

# Expanding International Collaboration for Space Weather Services

D.H. Boteler

International Space Environment Service

NOAA Space Weather Workshop, April 26-28, 2011, Boulder, USA



# History

- 1928 First forecast broadcast from Eiffel Tower  
URSIgram
- 1957 World Days Geophysical Calendar
- 1962 International URSIgram and World Days Service (IUWDS)
- 1972 SpaceWarn Bulletin
- 1996 International Space Environment Service





ISES

# International Space Environment Service



ISES | URSIgram Codes | Reports | Regional Warning Centres | Info | **Geo-Calendar**

# International Geophysical Calendar

## International Geophysical Calendar 2012 (DRAFT)

(See other side for information on use of this Calendar)

	S	M	T	W	T	F	S	S	M	T	W	T	F	S	
<b>JANUARY</b>	1	2	3	4	5	6	7	1	2	3 <sup>†</sup>	4	5	6	7	<b>JULY</b>
	8	9 <sup>†</sup>	10	11	12	13	14	8	9	10	11	12	13	14	
	15	16	17	18	19 <sup>*</sup>	20	21	15	16	17	18	19	20	21	
	22	23 <sup>†</sup>	24	25	26	27	28	22	23	24	25	26	27	28	
	29	30	31	1	2	3	4	29	30	31	1	2 <sup>†</sup>	3	4	<b>AUGUST</b>
<b>FEBRUARY</b>	5	6	7 <sup>†</sup>	8	9	10	11	5	6	7	8	9	10	11	
	12	13	14	15	16	17	18	12	13	14	15	16 <sup>*</sup>	17 <sup>†</sup>	18	
	19	20	21	22	23	24	25	19	20	21	22	23	24	25	
	26	27	28	29	1	2	3	26	27	28	29	30	31 <sup>†</sup>	1	<b>SEPTEMBER</b>
<b>MARCH</b>	4	5	6	7	8 <sup>†</sup>	9	10	2	3	4	5	6	7	8	
	11	12	13	14	15	16	17	9	10	11	12	13	14	15	
	18	19	20	21	22	23	24	16 <sup>*</sup>	17	18	19	20	21	22	
	25	26	27	28	29	30	31	23	24	25	26	27	28	29	
<b>APRIL</b>	1	2	3	4	5	6 <sup>†</sup>	7	30 <sup>†</sup>	1	2	3	4	5	6	<b>OCTOBER</b>
	8	9	10	11	12	13	14	7	8	9	10	11	12	13	
	15	16	17	18	19	20	21	14	15 <sup>*</sup>	16	17	18	19	20	
	22	23	24	25	26	27	28	21	22	23	24	25	26	27	
<b>MAY</b>	29	30	1	2	3	4	5	28	29	30	31	1	2	3	<b>NOVEMBER</b>
	6 <sup>†</sup>	7	8	9	10	11	12	4	5	6	7	8	9	10	
	13	14	15	16	17	18	19	11	12	13	14	15	16	17	
	20 <sup>*</sup>	21	22	23	24	25	26	18	19	20	21	22	23	24	
	27	28	29	30	31	1	2	25	26	27	28	29	30	1	<b>DECEMBER</b>
<b>JUNE</b>	3	4 <sup>†</sup>	5	6	7	8	9	2	3	4	5	6	7	8	
	10	11	12	13	14	15	16	9	10	11	12	13	14	15	
	17	18	19	20	21	22	23	16	17	18	19	20	21	22	
	24	25	26	27	28	29	30	23	24	25	26	27	28	29	<b>JANUARY 2013</b>

- ① Regular World Day (RWD)
- ② Priority Regular World Day (PRWD)
- ③ Quarterly World Day (QWD)  
also a PRWD and RWD
- ④ Regular Geophysical Day (RGD)
- [12 13] World Geophysical Interval (WGI)
- † Incoherent Scatter Coordinated Observation Day
- ④ Days of Solar Eclipse: May 20 annular & Nov 13 total
- [18 19] Airglow and Aurora Period
- 18<sup>†</sup> Dark Moon Geophysical Day (DMGD)

Final 2011 Calendar available online  
[ftp://ftp.ngdc.noaa.gov/STP/SOLAR\\_DATA/IGC\\_CALENDAR/](ftp://ftp.ngdc.noaa.gov/STP/SOLAR_DATA/IGC_CALENDAR/)

2012 Draft Calendar available for comments.

# Relatively Recent Happenings

## International Geophysical Calendars



**International Geophysical Calendar**  
Cooperative programs pertaining to solar activity and the Earth's environment.  
[Go to the ftp site for past calendars.](#)

The International Geophysical Calendar contains information about:

- 2009 Solar Eclipses
- 2009 Meteor Showers

and recommended scientific programs for:

- [Aurora and Aurora Phenomena](#)
- [Atmospheric Electricity](#)
- [Geomagnetic Phenomena](#)
- [Ionospheric Phenomena](#)
- [Vertical Incidence Sounding Program](#)
- [Incoherent Scatter Observation Program](#)
- [Meteorology](#)
- [Global Atmosphere Watch \(GAW\)](#)
- [Solar Phenomena](#)
- [Climate and Weather of the Sun-Earth System \(CAWSES\)](#)
- [International Heliophysical Year \(IHY\)](#)
- [Space Research, Interplanetary Phenomena, Cosmic Rays, Aeronomy](#)
- [Meteor Showers](#)

2009 DRAFT Calendar -- [PDF version](#)

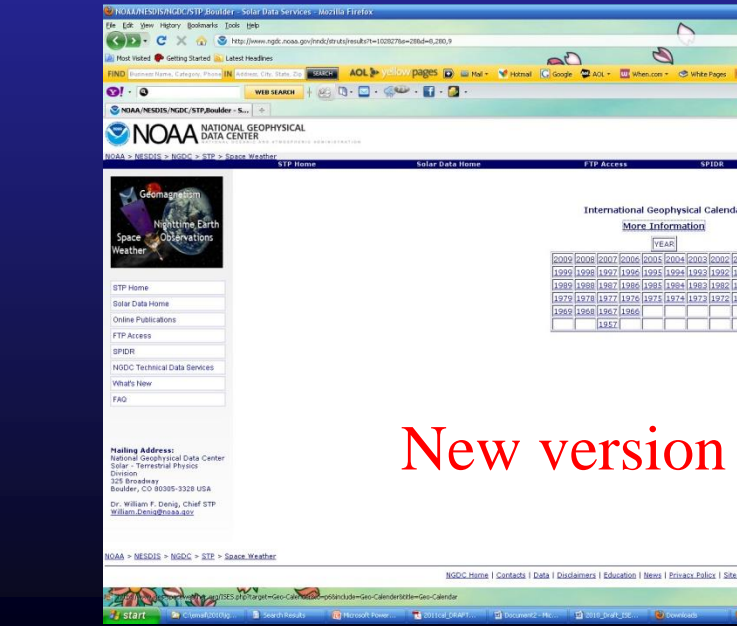
**EXPLANATIONS**

This Calendar continues the series begun for the 10Y years 1957-58, and is issued annually to recommend dates for solar and geophysical observations that cannot be carried out continuously. Thus, the amount of observational data in existence tends to be larger on Calendar days. The recommendation and especially the flow of data to World Data Centers (WDCs) in many instances emphasize Calendar days. The Calendar is prepared by the Space Environment Services (SES) with the advice of spokesmen for the various scientific disciplines. For some programs, greater detail concerning the time to time published in JAGA News, IUGG Chronicle, URSI Information Bulletin and other scientific journals or newsletters.

