N requirement by vegetation growth was measured through the summing method. The result showed that available inorganic N was approximately equal to N requirement by larch. In this study it didn't include N requirement by forest floor vegetation, it is indicated that inorganic N is limiting factor of plant growth.

Keywords: nitrogen cycling; permafrost; larch; available N

An application of inverse Lagrangian dispersion analysis method on the calculation of latent and sensible heat flux

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The evaluation of turbulent fluxes of mass and energy between the terrestrial biosphere and atmosphere is needed for a wide range of applications in the fields of atmospheric chemistry, biogeochemistry, climate modeling, ecology, hydrology, micro- and meso-meteorology and plant physiology. Latent and sensible heat flux are main components of energy balance, while latent heat flux, which can be used for the calculation of evapotranspiration, is an important element of the water budget at a catchment or field scale, is a major link between the global energy and hydrological cycles, and its accurate monitoring and estimation is the basis for effective planning, design, and operation of water-resource projects. Quantifying the exchange of latent and sensible heat flux between the biosphere and the atmosphere requires detailed understanding of the interaction between canopy structure and local canopy microclimate. Over the past two decades, a lot of models were developed to represent the complex interactions between the canopy microclimate and the atmosphere. Raupach suggested that Lagrangian transport approaches are better suited than their Eulerian counterpart given their ability to overcome flux-gradient closure model limitation in describing scalar and energy transport within the canopy. Such a conclusion demonstrated that Lagrangian transport approaches were a better choice to estimate the source/sink distribution of Latent and sensible heat and their fluxes within and above the canopy in forest using the microclimate data, and gave a suitable method to study the interaction between canopy structure and local canopy microclimate.

After the 'Localized Near Field' (*LNF*) theory was proposed by Raupach (1988, 1989a, b), Lagrangian transport approaches coupled with the distribution of vertical velocity standard deviation ($\sigma_w(z)$) and Lagrangian integral time scales ($T_L(z)$) within the canopy were used by a number of authors to derive and solve the expressions between source/sink strength and mean concentration profile. All the studies mentioned above reported good agreement between modeled turbulent fluxes and those measured above the canopy. But all the studies depend on the eddy covariance measurement to determine the friction velocity and the atmospheric stability parameter, which limited the method to be used widely. Wang et al. (2005) used the method to simulate the water vapor source/sink strength and evapotranspiration only using the gradient measurement of microclimate parameters, which produced good agreement between modeled evapotranspiration and those measured by the open-path eddy covariance measurement system.

The object of this study is to investigate the inverse Lagrangian dispersion analysis method (IL) developed by Raupach (1988, 1989a, b) for broadleaved Koreanpine forest in Changbai Mountain, China, for estimating both latent heat flux and sensible heat flux from 1 May to 30 Sep 2003, only using the gradient measurement of microclimate parameters. The calculated results are compared with the results measured by the open-path eddy covariance measurement system mounted on the

tower, and LE_t+H estimated by the inverse Lagrangian dispersion analysis method and measured by the open-path eddy covariance measurement system are compared to R_n-G-Q_s to evaluate the results. It showed that the inverse Lagrangian dispersion analysis method overestimated the latent heat flux about 15%, and overestimated the sensible heat flux about 30%, from the comparison. In order to evaluate both inverse Lagrangian dispersion analysis method and eddy covariance method, the summations of latent and sensible heat flux estimated and observed are compared to R_n-G-Q_s , in which R_n is measured net radiation, G is measured the heat flux into the soil surface and Q_s is the estimated storage heat flux within the volume. It can be concluded from the comparison that LE_t+H estimated by the inverse Lagrangian dispersion analysis method was larger about 5% than R_n-G-Q_s , and LE_t+H observed by the eddy covariance method was lower about 25% than R_n-G-Q_s . But the statistical calculations showed that LE_t+H observed by the eddy covariance method had better agreement than that estimated by the inverse Lagrangian dispersion analysis method with R_n-G-Q_s , because the linear correlation coefficients of the eddy covariance method was 0.8553, larger than 0.6462 of the inverse Lagrangian dispersion analysis method.

So, we demonstrated:

(1) The inverse Lagrangian dispersion analysis method, using the gradient measurement of microclimate parameters as the input of the model, produced agreement between modeled and measured sensible and latent heat flux from 1 May to 30 Sep 2003. Based on the linear correlation analysis, IL overestimated the latent heat flux about 15%, and overestimated the sensible heat flux about 30%, compared to the results observed by EC.

(2) Compared to R_n-G-Q_s , LE_t+H observed by EC was lower about 25%, and LE_t+H estimated by IL was larger about 5%. But the statistical calculations showed that LE_t+H observed by EC had better agreement than that estimated by IL with R_n-G-Q_s , because the linear correlation coefficients of EC was 0.8553, larger than 0.6462 of IL.

(3) The weather condition affected both the estimation of latent and sensible heat flux by IL and the observation by EC, and The effect on EC were lower than that on IL. But how and how much the weather affected on the estimation and observation of latent and sensible heat flux were not clear yet, which required further study.

(4) IL is suitable for the long term estimation of latent and sensible heat flux, especially at daytime.

Key words: lagrangian dispersion; source/sink distribution; atmospheric stability; latent heat flux; sensible heat flux

Response of soil enzyme activities to long-term fertilizer systems

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Soil enzymes played an important role in circle of carbon, nitrogen and phosphorus, which were concerned with metabolic processes in soil system. It was important to understand how soil enzyme activities were affected by fertilization because they controlled most biogeochemical processes and ecosystem productivity. Soil enzyme activities were very sensitive to the change of soil fertility. Measures of the soil enzyme activities could be used as an important index for remarking the paddy fertility. Changshu Agroecological Experiment Station of Chinese Ecosystem Research Network in Yangtse River delta was utilized to study effect of different fertilization treatments on soil enzyme activities, and the relationship between soil enzyme activities and soil nutrients by long-term different fertilizer experiments was studied.

The treatments included straw residues treatment, different inorganic fertilizer and organic fertilizer treatments. Urease, invertase, acid phosphatase and alkaline phosphatase activities of 15-30cm layer significantly decreased by 20-50% compared with that of 0-15cm layer. The results were showed that acid phosphatase activity was lower similarly than alkaline phosphatase activities in long-term fertilizer experiments but not in swine manure treatment. Straw residue was rich with nutrient elements for crop growth and it was an excellent natural resource. To utilize straw residues as a nutrient resource, rice-straw returned to the field right after the harvest had been becoming a common way in rice production in Yangtse River delta. Many related field studies showed that the soil quality could be improved by straw residues returned to the field and biological characteristics could be changed. Enzyme soil activities through a 16 year straw residues experiment were detected and analyzed. The straw residues experiment treatments included fertilizer only (NPK), straw residues incorporation with fertilizer (NPK+S) and a control (nothing added). The results showed that the way of different fertilization influenced soil enzyme activities significantly ($P < 0.05$), which of urease, invertase and acid phosphatase for NPK treatment increased by 108.7%, 170.2% and 58.0% respectively, compared with a control. Returning of corn straw into field was helpful to increase soil urease and invertase activity mainly. Similar results were obtained that urease, invertase and acid phosphatase activity for NPK+S treatment increased by 30.7%, 85.5% and 25.8% respectively, compared with the NPK treatment. The correlations between soil activities of urease, invertase and alkaline phosphatase were significant ($P < 0.01$). The study showed that soil activities of urease, invertase and alkaline phosphatase were significantly correlated with available P (The correlation coefficients were 0.884, 0.846 and 0.824 respectively, $P < 0.01$). The correlation coefficients between three kinds of enzyme activities and crop yield were 0.845, 0.812 and 0.824 respectively ($P < 0.01$), and this correlation was better than that between crop yield and soil nutrients.

Different inorganic and organic fertilizer treatments included swine manure only (M), different NPK level, swine manure combined with inorganic fertilizer (NPK+M) and a control (CK). The

results showed that under the condition of fertilization, the main soil nutrient contents were increased, and urease, invertase activities varied remarkably. The activities of urease, invertase and alkaline phosphatase in swine manure incorporation with inorganic fertilizer treatment is higher than that in chemical fertilizer treatment single, without fertilizer treatment, and low organic fertilizer treatment, Urease activity was in order of: CK < no N treatment < no K treatment < no P treatment < high P treatment < swine manure only < high K treatment < high N treatment < NPK+M. Urease activity increased with nitrogen fertilizer treatment and reached its peak on high N treatment. Under swine manure combined with inorganic fertilizer and high N treatment conditions, urease activity was significantly higher than that under the control and no N treatment, and there was significantly difference between high N treatment and no N control ($P < 0.01$). Urease activity could be used as an indicator for nitrogen levels. Invertase activity for NPK+M treatment increased by 48.4% and 224%, compared with the normal NPK fertilization and the control. Invertase activity was in order of: CK < no P treatment < high P treatment < high K treatment < no N treatment < swine manure only < high N treatment < NPK +M. Invertase activity for swine manure combined with chemical fertilizers treatment was much higher ($P < 0.01$) than all the other treatments including the control, and there was significantly difference between NPK treatment only and the control ($P < 0.01$). But there was no significantly difference between NPK treatment only and other treatments. Compared with the control treatment, swine manure combined with inorganic fertilizers could increase the quantity of available N and total P, K. The study showed that under the swine manure experiment condition, The $\text{NO}_3\text{-N}$ was the only soil nutrient which was well correlated to soil activities of urease, invertase and alkaline phosphatase. However, there were no correlation in available P and any soil enzyme activity. The correlation coefficients between urease and invertase activities and crop yield were 0.515 ($P < 0.05$) and 0.714 ($P < 0.01$) respectively, while there was no close relationship between crop yield and soil nutrients under swine manure experiment. The results indicated that soil urease, invertase activities could be considered as a kind of biological indicators of paddy fertility quality in Yangtse River delta. Soil enzyme activity responded more quickly to changes in fertilization management than did soil nutrients. In future, the study should focus on the soil enzymes responding to the effect of different fertilization treatments, soil degradation and environmental changes.

Key words: soil enzyme activities; soil nutrients; long-term experiment; fertilization

Long-term effect of chemical fertilizer, straw and manure on labile organic matter fractions in a paddy soil

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Labile organic matter fractions have been suggested as early indicators of soil quality because they respond rapidly to changes in soil management practices. In order to assess the effect of long-term (from October 1980 to June 2005) fertilization on labile organic matter fractions, we analyzed C and N mineralization and C and N content in soil, particulate organic matter (POM), light fraction organic matter (LFOM) and microbial biomass. The experiment included eight treatments: Control, N (fertilizer N), PK + N (fertilizer PK plus fertilizer N), straw + N (rice straw plus fertilizer N), manure (farmyard manure), manure + N (farmyard manure plus fertilizer N), manure + PK + N (farmyard manure plus fertilizer NPK) and manure + straw + N (an integration of farmyard manure, rice straw and fertilizer N). Results showed that even the soil from the control treatment contained more 10.5% N and 27.4% C than the original soil (in 1980). Fertilizer N decreased or did not affect the C and N amounts in soil fractions, except that N mineralization and soil total N. The C and N amounts in soil and its fractions increased with the application of fertilizer PK and rice straw. Generally, there was no significant difference between fertilizer PK and rice straw. Furthermore, application of manure was most effective in maintaining soil organic matter and labile organic matter fractions. Soils treated with manure alone had highest microbial biomass C and C and N mineralization. A significant correlation was observed between C content and N content in soil, POM, LFOM, microbial biomass, or the readily mineralized organic matter. The amounts of POM-N, LFOM-N, POM-C and LFOM-C closely correlated with soil organic C or total N content. Microbial biomass N was closely related to the amounts of POM-N, LFOM-N, POM-C and LFOM-C, while microbial biomass C was closely related to the amounts of POM-N, POM-C and soil total N. These results suggested that microbial biomass C and N closely correlated with POM rather than SOM. Carbon mineralization was closely related to the amounts of POM-N, POM-C, microbial biomass C, and soil organic C, but no significant correlation was detected between N mineralization with C or N amounts in soil and its fractions. Correlation analysis showed that there was no significant correlation between the yields of rice and the C or N contents of SOM and its fractions. However, the yields of rice were closely related to the C/N ratios of SOM, POM and LFOM. This suggested that the C/N ratios of SOM, POM and LFOM could be a good indicator of changes of rice yields due to fertilization treatments. Since the increase of labile organic matter fractions indicates the future increase of SOM, application of chemical fertilizer, rice straw and manure should be promoted in the region, guided by the levels of CFOM and LFOM.

Keywords: crop residues; density fractionation; particle size fractionation; rice-wheat system; carbon dioxide

Environmental effects on recharge groundwater with the Yellow River supplementary in Shangqiu Region

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The irrigation with the Yellow River supplementary began to be stable development in winter season from 1992; the annual water diversion volume has been about 30 million cubic meters to Shangqiu region. the total area of 565km² are including three types, namely Zhengge diversion rechargeable zone (it is belonging to micro-tilt lowland of elder-yellow-river-back, the observed zone is 16.74 km² where is located 19 holes observed groundwater table), Lizhuang dynamic observed zone combining of different aquifer (it is belonging to new Orleans fan-shaped land and the observed zone is 5.76 km² where are eight groups composed of 12 holes, each group consists of one deep hole and one shallow hole, the depth of deep hole is from 28 to 30 meters, the shallow hole is between 14 and 16 meters, the hole diameter is 100 mm, the underground water table is observed every five days), Shenji diversion rechargeable zone (it is belonging to the upper-beach heavy clay soil and the observed zone is 11.25 km²), a series of observation time is 20 years (from 1986 to 2005).The mainly results are as followings.

Annual dynamic characteristic of groundwater regime is that there is a trough and peak alternatively. The trough mostly appeared in the end of June or early July when water is demanded to surge after sowing summer corn or transplanting cotton, the peak takes shape usually in the end of January or early February (there is rarely winter irrigation in the observed zone). After the Yellow River supplementary, the trough timed later than that did in the same weather year and groundwater table shifted lightly. Trough appeared in early August and it lagged a month in 1996 than that did in 1986 before the Yellow River supplementary, the lowest water depth was lower 1.11m in 1987 than that did in normal water depth, but the bottom water depth was lower 0.83 m in 1996 than that did in normal water level, water depth picked up 0.27m, 10 years later it rose up to 0.21 m in early 2005. Therefore the underground water table with the Yellow River supplementary has gone up again obviously. (2) Changes of the buried depth groundwater table between years showed that the deeper depth area recharged with Yellow River supplementary has decreased, but the higher increased. The area of groundwater table less than 6m was of 46.05 km² occupied the total area 8.15% in June 1995, but it increased 26.84 km² and come to 72.89 km² accounting for observing the total land area of 12.9% in June 1996. the area of groundwater table about 9m depth was of 171.7 km² and accounted 30.39% of the total area in June 1995, but it decreased 93.85 km² and fell to 77.85 km² in June 1996 accounting 13.78% of the total. In 1997 and 1999, rainfall was respectively 438.4mm and 487.1mm, the general decline of the groundwater table was dropped sharply, but the rate of decline was slower than it did before the Yellow River supplementary. The downward trend of groundwater table was reversed. Typical observed hole (No.45) showed that groundwater table was 50.76 m in 1986 and dropped to 48.32m in 1992, the water table was down 2.44m in six years, the average decline was 0.4 m

annually; after the Yellow River supplementary, the groundwater table was from 48.32m in 1992 fell to 46.83m in 2005, it was down 1.49m in 14 years and declined 0.1 m annually. In the area of no-recharge with the Yellow River supplementary the groundwater table was from 48.62m in 1986 to 39.19m in early 2005 at No. 23 observed hole continuously, it dropped by 9.43m among 19 years, annual declined 0.5m. (3) Shallow groundwater aquifer is submitted "dual structure" the characteristic of lower layer is a stable sedimentary sand aquifer; aeration zone is consisting of sub-sandy and silt layered and thinned. Groundwater aquifer shows that there is a different stage between the upper aquifer and the lower aquifer, the lower aquifer is characteristic by micro-confined water compressions. In the early pumping, the upper aquifer dewatering lags in the lower aquifer water table, with the pumping time the upper draining speed will gradually catch up with the lower aquifer decline rate of water table. The correlation between the deep aquifer and the shallow aquifer is of 0.96 closely linked, it is instructive not only for developing and using shallow groundwater resources but also for rationally defining the depth and spacing stratified water. (4) Dynamic effects on soil salinity after recharged with the Yellow River water are significant, soil salinity decreased obviously, it dropped to 3% at the most; In addition, as long-term recharge groundwater with Yellow River, soil salinity moved down to deep layer and mainly concentrated in 1.00 - 1.60m under soil surface to be favorable to crop growth. (5) Monitoring of groundwater quality shows the sample has also being changed. There were four water chemistry types of shallow groundwater classified by Shuck Lev in the region recharged with the Yellow River water, they are called $\text{HCO}_3\text{---Na} + \text{K} \cdot \text{Mg}$ (mainly distributed in the ancient Yellow River and in the high-tilt sector), $\text{HCO}_3\text{---Na} + \text{K} \cdot \text{Mg} \cdot \text{Ca}$ (mainly in micro-tilt sector and the eastern lowland) and $\text{HCO}_3 \cdot \text{Cl---Na} + \text{K} \cdot \text{Mg}$, $\text{HCO}_3 \cdot \text{Cl} \cdot \text{SO}_4\text{---Na} + \text{K} \cdot \text{Mg}$ (mainly in micro-tilt sector western lowland) types, the salty was less than 2,000 mg / l. two types of $\text{HCO}_3 \cdot \text{Cl---Na} + \text{K}$ and $\text{Mg HCO}_3 \cdot \text{Cl S O}_4\text{---Na} + \text{K} \cdot \text{Mg}$ appeared after recharged with the Yellow River water, but there was a relatively large amount of Cl^- among 1000-2000mg / l, Cl^- concentration reached to 360.3 mg / l (No.17 water sample) and to 233.1 mg / l (No.19 water sample) in dry season; Nearly 1 / 3 water samples contented large amount of SO_4^{2-} , especially the concentration of SO_4^{2-} in No.19 water sample reached to 359.4 mg / l (in June,1999) and represented 24% of the ion; concentration of SO_4^{2-} was of 243.7 mg / l (June,1999, No.17 water sample) and represented 24.4% of the total ion. The well's groundwater was not directly used to drink according to the groundwater quality standards (GB / T 14843-93) in No.17 and No.19. (6) Shallow groundwater salinity has been obviously decreased after recharged with the Yellow River water (in June) than that did before recharged with Yellow River water (in November), it is a vital role to recharge groundwater with the Yellow River for improving shallow groundwater quality.

Key words: environmental effects; recharge groundwater with the Yellow River supplementary; buried depth groundwater table; groundwater quality.

Effect of long-term fertilization on paddy soil quality in subtropical China

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Soil quality has emerged as the central concept for examining and integrating relationships and functions among various biological, chemical and physical parameters of soils. Soil quality is important in the context of sustainable land use and management. Paddy soil is anthropic hydromorphic soil, and its evolution and formation are affected greatly by fertilization. Subtropical region is the major distribution area of Chinese paddy soil resource. However, due to irrational fertilization practices, such as long-term application of exclusively chemical fertilizer, paddy soils in the subtropical region are undergoing degradation of fertility and environmental quality, which negatively compact local agricultural sustainable development. The objectives of this study were to investigate the effect of long-term fertilization on paddy soil fertility quality and environmental quality, to discuss the processes and mechanisms of evolution of paddy soil quality in subtropical China, and to compare the responses of different soil quality indexes to those processes and their relationship between the indexes, aiming to provide scientific and practical guidance for rational nutrient management for paddy soils in subtropical China.

