

The First Asian CryoNet Workshop

Beijing, China

December 4, 2013

*Glacier ecosystems
on Asian High Mountains*

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Living organisms on snow and ice



Stone fly
(Patagonia)



Ice worm
(Alaska)



Cyanobacteria
(Asia)



Red snow alga
(North America)



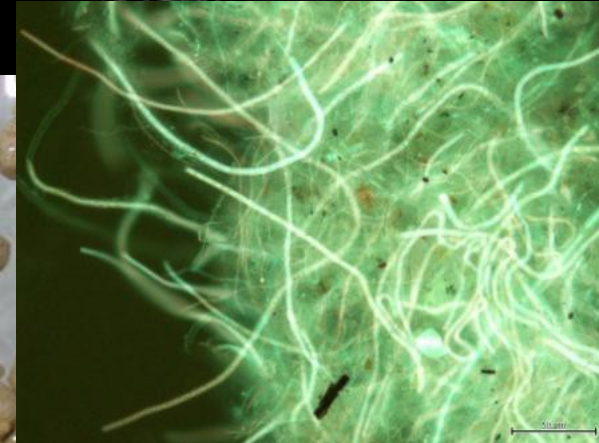
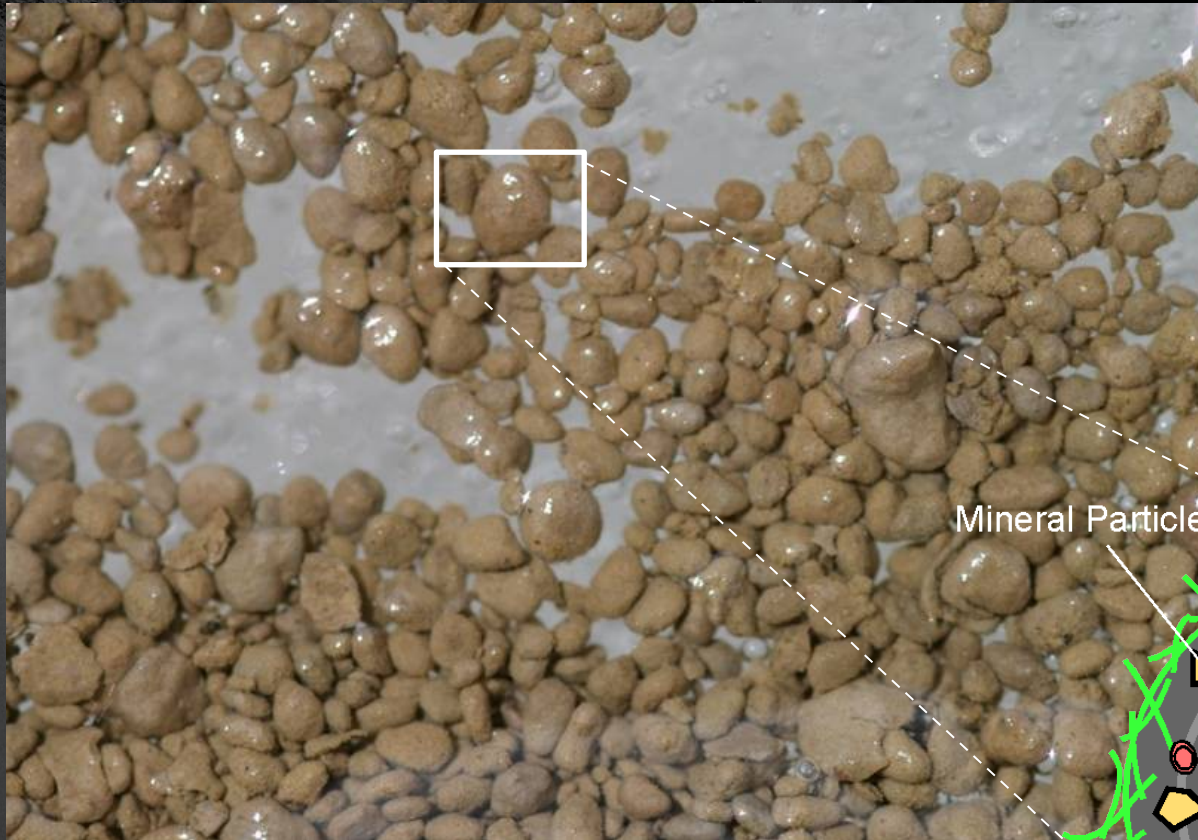
Red snow
(Alaska)