The Calendar provides links to many international programs, giving an opportunity for scientists to become involved with data monitoring and international scientists are encouraged to contact the key people and join the worldwide community effort to understand the Sun-Earth environment. The definitions of the designated days remain as described on previous Calendars. Universal Time (UT) is the standard time for all world days. Day Days (DD) are each Wednesday. Weekly World Days (WWD) are Thursdays. Monthly World Days (MWD) are Mondays. Quarterly World Days (QWD) are each 1st, 2nd, 3rd, and 4th of the month.

Old version

NGDC web pages replaced with strut system of data files. Extended web page information no longer available, but descriptive texts to be a click away at ISES or on ftp site. Calendars now available by year.



**International Geophysical Calendar**  
[More Information](#)

YEAR											
2009	2008	2007	2006	2005	2004	2003	2002	2001	2000	1999	1998
1997	1996	1995	1994	1993	1992	1991	1990	1989	1988	1987	1986
1985	1984	1983	1982	1981	1980	1979	1978	1977	1976	1975	1974
1973	1972	1971	1970	1969	1968	1967	1966	1965	1964	1963	1962
1961	1960	1959	1958	1957							

2009 DRAFT Calendar -- [PDF version](#)

**EXPLANATIONS**

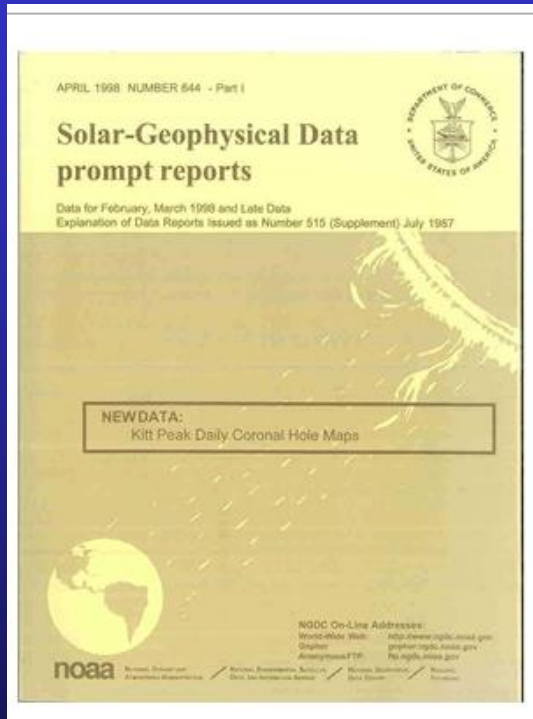
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New version

# Recent Happenings

## Solar-Geophysical Data 1955-2009 in PDF



**International community working together:**

Over many years the worldwide community provided solar activity data and its related geophysical effects to the WDCs. At NOAA NGDC these data were compiled into the monthly SGD report.



-- Includes descriptive texts

These reports are now available online at

**[ftp://ftp.ngdc.noaa.gov/STP/SOLAR\\_DATA/SGD\\_PDFversion](ftp://ftp.ngdc.noaa.gov/STP/SOLAR_DATA/SGD_PDFversion)**



# URSIGRAM Codes

## Radio Data Codes

Radio Data Codes are used by observatories to report solar radio data; radio bursts in discrete and sweep frequencies and quiet-sun levels in discrete radio frequencies.

- [URALN Code](#)-Noise Source
- [URANJ Code](#)-Fixed Frequencies
- [URASP Code](#)-Polarization and Flux Density of Solar Radio Emission at Single Sweep Frequency

## Satellite Data Codes

Satellite Data Codes are used by telemetry stations, forecast centers and others to encode solar geophysical data obtained from satellite-based sensors.

- [USXRA Code](#)-Solar X-ray Events
- [USPRO Code](#)-Solar Proton Events
- [UTELC Code](#)-Total Electron Content

## Satellite Ionospheric Data Codes

Ionospheric Data Codes are used to describe the state of the ionosphere through direct and indirect sensors.

- [IONFM Code](#)-Ionospheric Data
- [UABSE Code](#)-Absorption Observations
- [UFOFS, UFOFH, UMUFH, UFMNH, and UFESH Codes](#)-Critical Frequencies
- [USIDS Code](#)-Sudden Ionospheric Disturbance

## Geophysical Data Codes

Geophysical Data Codes are used to report geomagnetic, auroral, and cosmic-ray data derived from ground-based sensors.

- [UCOHO Code](#)-Coronal Holes
- [UCOSE Code](#)-Cosmic Rays
- [UMAGF Code](#)-Geomagnetic

## Regional Warning Center (RWC) and Specialized Codes

Regional and Specialized Codes are more nearly associated with an RWC than with a type of solar geophysical information.

- RWC Boulder Codes



# ISES Mission

- Encourage and facilitate near-real-time international monitoring and prediction of the space environment by:
  - **the rapid exchange of space environment information;**
  - **the standardization of the methodology for space environment observations and data reduction;**
  - **the uniform publication of observations and statistics;**
  - **the application of standardized space environment products and services to assist users reduce the impact of space weather on activities of human interest.**





ISES

# International Space Environment Service



[ISES](#) | [URSIgram Codes](#) | [Reports](#) | [Regional Warning Centres](#) | [Info](#) | [Geo-Calendar](#)

## Regional Warning Centres

 [Print this](#)

Australia (Sydney)

Belgium (Brussels)

Brazil (São José dos Campos)

Canada (Ottawa)

China (Beijing)

Czech Republic (Prague)

India (New Delhi )

Japan (Tokyo)





# IPS Radio & Space Services

RWC - Australia



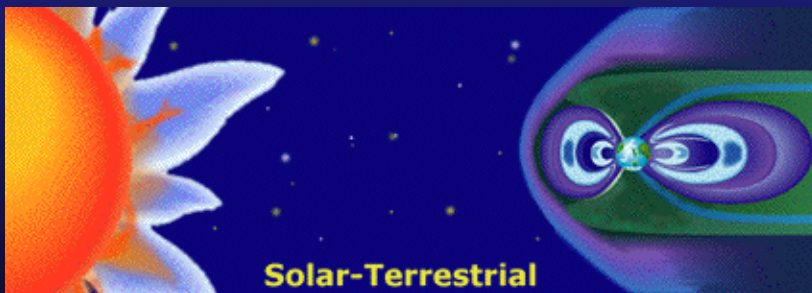
RWC - Canada



RWC - United States



RWC - China



Solar-Terrestrial

RWC - Japan



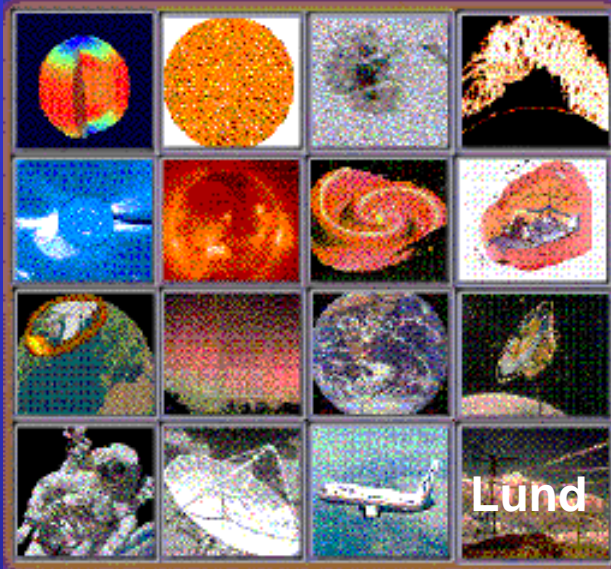
RWC - India

**SIDC**

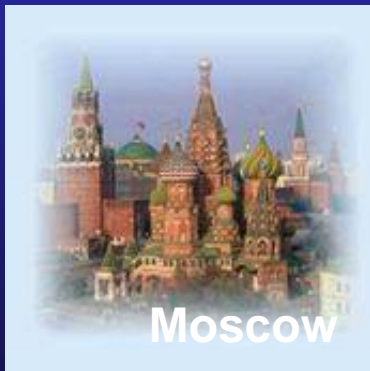
RWC  
Belgium  
World Data  
Center  
for the  
Sunspot  
Index