Field experiments were conducted at eight long-term located paddy experiments in Subtropical China. Started in 1987 on the sandy, loamy and clay paddy soils, these experiments compared the effect of long-term application of chemical fertilizers or farmyard manure on soil fertility and productivity. Treatments included: (i) no fertilizers or manure(CK); (ii) chemical fertilizers only(CF); (iii) combination of 70% chemical fertilizers with 30% farmyard manure(CM30); (iv) combination of 40% chemical fertilizers with 60% farmyard manure(CM60). Soil samples were collected at the depth of 0~20cm after late-rice harvested in 2004. Various soil quality indicators were determined, which included soil bulk density, porosity, aggregate content, pH, cation exchange capacity (CEC), nutrient content, total- and available-contents of Zn, Cu, Cd and Pb, total organic carbon(TOC) and active organic matter(hot-water extractable Carbon, *abbr.* HWC), etc.. Grain yield data were also collected from 1987 to 2005. The main results were summarized as follows:

(1) Long-term combination of chemical fertilizers and farmyard manure significantly improved soil structure and chemical properties. Combination of fertilizers and manure(CM30 or CM60) decreased bulk density and increased porosity, macro-aggregate content and its water stability, and improved the structural maintenance of micro-aggregate. Soil acid-base properties were modulated and kept tiny acidity to suit for growth of rice, and soil CEC increased in soils with combination of fertilizers and manure(CM30 or CM60). Chemical fertilizers only(CF) had a little influence on soil structure and chemical properties.

(2) Long-term combination of chemical fertilizers and farmyard manure clearly increased soil nutrient content and its availability. Soil total N, P contents and their availability declined obviously under CK treatment, and kept their balance under CF treatment, but increased significantly under CM30 or CM60 treatment. A most increase was under CM60 treatment, at a

rate of 33.5%, 65.1% respectively for total N and P, and at a rate of 30.4% and 96.2% respectively for available N and P, compared with CK treatment. However, soil K cool declined over time under all treatments, and a least decrease was under CM60 treatment.

(3) There was a bigger risk for paddy soils to be polluted by heavy metals under the treatment with long-term combination of chemical fertilizers and farmyard manure. Little change happened on the contents of total and available Zn, Cu, Cd, Pb and their activity under CF treatment. But total and available Zn, Cu, Cd contents and their activity significantly ascended under CM30 or CM60 treatment. A most increase was under CM60 treatment, at a rate of 6.1%, 18.7%, 8.3% respectively for total Zn, Cu, Cd contents, at a rate of 87.3%, 65.8%, 41.4% respectively for available Zn, Cu, Cd contents, and at a rate of 77.5%, 32.0%, 29.8% respectively for activity of Zn, Cu, Cd, compared with CK treatment. This increase was mainly caused by “activation” effect of farmyard manure. In addition, soil total Cd content overtopped Soil Environmental Quality Standard II (0.30 mg/kg) in all experiment sites, indicating that there was possibly prevalent Cd pollution in subtropical China.

(4) The contents of soil organic matter and its active part ascended significantly under CM30 or CM60 treatment, but little change happened under CF treatment. A most increase was under CM60 treatment, at a rate of 43.2% and 75.1% respectively for TOC and HWC, compared with CK treatment. Higher proportion of N existed in active organic matter than one in soil total C cool, and CM30 or CM60 treatment decreased the ratio of C to N in active organic matter, and thus made soil available N content increase. CF treatment had little influence on the ratio of C to N. TOC content linearly increased over time, but HWC content firstly decreased quickly, and then ascended slowly or leveled off over time, trends of which could be better described by quadratic equation. Compared with CF treatment, CM30 or CM60 had more influence on the trends of TOC and HWC, and it quickened the accumulation rate of TOC and made the decrease rate of HWC slow down.

(5) Long-term fertilization not only affected yield level, but also yield trend over time in paddy fields of subtropical China. Grain yield increased significantly at a rate of 80.2%, 94.1%, 93.3% respectively for CF, CM30 and CM60 treatment, compared with CK treatment. There were prevalent decline trends of early-rice yield under all treatments, and a significant decline under CK treatment ($P < 0.01$) and CF treatments ($P < 0.05$), respectively at a rate of -0.05t/ha per year and -0.02t/ha per year. As to late-rice yield, decline trends were also under almost treatments except CM60, and a significant decline under CK treatment ($P < 0.05$). The order of magnitude for yield decline trends was under all treatments as follows: CK≈NPK>CM30>CM60, which showed that long-term combination of chemical fertilizers and farmyard manure sustained the productivity of paddy fields a certain extent. The decline of soil fertility and higher initial yield were main reasons for the decline trend under CK or CF treatment.

(6) The contents of soil organic matter and its active fraction were related closely with the indexes of paddy soil fertility quality and environmental quality. HWC could reflect the change of soil quality exactly and was a better index to assess soil quality than TOC.

Key words: soil quality; long-term fertilization; paddy soil; hot-water extractable carbon; subtropical China

Free-air temperature enhancement (FATE) experiment in Qinghai-Tibet Plateau

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Atmospheric CO₂ concentrations are increasing and Earth is warming globally (IPCC, 2001). Many experiments have employed various types of controlled-environment chambers to study the effects of elevated CO₂ and/or temperature on plant carbon exchange and growth, but conditions are so unnatural that quantitative extrapolation to the field condition is questionable. Lack of confidence in the chamber approach stimulated the development of free-air CO₂ enrichment (FACE) technology to study the effects of elevated CO₂ (e.g., Hendrey, 1993). Analogous means to elevate temperature under field conditions remains problematic. As reviewed by Kimball (2005), Harte and colleagues (Harte and Shaw, 1995; Harte *et al.*, 1995) apparently were the first to utilize infrared heaters, and their experiment on Montane vegetation is continuing. They and several subsequent researchers used the heaters in a constant power mode, which resulted in large heating under calm nighttime conditions but little warming under unstable daytime conditions (Kimball, 2005). In contrast, Nijs *et al.* (1996) and Kimball (2005) devised controllers to modulate the heat output in order to maintain a constant canopy temperature rise compared to un-heated reference plots, a strategy which enables more controlled warming under both daytime and night conditions. Herein, we first time demonstrate the successful performance of the FATE (free-air temperature enhancement) systems deployed in alpine meadow of Haibei, Qinghai-Tibet plateau, China.

In May, 2006 eight hexagonal arrays of Mor FTE (1000W, 240V) infrared heaters like that in Fig. 1 were deployed over grass that had previously been heavily grazed by sheep during cool seasons from October to May of next year at the Haibei Alpine Meadow Ecosystem Research Station, Qinghai, China (latitude 37° 37' N, longitude 101° 12' E) along with eight dummy arrays over reference plots. The station lies in the northeast of Tibet in a large valley surrounded by the Qilian Mountains. The average altitude is 2900-3500 m for the valley area. The station experiences a typical plateau continental climate which is dominated by the southeast monsoon in summer and high pressure from Siberia in winter. Summers are short and cool summer and winters are long and severely cold. The annual average air temperature is -1.7 °C with maximum of 27.6 °C and minimum of -37.1 °C. The annual precipitation ranges from 426 mm to 860 mm, 80% of which falls in the growing season from May to September.

Two factors (warming and grazing) with 4 treatments were designed and 16 plots were completed randomly block distribution in the field. Canopy temperatures were sensed using infrared thermometers (Model IRT-P5, Apogee Instruments, Logan, Utah, USA), with generic calibrations. The heaters were controlled using the PID control system devised by Kimball (2005). The

dataloggers were Model CR1000, Campbell Scientific, Logan, Utah, USA with AM25T multiplexor. The setpoint difference between heated and corresponding reference plots was 1.2°C during daytime and 1.7°C at night in summer. The canopy temperature was scanned by the sensors every second and all data were averaged per 15 minutes. Air-temperature and moisture, soil temperature (0-5-10-20-40 cm) (measured by type T thermocouples) and moisture (10-20-30-40 cm) (measured by buriable three-prong Time Domain Reflectometer (TDR)) were collected at the same time. Fluxes of greenhouse gases (CO₂, CH₄ and N₂O) were measured at the intervals of one week from June 1 to September 20. Above- and below-ground (0-30 cm) biomass was collected on August 20.

Because grazing just did once on August 16 in 2006 and there was no significant difference between grazing and no-grazing treatments, the results showed here the effects of warming treatment. Here we first successfully simulated different elevated vegetation canopy temperatures during daytime (average 1.18°C) and at nighttime (average 1.68°C) which closely reached our set points of 1.2°C during daytime and 1.7°C at nighttime using free-air temperature enhancement (FATE) of infrared radiation heaters with a controlled feedback system in the Qinghai-Tibet plateau. FATE system did not affect significantly daily air temperature and relative air humidity in the growing seasons, whereas it increased daily maximum air temperature by 0.5°C which caused the increase of the diurnal air temperature range by 0.6°C. Average values of soil temperature of 0, 5, 10, 20 and 40 cm significant increased by 1.3~1.5°C (0~20 cm) and 0.5°C (40 cm), but warming did not affect significantly average soil moisture content at the different time scales (hourly, daily, monthly and seasonal) although it decreased approximately by 3~13% of relative value of soil moisture content from 10~40 cm on the volumetric basis. Therefore, FATE system completely simulates the global warming patterns and here different result from that predicted by GCMs was found in the diurnal air temperature range which was the same with reports of OTC.

Key words: FATE; micro-climate; alpine meadow ecosystem

Nitrogen loss through overland flow and subsurface flow from Slope Cropland in Purple Soil

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Nitrogen is the most important nutrient which could influence crop growth. But, a lot of environmental pollutions could be led by it, such as surface water eutrophication and groundwater nitrate pollution.

Field experiments and observation in runoff plot with function of overland flow and subsurface flow monitoring had been conducted to study nitrogen loss process through runoff from slope cropland of purple soil from 2004 to 2006. Objectives of this research were to analyse nitrogen loss process, so as to find out the approach and flux of nitrogen loss. Nitrogen concentration and runoff (overland flow and subsurface flow) flux were measured at every rain events. Results and conclusions were listed as follows: (1) Rainfall is the main driving force of nitrogen loss by forming runoff from the slope cropland in purple soil. Overland flow flux was 77.54mm which was abundant accounted for 41.75% of total runoff (overland flow and subsurface flow). But subsurface flow flux was 108.19mm which was abundant accounted for 58.25% of total runoff in the slope cropland (with slope degree of 7°) in this region. It could be concluded that subsurface flow was the main form of runoff in slope cropland of purple soil. (2) Particle-N absorbed by sediment was abundant accounted for 58.47% of total nitrogen in overland flow of slope cropland. And Nitrate-N was abundant accounted for 87.81% of total nitrogen in subsurface flow of slope cropland. So, it could be concluded that Particle-N was the main form of nitrogen loss through overland flow from slope cropland in purple soil. And Nitrate-N was the main form of nitrogen loss through subsurface flow from slope cropland in purple soil. (3) The nitrogen leaching flux through subsurface flow from slope cropland (with slope degree of 7°) is 34.41 kg N/hm².a at usual N fertilization rate. But the nitrogen loss flux through overland flow is only 2.60 kg/hm².a. So, it could be concluded that nitrogen loss through subsurface flow is the main approach of nitrogen loss through runoff from slope cropland in purple soil.

Results of this research could be useful for local chemical fertilizer management and offsite water environment protection of upper reaches of Yangtze River.

Keywords: purple soil; overland flow; subsurface flow; nitrogen loss; slope cropland

Soil heterotrophic respiration in a mixed plantation: seasonal dynamics and contributions

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Forest soil respiration is the sum of heterotrophic (microbes, soil fauna) and autotrophic (root) respiration. The contribution of each group needs to be understood to evaluate implications of environmental change on soil carbon cycling and sequestration. In order to investigate the annual variation of seasonal fluxes of CO₂ from soil and the contribution of heterotrophic respiration (H_R) to total soil respiration (S_R) in relation to seasonal changes of soil temperature and soil moisture in a mixed stand of alder (*Alnus cremastogyne*) and cypress (*Cupressus funebris*) in hilly areas of the central Sichuan Basin, China, we set up a series of experimental treatments in May 2004 where litter (no litter), roots (no roots, by trenching) or both were excluded from plots. Subsequently, we measured soil temperature and soil moisture in each subplot over two years. The treatments did not significantly affect soil temperature or soil moisture measured over 0-10cm depth. Both respirations of root-free soils (R_{RF}) and litter layer (R_L) showed a similar seasonal pattern with one single peak, which varied markedly during the year with high rates in summer and low rates in winter. Very high respiration rates were observed during the summer immediately after rainfall events. The maximum values of R_{RF} and R_L occurred during May to June and July to August, respectively. The minimum value of R_{RF} and R_L both occurred during January to February. The mean annual rate of R_L was 29.94 mg m⁻² h⁻¹ with the range of 1.99 to 79.54 mg m⁻² h⁻¹ and R_{RF} averaged 87.25 mg m⁻² h⁻¹ ranging from 22.50 to 204.09 mg m⁻² h⁻¹. The model $R = ae^{bT}W^c$ (R stands for soil CO₂ efflux, *T* for soil temperature and *W* for soil water content at 0~10 cm soil depth, and *a*, *b*, *c* for the constants) indicated that soil temperature and soil water content together could explain 79%~82% and 86%~91% of R_L and R_{RF}, respectively. R_L was more sensitive to variation in soil temperature and humidity than R_{RF}. Annual H_R was 2976.57 kg C·ha⁻¹·a⁻¹ in 2005, and 2622.98 kg C·ha⁻¹·a⁻¹ in 2006. The contribution of H_R to total soil respiration in 2005 and 2006 was 58.32%, 56.03%, respectively, with the average of 40.84%. And the contributions of R_L and R_{RF} were 14.62%, 40.84%, respectively.

Keywords: plantation forest; total soil respiration; heterotrophic respiration; soil temperature; soil moisture

Measurement of greenhouse gases in CERN stations

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The issue of global climate change has raised concern of the whole world. Scientists generally agree that the climate change will be affected by the increase in concentration of atmospheric greenhouse gases such as carbon dioxide, methane and nitrous oxide. Having an insight of Carbon cycle not only give basic knowledge of understanding and control of the global climate change, but also concern with other natural process (water cycle, nutrient cycle etc.) , human environment and social development. To further understand the problem, it is necessary to examine the carbon budget, that is, the inventory of carbon in the oceans, atmosphere and the terrene as well as the exchange between these major carbon reservoirs. As a country noted for its six typical ecosystems of forest, grassland, farmland, wetland, fresh water and marginal sea, China is an ideal experimental platform for the studies of global carbon budget. The work is most likely to make academic breakthroughs and greatly contribute to the global change studies. With the development of economy, China has been one of the world's major producers of carbon dioxide and other greenhouse gases, but is not obliged to reduce its emissions under the Kyoto Protocol. But recent data of IEA shows, China will be the largest producer of greenhouse gases instead of USA in year 2010 due to fast rate of economic development with high energy consume. For China, it is inevitable to shoulder its share of responsibility in fighting global warming in the coming years. It is urgent to got greenhouse gases flux data from terrestrial ecosystems for Chinese scientists, or else they can not provide countermeasures for greenhouse gases fixation and reduction which will disbennift China in environmental diplomatic negotiation.

Supported by the Knowledge Innovation Program of the Chinese Academy of Sciences (CAS) "Study on Carbon budget in Terrestrial and Marginal Sea Ecosystems of China (CBTSEC, KZCX1-SW-01)", ChinaFLUX is built in from 2001 to 2005. Now, ChinaFLUX consists of eight sites which apply micrometeorological method and sixteen sites that apply chamber/chromatography method. The sixteen sites which use chamber observational method cover all of the main ecosystems of China, includes six agroecosystem, four forests, two grasslands, two freshwater lakes and two wetlands, mainly measure the output of CO₂, CH₄ and N₂O in ecosystem. Based on carbon dioxide data of twelve sites from 2002-2005, we got primary attribution of CO₂ efflux in China typical ecosystems (as fig 1 shows) and main control elements (fig2 and fig 3). CO₂ efflux enhanced with the decrease of site latitude and increase of annual precipitation, it also positively correlated with the annual average soil temperature except three sites with abundant organic carbon.

CERN-CAS also carries out long-time observation of greenhouse gases under urban background. Concentrations of greenhouse gases from 1992 to 2003 in Beijing show that the average concentrations of CO₂, CH₄ and N₂O are 399 ppm, 1921 ppb and 320 ppb, respectively. And these concentrations are higher than global background stations Valiguan and Cape Kumukahi about 35 ppm, 128ppb and 5ppb, respectively. The increase curves of greenhouse gases of Beijing are similar with the curves of global background.

Spatial structure analysis of urban green space based on high-resolution RS image: a case study of Beijing

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Urban green space is an essential part of urban land use. It serves as a subsystem of urban ecosystem. Landscape analysis of urban green spaces is one of the most important study areas in the urban ecosystem. Remote sensing, as a comprehensive earth observing technology, with good capability of high efficiency, wide coverage and dynamic, could be a good supplement to the traditional survey. Especially the application of high-resolution images makes it possible to extract the green space information in a wide coverage and high precision.

Many scholars in China have done meaningful work in this area. Hou Biqing (2007) interpreted the QuickBird Image manually to analyze the green space system in Zhuzhou City. Wu Lijuan(2007) utilized SPOT Pan/Multi data and produced the green space information manually. However, the manual interpretation of remote sensing images is time-and-labor consuming, thus hardly meets the needs of rapid survey of urban green spaces.

To solve the problem, this paper utilizes a QuickBird multi-band image, and extracts the green space by computation of Vegetation Index. Based on the theory of landscape ecology, the grades, distribution and spatial structure of the green spaces in Beijing urban area are measured with the aid of GIS. An integrated evaluation of the urban green spaces along the city gradient is also carried out. The indexes in the evaluation include average area, density, perimeter-area fraction, and edge density.

The analysis show that green space within the 5th ring covers an area of 31903974.93m², which is 10.14% of the total area. 43% of the total areas is made up of large patches, whose areas are more than 1 0000m². The patch density is 1410 ones per km², edge density is 158.68 m per hm². The urban green space structure shows regular difference with the urban gradient. Overall, it manifests that with increasing human activity disturbance, accelerating landscape fragmentation and growing the edge density.

The results show that this method is more fast and convenient, and of high precision. The extracted green space information is as precise enough as to aid the green space system plan based on each street office, thus has practical meaning.

Long-term changes of the ecological environment in Daya Bay from 1982 to 2004

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The study analyzed the data collected from 12 marine monitoring stations in Daya Bay, China, from 1982 to 2004. The average ratio of N/P increased from 1.377 in 1985 to 49.09 in 2004, the limiting factor of nutrients in Daya Bay changed from N to P from 1985 to 2004. Annual mean values of chlorophyll *a* were 1.83-3.78 mg m⁻³ in different seasons at 1985-2004. The species of phytoplankton changed from 159 species of 46 genera in 1982 to 126 species of 44 genera in 2004. Main species of the zooplankton of Daya Bay changed from 46 species of 1983 to 36 species of 2004. 328 species of fish have been captured in the survey since 1985. The main fish species of Daya Bay changed from 20 to 28 from 1985 to 2004, and the mean individual weights of the fish decreased from 14.60 g tail⁻¹ in 1985 to 10.80 g tail⁻¹ in 2004. More than 700 species of benthos were found, the annual mean biomasses of benthic animals increased from 72.40 g m⁻² in 1996 to 126.68 g m⁻² in 2004. The mean biomasses and species of benthic animals near the Nuclear Power Plants decreased from 317.9 g m⁻² in 1991 to 45.24 g m⁻² in 2004 and from 250 species in 1991 to 177 species in 2004, the temperature value increased about 1 °C compared with the other sea areas in Daya Bay. There were formerly at least 18 hermatypic coral species of Daya Bay in 1984, accounting for 76.4% cover from Xiaolajia and Dalajia to the mouth of Daya Bay. 12 species and 16 species were found accounting for 32% and 36% of total cover in 1991 and 2002, and the dominant species *Acropora pruinosa* in 1983 was replaced by *Platygyra daedalea* in 2002. There were 13 species of 13 families mangrove plants in Daya Bay, which covered about 60-90% in the 1950s, and now only cover 4% in some areas along the Daya Bay coast. The dominant species were *Kandelia candel*, *Bruguiera gymnorrhiza*, *Aegiceras corniculatum* and *Avicennia marina*. At the same time, *Ceriops tagal*, *Lumnitzera eacemosa* and *Rhizophora stylosa* have gradually being disappeared. All results indicate that the ecosystem of Daya Bay in some areas and in some aspects is undergoing a rapid deterioration.