Glacial organisms: Specialized organisms adapted to snow and ice environments

Urumqi Glacier No.1: very dirty surface



Surface dust = Cryoconite: microbial aggregates

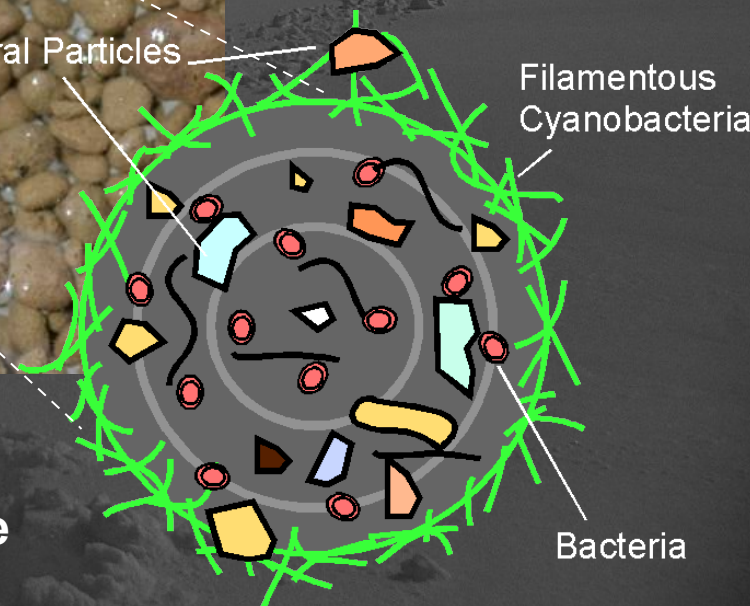


Mineral Particles

Filamentous
Cyanobacteria

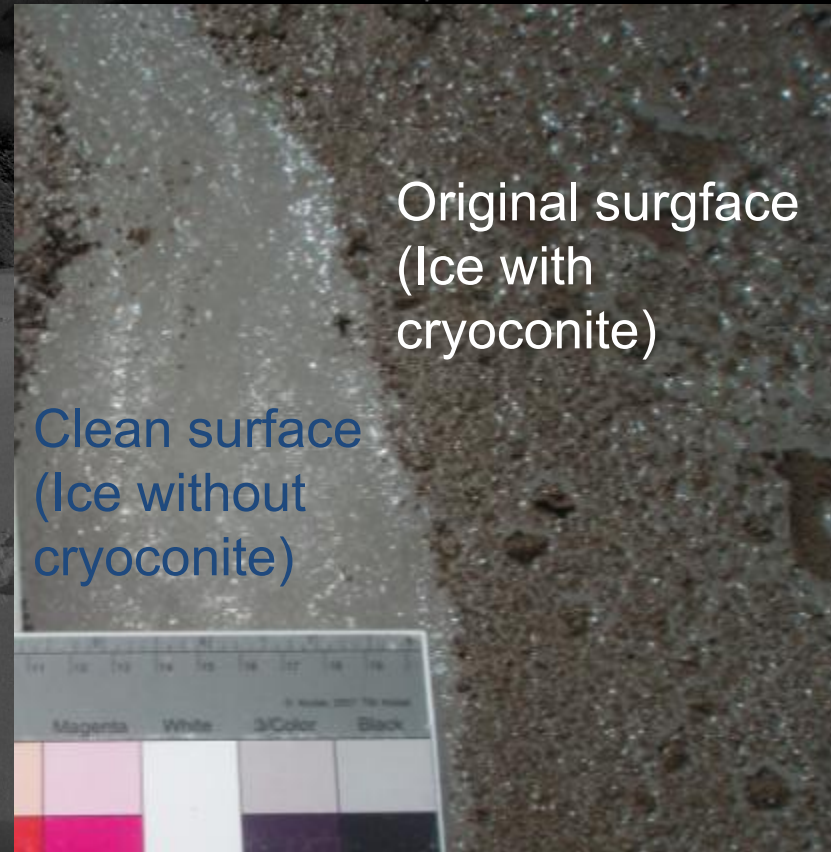
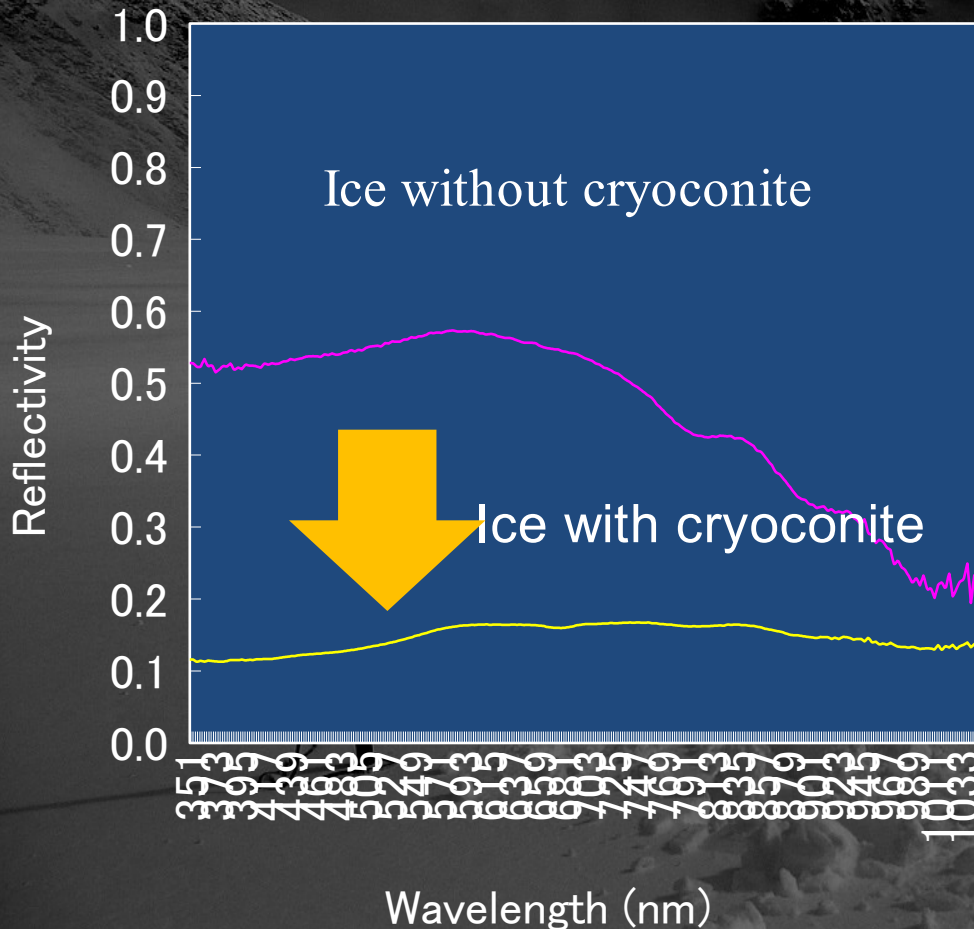
Schematic image of
a cryoconite granule