**Brussels**

**ARWC - Toulouse**



**RWC - Sweden**



**Moscow**

**RWC - Russia**



**RWC - Poland**



**Prague**

**RWC - Czech Republic**



ISES Regional Warning Centre for Africa

RWC – Africa

 Ministério da Ciência e Tecnologia



# EMBRACE

Estudo e Monitoramento Brasileiro do Clima Espacial



[INÍCIO](#)

[INPE](#)

[BOLETIM](#)

[WORKSHOP](#)

[EXECUTORES](#)



RWC – Brazil



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http://www.esa-spaceweather.net/swenet/index.html Go



Contents
Welcome
Introduction
What is Space Weather
Current Space Weather
ESA Space Weather Studies
International Activities
Models and Data
Resources
Space Weather Working Team (SWWT)
SWENET Newsletter
ESA Space Weather Workshops
Miscellaneous
Sitemap
Mail to Webmaster



**SWENET**

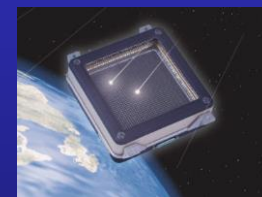
Space Weather European Network

SWENET Services
Ionospheric Effects
DIFS
GIFINT
GPS Validation
Ionosfera
Scintillation
Quickmaps
SFC
SIDC
SOARS
SPECTRE
STIF
SWIPPA
TSRS
Ground Effects
Spacecraft Effects

SWENET
Introduction
SWENET SDAs

# European Space Agency (ESA)

- ESA participates to ISES as an expert collaborative centre especially through:
  - its expertise in space environments and effects
    - run relevant R&D activities
    - include space environment monitors activity
  - a coordination role of space weather activities in Europe
    - harmonise and coordinate relevant R&D activities
    - responsible for the preparatory programme to develop a Space Situational Awareness (SSA) system that includes a Space Weather Component



# Highlights of 2011

- The ESA SSA Preparatory Programme is laying the groundwork for an operational European space weather application system.
- The current activities this year includes:
  - analysing the requirements and defining the system
  - transitioning relevant assets into operational elements
- TR&D in space environments and effects is continuing and is stimulated by the SSA preparatory programme.



# European Space Weather Week



8<sup>th</sup> edition confirmed!

When: 28 Nov – 2 Dec 2011

Where: Belgium, Namur

Web: [www.sidc.be/esww8/](http://www.sidc.be/esww8/)

250 participants  
during ESWW7  
from worldwide.

Focus of ESWW8 on innovations and challenges in SW Sciences, Services & Applications, Ionosphere & Plasmasphere, Space Climate, Image Processing, GIC's

# European Space Weather Week

## *Previous editions*



**Third European Space Weather Week**  
13-17 November, 2006

Venue:  
Royal Library of Belgium

**ESA** **SWNET**

This poster features several circular images: a satellite in orbit, a space station, a solar flare, a satellite antenna, and a view of Earth from space.



**Fifth European Space Weather Week**  
17-21 November, 2008

Venue: Royal Library of Belgium, Brussels  
Local Organization: Royal Observatory of Belgium  
[www.sidc.be/esww5](http://www.sidc.be/esww5)

**esww**

Program committee

- A. Glover, Co-Chair, ESA
- A. Belcher, Co-Chair, COST
- J. Liberton, LPJ-CNRS
- M. Paganoni, IRIAL-STFC
- J.-P. Laine, FMI
- R. Van der Linden, SIDC-STCE
- P. Vaninmela, SIDC-STCE
- J.-J. Valette, CLS
- A. Thomson, ISIS
- T. Dudok de Wit, CNRS
- P. Gilis, CNRS
- B. Zorn, INGV

Together diverse space weather communities and focuses on science and applications with a strong focus on user needs

...press, GNSS, offshore drilling, magnetic surveying and other models, data-tools-services, solar weather

... of Belgium, the Solar-Terrestrial Centre of Excellence, ESA, COST, COSPAR, ISES, EPS, EDARD, Belspo



**Sixth European Space Weather Week**  
16-20 November, 2009  
Brugge, Belgium

**esww**

Program committee

- A. Belcher, Co-Chair, NOAA (COST ES0803)
- A. Glover, Co-Chair, ESA
- M. Paganoni, IRIAL-STFC (SWNET)
- J.-P. Laine, FMI
- R. Van der Linden, SIDC-STCE
- P. Vaninmela, STCE
- A. Thomson, ISIS
- T. Dudok de Wit, CNRS (JIFRES)
- B. Zorn, INGV
- J. Waterman, CNRS
- M. Meuser, INM (COST ES0803)
- M. Meer, DLR

Local organization:  
SIDC, Solar-Terrestrial Centre of Excellence, Belgium

Science-Models-Applications-Services-Users  
Space Situational Awareness  
Impacts on Communications Systems  
Health Issues

<http://sidc.be/esww6>

Logos for ESA, ES0803, and other partners are shown at the bottom.



**FOURTH EUROPEAN SPACE WEATHER WEEK**  
5-9 November, 2007

Venue: Royal Library of Belgium Brussels  
Local Organization: Royal Observatory of Belgium - SIDC  
[www.sidc.be/esww4](http://www.sidc.be/esww4)

**esa** **SWNET**

This poster features a large image of a solar flare and a diagram of Earth's magnetic field.



**7TH EUROPEAN SPACE WEATHER WEEK**  
NOVEMBER 13-19, 2010  
BRUGES, BELGIUM  
[WWW.SIDC.BE/ESWW7](http://WWW.SIDC.BE/ESWW7)

Research - Applications - Products - Services

- Space Weather in support of European critical infrastructure
- New research Frontiers and Efforts
- Space Weather for: protecting atmospheric phenomena
- Science meeting: For: planetary space weather
- Atmospheric effects, direct effects of solar-terrestrial weather...

Local organization:  
SIDC, Solar-Terrestrial Centre of Excellence, Belgium

Logos for ESA, SWNET, and other partners are shown at the bottom.



# SIDC - Solar Influences Data Analysis Center

dicted AP index: 012

visit us at <http://www.sidc.be>

SIDC/RWC

- Main
- Projects
- Publications
- Seminars
- Sunspots
- Software
- Educational
- about SIDC
- be involved
- Job opportunities
- Space Weather Services
- Real Time Data
- Real Time Alerts
- Bulletins
- esww7

Welcome to the Solar Influences Data Analysis Center (SIDC), which is the solar physics research department of the **Royal Observatory of Belgium**. The SIDC includes the World Data Center for the sunspot index and the **ISES Regional Warning Center Brussels** for space weather forecasting.

PRESTO FROM SIDC - RWC BELGIUM Mon Jul 5 2010, 1223 UT

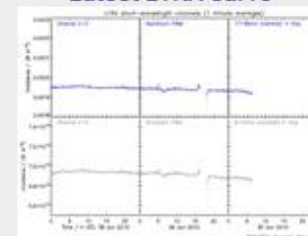
Two small sunspot groups are currently visible on the solar disc: Catania numbers 93 (NOAA AR 1084) and 95 (no NOAA number yet). We do not expect any significant flaring activity.

The Earth is currently inside a slow (460 km/s) solar wind flow with weak to average (2-4 nT) interplanetary magnetic field magnitude. We expect quiet geomagnetic conditions.