Keywords: Daya Bay (DYB); ecological environment; marine biological resources; coastal protection

Methane and nitrous oxide emissions from wheat straw addition paddy fields

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Paddy rice was grown in the kharif season (June-September) under waterlogged condition in hilly area of the central Sichuan basin, China (31°16' N and 105°27' E). Methane (CH₄) and nitrous Oxide (N₂O) emissions as influenced by wheat straw addition were monitored through static chamber/gas-chromatography techniques. Results showed with the increase of straw amount addition, mean CH₄ flux increased and mean N₂O flux decreased, at a rate of straw amount addition ($\geq 10620\text{kg}\cdot\text{hm}^{-2}$), CH₄ and N₂O fluxes began to vary significantly compared to that of the control ($P < 0.05$). In the same fertilizer nitrogen application level ($150\text{kg N}\cdot\text{hm}^{-2}$), with the increase of straw amount addition, grain yield increased. It seems like that over the whole measurement period the variations of N₂O fluxes did not appear to be related to plant biomass, N₂O fluxes and floodwater depths showed evidently negative correlations, whereas, CH₄ fluxes were significantly related to the 5cm subsoil temperature and biomass.

Key words: Methane and nitrous Oxide; flux; wheat straw addition; paddy field

Comparative studies on different determining methods of underground biomass in grassland ecosystems

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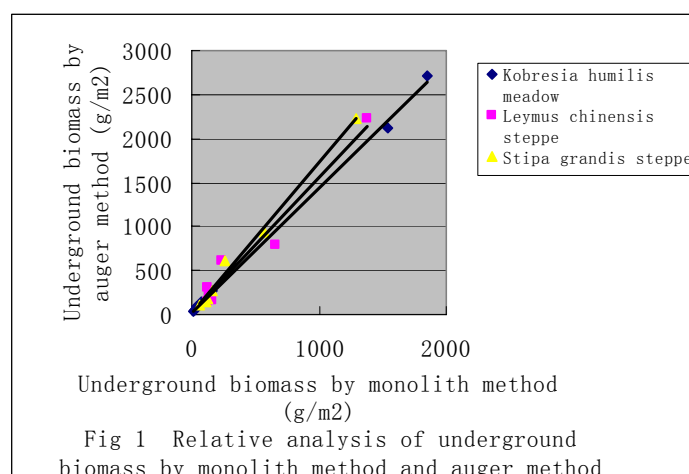
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Underground biomass plays an important role in the community productivity and soil carbon pool. However, root research has been greatly restricted due to technical and operational reasons. For a long time, monolith method is generally used in the observation of grass underground biomass. However, the method has a high cost in time and labor, and often results in serious damage to the sampling fields. Moreover, due to lack of uniform operating standards, the data has poor accuracy and comparability. These shortcomings are particularly prominent in the long-term ecosystem observations.

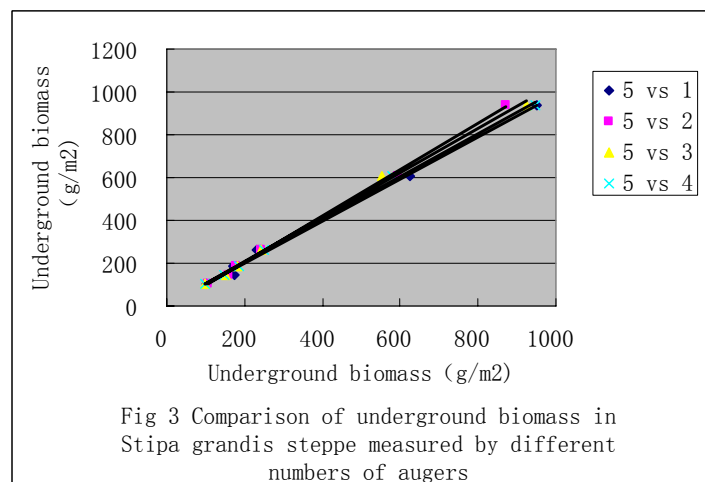
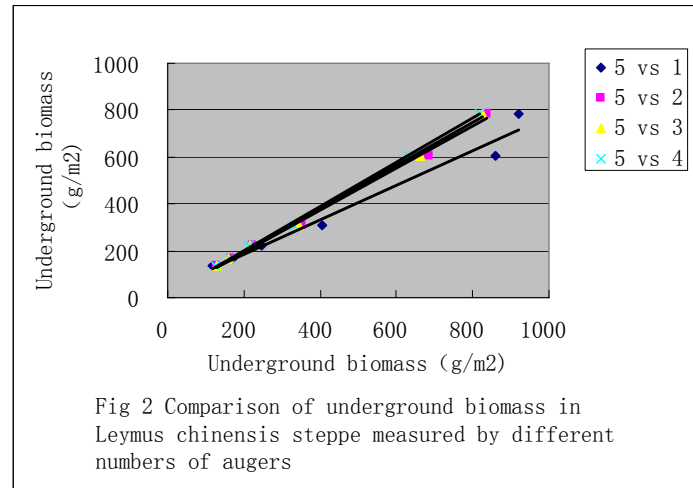
In this project, the authors take a comparative study on various methods (monolith method, auger method, Ingrowth soil core, Shoot/Root ratio method) in Inner Mongolia Grassland Ecosystem Research Station (IMGERS), and Haibei Alpine Meadow Ecosystem Research Station (HAMERS). Based on the comprehensive evaluation of different methods on the actual operation cost of labor, time costs, plot damage caused, data accuracy, technology standardization, the authors aim to raise a best set of root-biomass observing methods and standardize the operational technique for the two stations.

2005-2006, the authors took a preliminary comparative study at 3 different fields in IMGERS and HAMERS, and got some useful results:

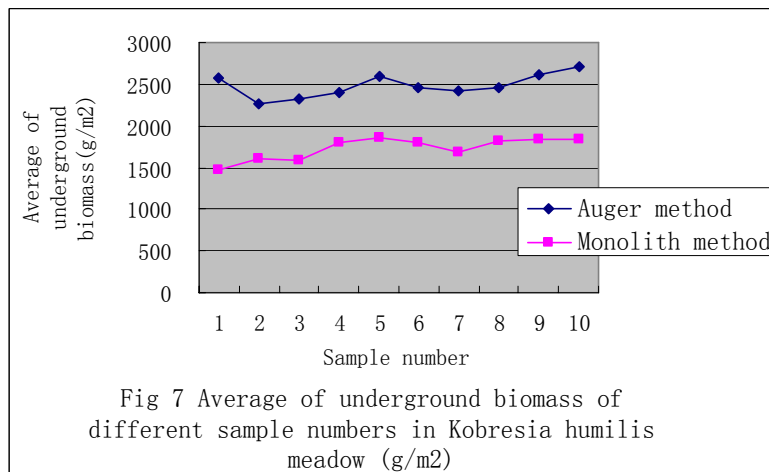
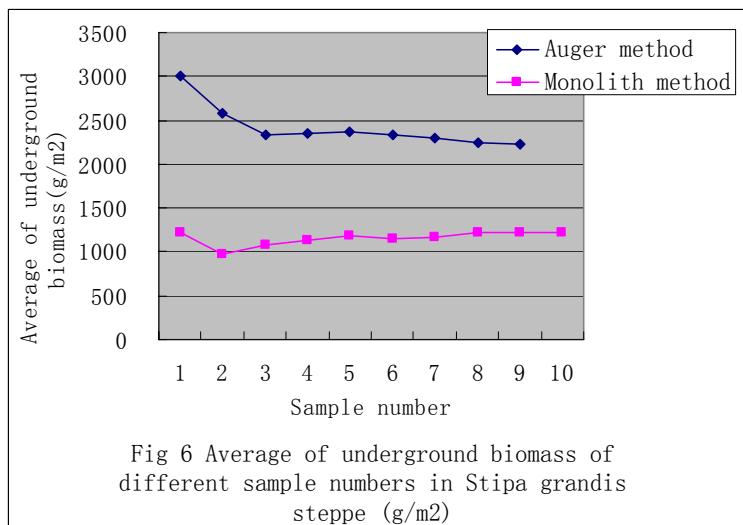
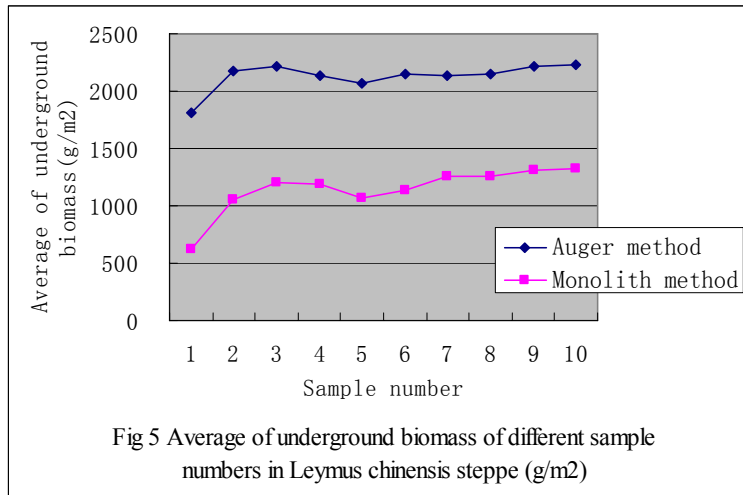
(1) Compared with the traditional method —monolith method, auger method got relatively larger root biomass value (Fig 5-7). However, the two methods had a very significant correlation (Fig 1). Further analysis found that auger method was more stable with the variation coefficients between each sampling point being smaller. To take advantage of less difficult, less destructive and other factors, auger method should be promoted. Further study is needed to find out the reason of the numerical difference and the conversion value between the two methods.



(2) For auger method, the authors took 10 samples each field, and 5 drillings each sample site. We found that underground biomass values from different drilling numbers were significantly correlated. Furthermore, the absolute values were very close (Fig 2-4). This implied that the suitable drilling number for each sample site needn't too big.



(3) The authors took 10 samples in each plot respectively for monolith method and auger method. By comparing the average value of sampling numbers, they found that average value become stable from 5 samples in *Kobresia humilis* meadow of HAMERS, and 4-5 in *Leymus chinensis* steppe of IMGERS, 3 in *Stipa grandis* steppe of IMGERS for (Fig 5-7). This implied that sampling number for underground biomass in these three plots can be decreased less than usually used 10 samples, which will much benefit for researchers and plot protection.



The basic changes and health evaluation of agro-ecosystem in irrigated area on lower reaches of Yellow River

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Agriculture is a type of large-scale production that need use resources much intensively. The essential function of agricultural production is to keeping more and more population depending on decreasing resources day by day. Fast growing of human population come into being greater pressure on the environment of the earth. If people couldn't manage agro-ecosystem health, the progress and development of society and human health of itself will suffer from serious stress. Agro-ecosystem health has been thus growing a new paradigm of agricultural production, since the subject of 'healthy soil-healthy food-healthy man' was proposed first as early as 1942.

Agro-ecosystems can be understood as multi-level nested hierarchies, with cross-level interactions that result in high levels of complexity. It can be defined at spatial scales according to the hierarchy theory of system analysis, ranging from field plots, regional dimension to the entire globe, forming nested hierarchy from lower level to higher level. A healthy agro-ecosystem means a good condition for sustainable development across various temporal and spatial scales, therefore it should performance as following: it should have a rational structure and good function; it should have the capability to resist to both natural disasters and socioeconomic risks; it should perform good service and to meet the rational demands of all stakeholders. From practical point of view, a healthy agro-ecosystem should use agricultural resources efficiently, capture better economic benefits, improve surrounding of both living and working, at the same time no harmful pressure to adjacent ecosystem.

The health of agro-ecosystems can only be adequately assessed by combining scientific insights with value judgments as to what is desirable. At a field level, the evaluation can be made using conventional experimental methods. The indicators for evaluation need to be integrated ecological factors with socioeconomic aspects, because it is influenced by both the ecological process and the socioeconomic components with human values. A general framework of the indicator system is set up according to some principles. The overall objective of the framework is to discover the status of agro-ecosystem health both at a regional and field level. At first, it is categorized three groups of indicator: the structure, the productivity and the stress-resistance of agro-ecosystem. The first group would be used mainly to examine the condition of resources and components of agro-ecosystem, which includes resource availability, accessibility, diversity and integrity. The second group would be used mainly to reflect how to match the aims of stakeholders, which includes productivity, efficiency, effectiveness and equitability (equity). The third group would be used mainly to investigate the relationship between agro-ecosystem development and environment, which includes self-productivity, stability, resilience and capacity to respond. Then, the three groups are secondly disassembled to several sub-group indicators, which are also analyzed continuously, step by step, down to measurable indicators.

In order to do quantitative assessment of agro-ecosystem health, it also needs to quantify the health criterion of every indicator. In this paper, the reference criterions of agro-ecosystem health indicators are suggested by the approach of experts' evaluation. The healthy status was marked off three cases: unhealthy, sub-healthy and healthy, and their corresponding score of indicators are 1, 5, and 10 respectively. It is from unhealthy approach to sub-healthy if the score between 1 and 5,

and from sub-healthy approach to healthy if the score between 5 and 10. Special explanation is that, as for stability indicators, there are only two cases, and it is healthy as long as grain yield and agricultural value per unit land are not decreased, otherwise unhealthy. Whereafter, by using the Analytic Hierarchy Processing (AHP) to get the weight coefficient of every indicator and every group, then calculate the aggregated health indexes (HI) of agro-ecosystem at field and regional scale by means of weighting sum.

A case of study: The agriculture on the lower reaches of the Yellow River is one of the important produce regions in China. In history, it is susceptible to drought and saline-alkaline disaster due to less precipitation and higher evaporation, although with irrigation water from the river and high groundwater table. The natural disasters with poor soil hampered both the stable agricultural production and high yield. To deal with the unfavorable factors much studies and measures have been undertaken since 1949, especially since 1978. The long-term practices shows that much cropland on the lower reaches could resistance to both drought and water-logging by irrigation and drainage, the saline-alkaline has been controlled effectively, as well as ameliorated the farming cultivation enhance the farmland productivity. However, the unfavorable factors of the above are still underlying and take place sometimes. Moreover, new challenge are emerging with the use of more and more agricultural chemicals such as fertilizer, pesticide etc., even water use. YuCheng County of Shandong Province is a good example for taken as a case study, which locates at the lower reaches of the Yellow River. The amount and quality of farmland represent the characteristics of structure. Although its area was decreasing the proportion of irrigation is increased from 0.82% at 1949 to 90.2% at now, meanwhile the soil fertility has been improved at deferent, the agricultural diversity also increased. The productivity is figured by yield and product per area, production efficiency and ecologic efficiency. The change of grain yield showed 3 periods clearly, it fluctuated below 1000 kg ha⁻¹ before 70's, then increased fast till 90's, and now it is stable above 6000 kg ha⁻¹. Alike yield, the comparable production value per hectare farmland didn't increase markedly and less than 800 ¥ ha⁻¹ before 1976, then increased constantly and became fast after 1991. The light use efficiency of cropland also has been increased from 0.10 to 0.35 since 1980 and reaches a stable level of 0.38 after 1998. Unfortunately, the auxiliary energy use efficiency such as fertilizer, pesticides showed a decrease. The proportion of cropland area resistance to saline-alkaline, drought and water-logging is the important indicators of stress-resistance, the former decreased from 34.1% of 1978 to 4.8% of 2000.

The agro-ecosystem health of Yucheng County has been evaluated according to indicator and methods. The primary results show that the agro-ecosystem at regional and field level in this area has been changed from unhealthy via sub-healthy to healthy during 1980~2000 in general, its HI enhanced from 4 to 6. The structural index turned into sub-healthy again when it has been evolved the state of structural health from sub-healthy to healthy because of the transition to unhealthy of resources availability and diversity. The productive index showed a transition of unhealthy via sub-healthy to healthy. The index of stress-resistance behaved a transition trend from sub-healthy to healthy.

Key words: agro-ecosystem health; regional and field level; indicators; evaluation

Modeling gross primary production of a temperate grassland ecosystem in Inner Mongolia, China using MODIS and climate data

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Carbon fluxes in temperate grassland ecosystems are characterized by large inter-annual variations due to fluctuations in precipitation. A CO₂ eddy flux tower site has been in operation since 2003 in the Xilingol grassland, Inner Mongolia, China, and provides abundant CO₂ flux observations and other environmental data for evaluating the biophysical performance of vegetation indices and models. A satellite-based Vegetation Photosynthesis Model (VPM) has recently been successfully applied to estimate gross primary production (GPP) in forests and alpine tundra. The input data required for the VPM model are: (1) Enhanced Vegetation Index (EVI); (2) Land Surface Water Index (LSWI); (3) air temperature (T_a); and (4) Photosynthetically Active Radiation (PAR). In this paper, we used CO₂ flux data to critically evaluate vegetation indices and the VPM model. We used the Moderate Resolution Imaging Spectroradiometer (MODIS) standard data product MOD09A1, which is the eight-day composite land surface reflectance data with 500-meter spatial resolution to calculate EVI and LSWI. Air temperature and PAR were acquired from regular meteorological observation at field stations. Field CO₂ flux data, which were measured using the eddy covariance method during the period from May, 2003 to September, 2005 were used to estimate the “observed” GPP for model validation. The simulated GPP (GPP_{vpm}) compared quite well (R²=0.903, n=111) with the observed GPP (GPP_{obs}) during 2003-2005. The seasonal dynamics of GPP_{vpm} also matched well with that of GPP_{obs}. The aggregate GPP_{obs} for the three years was 603.8gC.m⁻²; and the aggregate GPP_{vpm} was 641.5gC.m⁻², representing a ~6% over-estimation of GPP by the remote sensing based method. The results demonstrate that the VPM model has potential for estimating grassland GPP, and could be an effective tool for scaling-up GPP for grasslands worldwide.

Carbon accumulation and distribution in particle-size fractions of two soils as affected by long-term fertilizations

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Black soils (Mollisol, US Soil Taxonomy) and Brown soils (Alfisol, US Soil Taxonomy) are two of the dominant agricultural soil types in the northeast of China, and play very important role in food supply in China for its huge population. Unfortunately, the quality of the two soils have being degraded due to decline in the quantity and quality of soil organic matter (SOM) under the special conventional tillage system, with which all the above ground crop residues are removed from the land and used for heating and cooking. We all know that organic amendment is an effective way to improve soil organic carbon (SOC) quantity and quality. In order to better understand the mechanisms of the SOM restoration process after organic amendment, investigation of dynamics of SOC pools is a good strategy. The response of SOM dynamics to long-term fertilizations may be deduced from changes in the accumulation and distribution of different SOC pools. The SOC in particle-size fractions were therefore measured to assess the influences of organic manure and chemical fertilizer application on the characteristics of the size pools in the two soils.

A long-term experiment of fertilizations was set up in the Black soil area (Gongzhuling, China) in 1979 and the composite soil surface samples (0-20cm) were collected in 2005 from 12 treatment plots, including (1) CK, (2) N, (3) NP, (4) NPK, (5) M₁, (6) M₁N, (7) M₁NP, (8) M₁NPK, (9) M₂, (10) M₂N, (11) M₂NP and (12) M₂NPK. CK indicates nil; M₁ and M₂ mean pig manure applied at the rate of 150 and 300 kg N hm⁻² yr⁻¹ respectively; N, P and K are chemical N (urea), P (multiple superphosphate) and K (potassium sulfate) fertilizers added at the rate of 165, 82.5 and 82.5 kg hm⁻², respectively. Another long-term experiment of fertilizations was set up in the Brown soil area (Shenyang, China) in 1987 and the composite soil surface samples (0-20cm) were collected in 2006 from 7 treatment plots, including (1) CK, (2) M₂, (3) M₄, (4) N₂, (5) M₁N₁, (6) M₁N₁P₁, (7) M₂N₁P₁. CK indicates nil; M₁, M₂ and M₄ mean pig manure applied at the rate of 67.5, 135 and 270 kg N hm⁻² yr⁻¹ respectively; N₁ and N₂ mean chemical N fertilizer applied at the rate of 67.5 and 135 kg N hm⁻² yr⁻¹ respectively; P₁ is chemical P (Phosphorus pentoxide) fertilizer added at the rate of 67.5 kg hm⁻² yr⁻¹. Afterwards, the samples were fractionated into fine clay (<0.2μm), coarse clay (0.2-2μm), silt (2-50μm), fine sand (50-250μm) and coarse sand (250-2000μm) and then SOC contents were measured.