Bacteria



Microbes can melt glaciers

~Albedo effect

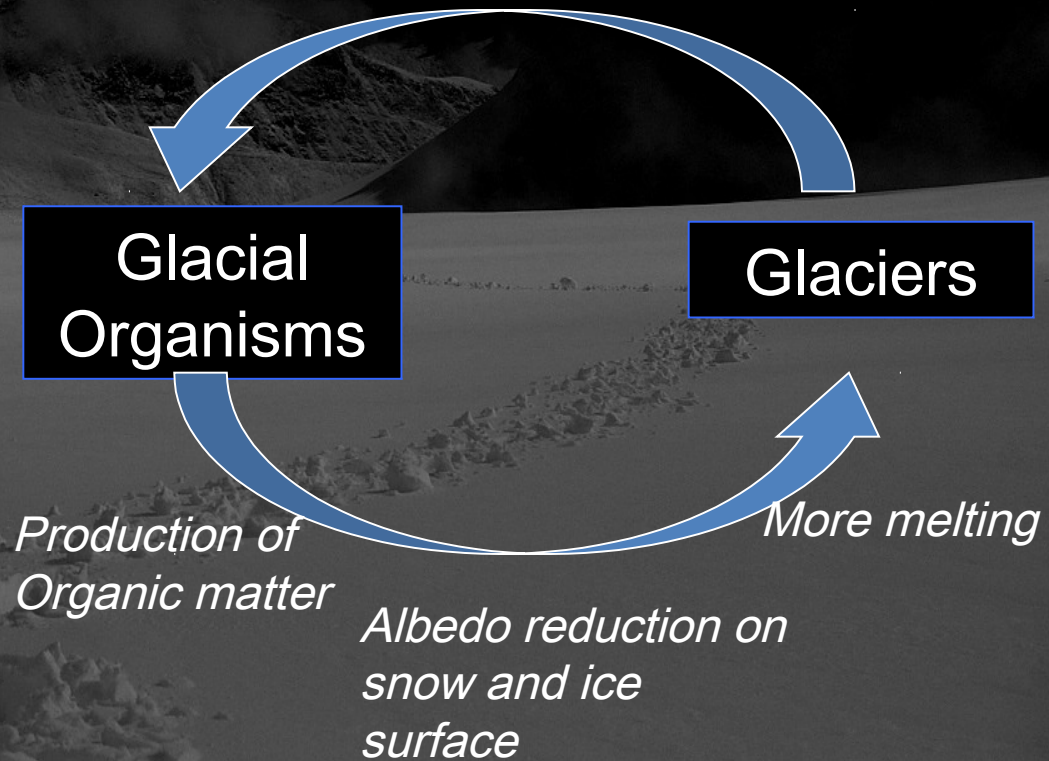


Urumqi Glacier No.1, China

Interactions between microbes and glaciers



Physical / Chemical conditions

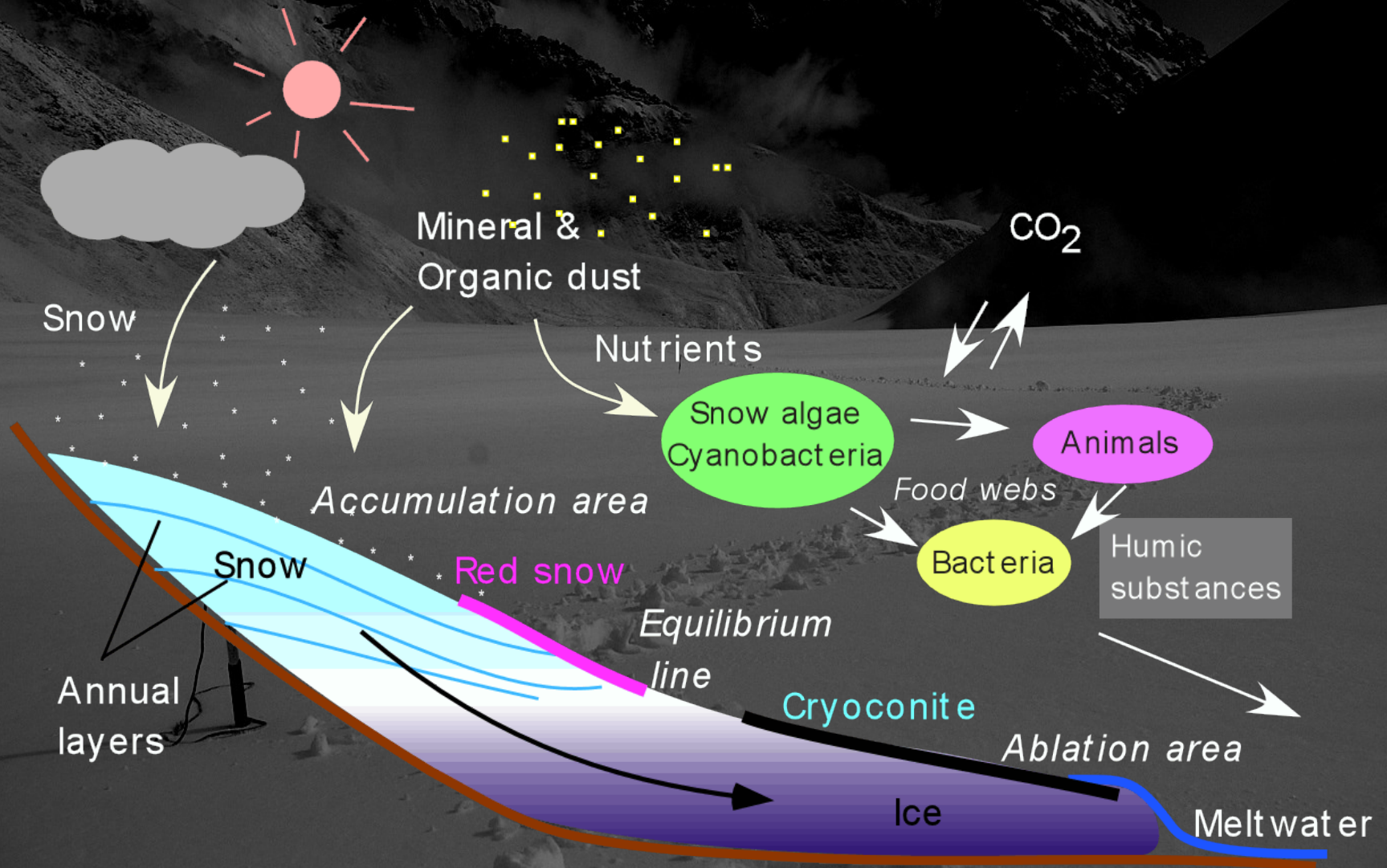


Recent glacial shrinkage



- Global warming
- Change of lives on glacier?