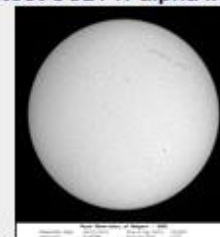
Latest SWAP image



Latest LYRA curve



Latest USET H-alpha image



## Most recent alerts

2010 Jul 05 1226 UTC  
 START OF ALL QUIET ALERT ..... The SIDC - RWC Belgium [\[more\]](#)

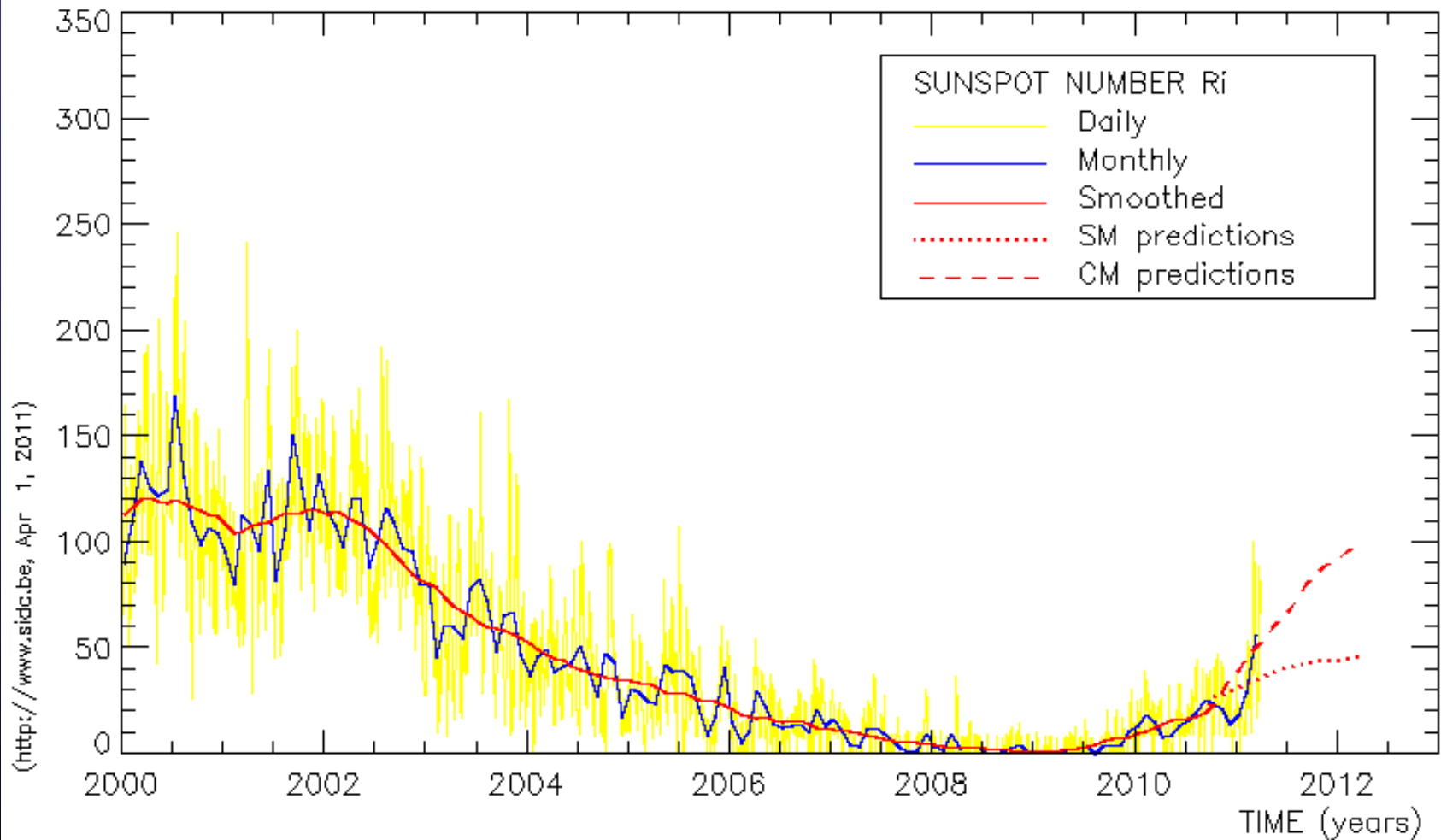
2010 Jun 15 0824 UTC  
 The ACE spacecraft is measuring the first signs of the influence of a transequatorial [\[more\]](#)



CESRA2010



# Core product: International Sunspot Number



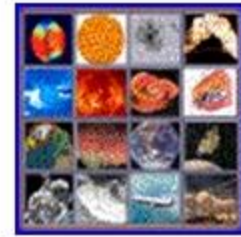




Swedish  
Institute of  
Space Physics in  
Lund

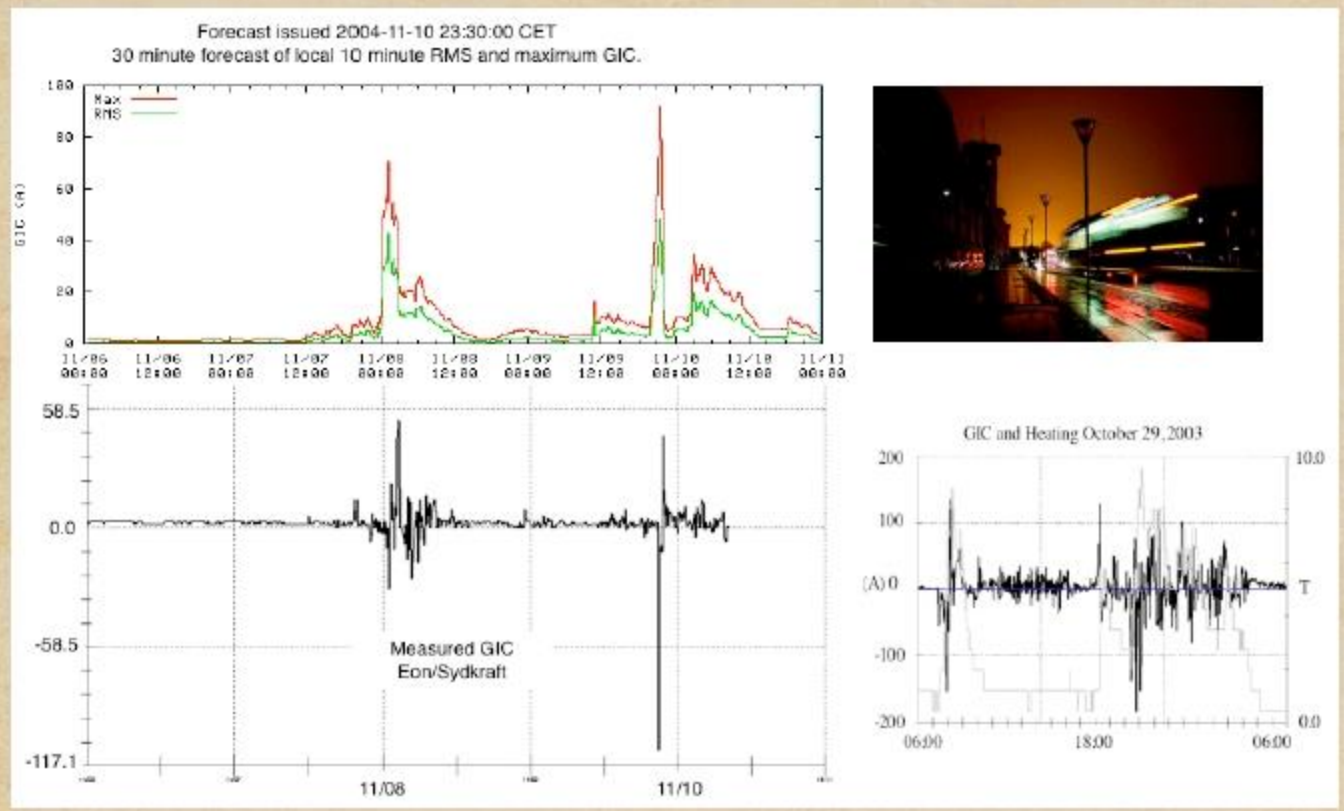
# Regional Warning Center Sweden (RWC-Sweden)

in Lund



Lund Space Weather  
Center

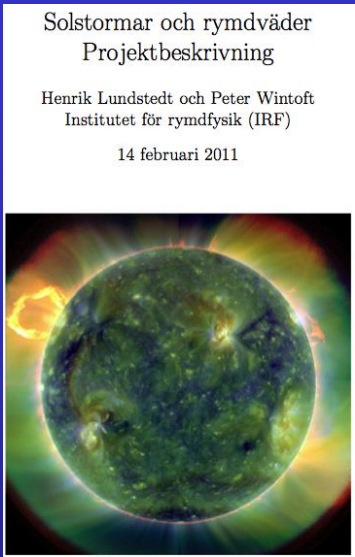
## Forecasts of geomagnetic storms and geomagnetically induced currents