Our results show that although the clay and silt fractions comprised the major SOC pools, there was a large variation among the size separates due to fertilizations effect. Compared to Black soil, the clay-sized fraction obviously acted as more important sink for SOC in Brown soil. The application of organic manure alone resulted in a significantly increased accumulation of SOC in each particle size fraction in the two soils, but preferential enrichment was especially found in the

coarse sand, indicating that organic manure is effective in restoring SOM in the two soils under the maize monocropping tillage system and specific climate. The application of chemical fertilizers had no clear effect on either SOC accumulation or distribution in size fractions in the two soils. The effects of the combined application of chemical fertilizers and organic manure on the two soils are different. Not only was the accumulation of SOC enhanced in all size fractions in the Black soil, but also a shift of SOC from fine to coarse particles was found. The shift suggests a hierarchy model for SOC protection order from fine to coarse particles, i.e. the SOC will be preferentially accumulated in fine fractions with a lower organic input, and once the fine fractions are saturated, the SOC is shifted towards coarser fractions gradually. The higher contents and enrichment of SOC in coarse sands can be an indicator of higher soil quality. However, the combined application with the low amount of organic manure in Brown soil did neither enhance the accumulation of SOC, nor the shift of SOC from fine to coarse particles. Only, the combined application with a high amount of organic manure can cause a shift of SOC from fine to coarse particles. Therefore, the findings reveal that the effect of long-term fertilization on SOM is related closely to the soil types. In the Black soil there is clear interactive impact between chemical fertilizers and organic manure. This interaction is important not only for improving SOM quantity, but also quality. In the Brown soil the application of organic manure is the key to SOM restoration.

Keywords: long-term fertilization; Black soil; Brown soil; particle-size fraction; soil organic carbon

Potential of visible—near-infrared reflectance spectroscopy to predict soil organic matter and heavy metal content —— a case study of soils around a cooper smelter in Jiangxi Province, China

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Rapid and inexpensive method for quantitative and qualitative determination of various soil properties is needed because there is a great demand for environmental monitoring, precision agriculture, as well as ecological assessment. In these fields, the sampling intensity required for effective spatial and temporal characterization and observational control of confounding factors results in significant analytical costs, and frequently less than desirable sample density and analytic diversity.

Recently, with improved instrumentation and data-processing techniques, the ability of laboratory reflectance spectroscopy to provide rapid nondestructive prediction of soil physical, chemical, and biological properties has been accepted increasingly as possible alternatives to enhance or replace conventional methods of soil analysis. The reflectance spectroscopy analytical technique takes advantage of the selective absorption of electromagnetic radiations from electronic transitions of atoms and vibration stretching and bending of structural groups that form molecules or crystals in the sample. The intensity of the absorbance is related to the chemical composition of the sample.

Soil materials, organic and inorganic phases, carry significant information across visible (VIS, 0.38–0.7 nm), near-infrared (NIR, 0.7–2.5 nm) and mid-infrared (MIR, 2.5–25 μm) portions of the electromagnetic spectrum. Fundamental harmonic oscillations of organic bonds (e.g. C-H, N-H, and O-H) and inorganic mineral functional groups (metal oxides, minerals, ions) are primarily found in the mid-infrared range. Multiple overtones and combinations of these fundamental vibrations due to the stretching and bending of organic groups dominate the near-infrared range and electronic transitions the visible range. Chemometric developments are proven to promote quantitative analysis of soil using this analytical technique. Generally, MIR spectra technology is more complex and more expensive than that used for VIS and NIR measurements. The advantages of visible—near-infrared (VNIR, 0.38–2.5 μm) reflectance spectroscopy analytical technique are speed of analysis, simplicity in sample preparation, multiplicity of analysis and that it does not use chemical reagents. One other advantage is that the wavelength region of VNIR, overlapping sun radiation response, are very important for multi- and hyper-spectral satellite sensor spectra. These advantages make VNIR ideal for routine spectral assessment of soil quality for environmental monitoring, precision agriculture and ecosystem studies.

The main constituents, such as organic matter, clay and moisture, were precisely predicted using VNIR reflectance spectroscopy in a wide range of soils. This technique has also been used to predict several trace metal contents in sediments and soils successfully. Detailed monitoring of trace metals content in soils is important in regions under present or former influence of industrial activities for ecological risk assessment.

In this study, the VNIR reflectance spectroscopy was used to predict contents of soil organic matter (OM), iron (Fe), chromium (Cr), copper (Cu), lead (Pb), Zinc (Zn) and cadmium (Cd) in a

pollution area (3.1 km²) around a large copper smelter, Guixi copper smelter (28°19' N, 117°12' E), Jiangxi Province, Eastern China.

The dominant type of land use in the study area is paddy field suffering sewage-irrigation and dust pollution from the smelter. A total of 96 topsoil (0-15cm) samples were collected. The soil pH ranged in 3.12-5.07, and OM in 1.32-37.14 g kg⁻¹. Soils had various contents of metals (3373-19320 mg kg⁻¹ for Fe, 6.2-24 mg kg⁻¹ for Cr, 20.76-565 mg kg⁻¹ for Cu, 9.83-64.67 mg kg⁻¹ for Pb, 15.45-222.7 mg kg⁻¹ for Zn and 0.36-6.02 for mg kg⁻¹Cd), demonstrating a serious contamination of Cu.

The spectral reflectance of the soil samples was measured using a FieldSpec FR spectroradiometer (Analytical Spectral Devices Inc., Boulder, Colorado) at wavelengths from 0.35 to 2.5 μm. Principal component analysis (PCA) was used to detect suspect spectra. 4 suspect spectra were removed and the remaining 92 samples were divided into two groups: 70 samples were used for calibration and the remaining 22 for validation. Partial least-squares regression (PLS) was used to calibrate the spectral data with the laboratory measured data of soil properties. Leave-one-out cross validation was applied to avoid overfitting of the models. The standard error of calibration (SEC), standard error of cross validation (SECV), the determination coefficient (R_{CAL}^2) of the simple linear regression between reference values and VNIR predicted values of the calibration set and the number of PLS factors were calculated. Models were developed by different pretreatments (standard normal variate transformation, first and second derivation) and different wavelength ranges (380–1000 nm, 1000–2430 nm and 380-2430nm). For selection of the best calibration model, the highest coefficient of determination and the lowest standard error of cross validation (SECV) were used as criterion. The predictive capacity of the models were tested with the standard error of prediction (SEP) and the determination coefficient (R_{VAL}^2) of the calibration set. The ratio of the standard deviation of the reference validation data to the SEP (RPD) was used to indicate the performance of the models.

For the best calibration models, the coefficient of determination in calibration (R_{CAL}^2) and the standard errors in cross validation (SECV) were: OM, 0.81 (SECV: 3.26); Fe, 0.87 (SECV: 1309); Cr, 0.73 (SECV 2.80); Cu, 0.84 (SECV: 53.1); Pb, 0.66 (SECV: 5.42); Zn, 0.83 (SECV 9.28); Cd, 0.31 (SECV: 0.53). The RPD values obtained in the present study were within 1.5-2.0 for OM (1.58), Fe (1.69), Cr (1.60) and Cu (1.63), were < 1.5 for Pb (1.21), Zn (1.11) and Cd (0.90). The results show that the prediction for OM and most of heavy metals are acceptable, except for Cd unacceptable ($R_{CAL}^2 < 0.50$), and for Pb and Zn unreliable (RPD < 1.5). In environmental application, where samples are much more variable, no critical levels of RPD values have been set for the reflectance spectroscopy analysis of soil, but an RPD > 1.5 is generally acceptable.

Although the prediction accuracy for soil organic matter and heavy metal contents need a more improvement by such methods as pre-treatment of soil samples and signal strengthening method to get more accurate reflectance spectrum, our study indicates that VNIR has the potential for the rapid inexpensive prediction of several soil heavy metals specially in contaminated area.

Keywords: contaminated soil; visible—near-infrared reflectance spectroscopy (VNIR); organic matter; heavy metal; partial least squares regression (PLS)

Aerosol optical properties observed by the Chinese Sun Hazemeter Network and evaluation of the MODIS AOD products over China

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To reduce uncertainties in the quantitative assessment of aerosol effects on regional climate and environmental changes, extensive measurements of aerosol optical properties were made with hand-held sun hazemeters in the Chinese Ecosystem Research Network (CERN) starting in August 2004. The seasonal variations of background aerosol optical depth (AOD) and aerosol type are investigated over Chinese various ecosystems by about two-year records of the Chinese Sun Hazemeter Network (CSHNET) and meteorological data. In most parts of China, seasonal cycles of AODs show a maximum in spring or summer and a minimum in autumn or winter. With little standard deviation, the smallest annual mean AOD (≤ 0.20) at 500 nm is found in the Qinghai-Tibetan Plateau, the remote northeast corner and Hainan Island. The background zones, for example the oasis, sandy grassland and forest ecosystems, are also clean ($\text{AOD} \leq 0.27$) at the northern China, while the desert and the Loess Plateau have moderately high AODs (~ 0.37). With large standard deviation, the high AODs (0.50~0.90) occur in the high-intensity agricultural and industrial region lay in the centre-eastern, the southern China and the eastern coastal areas, where emission of anthropogenic sulfate aerosol is rich through a year. Due to biomass and fossil fuel burning from extensive agriculture and rural areas in the northern region, smoke and soot aerosol remarkably rise in autumn and winter, while dust and soil aerosol in spring and summer.

To evaluate MODIS aerosol products, we compare MODIS AOD products with the CSHNET data as ground truths over different ecological regions over China. The evaluation results show very large differences of MODIS products between different ecosystems and geographic locations. The most agreement between MODIS data and CSHNET' is at farmland sites in the central southern China, where high correlation ($R > 0.82$) and large percentages ($> 72\%$) within the expected error lines issued by NASA are found. In temperate forest, coastal regions, and northeast and central farmlands, there appear moderate agreement with $R \sim 0.64-0.80$ and 45%-73% of retrieval data falling within the expected errors. The poorest agreement is existed in the northern desert/semi-desert regions, and the remote northeast farmlands, and the Tibetan and Loess Plateau, and southern forests, where 13%-54% retrieval data falling with the expected errors. In addition, MODIS products are significantly overestimated in the northern deserts/semi-deserts and underestimated in the remote northeast farmlands and southern forests.

Keywords: the Chinese Ecosystem Research Network (CERN); the Chinese Sun Hazemeter Network (CSHNET); aerosol optical properties; MODIS AOD product; China

A Smart Network Monitoring System for Soil Moisture

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Soil water is an important variable in real-time flow prediction, weather and climate studies, and agricultural studies. Establishment of a network for monitoring soil moisture in region allows producers and governments to make decisions with respect to ravages of a drought prediction, crop water management. However, it is unfortunate that there exist very few real-time sites with records of soil moisture or soil water content with sufficient length and spatial coverage to allow reliable scientific analysis on region scales in China. The purpose of this paper to clarify the thought of establishment of a network for measuring on-site soil moisture in region, and to develop a pilot system that can provide real-time basic data of soil moisture on large scale by wireless transmission modules.

We established and improved a network for monitoring in region, which included soil moisture information collection, transmission, report, analysis, and announcement. Soil moisture can be measured by various methods, including time-domain reflectometry (TDR), electrical capacitance sensor, electrical resistance measurements, and electric tensiometer, and comparison of these methods was mentioned. The analog output of the sensors was transformed to standard electric current / voltage signals, which can be transmitted to control centre by GPRS/GSM wireless, transmit-receive module. Soil moisture collection and transmission modules can be incorporated and placed in the measured sites, then regional network for monitoring soil moisture was set up through laying multi-stations. The control centre of the network can transmit orders to the measured sites and carry out the orders by mobile terminal technique. In addition, the measured data can be announced through Web-GIS, the governments and farmers in the region can be found in the internet.

The pilot network based on aforementioned theory was tested in Fengqiu County in the North China Plain. In our system, the electrical tensiometer was used as soil moisture sensor because of convenience of signal transformation. Eight sites were experimented in this network, and the long-term results showed that the system was potential to popularize.

Stable carbon isotope variations in surface bloom scum and subsurface seston among shallow eutrophic lakes

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Carbon stable isotope analysis of surface bloom scum and subsurface seston samples was conducted in shallow eutrophic lakes in China during warm seasons from 2003 to 2004. $\delta^{13}\text{C}$ values of bloom scum were always higher (averaged 5‰) than those of seston in this study, and the possible reasons were attributed to (i) direct use of atmospheric CO_2 at the air–water interface; (ii) decrease in ^{13}C fractionation due to higher carbon fixation, (iii) active CO_2 transport; and/or (iv) HCO_3^- accumulation. Negative correlation between $\delta^{13}\text{C}_{\text{scum}} - \delta^{13}\text{C}_{\text{seston}}$ and pH in the test lakes indicated that phytoplankton at the subsurface water column increased isotopic enrichment under the carbon limitation along with the increase of pH, which might in turn decreased the differences in $\delta^{13}\text{C}$ between the subsurface seston and the surface scums. Significant positive correlations of seston $\delta^{13}\text{C}$ with total concentrations of nitrogen and phosphorus in water column suggested that the increase in $\delta^{13}\text{C}$ of seston with trophic state was depending on nutrient (N or P, or both) supply. Our study showed that $\delta^{13}\text{C}$ of phytoplankton was indicative of carbon utilization, primary productivity, and nutrient supply among the eutrophic lakes.

Keywords: bloom scum; eutrophic lakes; seston; stable carbon isotope

Changes of soil nitrogen dynamics in a suburban pine forest in Hefei: effect of dieback from pine wilt disease

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Soil N transformation, particularly nitrification, is of great agricultural and environmental importance. This process may result in instability of the N supply to plants because nitrate is easily removed from soils by denitrification and leaching. Despite the widely recognized importance of disturbance in accelerating the loss of N from land, there have been few empirical studies of the effects of natural disturbances on N dynamics in forest ecosystems. In this study, we reported the effects of pine-dieback disturbance resulting by pine-wilt disease on soil N dynamics in a suburban forested catchment in Hefei, Eastern China. The purpose of this study was to examine the mechanisms and magnitudes of N-cycle perturbation by partial pine dieback.

The study site is located at Shushan Forest Park in suburban Hefei (30°8'N, 117°4'E). The total area of the park is 570 ha. Mean annual temperature is about 15.8°C. Annual mean precipitation is about 1000 mm. The major soil type is Alfisols. The forest coverage is 90%, which is almost composed of plantations of *Pinus massoniana* (contributing 40% of the total), *P. thunbergii*, *Liquidambar formosana*, *Quercus acutissima* established in 1950s. The partial pine forests have been damaged by pine wilt disease since it was first found in 1998. Dieback occurred during 2002~2004. Two fixed plot (PM1 and PM2) were established in 1992, with no significant differences in soil and stand structure. However, pine wilt disease made 11% and 53% trees die off at PM1 and PM2, respectively, during 2002 to 2004. We investigated the changes of soil mineral N pools and N mineralization rates via in situ incubation method at the two stands.

The mean concentrations of organic C and total N in the surface 10 cm mineral layer increased significantly at PM1 and PM2 from 1992 to 2002. However, no significant changes were found at both stands during 2002 to 2005 although 53% pine trees die off in this period. The mineral N pools in the surface layer in PM1 and PM2 in 2005 were, respectively, 1.26 and 2.38 times greater than in 2002. The content of nitrate in PM1 increased 33% between 2002 and 2005, while 71% in PM2. The mean rates of net N mineralization and nitrification increased 21% and 39% in PM1, 52% and 87% in PM2, respectively. Unfortunately, very little information is available on the long-term effect of pine dieback on nitrate leaching. The increase in the net mineralization and nitrification after pine dieback must be regarded as positive with respect to the risk of nitrate leaching. The results from this study demonstrated that the soil N dynamics was dramatically altered by pine dieback.

Evolution of Soil Bio-characteristics in the Ecological Restoration Process in the hilly Loess plateau

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Aimed at the hotspot in vegetation construction and eco-environment sustainable development and requirement of the assessment of ecosystem health in the Loess Plateau, taking on the eroded soil in long trial sites located in Ansai Research Station of Soil and Conservation research object, through the approach of substituting the temporal serial with spatial serial, the dynamics of soil microbial characteristics, biochemical activities and active organic carbon pool were studied systematically and their implications for ecological rehabilitation were analyzed in this dissertation. The goal was to provide scientific reference and enrich the theory for vegetation rehabilitation and assessment of soil quality as well as biological effect in the hilly Loess Plateau. The main results are as follows:

1. Soil physico-chemical properties and anti-erodibility of different vegetation restoration models was compared. The results showed that soil anti-erodibility and physical and chemical properties increased apparently in different modes of abandoned arable land, closing hillsides, artificial woodland and grassland, construction terrace and so on, and increased slowly with the extension of rehabilitation process. Different types of vegetation restoration are different in improving soil properties. In general, mixed woodland had the most remarkable effect, followed by fallow land and pure woodland was the smallest. It need a long time to reach to the soil quality of middling level, altitude level and the climax before vegetation destruction and the time is different in eco-environment restoration models.

2. Soil microbial biomass and SIR were low and can increased apparently through vegetation rehabilitation in the hilly Loess Plateau. The time to reach to the climax before vegetation destruction is a long time, maybe more than 100 years. The dynamics of soil microbial respiration was complex in different vegetation restoration models. The first kind is abandoned arable land which soil microbial respiration was enhanced rapidly in the initial stages of abandoned then kept a relatively stable state. The second is closing hillsides on northern slope and artificial woodland which soil microbial respiration was enhanced in the early stage and then weakened in the late stage. The third kind is orchard, terrace and closing hillsides on southern slope which soil microbial respiration was enhanced with the utilization period. Metabolic quotient (qCO_2) was significantly higher in agro-ecosystem which qCO_2 increased gradually than other ecosystem which qCO_2 decreased step by step with the utilization period.

3. Soil enzymatic activities improved in different vegetation restoration models. The activity of soil enzyme enhanced which include Phosphatases, invertase, urease, cellulose and catalase, acid phosphatase, catalase and peroxidase, while Polyphenol Oxidase weakened with the increasing of years. The abilities of different types of vegetation restoration in improving soil enzymatic activities from high to low was closing hillsides, artificial woodland, abandoned arable land, orchard and terrace. The results of study on the dynamics of soil active organic carbon pool in different vegetation restoration models showed that each fraction of soil organic carbons such as :

soil total organic C (TOC) , microbial organic C (MBC) , water-soluble organic C(WSOC) and microbial Biomass C (MBC) increased with the growing of vegetation. The abilities from high to low were mixed woodland, pure woodland, fallow land and farm land. The same vegetation restoration model has different increased abilities in each fraction of soil organic carbons.

4. A significant relationship was found between soil microbial biomass, microbial respiration, enzymatic activities, fraction of soil organic carbons and physico-chemical properties and anti-erodibility. The classification and the linear regression models were established on the basis of the analysis of relationship and the frequency of soil involved was analyzed in the dissertation. Based on the soil quality evolution models established, we estimated the time needed for soil quality to reach to middle level, high level and the climax before vegetation destruction respectively in revegetated grassland, orchard, planted shrub land and planted woodland.

5. A large difference in sensitivity of soil property was found. Some soil property including available phosphorous, bio-quality and fraction of soil organic carbons were considered as potential implications. The same rehabilitation model has different kinds and amount of sensitive soil property, while the same soil property has different sensitivity in different vegetation restoration models. EOC, urease, SMBP and soil structure coefficient can be used as implications for ecological rehabilitation.

6. Through sensitivity analysis, 6 soil bio-quality indicators were identified including SIR, invertase, non-active carbon, SMBN, HWOC, and WOC, which SIR, invertase and non-active carbon were key implications indicators. Soil bio-quality assessment indicators and corresponding assessment model for reflection the bio-quality change of ecological rehabilitation in the hilly gully region of Loess Plateau were established. Seven bio- property index were defined and described such as soil properties indexation, relative soil properties indexation, degradation indexation, restoration indexation, and so on. The linear regression models of bio-quality assessment index were clarified with landuse years in different vegetation restoration models. The regression models for soil quality evolution were also established. The seven bio- property index had a good practicability and different ecological significance in vegetation restoration, so they can be used as to depict different ecological process.

Keywords: ecological restoration; the loess hilly regions; soil bio-characteristics

Distribution characteristics of soil organic matter and nitrogen on the Yajiageng-Dadu River vertical belt, Mt. Gongga

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Soil organic matter and nitrogen are two main components in the forest soil, and also are important factors affecting the soil's respiration. The dynamic changes of C, N has aroused the wide attention in the global change research plan. Specially, many studies have emphasized the importance to study the trend of C and N in the sub-alpine forest soil.