Concept of glacier ecosystems

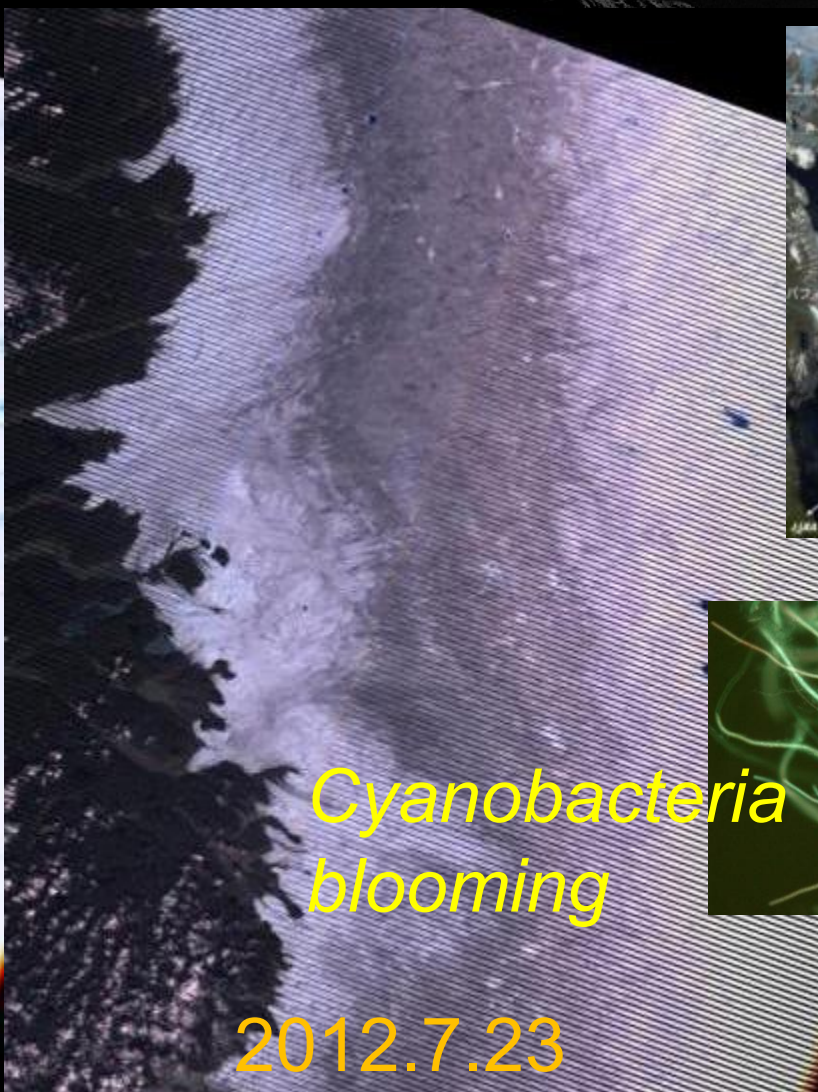


Darkening Greenland Icesheet by microbes

Landsat
satellite
images

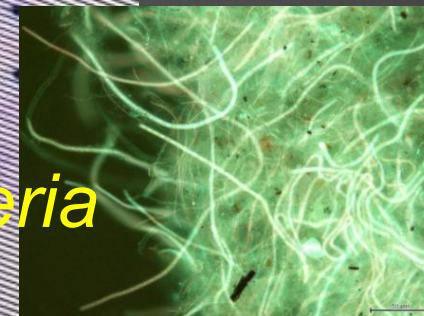


1987.8.12



*Cyanobacteria
blooming*

2012.7.23

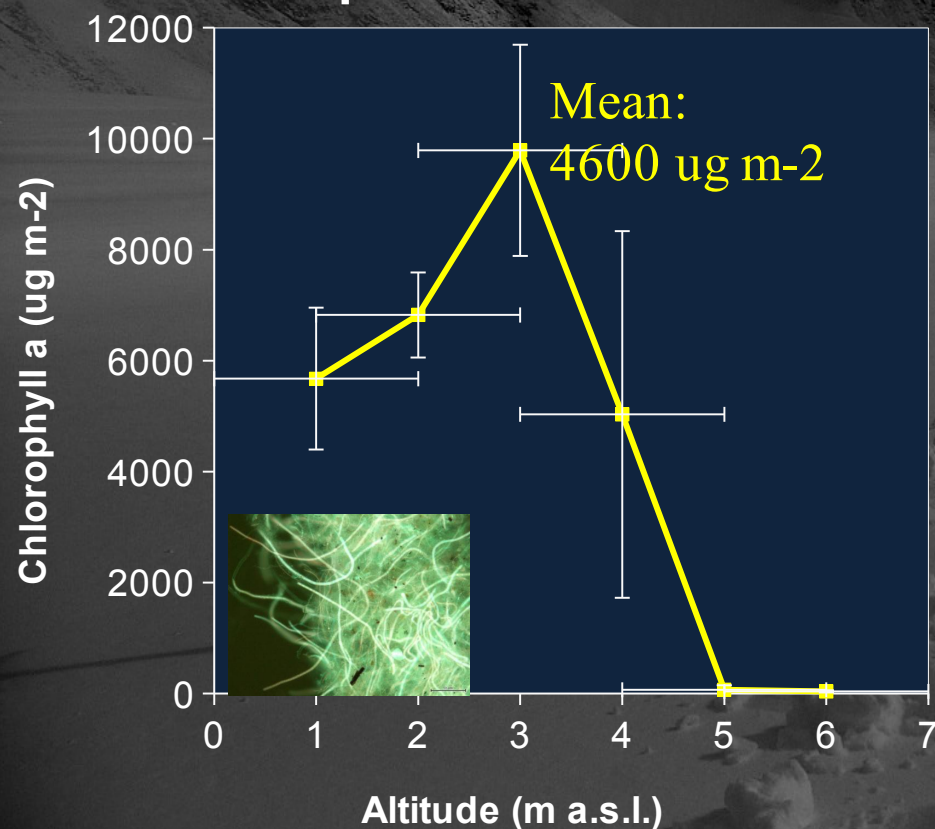


We need to watch glaciers as ecosystems

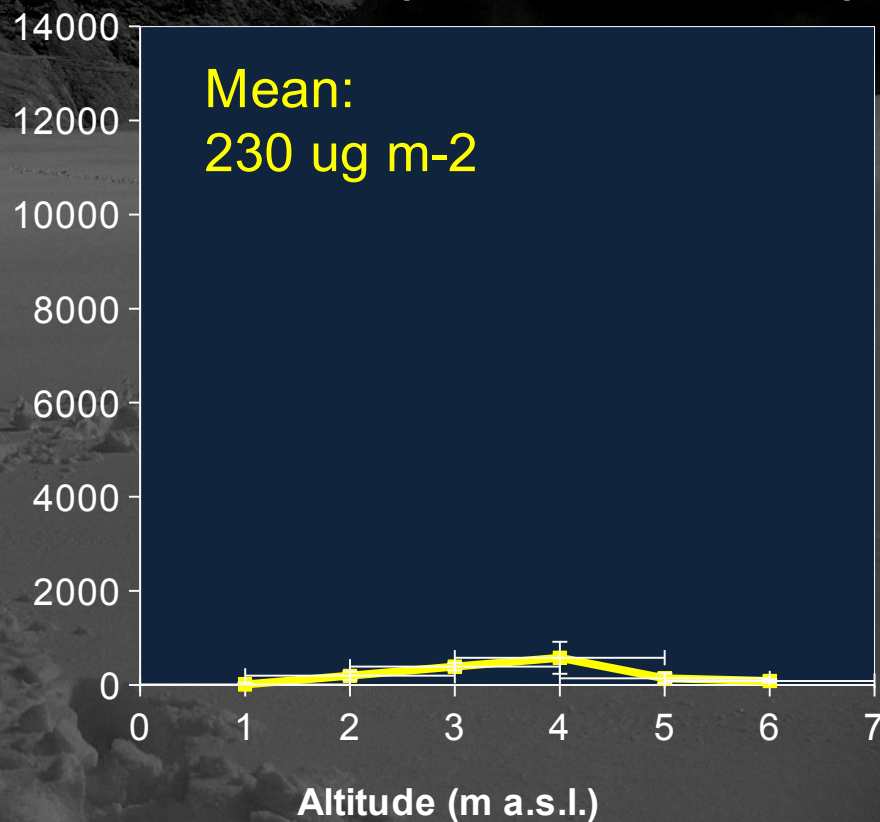
Chlorophyll a abundance on the glacier surface