### NOWCAST and ANALYSIS

- [Today's and recent geomagnetic activity](#)
- [Today's Space Weather \(SEC\)](#)
- [The Space Weather \(NASA\)](#)
- [Progress of solar cycle](#)
- [Forecast input data](#)
- [Recent space weather](#)
- [Space missions](#)
- [A proposed future](#)

# A Global Super Storm and Society



A Research and RWC application have been submitted to MSB

## Annual Meeting

17-21 February 2011 • Washington, DC

Start | Speaker Index

**5594** Civil Protection and Emergency Preparedness - Severe Space Weather

Saturday, February 19, 2011: 2:00 PM  
145B (Washington Convention Center)

**Helena Lindberg**, Swedish Civil Contingencies Agency (MSB), Karlstad, Sweden

Solar activities are hard to precisely predict, and even if one could, a large number of sunspots per year does not automatically increased impact on earth. The talk will present three different classes of impact that have been identified by solar scientists, all of different type (radio outages, geomagnetic storms and solar radiation). The findings from century-long observations of the solar cycles and the magnetic field of the earth will be explained and combined with the most recent models for solar activity predictions in all three categories to create a scenario for the 2014 time horizon when the next peak of activities is expected. The presentation concludes with a look at possible warning and reaction lead times and emphasizes the growing role of numerical space weather prediction models in providing longer lead times to protect critical infrastructure and national security.

**Gomorron Sverige**

Kategori: Nyheter  
Solstormar kan slå ut tele- och datatrafik

- ✦ Klippinformation
- ✦ Programinformation

Gomorron Sverige på svt.se

A photograph showing three people sitting on a sofa in a studio setting, engaged in an interview.

In Swedish TV about solar storms and society (H. Lindberg (MSB) and H. Lundstedt interviewed)

<http://www.lund.irf.se/HeliosHome/femamsb.html>





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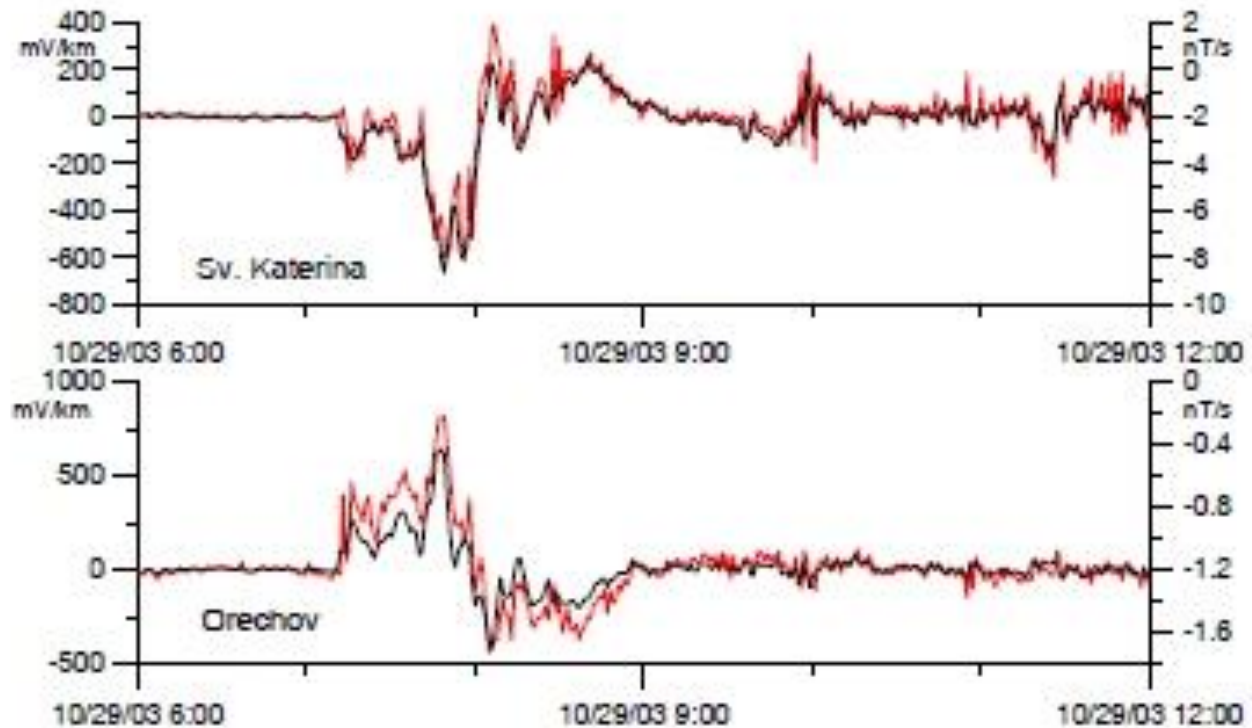
About

People

Links

Publications

## Pipelines affected by Geomagnetic Activity





**Space weather. Definitions**

State of the art in space weather observational activities and data management in Europe

Users of forecast

Space Physics Research

Solar Terrestrial Reports review and forecast

RWC WID  
Warsaw Ionospheric Database

Ionospheric Dispatch Centre in Europe

IDCE ftp data base

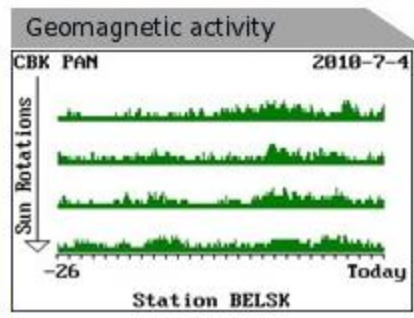
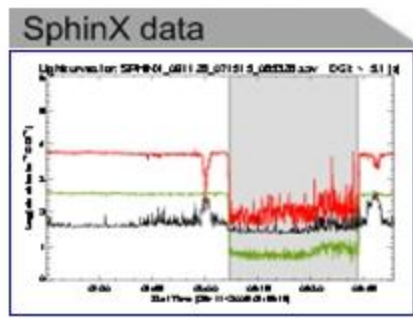
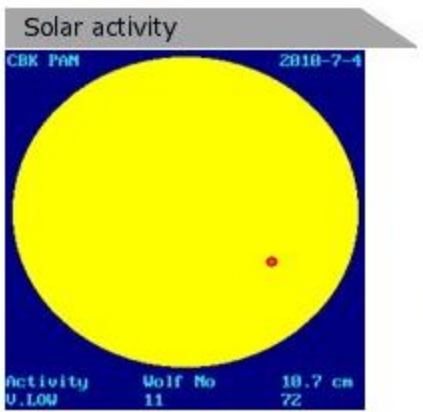
Solar activity