As the unique geographic region with above 4000 average altitude, Qinghai-Tibetan plateau is a natural laboratory to study the impact of global climate change on ecosystem. The Yajiageng-Dadu River vertical belt locates on the Gongga Mountain region of eastern Qinghai-Tibetan plateau. The belt provides favorable condition to research C and N changes of soil with different altitude. In the region, previous studies have mainly discussed the structure and dynamic change of forest communities, litterfall and hydrological regime and so on. But there are few of studies on soil properties. The aim of the study is to find vertical change trend of soil organic matter (SOM) and nitrogen (N) along the vertical belt. The results showed that the contents of SOM and total N increased with elevation gradient, in the order of spruce forest (2737m) < fir/spruce forest(3027m) < fir forest(3301m), and then it has appear fluctuation. In the transitional community such as treeline, the contents of SOM and N were lower than other vegetation types, then, the contents of SOM and N from treeline(3564m), sub-alpine shrub(3565m) to sub-alpine meadow(3873m) reascending with the increase of the elevation gradient. In all kinds of vegetation types, the vertical distribution of SOM and N in soil profile had similar trend. With the increased of soil profile depth, the contents of SOM and N gradually decreased. Moreover, for differently vegetation types, the contents of SOM and N of fir forest obviously were higher than others vegetation types. A possible explained is that its growth conditions would be propitious to accumulation of the SOM and N. The ratio of C/N ranged from 13.5 to 27.5, which is lower relative to the appropriate C/N of 25~30, and indicated the soil in favor of the organic matter decomposition and nutrients release. No evidence shows that the ratio of C/N is relative to elevation gradient. However, its vertical distribution in the soil profile varied with different vegetation types, i.e. the ratio of C/N increases with the increase of the soil depth in the sub-alpine meadow, the sub-alpine shrub and the spruce forest, and it is no obvious change in the fir/spruce forest, whereas it decreases in the fir forest.

Influence of underground water table to niche of plant population at fringe of Minqin Oasis

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At fringe of Minqin oasis, influences of descending underground water table to niche of plant population was studied by underground water table of special difference at Hu-qu region with 8-12 meter, Quan-shan with 15-17 meter and Ba-qu with 20-23 meter, and in time grade of descending grads of underground water table during 1984 to 1992 at Sha-jin-zi of 7.45-11.65 meter. As the underground water at special difference descend, the breadth of niche of plant population decreases, and the population degenerates. Moreover in time grade, the underground water table descends, *Nitraria tangutorum* population extends, while the others decrease. The *Nitraria tangutorum* is an edificetor, and that of population is the largest in desert plant community at fringe of Minqin oasis. The *Nitraria tangutorum* population extends generally at an underground water table of the some 10 meter, so the critical water table for improving ecological environment is not less 10 meter at Minqin oasis.

Key words: fringe of Minqin Oasis; niche of population; grads of underground water table

Seasonal and spatial variations of dissolved inorganic carbon in the Xijiang River and its export flux

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River systems are the major linkage between the land and the ocean, not only transporting substantive carbon from terrestrial environment to the ocean, but also transforming it during the transportation and ultimately impacting the CO₂ uptake capacity of the ocean through disturbance on the ocean 'biotic pump' and 'dissolved pump', actively involved in the global carbon biogeochemical cycle. The dissolved inorganic carbon (DIC), mainly originating from carbonates, soil CO₂ and atmospheric CO₂, constitutes about 45% of the riverine carbon exported to the ocean, i.e. $3.8 \times 10^{14} \text{gCyr}^{-1}$. Being a dynamic open-system, the riverine DIC is closely related with the characteristic of drainage basin, including lithology, climate and hydrology. It has been proved that even if present in minor amounts, carbonates still are the primary controlling factor of the riverine DIC. The Xijiang River drains the humid subtropical monsoon area mainly underlain by carbonate rocks. Its DIC transportation will response to these special characteristics of drainage basin.

Water sampling and field measurements were conducted at 6 sites along the entire length of the lower reaches in the Xijiang River and from the mouths of its major tributaries across a whole hydrological year from April 2005 to March 2006, and intensive sampling was also conducted during the flood event at Wuzhou gauge station and Makou gauge station, to reveal seasonal and spatial variations of riverine dissolved inorganic carbon (DIC), as well as to estimate riverine DIC export flux, using the water hydrochemical parameters. The results indicate that DIC concentration in the Xijiang River is controlled by basin geology and climate, and presents obvious seasonal and spatial variations, ranging from 1.16 to 2.40mML⁻¹ for the mainstream, as well as 0.83~1.78mML⁻¹ and 0.74~1.79mML⁻¹ for two tributaries the Guijiang River and the Hejiang River, respectively. The seasonal changing patterns of DIC concentration in the mainstream of the Xijiang River and its tributaries were nearly consistent with each other. The DIC concentrations in the dry season were lower than those in the wet season, and the minimum values almost occurred during the flood mainly due to the dilution effect of flood water. This seasonal variation mainly results from seasonal variation of bacterial activity and CO₂ content in soil, as well as of carbonate/silicate minerals weathering, which caused by seasonal variation of precipitation and temperature in basin. The spatial variation of riverine DIC concentration was consistent with the distribution of carbonate rocks in basin. DIC concentration in the mainstream of the lower reaches in the Xijiang River was obviously higher than that in its tributaries, and for the mainstream, DIC concentration was downstream decreasing. Extensively distributed carbonate rocks in the Xijiang River drainage basin occur intensive weathering under the humid subtropical climate, greatly accelerating export of terrestrial inorganic carbon from the land to the ocean. DIC export flux in the Xijiang River basin is about 12.95gCm⁻²yr⁻¹, slightly higher than global mean level. The Xijiang River annually exports DIC about $4.57 \times 10^{12} \text{gC}$, approximately accounting for 1% of the global riverine DIC export, in which, 84% occurred in the wet season and 40% during the flood in June.

Key words: dissolved inorganic carbon; seasonal and spatial variation; flux; Xijiang River

Effect of organic matter incorporation on flooded soil solution CO₂ concentration and growth and yield formation of rice

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Laboratory incubation was conducted in international rice research institute (IRRI) greenhouse to investigate the CO₂ concentration in soil solution under flooded conditions, which two organic matter rate, 1g·kg⁻¹ and 4g·kg⁻¹ were used to incorporated into soil. And each rate of organic matter incorporation had N fertilizer and no N fertilizer treatment to study whether the N fertilizer affect the CO₂ concentration in soil solution. Another field experiment was carried out to determine the effect of organic matter incorporation on growth and yield formation in rice including early rice and late rice in the long-term fertilization experimental field of National Observation Station of Taoyuan Agro-ecology System. 3599.78kg·hm⁻² (CK+C) and 5069.96kg·hm⁻² (NPK+C) organic matter were incorporated in early rice and in late rice, the rate of organic matter incorporation was 2814.63kg·hm⁻² (CK+C) and 3684.58kg·hm⁻² (NPK+C). Results showed that the concentration of CO₂ in soil solution increased with the rate of organic matter incorporated. The maximum of CO₂ concentration in soil solution was 27.39% (v/v) of CK and it increased to 31.36% (v/v) and 46.49% (v/v) when 1g·kg⁻¹ and 4g·kg⁻¹ organic matter was incorporated respectively in no N fertilizer treatment. And the maximum of CO₂ concentration in soil solution was 24.28%, 32.51% and 43.06% respectively in N fertilizer treatment. The difference was significant between different organic matter incorporation rate and adding N fertilizer had no evident influence on CO₂ concentration in soil solution. In field experiment, the results showed that organic matter incorporation had obvious effect on growth and yield formation in early rice than in late rice. The number of tillering obviously increased in early rice by adding organic matter but it didn't showed in late rice when organic matter was incorporated, especial between NPK+C treatment and NPK treatment. Organic matter incorporation into soil remarkable improve leaf area index of early rice, making leaf area rapidly increase in early stage of rice growth and keeping higher leaf area in late stage of rice growth. Although organic matter incorporation also can markedly improve leaf area compared with the treatment without organic matter incorporation, leaf area decrease rapidly and it was as the same with no organic matter incorporation in late stage of late rice growth. The yield of early rice and late rice increased 12.3% and 2.7% respectively in fertilizer treatment. And in no fertilizer treatment, it increased 28% and 25% respectively. The results of incubation experiment showed that the concentration of CO₂ in soil solution increased with the rate of organic matter incorporation. Many researchers think that the higher CO₂ concentration in soil solution had adverse effect on rice growth. In our field experiment, the rate of organic matter incorporation in early rice was almost twice higher than in late rice, but it didn't showed any adverse effect on early rice growth compared with late rice and even the lower

organic matter incorporation, on the contrary, had showed the disadvantage in early stage of late rice growth. The possible reason is temperature and microbial activity. The temperature affect the decomposition rate of organic matter, the release of some adverse matter to rice growth like CO₂, organic acids etc, and also affect the activity of microorganism. The microbial activity also affect the decomposition rate of organic matter and so affect the nutrition release of organic matter and the nutrition condition of soil. Whether the organic matter incorporation had the adverse effect on rice growth not only depends on the rate of organic matter incorporation but also depends on the factors which affect the decomposition rate of organic matter and nutrition release of organic matter.

Key Words: organic matter; CO₂ concentration; growth; yield; rice

Seasonal variations of ecosystem respiration in different terrestrial ecosystems of ChinaFLUX

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In this paper, seasonal patterns of ecosystem respiration from eddy covariance measurements in 9 ChinaFLUX sites were evaluated including a temperate mixed forest(CBS), a subtropic evergreen coniferous forest(QYZ), a subtropic mixed evergreen broad-leaved forest(DHS), a tropic seasonal rain forest(XSBN), a semi-arid grassland(NMG), an alpine shrub(GCT), an alpine swamp(SD) and an alpine meadow(DX), as well as the environmental controls were investigated. Our study ecosystems presented similar seasonal variability with ecosystem respiration reaching maximum in summer except in QYZ site due to water stress in summer and in YC site for cropping system. Highest to lowest rates of annual ecosystem respiration were QYZ>CBS>DHS>YC>SD>GCT>NMG>DX. Temperature controlled the seasonal variation of ecosystem respiration across these 9 ecosystems, but temperature sensitivity (Q_{10}) increased in the order tropic forest < subtropic forest < semi-arid grassland < temperate forest < alpine meadow/shrub. Soil water content significantly affected the dynamics of ecosystem respiration and its relationship with temperature in the drought-stressed ecosystems (QYZ, NMG, DX) and plus rain events stimulated CO₂ release from soil during dry season in these three sites. Seasonal variations of ecosystem respiration in CBS and YC site were affected remarkably by vegetation phenology related to photosynthetic substrate supply.

Key word: ecosystem respiration; ChinaFLUX; terrestrial ecosystem; eddy covariance

Water characteristics of *Populus euphratica* growing in different heights of sand dune in the foreland of Takelamakan Desert

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The effect of depth to ground water on water relations of obligate phreatophyte *Populus euphratica* (Salicaceae) was investigated in the foreland of the hyper-arid Takelamakan Desert in Xinjiang, NW China. *P. euphratica* grow on sand dunes of different height (0--15.4m) above ground water that was the only water source for the species. The depth to ground water from the surface of the lowest sand dune was 6.8m under *Populus*. The water relation data illustrated the negative impact of sand dune height on water status of the species. Predawn and midday water potentials decreased significantly with increasing sand dune height. Water relation data suggest that decreases in hydraulic conductance with increasing distance to ground water have caused decreases in stomatal conductance due to a diminished water supply in plants on higher sand dunes. Results of this study indicate that whole-tree hydraulic conductance for *Populus* is heavily influenced by below ground hydraulic conductance. Whether the variations in hydraulic conductance are a function of increased path length or if they are the result of morphological changes in the conducting tissues remains further investigation. A detailed knowledge of hydraulic parameters in the root system is required to assess the effects of hydraulic limitations on plant water relations,

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Key words: Takelamakan Desert; dunes; *Populus euphratica*; water relation;

Yield trends, soil structure change of a long-term fertilization experiment for intensive rice monoculture system in southeast China

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The long-term performance of intensive agricultural systems is important for sustaining food production in the face of increasing population in Asia. Long-term fertility experiments under controlled conditions are an important tool to understand elaborate interactions among fertilizer application and rice grain yield trends and soil physical structure. A research program from Natural Science Foundation of China (NSFC) on soil-rice system showed that (i) long-term organic amendments improved soil fertility which contributes positively to the rice yield; (ii) there is no significant rice yield declining trends among the different kind of fertilizer for the period 1981-2006, but a close linkage between rice grain yield trends and organic amendments were found, when compared to that of recommended full dose application (NPK) each year; (iii) long-term no fertilizer application and single chemical fertilizer(CF) application increased soil rigidity when compared to that of the treatments with farmyard manure or green manure; (iv)different amount of hard clods were found between different fertilizer treatments, which is the reason for the variation of soil rigidity. This report shows that a proper amount of farmyard manure or green manure should not be omitted for the consideration of sustainable rice yield and soil structure.

Effect of heavy metal stress on antioxidative enzymes and lipid peroxidation in leaves and roots of two mangrove plant seedlings (*Kandelia candel* and *Bruguiera gymnorrhiza*)

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The effects of multiple heavy metals stress on the activity of antioxidative enzymes and lipid peroxidation were studied in leaves and roots of two mangrove plants, *Kandelia candel* and *Bruguiera gymnorrhiza*, grown under control (10‰ NaCl nutrient solution) or five levels of multiple heavy metals stress (10‰ NaCl nutrient solution containing Pb, Cd, Hg) conditions. Leaves and roots of control and heavy metals-stressed plants were harvested after two months. In leaves of heavy metals-stressed plants when compared to the control, superoxide dismutase (SOD) activity, first slightly decreased, then increased with the increase of stress level, finally rapidly declined; catalase (CAT) activity increased with the increase of stress level in *K. candel*, while not affected in *B. gymnorrhiza*; and peroxidase (POD) increased with the increase of stress level, but decreased at the fifth level stress. In roots of heavy metals-stressed plants, SOD, CAT, and POD activities increased, and then decreased with increase of stress level in comparison with the control. The increase in enzyme activities was demonstrated *K. candel* is more tolerance to heavy metals than *B. gymnorrhiza*. Lipid peroxidation was gradual enhanced only in leave of heavy metals-stressed *B. gymnorrhiza*. These results indicate that antioxidative activities may play an important role in both *K. candel* and *B. gymnorrhiza* under heavy metals stress, and that leaves and roots of *K. candel* have greater protection of cellular membrane.

Keywords: heavy metal stress; superoxide dismutase (SOD); catalase (CAT); peroxidase (POD); lipid peroxidation; *Kandelia candel*; *Bruguiera gymnorrhiza*

Sustainable Productivity and Environmental Impact of Intensive Farmland Ecosystem in HuangHuaiHai Plain

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Fertilization long-term influence on the yield of wheat-maize cropping system The highest and most stable winter wheat and maize yields were obtained in the treatment with application of chemical N fertilizer at rate of 150 kg hm⁻² per crop season with P and K fertilizer (NPK). The 14-years averages of winter wheat and maize were 5261 kg hm⁻² and 7633 kg hm⁻², respectively. At the same application rates of N, P, and K as those in NPK, the average yields of winter wheat and maize in the treatment that half N from organic manure (1/2MN) were slightly but significantly lower than those in NPK, and at the treatment that all N was from organic manure (OM), the winter wheat and maize yields were unstable and the average yields were 22% and 16% lower than those in NPK, respectively, but increased significantly with time ($p < 0.05$). In the NP treatment the maize yields were equivalent to those in NPK, but the wheat yields were lower and lower compared with those in NPK after ten years. The yields in PK treatment without N and NK treatment without P did not show significant differences from the check (CK). The average N use efficiencies of wheat and maize were 60% and 61% in NPK, 51% and 56% in 1/2OM, and 34% and 43% in OM, respectively. We can conclude from the results that sustainable production with high yield in fluvo-aquic soil can be kept when chemical fertilizers with NPK balance were applied in long-term, which is against traditional concept: the organic manure treatment could enhance the sustainable production of farmland ecosystem.

What reasons result in long-term high yields in chemical NPK fertilizers treatment? Following these maybe could support the conclusion: Firstly, the relatively high pH of fluvo-aquic soil effectively buffered the acidification process from chemical fertilizer application. The pH value of NPK treatment slightly declined from 8.4 to 8.0, and NP from 8.4 to 7.9 after 16-year chemical fertilizer application, and became more suitable for crop growth. Secondly, the increase in crop biomass and soil organic carbon and organic nitrogen contents effectively improved the soil fertility and soil structure. It was found that both in the chemical fertilizers treatments (NPK, NP) and in organic manure treatments (OM, 1/2MN) soil organic matter and total nitrogen significantly increased with time, the increase rank followed OM > 1/2OMN > NPK > NP. It is because the application of chemical fertilizers enhanced the C and N immobilization in soil resulted from large amount of root exudates and residues with high crop biomass. Thirdly, the bacterial community structure in soil didn't affected by long-term different fertilizations and underground bio-transformation system kept stable. The results from long-term experiments showed that long-term fertilization greatly increased soil microbial biomass C and dehydrogenase activity, except that the P-deficiency fertilization had no significant effect. Organic manure had a significantly greater ($P < 0.05$) impact on the biomass C and the activity, compared with mineral fertilizers. Microbial metabolic activity (dehydrogenase activity per microbial biomass C) was significantly higher ($P < 0.05$) under balanced fertilization than under nutrient-deficiency

fertilization. General bacterial community structure was analyzed by PCR-denaturing gradient gel electrophoresis (DGGE) targeting eubacterial 16S rRNA gene. Mineral fertilization did not affect the DGGE banding pattern, while specific DGGE band was observed in organic manure-fertilized soils. Phylogenetic analysis showed that the change of bacterial community in organic manure-fertilized soil might not be because of the direct influence of the bacteria in the compost, but because of the promoting effect of the compost on the growth of an indigenous *Bacillus* sp. in the soil. Fourthly, the enhancement of nitrification potential induced by chemical N fertilizer could effectively reduce the toxicity of ammonia on soil microorganisms, and maintained the stability of soil microorganism community.

Soil quality under long-term intensive farming Fluvo-aquic soil is widely distributed in Huanghuai Plain (HHH-Plain), previously it is a poor fertile soil with nutrient deficiency, particularly nitrogen (N) and phosphorus (P) deficiencies except potassium (K) due to light texture, low organic matter, higher soluble salts and calcareousness. In the last 2 decades productivity potential of fluvo-aquic soil was enhanced by intensive practice, such as huge nutrient input, expanding of effective irrigation area and increase in irrigation water amount by pumping groundwater through wells, which resulted in the HHH-Plain became the highest yield area in China. However, a question has been concerned, i.e. how does the long-term intensive practice influence on fluvo-aquic soil quality? For this sensitive problem researchers from Fengqiu Station conducted long-term experiments for monitoring and observing the change of fluvo-aquic soil quality (such as simulation studies in lysimeters, long-term field experiment, gridding soil survey in 8 typical counties selected from HHH-Plain).

The results from laboratory and field experiments indicated that there was not only high nitrification potential but favorable environment for ammonia volatilization in fluvo-aquic soil. Therefore gaseous loss and leaching of nitrogen were two important processes in decreasing the use efficiency of nitrogen fertilizer in fluvo-aquic soil. On the other hand, large amount of phosphoric fertilizer was applied and immobilized at Ca-P form in fluvo-aquic soil with calcareous property. Since P slowly releases from Ca-P, accumulated P can be re-used by plants, and prone to increase available P level in fluvo-aquic soil. The results also showed that potassium was abundant in fluvo-aquic soil, but after 10 year intensive cropping soil available potassium was decreasing because the removed potassium amount through harvesting exceeded soil capacity for releasing K when fertilization without K. The results from long-term monitoring of transport of water and salts in fluvo-aquic soil indicated that the salts moved into the layer under root zone or deeper through irrigation washing process in HHH-Plain when great groundwater was exploited for flooding irrigation in the last 20 years. This irrigation approach was positive on preventing secondary salinization but negative on sustainable utility of water resources and nutrient conservation in HHH-Plain. Long-term experiment demonstrated that certain amount of nitrate leached into groundwater every year and polluted the groundwater. Soil organic matter, as an important index of soil fertility quality and ecosystem stability was elevated, and high yield also sustained even under long-term application of chemical fertilizers (NPK), which was demonstrated by both the long-term nutrient experiment and the long-term on-site monitoring in two county region: Fengqiu and Yanjin. The reason is that soil organic matter was promoted by high yield with huge crop biomass, the soil productivity increased in accord with elevation of soil organic matter.