Chlorophyll a = Algal pigment
= Proxy of photosynthetic microbes

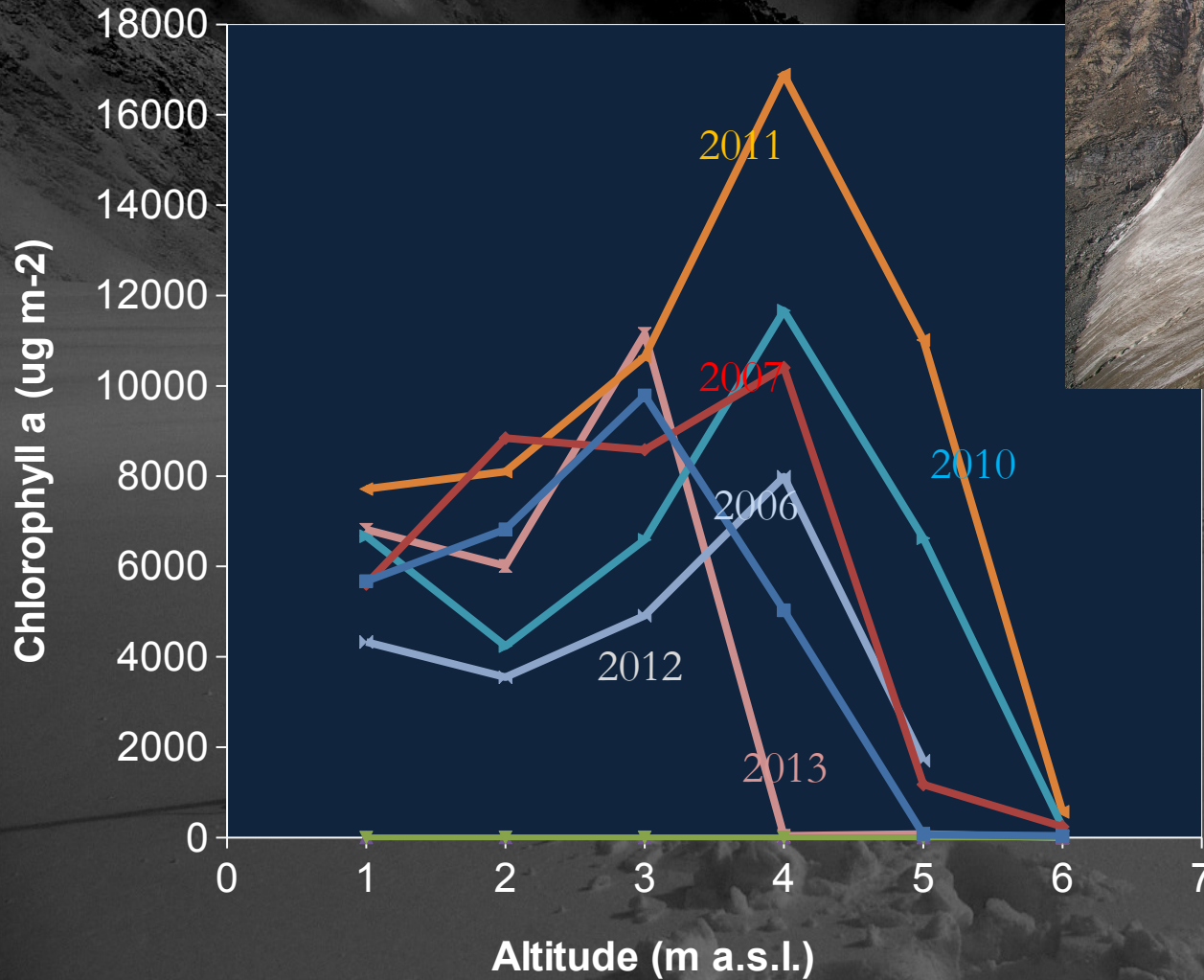
Urumqi Glacier No.1



Greenland (Qaanaaq Glacier)



Watching Chlorophyll on Urumqi Glacier



Watching the DNA of glacial microbes ~ Cyanobacteria 16S RNA gene

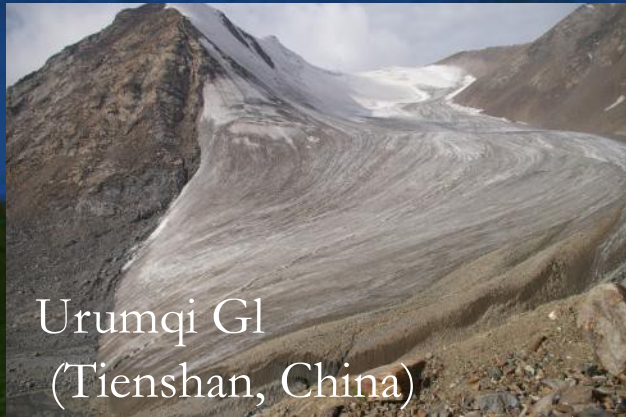
1500bp , 1578 clones in total, OTUs: 97% similarity

	Culture top1 in NCBI nt	Accession	Similarity	
OTU0	Tychonema sp. K27	GQ324965	99	Oscillatoriales
OTU1	Phormidium priestleyi ANT.L66.1	AY493581	93	Oscillatoriales
OTU2	Leptolyngbya frigida ANT.L53B.2	AY493576	95	Oscillatoriales
OTU3	Phormidium priestleyi ANT.LG2.4	AY493580	99	Oscillatoriales
OTU4	Geitlerinema sp. Sai004	GU935348	99	Oscillatoriales
OTU5	Chamaesiphon subglobosus PCC 7430	AY170472	97	Chroococcales
OTU6	Limnothrix redekei CCAP 1459/29	HE974998	98	Oscillatoriales
OTU7	Leptolyngbya frigida ANT.L52.2	AY493575	95	Oscillatoriales
OTU8	Gloeobacter violaceus PCC 7421	NR_074282	85	Gloeobacteria
OTU9	Leptolyngbya antarctica ANT.L67.1	AY493572	99	Oscillatoriales
OTU10	Chamaesiphon minutus PCC 6605	NR_102459	96	Chroococcales
OTU11	Bacterium EJ10-B11-5	JF418125	97	Uncultured
OTU12	Pleurocapsa cf. concharum 1d-08	FR798928	95	Pleurocapsales