Geomagnetic activity

URSIGRAMS Warsaw

Daily reports

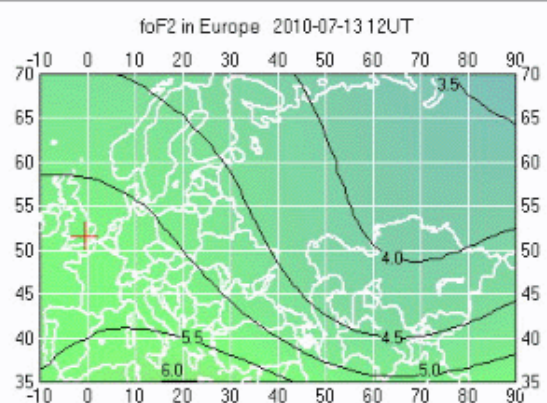
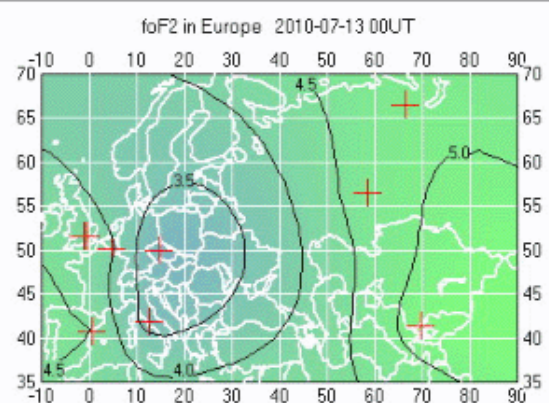
HF Radiocommunication Prediction and Forecast Service



Solar Physics Division SRC PAS

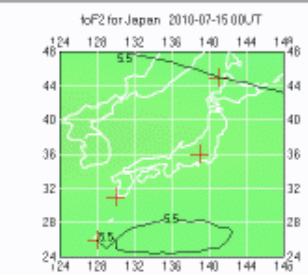
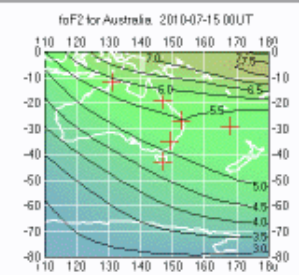
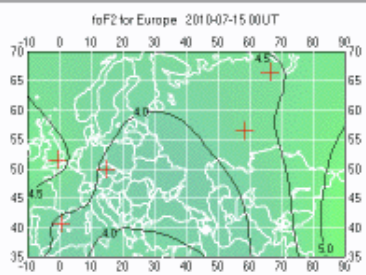
[read more](#)

**Ionospheric instantaneous maps**



[read more](#)

**foF2 24-hours forecast**



Europe

Australia

Japan

[Links](#)



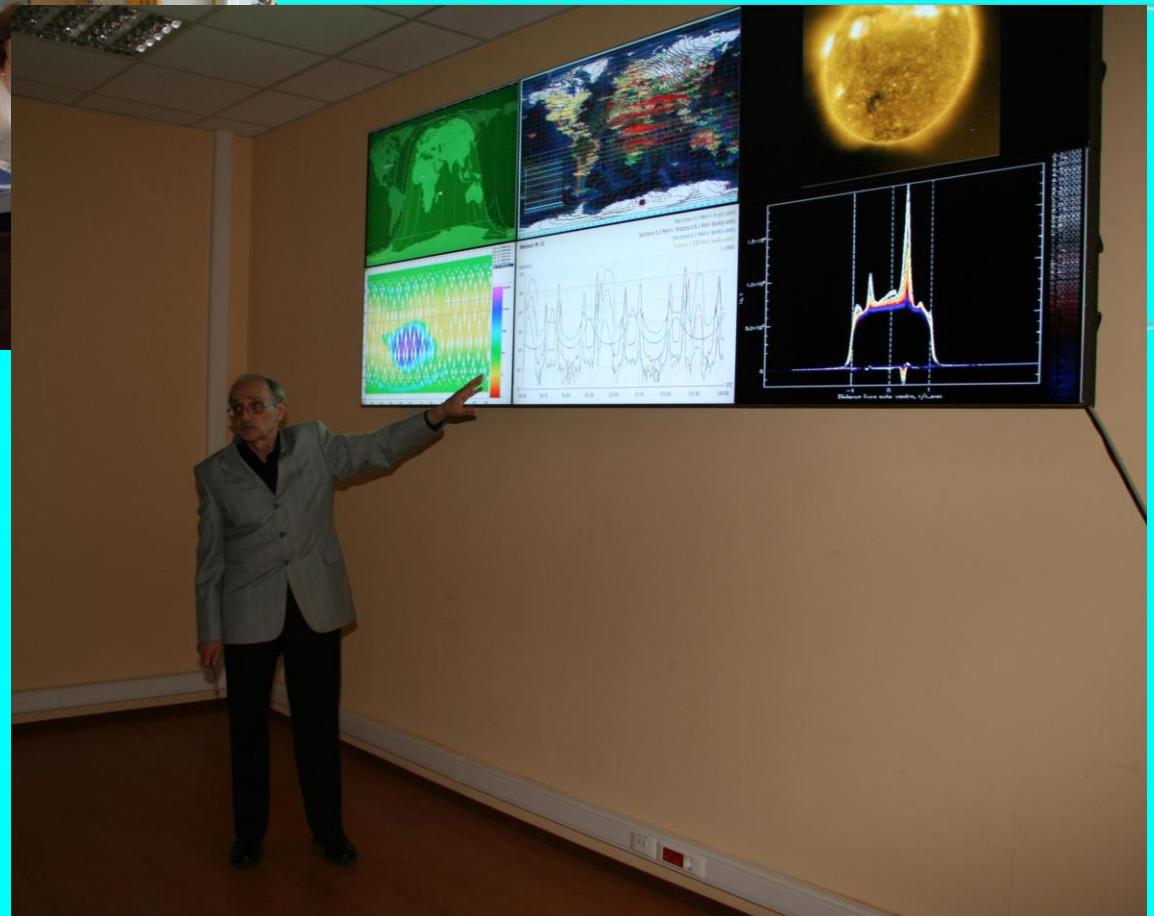
International Space Environment Service







«Институт геофизики  
и космических исследований  
имени Е. К. Федорова»



Телефон:  
Факс:  
E-mail:

[Мурманское УГМС](#)  
[Западно-Сибирское УГМС](#)  
[Дальневосточное УГМС](#)  
[Today's Space Weather](#)  
[Space Weather](#)  
[ACE RTSW \(Estimated\) MAG & SWEPAM](#)

# January 19, 2011: Launch of Geostationary satellite

Sensors:

X-ray

Ultra-Violet

Magnetometer

Energetic  
Particles

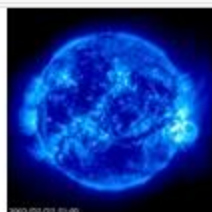






## SECTIONS :

- INDOEX
- SASCOM
- RWC-India
- GHG/Inventory
- Global Change Data
- Indian Space Data
- Special Program



### INDIA

- Overview - Regional Warning Centre
- RWC - India
- Daily RWC Message
- Monthly Geophysical Bulletin
- Ionospheric Data
- Ionospheric Prediction Models
- Solar Activity Prediction
- Meetings/Workshops
- News/Newsletter
- Events/Announcements
- Related Links
- Publications

## Visitor's View

- R.C Budhani**  
Director, NPL
- M.K. Tiwari**  
Director, South Asian START  
SD, NPL
- Hassan Virji**  
Director - International STAI
- S.K. Sarkar**  
ad, RASD
- C. Sharma**  
entist

## Today's Space Weather

Events	Past 24 hours	Current
Geomagnetic Storms	None	None
Solar Radio Storms	None	None
Radio Blackouts	None	None

## Overview - Regional Warning Centre ::

### Introduction | Main Activities

#### Introduction :

The Regional Warning Centres, as part of International Space Environment Service (ISES) chain, are responsible for collection and dissemination of recent observational data on solar geophysical conditions to users within the country and around the globe. A data exchange schedule operates with each centre providing and relaying data to the other centres. The centre in Boulder plays a special role as "World Warning Agency", acting as a hub for data exchange and forecasts.