Gridding survey was done to identify what regional soil quality changes. One thousand seven hundred fifty-five soil samples were collected from 7 typical counties, i.e. Yuanyang, Fengqiu, Yanjin, Changyuan, Jizhou, Pingyuan, Yucheng, which were distributed in 3 provinces (Henan, Hebei, Shandong) of HHH-Plain. Twenty-three items were analyzed each sample. Some data, such as the second national soil survey in 1979-1983, soil environmental background investigation was collected too. The results showed that after 20-year intensive cropping, salinity was hardly found in root zone, soil organic matter and available phosphorus gradually increased, but soil available potassium was decreasing. The average residues of DDT in surface soil were much less after 20 year degradation, and only 3% samples exceeded the national standard for soil environment ($50 \text{ ug}\cdot\text{kg}^{-1}$). The average residues of hexachlorocyclohexane ($\text{C}_6\text{H}_6\text{Cl}_6$) were far lower than the standard ($50 \text{ ug}\cdot\text{kg}^{-1}$), and 97% CHC was degraded compared to the residues 20 year ago. The heavy metal contents in fluvo-aquic soil (especially Cd, Cr, Pb, Cu, Zn and so on) weren't beyond the standard, but all of them had an accumulative effect to different extents except Cr compared with the data 20 year ago, for example, in surface soil in Fengqiu increase of Cd and Pb was more than 80%, and Cu and Zn more than 60%, only Cr wasn't significant. The identification of pollution sources indicated that long-term fertilization, particularly phosphoric fertilizer application would lead to accumulation of heavy metals (As, Hg, Cd, Pb so on) in soil besides the effect of the macro-environment, such as dry and wet falls from atmosphere.

Environmental impact of intensive farmland ecosystem The results from long-term field experiment, on-site observation and regional investigation all indicated that the organic matter in the fluvo-aquic soil was increasing in both chemical fertilizers and organic manure. We conclude that farmland ecosystems in HHH-Plain is as a carbon sink. For instance, soil carbon immobilization increased by 27% in balanced fertilization of NPK (150 N kg ha^{-1} per crop season) for 14years, and most of the increased soil carbon was the heavy fraction which is difficult to mineralization. Of course, the soil carbon immobilization can be promoted by organic manure application, but the proportion of the light fraction of organic carbon increased evidently. The field monitoring indicated that CO_2 emission in Agro-ecosystem was related to soil organic matter content and crop biomass. In maize seasons CO_2 emission was mainly related to maize biomass, while mainly related to soil organic matter content in wheat seasons. During maize seasons, $2.94\text{Mg organic-C ha}^{-1}$ was mineralized in Fluvo-aquic soil, which accounted for 8% of total soil organic carbon in 0~40cm layer. In NPK treatment the mineralization of organic carbon could be compensated by crop root exudates and residues of plants. The maize growth evidently increased soil CO_2 emission, that was mainly attributed to the rhizosphere respiration, from which the contribution to CO_2 emission was 46~50% during the whole maize seasons. Application of N fertilizer effectively decreased soil respiration by 10%, and also lowered diel variation range of soil respiration. In maize-wheat cropping system N_2O emission was seasonally various, which was deeply influenced by soil water regime in maize seasons and an optimum moisture for the emission was 45 ~ 60% (water-filled pore space-WFPS), while in wheat seasons, N_2O emission mainly by soil temperature. The N_2O emission factor from N fertilizer at application rate of 150 kg N ha^{-1} per season was 0.61 ~ 0.77% annually, and 1.05~1.34% and 0.24 ~ 0.26% in the maize seasons and wheat seasons, respectively, therefore, most of N_2O was emitted in summer seasons. The N_2O emission factor was enlarged by increase in N application rate. Long-term application of organic manure significantly elevated the potential of N_2O emission, but a large amount of N_2O

emission wasn't observed in field, and it is probably because low transforming rate of NH_4^+ from mineralization of organic manure restrained N_2O formation. Long-term monitoring showed that at an application rate of 150 kg N ha^{-1} (balanced with P, K), little $\text{NO}_3\text{-N}$ leached into deep soil layer and groundwater, and the environmental impact from N fertilizer was slight too. However, more than the application rate would lead to $\text{NO}_3\text{-N}$ leaching. The results from 3 year field monitoring indicated that when total nitrogen input reached $230 \sim 290 \text{ kg N ha}^{-1}$ per season $4.8 \sim 18.0\%$ of N fertilizer leached into deep soil layer and groundwater.

Key words: sustainable productivity; cropping system; ecosystem; soil quality; long-term experiment; greenhouse gas; nitrate leaching

Dominant zooplankton species shift in Changjiang River Estuary: possible causes

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Zooplankton in the Changjiang River Estuary was investigated quarterly in 2004, the first year after the Three Gorges Reservoir was impounded to a water level of 135 m. Compared with zooplankton assemblages during 1955-56, 1985-86, and in 2002, evident dominant species shift was observed only in August. A tropical-subtropical copepod species *Temora turbinata* (Dana, 1849), recognized as seasonally appeared and non-dominant in this area before 2003, became the most abundant zooplankton species in August 2004, while previous dominant species, such as *Calanus sinicus*, *Euchaeta concinna* and *Labidocera euchaeta*, decreased in density and appearing frequency. *T. turbinata* is perennially found and seasonally predominant in coastal and estuary areas in the south of China, such as both sides of the Taiwan Strait. It appears in the Changjiang River Estuary in summer, in correspondence with northwards invasion of the Taiwan Warm Current. Our findings indicate that in summer 2004 the Changjiang River Diluted Water shrank its range and the Taiwan Warm Current occupied a larger area in both bottom and surface layers, comparing to long-term average. It is suggested that *T. turbinata* in Changjiang River Estuary originates from south of the East China Sea, but reasons of its prosperity in this area is uncertain till now. It may be another example of northward extension of warm-water species resulted from global warming, or effects of water control of the Three Gorges Reservoir in the estuarine ecosystem.

Key words: Changjiang Estuary; zooplankton; species shift

Satellite-based long-term estimate of carbon/water fluxes over an old-growth Chinese temperate mixed forest: 2000-2006

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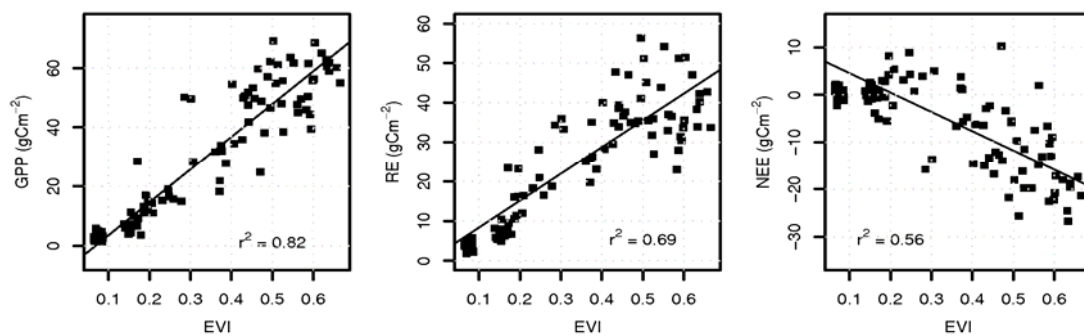


Figure 1 relationships between 8-day sum of GPP, RE and NEE and MODIS 8-day composite EVI data.

Methods

Flux measurements of CO₂, H₂O, energy and routine meteorological variables at this site were collected with Eddy-covariance method between 2003 and 2005. Artificial neural network (ANN) technique was applied to fill data gaps and to partition NEE series into GPP and RE.

We downloaded the 8-day Land Surface Reflectance (MOD09-A1) and 8-day Land Surface Temperature (MOD11A2) data sets for the period of 2003–2005 from the EROS Data Center, US Geological Survey (<http://www.edc.usgs.gov/>). EVI were calculated with the reflectance data. Cloudy observations in a time series of vegetation indices were gap-filled using a simple gap-filling method and the cloud quality flag in the surface reflectance files. Winter EVI was replaced with that of snow-free periods very close to winter.

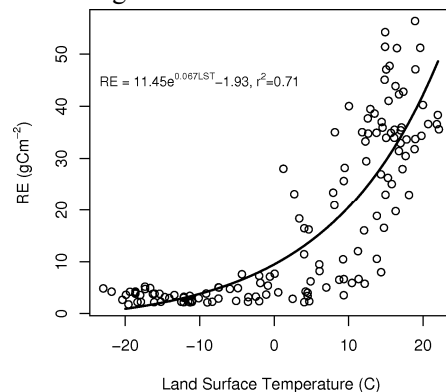


Figure 2. relationship between 8-day sum of respiration and MODIS land surface temperature data.

Results

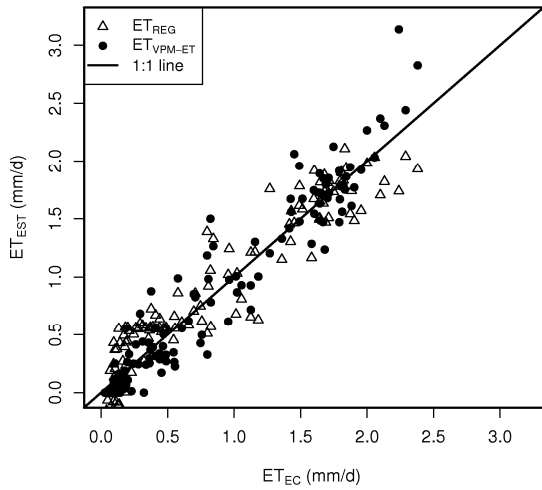
1 EVI based carbon fluxes

EVI was better correlated with GPP than RE and NEE (Figure 1). Although variation in respiration probably accounted for by variation in surface temperature rather than greenness (Figure 1 and Figure 2), respiration by EVI was better than that by temperature probably for, in this ecosystem, plant respiration consumed about 60% of GPP.

Table 1 shows estimates of GPP, RE and NEE for 2000 to 2006. This old-growth forest ecosystem is carbon sink although there were significant inter-annual variations in fluxes components.

Table 1. EVI based estimates of flux components for year 2000 to 2006. units: gC m⁻²

YEAR	GPP			RE			NEE		
	Q50	Q2.5	Q97.5	Q50	Q2.5	Q97.5	Q50	Q2.5	Q97.5
2000	-891	-857	-930	735	704	768	-156	-153	-162
2001	-867	-829	-910	727	688	767	-141	-141	-143
2002	-946	-900	-995	766	740	794	-179	-161	-201
2003	-806	-885	-218	-212	-229				
2004	768	843	-206	-198	-218				
2005	741	818	-170	-166	-178				
2006	759	842	-179	-182	-179				



(eqn. 1). The model performed reasonably well against measured ET (Figure 3).

$$y = 1.39x - 4.39, R^2=0.87, P<0.05 \quad (1)$$

Figure 3. Comparisons between satellite-based estimates and VPM-ET estimation with measured ET.

Key words: CO₂/H₂O fluxes; EVI; LST; old-growth forest; long-term

Temporal and spatial dynamic of litterfall of a mixed Beech forest in Shennongjia area, China

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The study on litter fall has been a key component to the systemic study of the nutrient cycling in the forest's ecosystem. This nutrient cycling is indispensable in maintaining forest's healthy and vitality condition. Shennongjia Nature Reserve Area, one of the protected core areas with a great biodiversity, has a perpendicular distribution of *Fagus engleriana* and *Cyclobalanopsis oxyodon*, which has formed the main subtropical evergreen broad-leaved community in its geographical vegetation distribution. Through the investigation of the mixed-species, we are going to probe the space and time pattern of the litter fall by the statistics of quantitative dynamics in constitution, distribution and nutrient cycling, and by analyzing the relationship among the quantity of litterfall, landform and main species in the community. The average annual quantity of litter fall reached to $329.03 \text{ kg}\cdot\text{hm}^{-2}\cdot\text{h}^{-1}$, which provided $146.53 \text{ kg}\cdot\text{hm}^{-2}\cdot\text{h}^{-1}$ in annual nutrition reversion. The concentration of nutrition in the litterfall had different peak in different month, which was closely related to the structure of the mixed deciduous and evergreen community. In the special pattern of the nutrition content of litterfall, the related arrangement of other species was small, *F. engleriana* took the second place, and *C. oxyodon* had the highest value. This is probably due to other species showed the pattern of entire community and the pattern was small. *C. oxyodon* was the richest species in the community, thus the scale of its pattern was large. Analyzing the relationship between litterfall and slope, total stands, the numbers of *F. engleriana*, and the numbers of *C. oxyodon*, the results showed that the numbers of *C. oxyodon* and *F. engleriana* were significantly positively correlated, and negatively correlated with the total stands. This illustrated that the numbers of *C. oxyodon* influenced the number of total stands. There was large tree of *F. engleriana*, but the number was small, that's why it was negatively related with total stands.

Key words: evergreen-deciduous broad-leaved forest; topography; geostatistic; return rate; nutrition cycling.

Biomass allocation and clonal growth in response to nutrient availability in the stoloniferous herb *Potentilla reptans* L var. *sericophylla*

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Plasticity in biomass allocation of plants under different growing conditions is often assumed to be adaptive. Biomass allocation patterns in clonal plants are usually different from that in non-clonal plants due to clonal architecture and clonal morphology. de Kroon and Schieving (1990) published a model to predict the likely pattern of biomass allocation to spacers (i.e. stolons or rhizomes) as resource supply varies. The model predicted that under moderate resource levels, clonal plants would allocate more biomass to spacers to efficiently utilize resources. The aim of this study is to experimentally test the feasibility of this prediction.

In a greenhouse experiment, *Potentilla reptans* L var. *sericophylla* plants were subjected to eight levels (i.e. N1 to N8 in decreasing order) of nutrient supply. N1 was equivalent to 600 kg nitrogen as NH_4NO_3 , 240 kg phosphorus as NaH_2PO_4 and 600 kg K as KCl per ha per year. N2 to N8 were 50%, 25%, 12.5%, 6.25%, 3.13%, 1.57% and 0% of N1, respectively. The experiment was started on April 6, 2003 and ended on June 3, 2003.

P. reptans had greater biomass, produced more stolons and had longer stolon internode at the moderate levels (i.e. N3 and N4 treatments) of nutrient supply. Biomass allocation to different plant organs (roots, stolons, laminae and petioles) responded greatly to the nutrient treatments. With decreasing nutrient supply, biomass allocation to laminae and petioles decreased, whereas that to roots increased. Biomass allocation to stolons tended to be the highest at the moderate levels (N3, N4) of nutrient supply and became smaller at both the lower and higher nutrient conditions.

Patterns of biomass allocation to stolons in *P. reptans* under different levels of nutrient supply agree with the model prediction of de Kroon and Schieving (1990), suggesting that allocating more biomass to spacers (i.e. stolons or rhizomes) at moderate nutrient levels enables clonal plants to efficiently utilize resources.

Keywords: clonal plants; plasticity; biomass allocation model; biomass allocation to stolons

Spatial and seasonal variations of nitrogen and phosphorus in the surface and ground waters within typical terrestrial ecosystems in China

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Water quality is influenced by agricultural development and varies with surrounding land management. The losses of nitrogen (N) and phosphorus (P) from agriculture to watercourse have increased over the past decades as a result of intensive farming and development of a more industry-based type of agriculture. In this paper, the water quality indexes which have been surveyed and monitored regularly since 1998 for 31 typical terrestrial ecosystem field stations in the Chinese Ecosystem Research Network (CERN) were reviewed. Furthermore, spatial and seasonal patterns in the concentrations of N ($\text{NO}_3\text{-N}$ and total N) and P ($\text{PO}_4\text{-P}$ and total P) were analyzed in the running water, standing water and ground water under 8 typical ecosystems from 2004 to 2006. Water samples were collected regularly at the same position within each site at the same time, using standard protocols incorporating standard quality control procedures. Statistical differences were conducted using the SPSS computer program. Spatial and seasonal variations of N and P concentrations were noted among the different ecosystems. The N and P concentrations can be ranked as the inland oasis agriculture sites (Linze station, E 99° 35', N 39° 04') > the marsh plain sites (Sanjiang station, E 133° 31', N 47° 35') > the multiple ponds with rice growing and fishery sites (Changshu station, E 120° 41' 53", N 31° 32' 56") > the agriculture sites in the Yellow River irrigation area (Fengqiu station, E 114° 32', N 35° 01') > the upland agriculture and forest sites in the red soil area (Yingtian station, E 116° 55', N 28° 15'; Qianyanzhou station, E 115° 04' 00", N 26° 44' 51") > the subtropical forest sites (Ailao Mountain station, E 101° 01', N 24° 32') > the desert sites (Shapotou station, E 104° 57', N 37° 27'). The N and P concentrations in the ground water, standing and running waters in the different ecosystem sites were fluctuated seasonally and annually. However, the variation trends were not found. Further data are needed to analysis the seasonal variation. The $\text{PO}_4\text{-P}$ and the total P concentrations can be ranked as ground water > running water > standing water, while the $\text{NO}_3\text{-N}$ and total N concentrations can be ranked as ground water > standing water > running water across the 8 ecosystems. The results indicate that agriculture practices have obvious influences on water quality in the ground, standing and running waters.

Keywords: CERN; terrestrial ecosystem; water quality indicators; nitrogen concentration; phosphorus concentration

Evaluation of the CERES-wheat model for predicting wheat growth, development and yield on the Tibet Plateau

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The CERES-Wheat model of DSSAT has been evaluated for simulation of plant development, growth and yield under a wide range of environment conditions. However, there are concerns about the applicability of DSSAT for agricultural development for high elevation plateau areas where there are low air pressure conditions. The objective of this study was to evaluate the CERES-Wheat model for its ability to simulate winter wheat development, growth, and yield for environmental conditions of the Tibet Plateau. The input data used for model were provided by the Lhasa Agroecosystem Research Staion(91°20'E, 29°41'N, elevation 3688m), Chinese Academy of Sciences. The field experimental data for growing season of 1994-1995 for cultivar Zangdong92-66 and 1999-2000 for cultivar Bussyd were used for model calibration. Independent field experimental data for growing season of 1997-1998, 1998-1999 and 2000-2001 were used for model evaluation. The goodness of fit between model outputs and field measurement for the specific cultivar as Zangdong_92-66 was assessed for anthesis and harvest maturity dates, above-ground dry matter and grain yield under model calibration. The CERES-Wheat model don't gives good prediction of crop behaviour for another cultivar Bussyd. The main reason was that sensitivities to thermal time were different among cultivars in actual world. The cultivar Bussyd have a higher base temperature than cultivar Zangdong_92-66. We recommend that a new genotype coefficient is needed in order to be able to adjust the base temperature.

Keywords: evaluation; CERES-wheat model; winter wheat; growth, development and yield; Tibet Plateau.

Changing in farmland water use and grain production associated with cultivars and agronomic practices in the North China Plain

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Winter wheat (*Triticum aestivum* L.) and maize (*Zea mays* L.) are the two staple crops in the North China Plain and together they form the two crops per year rotation system. Field measuring conducted at Luancheng Station showed that from 1980 to present the evapotranspiration increased slightly, while the crop yield was improved by 50%, resulting the significant increase in water use efficiency (WUE), especially for maize. Water use efficiency was improved from 1.0 kg/m³ to 1.5 kg/m³ for winter wheat and from 1.4 kg/m³ to 2.0 kg/m³ for maize in the Piedmont of Mt. Taihang in the North China Plain. The improvement both in grain production and WUE were associated with cultivars and agronomic management practices.

Introducing new cultivars played an important role in grain yield improvement. Typical winter wheat cultivars grown widely in Hebei Province in North China Plain during different time from 1970s to present were tested under same growing condition (fully supplied with water and nutrients). The results showed that yield of the most recent breed cultivars were over 20% higher than that the cultivars grown in 1970s. The renewing in cultivars contributed averagely 1% grain yield increase per year for winter wheat. An increase in kernels per unit area plays a major role in the increase in grain yield. The new cultivars had higher harvest index and lower plant height than the old cultivars. No significant change was found on kernels per spike and kernel weight. There was also difference in water use and grain yield among modern cultivars. Results showed that difference in grain yield and WUE was apparent among 16 modern winter wheat cultivars in field experiments during 2002/03 and 03/04, in the high production area of Mount Taihang in the North China Plain (NCP). Cultivars producing higher grain yield had higher WUE. Cultivars responded differently to irrigation applications. Some cultivars performed better under limited irrigation. Earlier flowering cultivars tended to have higher grain yield, since they had the advantage of longer grain-filling duration under this climatic condition. Using a good cultivar has the potential to improve yield and WUE and reduce irrigation water use in this region.