Filamentous

Coccoid

Analyzed by
Takahiro
Segawa
(NIPR)



Urumqi Gl
(Tianshan, China)



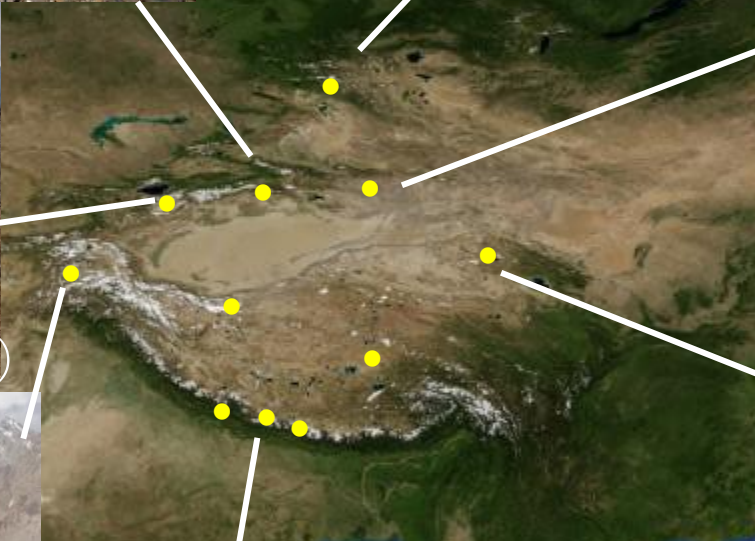
Akkem Gl
(Altai, Russia)



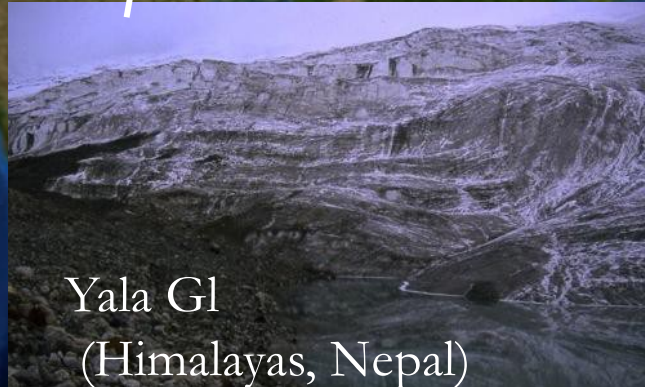
Miaoergou Gl
(Tianshan, China)



Grigoreva Gl
(Tianshan, Kyrgyzs)



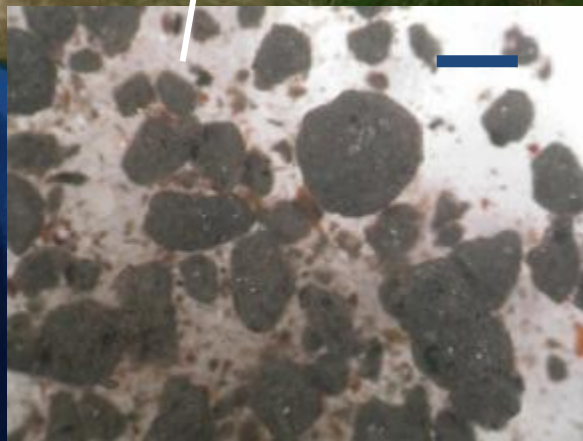
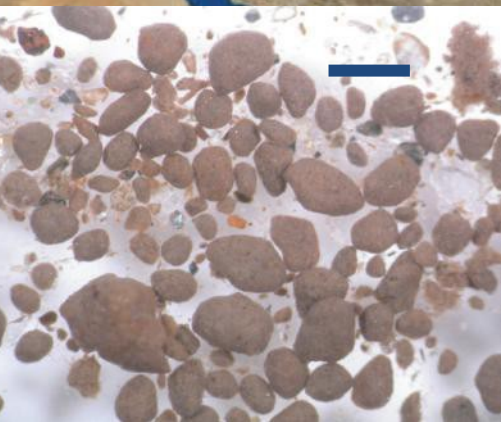
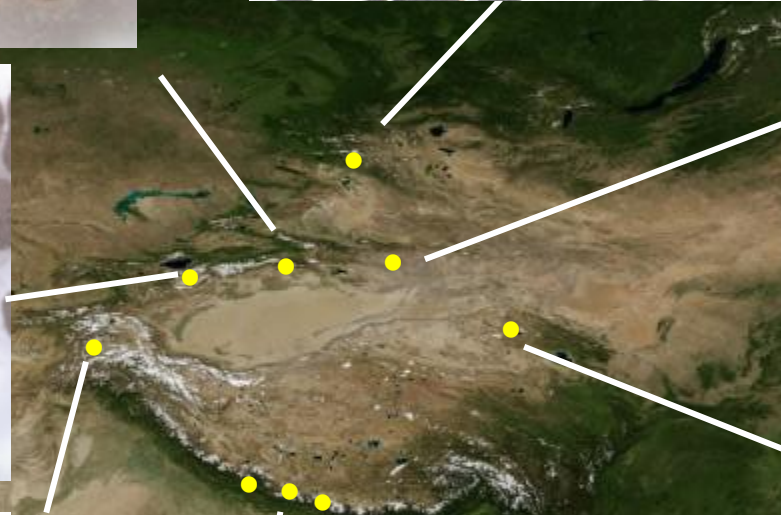
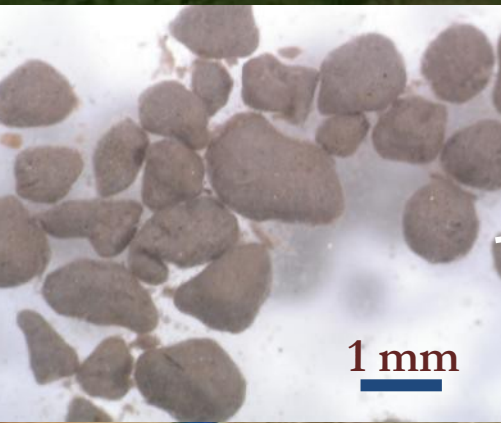
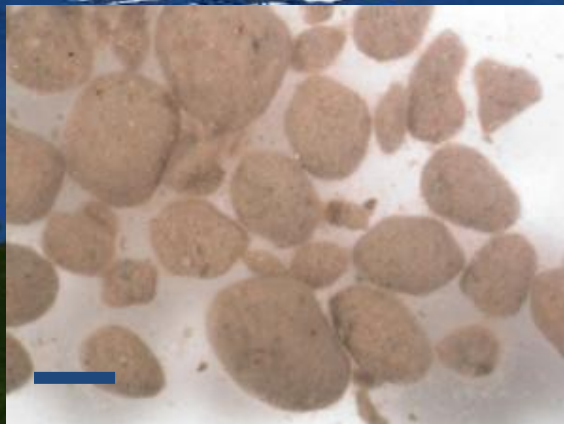
Fedchenko Gl
(Pamir, Tajikistan)