At present, there are 12 Regional Warning Centres scattered around the globe. These centres are located in India (New Delhi), China (Beijing), USA (Boulder), Russia (Moscow), Canada (Ottawa), Czech Republic (Prague), Japan (Tokyo), Australia (Sydney), Sweden (Lund), Belgium (Brussels), Poland (Warsaw), The European Space Agency (Noordwijk) is the 12th centre, providing a venue for data and product exchange for activities in Europe.



## राष्ट्रीय भौतिक प्रयोगशाला, नई दिल्ली

### List of 12 RWC's managed by ISES worldwide

- India (New Delhi)
- USA (Boulder)
- Russia (Moscow)
- China (Beijing)
- Canada (Ottawa)
- Czech Republic (Prague)
- Japan (Tokyo)
- Australia (Sydney)
- Sweden (Lund)
- Belgium (Brussels)
- Poland (Warsaw)
- The European Space Agency (Noordwijk)

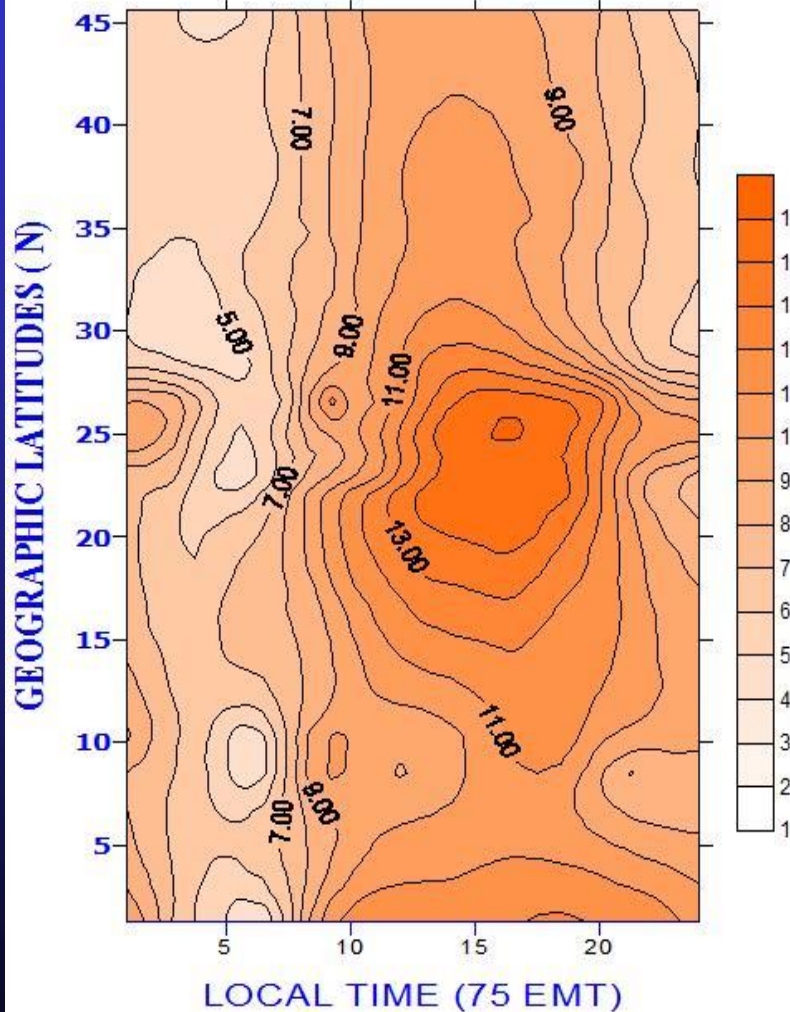
### Related Links

- International Space Environment Service

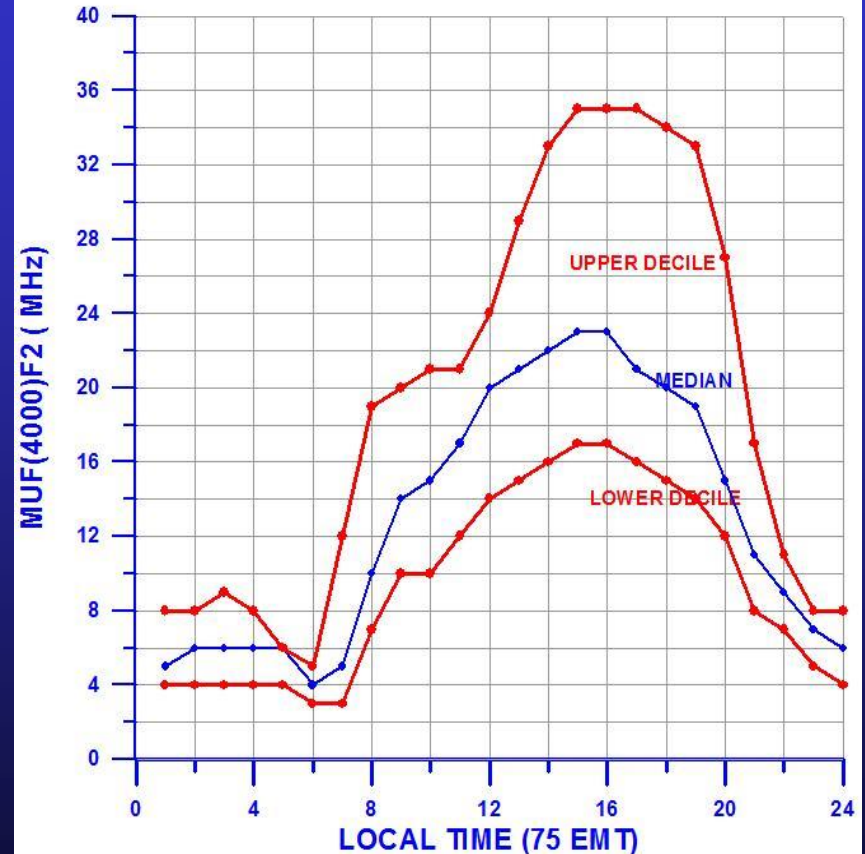
**INTERNATIONAL SPACE ENVIRONMENT SERVICES (ISES)  
OPERATES 13 REGIONAL WARNING CENTRES GLOBALLY**

# NPL-MODEL PREDICTION FOR foF2 & HF LINK FOR THE MONTH OF APRIL 2011

CONTOUR PLOT OF foF2  
USING NPL HF-MODEL (APRIL-2011)