Mulch is an effective way to prevent soil evaporation. The wide using of combine at the beginning of 1990s in the region made it possible to mulch maize using wheat straw. The mulch significantly reduced soil evaporation. Results from micro-lysimeter measuring showed that the average soil evaporation rate for mulched treatment was smaller than that of non-mulched treatment, especially at the earlier stage of maize when leaf area was smaller. The average soil evaporation was 0.52 mm/day and 1.17 mm/day for the mulched and non-mulched treatments, respectively. Totally more than 50 mm evaporation from soil surface could be saved by the mulch practice. The comparison in WUE under mulched and non-mulched conditions also showed that mulch significantly improved WUE of maize by 6% to 10% for 12 seasons.

It was reported in 1970s, winter wheat in this region was irrigated by 7 to 10 times each season. In

1980s, the irrigation number was reduced to 4 to 5 times, and presently irrigation numbers was at 3 to 4 for winter wheat. Scientific scheduling of winter wheat not only reduced irrigation application, but also increased water use efficiency. Experimental results showed that the effects of irrigation application on yield and WUE were significant ($P=0.01$) and relative consistence. Removing the irrigations during crop revival and the late grain filling stages not only improved grain production but also WUE. Irrigation twice, at jointing and at booting to anthesis, produced the maximum grain production by comparison with other arrangements under normal rainfall situation. Jointing, booting and grain filling were the best time for irrigation, when applying water three times in dry seasons. Reducing the normal number of 4 irrigations to either 3 or even 2 is an option for reducing irrigation water use in the region. Because the double cropping of winter wheat and summer maize in the North China Plain requires intensive irrigation that results in rapidly depleting aquifers and threatens the sustainable agricultural development in the region. A further study investigated the possibility of growing winter wheat and maize with minimum irrigation (MI) by bringing soil moisture in the top root zone profile to field capacity at sowing with no further irrigation afterwards. Results over 8-yrs (1997-2005) showed that grain yield of winter wheat was over 5000 kg ha^{-1} and maize was over 6000 kg ha^{-1} in most of the seasons under MI. The average yield was decreased by 14% for winter wheat and 13% for maize compared with the full irrigated treatments (FI). Water use efficiency (WUE) under MI was increased by 15% for winter wheat and 10% for maize compared with that under FI. Average seasonal evapotranspiration (ET) was 335 mm under MI and 447 mm under FI for winter wheat, and 319 mm and 403mm for maize, respectively. The mean annual total ET of the double cropping system was 654 mm under MI and 850 mm under FI. The annual supplemental irrigation requirement of MI was only half that of the FI. Approximately 200 mm irrigation water use could be reduced annually under MI. The success of MI depended on the deeper rooting system of winter wheat using soil moisture that accumulated below the shallower rooted maize over the summer rainfall season. The results showed that an MI strategy that would be simple to implement for farmers would contribute significantly to the sustainability of the groundwater resources.

The overall results showed that with slightly increase in water consumption, crop yield was significantly increased and WUE was improved. This has a significant implication to this serious water deficit region.

Aggregate pools of soil organic carbon in a Chinese Mollisol and Alfisol as influenced by long-term fertilizations

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Mollisols and Alfisols in China are mainly distributed in the northeastern region, where almost all the soils have been cultivated for food production since the soils, by nature, were fertile and productive; hence they play a very important role in food supply in China. Since the reclamation of the soils, especially in the last 50 years, they have been intensively used in an improper way, i.e. Chinese conventional cultivation system. Consequently, the quality of the soils has been deteriorated due to the decline in the quantity and quality of soil organic matter (SOM). Lack of SOM resulted in poor soil structure, which, in turn, led to losses of water and nutrients by runoff. This has become a serious problem in the region in terms of sustainability. Studies have shown that SOM can be restored by increasing organic residue input and also management is very crucial for SOC dynamics, but we still do not know how the long-term application of organic fertilizers affects SOM accumulation in the Chinese Mollisols. Aggregate fractionation is directly related to the structure and function of SOM *in situ* and aggregates can protect SOC from mineralization physically. Thereby, it is important to investigate the aggregate pools of SOC as influenced by long-term fertilization. Nevertheless, SOC and TN accumulation and dynamics are a long process; any convincing evidence can surely be obtained by long-term experiments. Our objectives are therefore to identify how the long-term organic manure amendments affect the aggregate distribution in the soils, how SOC is sequestered or depleted in different class aggregates, and what is the role of soil aggregation in SOC storage and stabilization. This study has great implications for the sustainable use of the Chinese soils.

Our study is conducted on the base of two long-term field located experiments of fertilization. Mollisol samples were sampled in April 2005 from Gongzhuling long-term located experiment site established in 1979. Three treatments were selected as follows: CK (zero fertilizer), and M1 and M2, indicating two levels of pig manure respectively. Alfisol samples were sampled in April 2006 from the Shenyang long-term located experiment site established in 1987. The selected fertilization treatments was CK (zero fertilizer), M2 and M4 (also two levels of pig manure). Four aggregate fractions, i.e. large macroaggregate (>2000 μm), small macroaggregate (250-2000 μm), microaggregate (53-250 μm) and silt+clay fraction (<53 μm), respectively, were obtained by wet sieving. Aggregate fractions retained were dried at 50°C. The organic carbon contents were analyzed by an element analyzer.

The results showed that the small macroaggregate was the most abundant component in both of the soils, accounting for 54.53-60.24% and 48.22-52.29% of the dry soil mass in Mollisol and Alfisol, respectively. Hence, about 50% of SOC in both two soils were observed in the small macroaggregate. Although long-term manure application facilitated the aggregation process in both soils, the aggregation mechanism was different. Small macroaggregate proportion decreased,

while large macroaggregate percentage increased significantly in Mollisol after organic manure treatment, indicating that the re-aggregation of small macroaggregate into larger aggregate fractions is important for SOC sequestration in the Mollisol amended with organic manure. However, in the Alfisol samples, microaggregate and silt+clay fractions were re-aggregated into larger aggregate fractions by manure application. Nevertheless, the SOC contents in all the four aggregates in both types of soils increased remarkably with organic manure application, and the new sequestered SOC mainly distributed in $>53\mu\text{m}$ aggregates. The findings indicate that the coarse aggregates was more important in SOC sequestration. The enrichment factor for SOC (E_C) decreased with the decreasing of aggregate size, which confirmed the preferential accumulation of SOC in the coarse aggregates. The shift of SOC from small macroaggregate to large macroaggregate in the Mollisol and from microaggregate and silt+clay fraction to small macroaggregate in the Alfisol was observed due to the different aggregation mechanism of the two soils caused by manure application. In conclusion, the present study revealed that organic manure application does not only enhance the sequestration of SOC, but also improve the quality of SOC by aggregation effect.

Keywords: soil organic carbon; aggregate; fertilization; mollisol; alfisol

Soil net nitrogen transformation during the non-growing season in Inner Mongolia, China

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We periodically measured N availability and its responses to freeze-thaw events by *in situ* intact soil core incubation in soils of four land-use types, i.e., fenced steppe (FS), grazed steppe (GS), abandoned field (AF), and crop field (CF), in an agro-pasture ecotone in Inner Mongolia, China, during the non-growing season (October 2004 – April 2005). Our objectives were to investigate and compare the temporal variations in net ammonification, net nitrification and net N mineralization in the soils over the course of the study. Comparing with the beginning of the study in October 2004, the mean NH_4^+ -N concentration in the soils of the four land-use types declined by 53.3%, while the mean NO_3^- -N concentration increased by 192.7% at the end of incubation. Net N mineralization rates ranged from -0.19 to $0.23 \mu\text{g g}^{-1} \text{d}^{-1}$ during the non-growing season, and the temporal variations were significantly related to soil temperature, but the patterns varied among the land-use types and follow the order: GS > FS and CF > AF.

Keywords: nitrogen cycle; mineralization; land-use conversion; non-growing season; freeze-thaw

Seasonal and vertical variations of phytoplankton biomass and their response to upwelling in Sanya Bay, South China Sea

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A submersible fluorescence probe (bbe FluoroProbe) for in situ phytoplankton quantification (showed as chlorophyll a concentration) was conducted in Sanya Bay from January 2005 to February 2006. Four groups of algae were detected, of which almost 80% were diatoms. The total phytoplankton concentration featured high correlation with the concentration of diatoms, and their relationship is total chlorophyll a concentration = 1.1101 diatom concentration + 0.1848 ($R^2=0.9812$). Seasonal variation of chlorophyll a concentration showed high value (averaged 2.20 mg m⁻³) present in summer, low concentration (averaged 0.68 mg m⁻³) occurred in spring. Wind-induced coastal upwelling reveals a distinct southeast-northwest gradient. The maximum thermocline intensity averaged 1.186 °C m⁻¹ was detected at station S03, and situated at the depth of 6-13 m. While there was no thermocline detected at station S01, which located at the estuary of Sanya River. An intensive study carried out at a fixed station S03 showed that the upwelling caused a 7.13 °C temperature drop of the surface water (0-5m). The total chlorophyll a concentration sharply increased in the area affected by the upwelled water. And the highest value of total chlorophyll a concentration (averaged 5.83 mg m⁻³) occurred in the deep layer water (10-20m) in July. Negative relationship was found between total chlorophyll a concentration and sea water temperature in summer when the thermocline was at its strongest. Remarkable community structure succession was detected in phytoplankton composition. The concentration of green algae decreased sharply in autumn, when the concentration of cyanobacteria and cryptophyta increased greatly.

Keywords: bbe FluoroProbe; phytoplankton; thermocline; upwelling; Sanya Bay;

Climate change from 1960 to 2000 in the Lancang River Valley, China

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Archival data of monthly air temperature and precipitation series were used to investigate climate change trends and characteristics during 1960–2000 at 19 stations along Lancang River from the north to the south, in the mountainous Himalayan region of southwest China. The magnitude of a trend was estimated using Sen's Nonparametric Estimator of Slope approach. The station significance of a trend was assessed by the MK test. Over the observation period of 41 years, mean annual air temperature increased at the rate of 0.01°C/yr to 0.04°C/yr in 12 stations at the significance level $\alpha = 0.01$. The changes in precipitation in different areas are very dissimilar and complex. Mean annual precipitation that decreased from –2.86mm/yr to –5.29mm/yr at 3 stations, and mean annual precipitation that increased from 5.77mm/yr and 7.44mm/yr at 2 stations, were statistically significant at the significance level $\alpha = 0.05$. The lower reaches of Lancang River experienced much more severe temperature increase, precipitation decrease, and drought development than the upper reaches in the past 41 years.

Keywords: climate change; long-term temperature

Nitrous oxide emissions and denitrification from long-term fertilized wheat and maize fields in the North China Plain

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Denitrification caused reduction of N fertilizer use efficiency and environmental pollution in agricultural lands. This study was conducted to examine the potential denitrification in subsoil and rates of denitrification and N₂O emissions from surface soil, respectively, as influenced by the application of N fertilizers in an irrigated winter wheat and summer maize rotation in the North China Plain. The treatments included four rates of N fertilizer: 0 (N1), 200 (N2), 400 (N3) and 600 (N4) kg N ha⁻¹ year⁻¹. The acetylene inhibition technique was applied, and potential denitrification of subsoil was estimated in theoretically optimal conditions for denitrification. Potential denitrification ranged from 0.2 to 5.1 mg N₂O-N kg⁻¹ day⁻¹ in the surface soil, and increased as the amount of N applied increased. The potential denitrification for subsoil (20-160 cm) was, for all treatments, only a small fraction of the rate in the surface soil, less than 3%.

Soil moisture and temperature were monitored, and soil nitrate (NO₃⁻-N) and ammonium (NH₄⁺-N) concentrations were analysed. Soil moisture content was the key factor influencing denitrification. Soil NO₃⁻-N was not the main limitation in this soil. There were short bursts of N₂O emission and denitrification when irrigation/heavy rainfalls followed application of N fertilizer. There were 2-3 days lag between the peaks of N₂O emission/denitrification and these events. The highest fluxes of N₂O emission (170 g N ha⁻¹ d⁻¹) and denitrification (288g N ha⁻¹ d⁻¹) were observed in the 600 kg N ha⁻¹ year⁻¹ treatment during the maize growing season in July. Total N₂O emissions from maize were 0.6~4.5 kg N ha⁻¹, accounting for 0.08%~1.28% of the applied N fertilizer. Denitrification losses were 0.8~6.1 kg N ha⁻¹, accounting for 0.7%~2.7 %. The N₂O fluxes and denitrification rate were much lower for the winter wheat compared to the maize. Total N₂O emissions from the winter wheat were 0.8~1.8 kg N ha⁻¹, accounting for 0.25%~0.34% of the applied N fertilizer. Denitrification losses were 1.0~2.5 kg N ha⁻¹, accounting for 0.27%~0.49%. The relatively small difference between N₂O emissions and denitrification indicates that nitrification was an important source of the N₂O, except when soil moisture content was high. The results suggest that whilst denitrification was not a very important pathway of applied N fertilizer loss from this light textured soil, the effect on the environment cannot be overlooked.

Canopy water use efficiency at 8 sites of ChinaFlux

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Canopy water use efficiency (W), the ratio of gross ecosystem productivity (GEP) to evapotranspiration (ET), is critical in determining the ecosystem productivity and water use. It is also a critical parameter for the coupled cycles of carbon and water in the terrestrial ecosystem. With the eddy covariance (EC) technique, we estimated the W in three growing seasons (2003-2005) at eight sites of ChinaFlux: one crop ecosystem of winter wheat (YC); four grassland ecosystems of alpine swamp meadow (SD), alpine shrub-grass meadow (GCT), alpine meadow-steppe (DX) and temperate steppe (NM); three forest ecosystems of temperate coniferous and broad-leaved mixed forest (CBS), subtropical coniferous plantation (QYZ) and subtropical evergreen broad-leaved forest (DHS). In sequence, the W was 5.26-6.78 g C kg⁻¹ in the crop ecosystem, 1.66-3.67 g C kg⁻¹ in forest ecosystem and 0.23-1.31 g C kg⁻¹ in the grassland ecosystem. Except for in the two subtropical forest sites of QYZ and DHS, the W showed similar seasonal variation as the seasonal variation of leaf area index (LAI) in the crop ecosystem, four grassland ecosystems and the temperate forest ecosystem of CBS. In the crop ecosystem, with sufficient water and nutrient supply, the more solar radiation and higher vapor pressure deficit (VPD) could reduce the W . In the four grassland ecosystems, with comparative scarce water resources, the W was mainly dominated by GEP. In the forest ecosystems, the W decreased linearly with increasing precipitation (P) and air temperature (T_a), and the effect of T_a was more significant than that of P .

Keywords: water use efficiency; ChinaFlux; crop; grassland; forest

Soil respiration characteristics of four forest type in Dagangshan in Jiangxi province

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The global warming is the most serious environmental problems that we are facing with now. In this paper, the soil respiration rates of evergreen broadleaved forest, *Phyllostachys pubescens* plantation, Chinese fir plantation and coniferous and broad-leaved mixed forest in Dagangshan were measured by LI-6400 CO₂ analysis system from June to November in 2005, with the microclimate factors determined synchronously. The object of this study was to discover the effects of changes of land utility ways on the soil carbon output.

The soil respiration rule in the four forest types is approximately the same, but the mean values of the soil respiration rate have remarkable difference. The daily mean soil respiration rate of *Phyllostachys pubescens* plantation, evergreen broadleaved forest, coniferous and broad-leaved mixed forest and Chinese fir forest is 5.76, 4.28, 3.51, 2.47 $\mu\text{mol} \cdot \text{m}^{-2} \cdot \text{s}^{-1}$ respectively.

From the comparison of soil respiration diurnal changes of the four forest types, it is known that the variation of soil respiration rate is very little. We consider that it is because of the little soil temperature changes. So it is feasible to replace the soil mean respiration rate of the whole day by the measures at 9:00 AM.

The exponential relation equation of evergreen broadleaved forest, *Phyllostachys pubescens* plantation, Chinese fir plantation and coniferous and broad-leaved mixed forest is $y=0.94e^{0.066x}$, $y=0.83e^{0.081x}$, $y=0.95e^{0.038x}$ and $y=0.7e^{0.072x}$ respectively.

The relations between soil respiration and soil humidity are remarkable, besides the Chinese fir forest.

From the study in the evergreen broadleaved forest, we know that the litters has remarkable effects on soil respiration, and the primary result was that CO₂ released from the litters contribute 33% to the soil respiration. In addition, the rain has remarkable activity to the soil respiration.

Keywords: soil respiration rate, evergreen broadleaved forest, *Phyllostachys pubescens* plantation, Chinese fir plantation, coniferous and broad-leaved mixed forest

A seasonal round observation of soil respiration in three types of communities along grass-shrub transition in Inner Mongolia, China

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Grasslands as one of the most widespread vegetation types worldwide, cover nearly one-fifth of the world's land surface area and play a significant but poorly recognized role in the global carbon cycle. Up to date, a large area of grasslands in the world has been faced a severe problem-degradation and desertification. One form of desertification is the conversion of homogeneous grasslands into shrub-dominated ecosystems and such conversion has been noted over wide areas in the world. The change of plant type and cover from grasslands to shrub lands greatly affected ecosystem function and biogeochemistry cycle, among which carbon biogeochemical cycle is an important aspect. Many researchers generally thought that the invasion of woody vegetation into grasslands can lead to an increase in the amount of carbon storage in those ecosystems, but some researchers found ecosystem carbon loss with woody plant encroachment of grasslands. Soil respiration is the key process of ecosystem carbon cycle and partly controls the potential of ecosystem carbon sink. Unfortunately, the information about soil respiration changes accompanying with plant conversion from grasslands to shrublands is still very scarce. China has an area of grasslands of about 4×10^6 km² or about 40% of the nation's total land surface, but most of them have been affected by desertification and shrub invasion is also very popular in northwest grasslands of China, but rare are reports about soil respiration of grass-shrub transition areas. Therefore, reinforcing research on soil respiration and carbon cycle of such grassland biome is crucial for accurately predicting the potential carbon sink of terrestrial ecosystems in China.

In the present study, seasonal dynamics of soil respiration over a grassland (*Stipa bungeana*), a fully developed shrubland (*Artemisia ordosica*) and a severely sandy shrub-perennial mosaic (*Artemisia ordosica* + *Cynanchum komarovii*) were investigated in the primary growing season (May-October), 2006 to evaluate potential consequences of grassland degradation and shrub invasion on ecosystem carbon cycle. In the growing season, seasonal dynamics of soil respiration in the three communities held similar characteristics and the peak value occurred at July and August and was driven by suitable temperature and soil water condition in this period. Temperature, soil surface moisture independently or interactively affected soil respiration and the different responses of soil respiration to water-heat factors in the three communities were attributed to different soil textures and distribution patterns of plant roots. In desert ecosystems, precipitation is the switch of soil respiration pulses. After soil rewetting, soil respiration rates immediately increased to a high level and precipitation pulses could profoundly influence the estimation of total soil CO₂ effluxes. According to the field data measured normally with no precipitation pulses in the growing season, soil CO₂ effluxes were 449.41, 315.33 and 408.18 g m⁻² along communities of *S.bungeana*, *A.ordosica*, *A.ordosica* + *C.komarovii*. If added the carbon

release triggered by two times of precipitation pulses to the amount of soil CO₂ effluxes normally investigated in the growing season and the amounts were 475.36, 438.95 and 454.47g m⁻² for three communities respectively. In desert ecosystems, continuous measurement of soil respiration in field may be the best way to accurately estimate the amount of soil carbon release, but we generally can't achieve the target because of big workload. Additionally, precipitation pulse is a complicated process and soil respiration shows different responses to storm size and time. Simulated experiment in laboratory is a good way to solve the problem, but there is a gap between field condition and lab experiment. Accordingly, shortening the gap between field condition and lab experiment can do much favor.