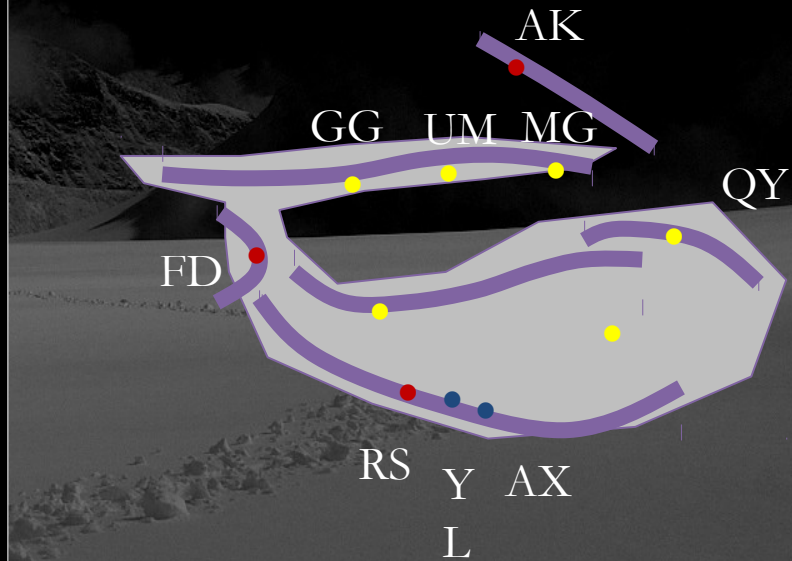
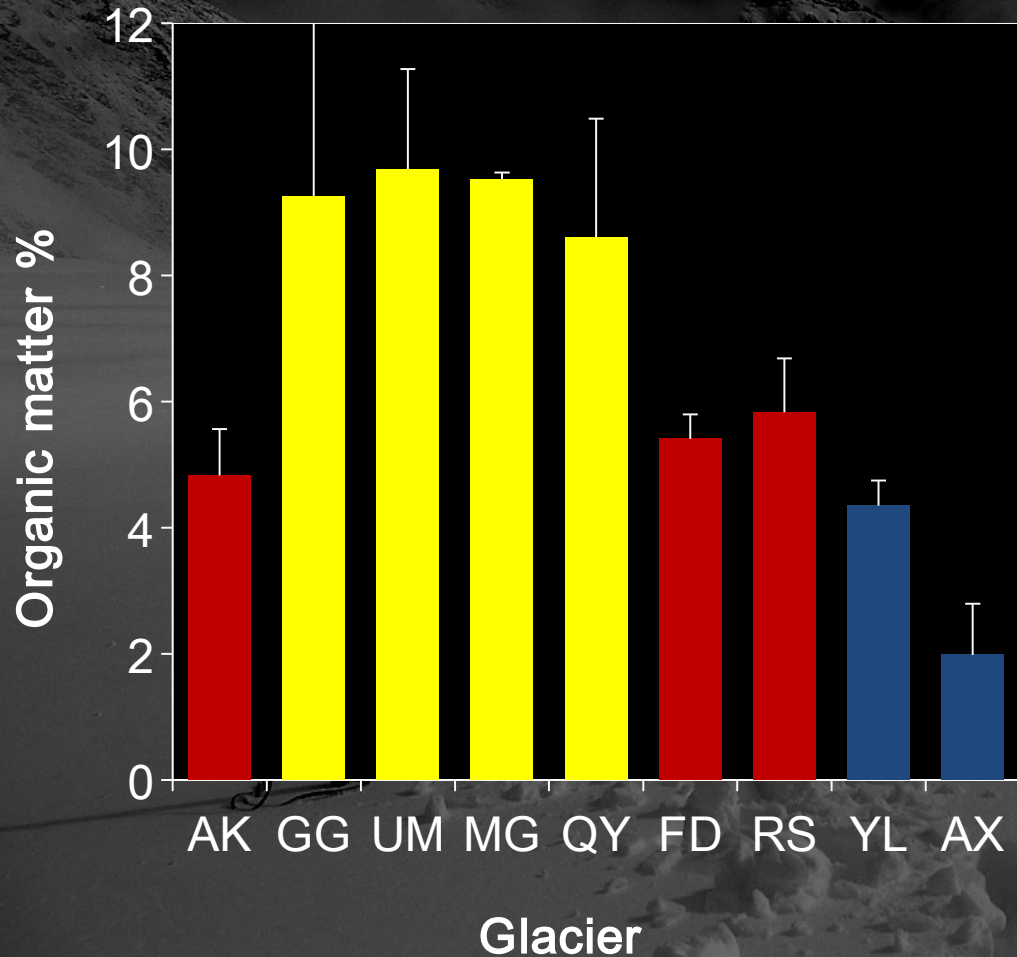
Yala Gl
(Himalayas, Nepal)



Qiyi Gl
(Qilian, China)



Organic matter content in cryoconite (dry weight)



Pale-cryoconite : high organic cont.
Black- cryoconite: low organic cont.

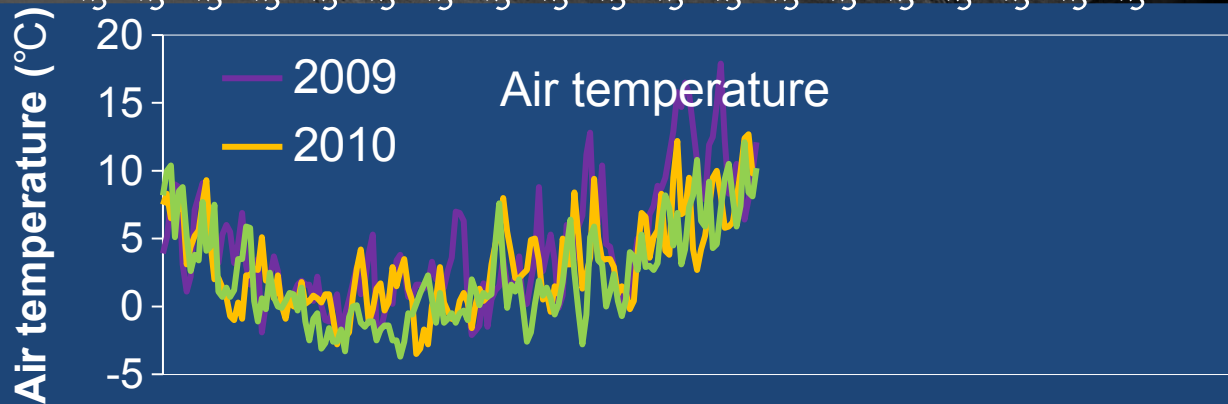
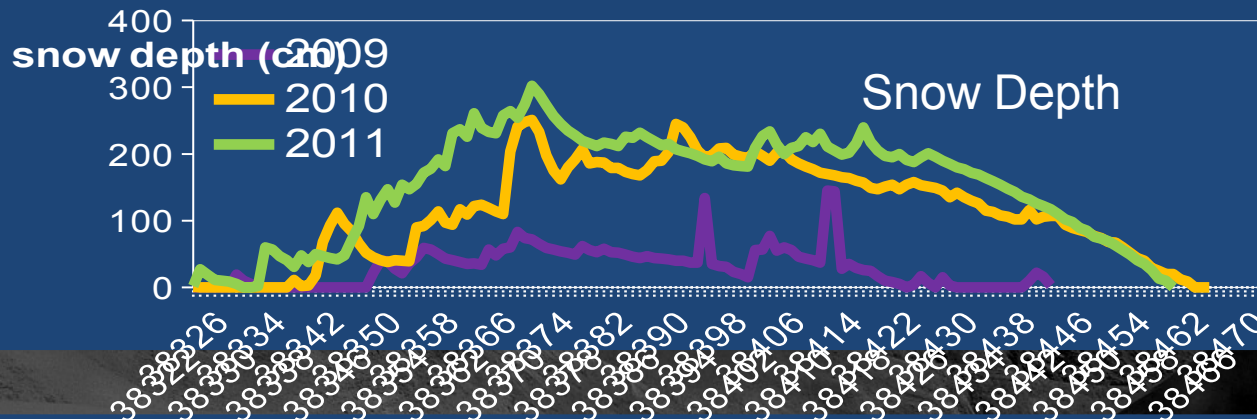
Snow observatories in Japan



No glacier, but a large amount of winter snow (more than 10 m)

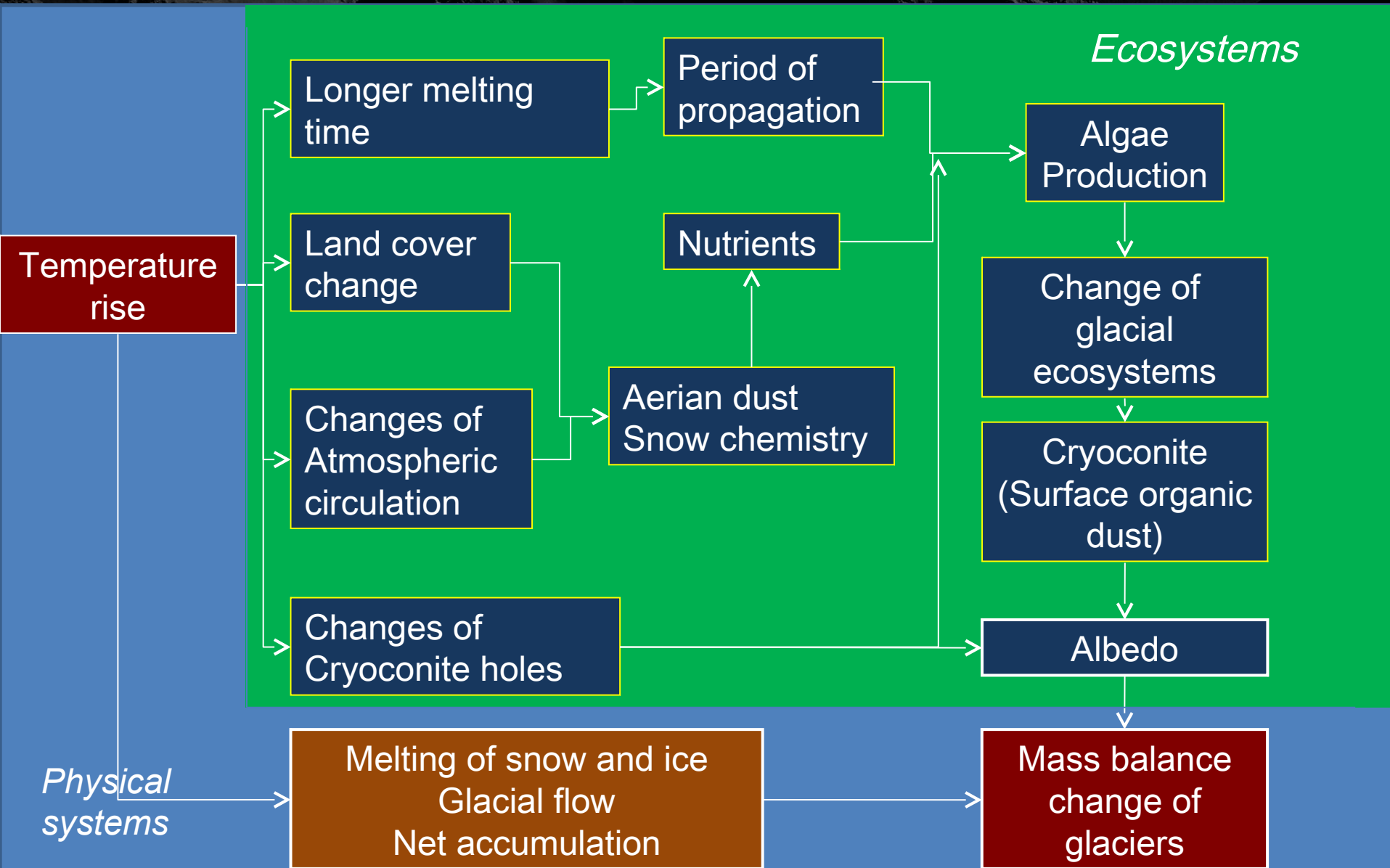


Tokamachi Station, Niigata prefecture



chlorophyll(-µg / m)²

Watching glaciers as ecosystems



Summary

- Glaciers are not simple physical systems of snow and ice, but are ecosystems, including microbial community.
- The microbes and their products substantially reduce surface albedo, consequently could contribute the recent glacial shrinkage.
- Although the concept of glacier ecosystems are still in exploring stage, watching microbes and biogeochemistry of glaciers and icesheet could be very valuable to understand the glacier ecosystems.