Key words: soil respiration; grass-shrub transition; *Stipa bungeana*; *Artemisia ordosica*; *Artemisia ordosica* + *Cynanchum komarovii*; Ordos Plateau

Disturbance and succession of forest communities in an arid inland river basin

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Disturbance and succession are inextricably linked because disturbance may act as a reset mechanism for succession. However, the role of disturbances and succession process of forest communities in arid inland river basin are poorly understood. Consequently, we used data from tree rings, direct and indirect age estimates, measures of stand structure and geostatistics methods to reconstruct the historical disturbance regime, stand development patterns, and succession process of mountain forest and desert riparian forest in the Hehei River Basin, Northwest of China. The results showed that anthropogenic disturbance, including logging and water resource controlling, could not create opportunity for the recolonizing success of other tree species unless survival conditions of forest populations have been changed after disturbance. For example, the change of *Picea crassifolia* forest density submitted to exponent curve ($y=2.37e^{0.14x}$, $R^2=0.97$) during 30 years after deforesting disturbance, but other tree species did not discovered in the succession process. At the longer temporal scale, deforesting disturbance controlled tree-ring growth, but precipitation and temperature were main control factors at the shorter temporal scale. For the desert riparian forest, water resource influenced reproductive potential of *Populus euphratica*. In the core zone of oasis, groundwater level has not been changed, so growth rate of *Populus euphratica* was not also restricted obviously. However, when disturbance intensity increased and survival conditions of *Populus euphratica* disappeared, including runoff disappeared, groundwater level decreased, and surface soil erosion, climax community of *Populus euphratica* forest could be replaced by *Tamarix chinensis*.

Key words: inland river basin; mountain forest; desert riparian forest, disturbance; succession.

A preliminary study on ecosystem quantitative assessment

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The study on the value of ecosystem services first traced back to the concept of “exterior economy” proposed by Alfred Marshall in 1890. “Negative externalities” in the process of production relates the economical benefit to the ecological benefit, and thus the external cost consumed in the process of production, i.e. ecological cost should be included in National Accounting. After Robert Costanza et al. published their paper that calculated the value of the world’s ecosystem services in the journal Nature in 1997, Costanza and many other ecologists did a lot of work in the field of calculating the value of ecosystem services. The study on human well-being can trace back to Wealth and Welfare written by A.C. Pigon in 1912. Pigon is Marshall’s student. He developed the concept of “exterior economy”. In the system of Green National Accounting, besides considering the natural capital and making the sustainable income accounting, ecologists should also make human well-being accounting. Human well-being accounting directly reviews the extent to which human demands are satisfied. In the past two years, Costanza led his research group to do some effective work in the field of human well-being accounting. Until now has Costanza not yet combined the calculating of the value of ecosystem services with human well-being accounting.

The Millennium Ecosystem Assessment (MA) is an international work program designed to meet the needs of decision makers and the public for scientific information concerning the consequences of ecosystem change for human well-being and options for responding to those changes. In order to achieve the goal of MA, ecologists need to trace through and quantify a chain of causality between changes in ecosystem condition and human well-being and then do a full assessment of the consequences of altering ecosystem state and function. Quantifying ecosystem change needs to calculate the value of ecosystem services, and now that work was done a lot. Quantifying human well-being needs to make human well-being accounting, and now that work was done a little. However, the conceptual framework for the MA places human well-being as the central focus for assessment. The MA conceptual framework assumes that a dynamic interaction exists between people and ecosystems, with the changing human condition serving to both directly and indirectly drive change in ecosystems and with changes in ecosystems causing changes in human well-being. Therefore, when ecologists do ecosystem assessment, they should not only calculate the value of ecosystem services, but also make human well-being accounting, i.e. ecologists should combine the numerical value of ecosystem services’ value with that of human well-being and then do ecosystem quantitative assessment.

Keywords: value of ecosystem services; human well-being; MA; quantify; ecosystem quantitative assessment

Ammonia volatilization in relation to N application rate and climate factors in upland red soil in spring and autumn

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Ammonia volatilization in relation to N application rate and climate factors was studied through field experiment in red soil under the crop rotation of Smooth Crabgrass (*Digitaria ischaemum*) in Spring and Winter Radish (*Raphanus sativus*) in Autumn. The N flux and total N loss through ammonia volatilization in Spring and in Autumn is significantly correlated with the climate factors, such as air temperature, atmospheric pressure, soil temperature and evaporation rate.

The experimental field locates at Ecological Experimental Station of Red Soil of CERN, CAS, Yingtan, Jiangxi province (116°55'E, 28°12'N).

Soil and treatments The soil is the upland red soil derived from Quaternary red clay (Ferric Acrisols in FAO classification system; Typic Hapludult in USDA Taxonomy). The treatment was set up by three N application rates (N=90, 160 and 230 kg hm⁻²) in Spring and four N application rates (N=50, 90, 130 and 175 kg hm⁻²) in Autumn, each with 3 replicates.

Ammonia volatilization was measured by method of aerated seal room. The factors of climate for example air temperature was observed and recorded by VSALA-M520 auto-climate observation instrument fixed in climate observation station near by 100m from the experiment field.

Ammonia volatilization is affected synthetically by multi-factors including environment ones, and it may be in relation to the environment factors of air temperature, soil temperature, wind velocity, evaporation capacity, atmospheric pressure, etc. We have found the N flux and total N loss through ammonia volatilization in Spring and in Autumn is significantly correlated with the climate factors, such as air temperature, atmospheric pressure, soil temperature and evaporation capacity.

1 How factors of environment climate affected ammonia volatilization in Spring under different N application rates. Table 1 showed correlations matrix between environmental factors and ammonia volatilization in spring Smooth grass fields of red soil different in N application rate.

Table 1 showed correlations matrix between environmental factors and ammonia volatilization in spring Smooth grass fields of red soil different in N application rate.

	Factors of environment					Ammonia volatile flux by N rates		
	X ₁	X ₂	X ₃	X ₄	X ₅	N90 (y ₁)	N160 (y ₂)	N230 (y ₃)
X ₁	1.0000	0.8345	0.2386	0.2019	-0.2123	-0.1200	0.1250	0.2171
X ₂	0.8345	1.0000	0.1415	0.2869	-0.2943	-0.2625	0.0424	0.2756
[®] X ₃	0.2386	0.1415	1.0000	0.5477	-0.5501	-0.6289	0.0272	0.5576
X ₄	0.2019	0.2869	0.5477	1.0000	-0.9999	-0.2666	0.4174	0.9966
X ₅	-0.2123	-0.2943	-0.5501	-0.9999	1.0000	0.2697	-0.4149	-0.9967

X₁:Air Temperature; X₂:Soil Temperature; X₃:Wind Velocity; X₄:Evaporation Capacity
X₅:Atmospheric Pressure

The flux of ammonia volatilization by each of the three N rates corresponding to environment factors(air temperature, soil temperature, wind velocity, evaporation capacity, atmospheric pressure)formed 1 mutual type variable. F value of type correlation coefficient of the first and second mutual type variable reaches respectively level of significance ($p<0.05$ and $p<0.01$) under the three N application rates in spring. The linear equations of the two type variables as follows

$$V_1=0.0148*x_1-0.0330*x_2+0.0305*x_3-0.9837*x_4-1.9727*x_5$$

$$W_1=0.0009*y_1-0.0831*y_2+1.0370*y_3$$

$$V_2=1.2452*x_1-1.1614*x_2-1.1049*x_3+24.3350*x_4+23.6302*x_5$$

$$W_2=1.1040*y_1-0.1304*y_2+0.3659*y_3$$

Above functions, V₁ and V₂ express 2 linear classes of environment climate factors, and W₁ and W₂ indicate respectively 2 linear classes of ammonia volatilization flux with N rates in upland red soil, and the x₁, x₂, x₃, x₄ and x₅ express respectively air temperature, soil temperature, wind velocity, evaporation capacity and atmospheric pressure, and the y₁, y₂ and y₃ express respectively the ammonia volatile flux of N applied 90,160 and 230 kghm⁻²

By statistical analysis of SAS, the 41.37% of the total amount of N loss through ammonia volatilization is contributed by the 49.03% of climate factors under N applied 230 kghm⁻² treatment. The same way, the 65.58% of total amount of N loss through ammonia volatilization is contributed by the 54.77% of climate factors under N applied 90 kghm⁻² treatment in spring. Otherwise, the N loss of ammonia volatilization is very little in correlation to the climate factors under N applied 160 kghm⁻² treatment.

2 How factors of environment climate affected ammonia volatilization in Autumn with different N application rates. The table 2 showed the correlations matrix between environmental factors and ammonia volatilization of N fertilizer in Autumn

	Factors of environment					Ammonia volatile flux by N rates			
	X ₁	X ₂	X ₃	X ₄	X ₅	N50(y ₁)	N90(y ₂)	N130(y ₃)	N175(y ₄)
X ₁	1.0000	0.7564	0.3604	-0.1977	-0.0813	-0.4503	-0.5387	-0.0802	0.0945
X ₂	0.7564	1.0000	0.3693	0.0406	0.2466	-0.6107	-0.3413	-0.1671	0.2946
X ₃	0.3604	0.3693	1.0000	0.4688	0.229	-0.3348	-0.3909	-0.1458	0.0706
X ₄	-0.1977	0.0406	0.4688	1.0000	-0.269	-0.2718	-0.1389	-0.3410	-0.1400
X ₅	-0.0813	0.2466	0.2293	-0.2698	1.0000	0.1480	-0.0388	-0.0374	0.0619

X₁:Air Temperature; X₂:Soil Temperature; X₃:Wind Velocity; X₄:Evaporation Capacity
X₅:Atmospheric Pressure

By statistical analysis of SAS, in Autumn ammonia volatilization flux by each of the four N rates corresponding to environment factors(air temperature, soil temperature, wind velocity, evaporation capacity, atmospheric pressure) formed 1 mutual type variable. F value of type correlation coefficient of the only one mutual type variables reaches level of significance ($p < 0.05$) in the four N rates. The linear equations of this mutual type variable as follows

$$V_1 = -1.1489 * x_1 + 1.6980 * x_2 + 0.7366 * x_3 - 0.58617 * x_4 - 0.7745 * x_5$$

$$w_1 = -0.3966 * y_1 - 0.4000 * y_2 - 0.8044 * y_3 + 1.2499 * y_4$$

Above functions, V_1 indicates one linear classes of environment climate factors, and W_1 indicates one linear classes of ammonia volatilization flux with N rates in upland red soil. the x_1, x_2, x_3, x_4 and x_5 express respectively air temperature, soil temperature, wind velocity, evaporation capacity and atmospheric pressure. The y_1, y_2, y_3 and y_4 express respectively the ammonia volatile flux of N applied 50, 90, 130 and 175 kg hm^{-2} N application rates.

In autumn, the 19.31% of the total amount of N loss through ammonia volatilization is contributed by the 28.54% of climate factors under N applied 175 kg hm^{-2} treatment by the statistical analysis of SAS. Otherwise, the N loss of ammonia volatilization is very little in correlation to the climate factors under other N applied rates for instance of 50, 90 and 130 kg hm^{-2} treatments.

Water balance and nitrate leaching losses under intensive crop production on Ochric Aquic Cambosols in the North China Plain

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Introduction: Since the last decade, some agricultural production areas started to suffer from environmental problems resulting from inappropriate nitrogen application or related agricultural management. Irrigation and N fertilizers application in excess of crop requirements tend to increase the potential risk of nitrate pollution to groundwater, especially for light-textured soils, well-drained soils and intensive production of shallow-rooted crops under irrigated or high rainfall conditions, which can lead to considerable nitrate leaching losses. A common conclusion reported by many researchers indicated that proper fertilizer, crop, water and soil management can minimize leaching of nitrates and increase crop yields.

To quantify water balance and evaluate soil water loss by deep drainage and nitrate loss by leaching out of the root zone under the current agricultural practices, a 2-year field experiment was conducted in an Ochric Aquic Cambosols on a 1-ha field with rotation of winter wheat – summer corn located in Fengqiu County in North China Plain from 1 October 1998 to 30 September 2000. The objectives of this study were: 1) to examine water balance of irrigated wheat and corn, and 2) to evaluate soil water loss by deep drainage and nitrate leaching loss out of the root zone under the current agricultural practices. It was intended to provide more information to increase the efficiency of irrigation and N fertilization under intensive crop production while maintaining acceptable yields for the farmer without incurring environmental costs.

Results and discussion

Soil water balance and deep drainage

Considerable deep drainage (out of root zone) occurred under current agricultural practices, especially in 1999-2000, up to 273.9 mm, accounting for 60.6% of total amount of irrigation and 24.7% of total surface input (rainfall + irrigation). Even in both wheat cropping seasons when total amount of input was less than total actual evapotranspiration, 84.0 and 121.3 mm water were drained at bottom boundary respectively, which implied that the main reason of occurrence of deep drainage at the experimental site was inappropriate and excessive irrigation which was not consistent with status of soil water deficits. The great deep drainage resulted in low efficiency of water use (WUE), ranged from 1.1 to 1.5 kg m⁻³, which was rather below the level of 2.0 kg m⁻³ found in the developed countries. The results of soil water deficits and deep drainage dynamic indicated that the current irrigation practice of farmers was inappropriate, and the amount of irrigation is excessive each time, and frequency was low.

Nitrate leaching losses

NO₃⁻-N concentrations in suction-cup samples at 170 cm depth ranged from 15.5 to 43.5 mg N L⁻¹ during the 1 Oct. 1998 - 30 Sep. 2000 period. Concentrations of NO₃⁻-N consistently exceeded the recommended EU drinking water level of 11.3 mg N L⁻¹ (EU Nitrates Directive 91/676/EEC), and most of them were often above the 20 mg N L⁻¹ maximum contaminant limit permitted in China for drinking water.

Nitrate leaching losses occurred in every cropping season, and ranged from 11.0 kg N ha⁻¹ in the corn season of 1999 to 51.7 kg N ha⁻¹ in the wheat season of 1999-2000. Nitrate leaching increased in proportion to the total water loss, except for the wheat season of 1999-2000, because a great nitrate leaching of about 40 kg N ha⁻¹ resulted from a high deep drainage and a high nitrate concentration in soil at 170 cm depth occurred in early October in 1999. Results showed that 28.6 kg N ha⁻¹ in 1998-1999 cropping year, accounting for 5.9% total N inputs, and 81.8 kg N ha⁻¹ in 1999-2000 cropping year, accounting for 15.7% total N inputs, were leached out of root zone and into groundwater respectively. This significant nitrate leaching in 1999-2000 was related to the excessive amount of N fertilization, 513.1 kg N ha⁻¹ in 1999-2000, and excessive irrigation under fertilization, and storm intensities. The risk of nitrate leaching to groundwater was obvious.

Conclusions

The semi-arid region with shallow water tables tended to present problems of groundwater pollution by nitrate which was arisen from deep drainage and nitrate leaching in the intensive cropping system with excessive irrigation and high N application besides costing water resource and energy for pumping. Therefore, effective water and nutrient management regimes are important for addressing the problems of excessive nitrate leaching and groundwater pollution in the agricultural productions of North China Plain.

Keywords: water balance; deep drainage; nitrate leaching; groundwater pollution

Non-point-source nitrogen pollution in a small catchment in the Sichuan Basin, China

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Nitrogen is the most important essential nutrient for terrestrial ecosystem. However, excessive nitrogen loads to the environment results in severe non-point-source pollution which would exacerbate water quality.

A long term orientation-monitoring on N movement through runoff in a small hilly catchment in the central Sichuan Basin (105°27'E, 31°16'N), upper reaches of Yangtze River has been undertaken. Continuous observations, sampling and analyses have been conducted from 2002 to 2006 to monitor total N, nitrate-N, ammonium-N in runoff, sediment, surface and ground water so as to understand nitrogen forms, approaches, loads from different sources and effects on water environment.

Results showed, particulate-nitrogen taken by sediment from slope cropland, bareland, forestry land and grassland accounted for 57~82% of total N respectively, whereas soluble nitrogen through water flow from residence area contributed to 72% of total N. N loads from slope cropland and residence accounted for 52.4% and 25.7% of total nitrogen loads in the catchment averagely, indicated slope cropland, residence were main contributors for non-point-source N. Total N of surface water in this catchment averaged to 2.58 mg/L revealed obvious eutrophication of local water body. NO_3^- -N of the ground water reached to 10.55 mg/L averagely which could not be used as drinking water based on WHO threshold (10.0 mg/L). High contents of NO_3^- -N in the ground water were derived from slope cropland through subsurface flow because of shallow soil layer, plenty of rainfall and high application rate of N-fertilizer. The content of NO_3^- -N was persistently high with average content of 17.25 mg/L in subsurface flow of slope cropland, and annual average loss flux of NO_3^- -N was 33.81 kg/hm².

This research suggests that non-point-source nitrogen pollution is serious in the hilly area of Sichuan Basin and brings to great pressure to local water environment. Meanwhile, non-point-source nitrogen maybe imposes to off-site water environment of Yangtze River and Three Gorges Reservoir through long distance travel of soluble nitrate.

Patterns of species composition and cover between two managements in Inner Mongolia

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Overgrazing and reclamation in grassland for farming have resulted in degradation and fragmentation of natural grasslands in Inner Mongolia. It is essential to efficiently manage these lands in the region. Ex-grazing and ex-farming provided available approaches for ecosystem restoration. This study assessed the effects of the two managements on vegetation dynamics patterns. Vegetation cover and species diversity were determined in one ex-arable field and two native steppe fields in 2005. Litter in ex-arable field was significantly less than those in steppe fields, but vegetation covers were similar for them. There were more species in ex-arable field than in native steppe, but the number of dominant species was the same between the two managements. The potential diversity of species in natural grassland was greater than that in ex-arable field. Grasses were dominant species, while legumes were scarce. In order to efficiently manage degraded communities, the patterns of vegetation succession under different strategies were suggested.

Key Words: diversity; ex-arable field; ex-grazing; steppe; grassland

Annual time-series analyses of total gaseous mercury measurement and its influence factors in the Gongga Mountain on the south-eastern fringe of the Tibetan Plateau

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Long-term monitoring programs of atmospheric mercury concentrations are presently recognized as powerful tools for local, regional and global studies of atmospheric long-range transport processes, and they could also provide valuable information about the impact of emission controls on the global budget of atmospheric mercury, their observance and an insight into the global mercury cycle. Several highly-time resolved mercury monitoring stations have been constructed in the North America and Europe with the aid of fast advancement in automatization techniques of Hg determination since the mid-1990s. China is believed to be an increasing atmospheric mercury emission source; however, only a few measurements of mercury, to our knowledge, have been done in ambient air of China. Measurement of highly-time resolved atmospheric mercury concentrations have been measured at Moxi Base Station (102°72'E 29°92'N, 1640m a.s.l.) of the Gongga Alpine Ecosystem Observation and Experiment Station of Chinese Academy of Sciences (CAS) during the period of May 2005—June 2006 by using a set of Automatic Atmospheric Mercury Speciation Analyzers (Tekran 2537A). Measurements were carried out with a time resolution of every 5 or 15 minutes. The overall average TGM covering the measurement periods was $4 \pm 1.38 \text{ ng m}^{-3}$ (N=57310), which is higher than the global background level of approximately $1.5\text{--}2.0 \text{ ng m}^{-3}$. The measurements in all seasons showed a similar diurnal change pattern with a high concentration during daytime relative to nighttime and maximum concentration near solar noon and minimum concentration immediately before sunrise. The presence of diurnal TGM peaks during spring and summer is found earlier than during fall and winter. When divided seasonally, it was found that the concentrations of TGM were highest in winter with $6.13 \pm 1.78 \text{ ng m}^{-3}$ and lowest during summer with $3.17 \pm 0.67 \text{ ng m}^{-3}$. There are not significantly TGM differences between each wind sectors during each season. Whereas Hg generally exhibited significant correlations with such parameters as temperature, saturated vapor pressure, precipitation, ultraviolet radiation (UV) and atmospheric pressure during the whole measurement stage, its relationship varied seasonally. Our results suggest that the local or regional sources (the abundant geothermal activity such as thermal spring, anthropogenic source processes and changes in meteorological conditions) regulate and affect Hg behavior in the study area.

Keywords: total gaseous mercury (TGM); diurnal variability; seasonal variability; meteorological factors; Gongga Mountain



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