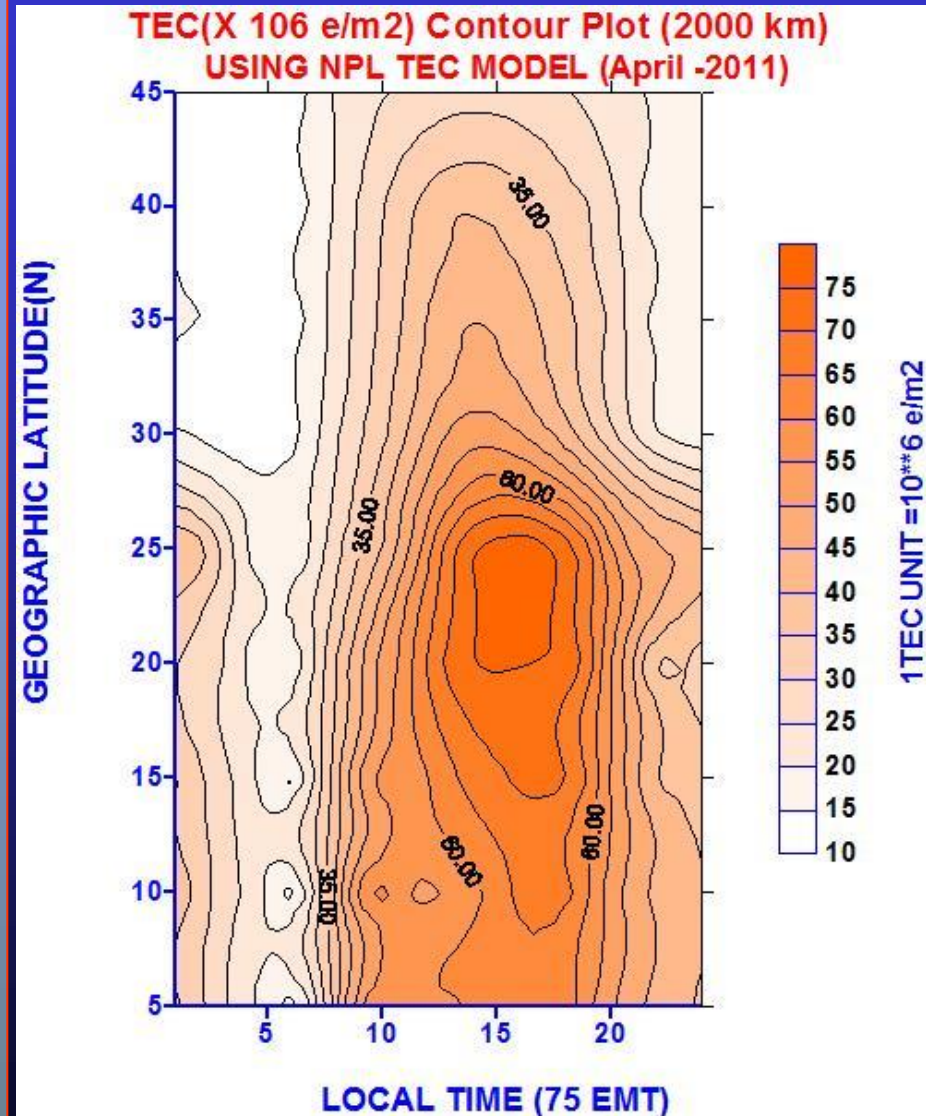
DELHI-MADRAS HF-LINK PREDICTION  
APRIL - 2011





# NPL-TEC PREDICTION MODEL FOR INDIAN ZONE

- **TEC-INTEGRAL OF Ne ALONG A RAY PATH ( $e/m^2$ ) IS SIGNIFICANT IN DETERMINING OF PHASE PATH, GROUP DELAY, DESPERSION, REFRACTION AND FARADAY POLARIZATION ROTATION OF TRANS-IONOSPHERIC SIGNALS**
- **NPL DEVELOPED A TEC MODEL FOR INDIAN ZONE USING 20 - 30 YRS OF MONTHLY MEDIAN foF2 & hmF2 VALUES FROM 16 STATIONS AS INPUT TO IRI 2000 MODEL AND GENERATED TEC FOR DIFFERENT R12 VALUES.**
- **THEN DERIVED OUR OWN 2<sup>nd</sup> DEG. COEFFICIENTS FOR EACH STATION FOR ALL THE 24 HRS. OF EACH MONTHS THE TEC MODEL.**
- **THE MODEL USES R12 PREDICTIONS AND THE USERS HAVE TO GIVE ONLY STATION LAT. MONTH AND YEAR FOR WHICH TEC IS DESIRED.**
- **THE AMOUNT OF TIME DELAY IS**  
$$t_g = 1.34 \times 10^6 \times \text{TEC} / f^2 \quad (\text{nanosec})$$
**WHERE TEC IS IN UNIT OF  $10^{16} e/m^2$**





# 中国科学院国家天文台 太阳活动预报中心

Solar Activity Prediction Center  
National Astronomical  
Observatories, CAS

Home News Team Knowledge History data English  
首页 中心新闻 团组介绍 科普园地 历史数据 英文版



## 今日预报

发布时间: 2010年7月19日

### 过去24小时太阳活动综述

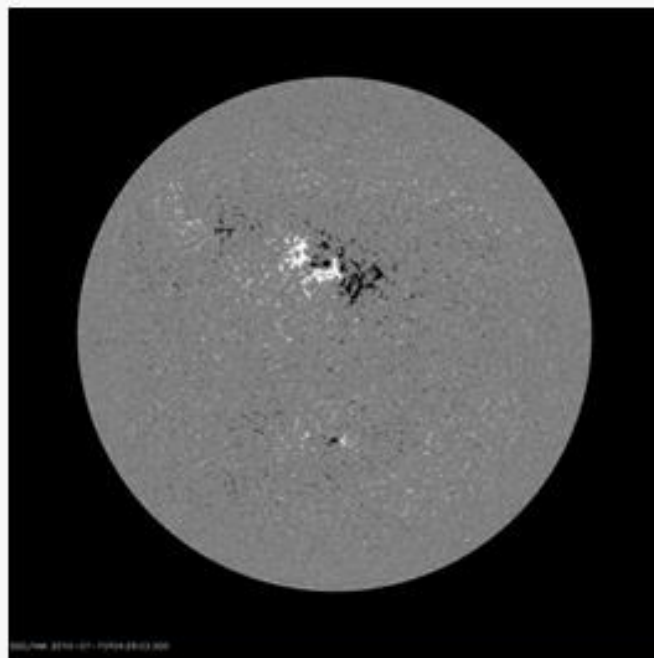
2010年07月19日 在过去24小时中, 太阳活动为低水平。日面上有1群黑子, 编号为NOAA 1087 (N24, L334), 面积为: 0010, 磁分类为Alpha。McIntosh分类为Axx。该期间无C级及以上耀斑发生。地磁场平静。

### 未来48小时太阳x射线耀斑和地磁活动预报

发布日期	X射线耀斑	地磁活动
20100719	无	平静

### 未来三天太阳F10.7cm射电流量预报

第一天	第二天	第三天



太阳磁场像 (资料获取顺序: HSOS, SoHO)



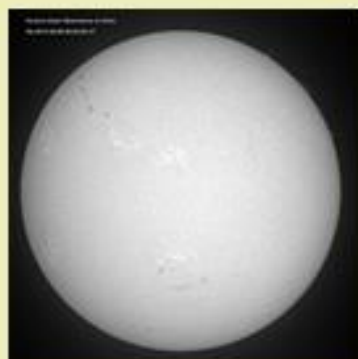
## 太阳活动预报中心

1991年国家科委和中国科学院批准成立世界警报中心北京日地物理预报中心。日地物理预报中心 (RWC—Beijing) 下设四个分中心: 地球物理预报中心、空间环境预报中心, 电离层预报中心和太阳活动预报中心, 总部设在北京天文台。2000年根据国际空间环境服务组织的要求, 更名为中国区域警报中心 (RWC-China), 其宗旨是: 提高日地物理预报水平, 扩大服务范围、推进日地空间环境的研究和预报, 开展日地物理研究与预报的国内和国际合作与交流, 与国际其他区域警报中心进行快速资料交换, 以获得全球日地物理资料和预报, 为本地区服务。





Full Disk H-alpha Image



## Today's Space Weather

19/7/2010

### 1. Flare & Geomagnetism Activity

Date	X-ray flare	Geomagnetic Activity
2010-7-16	C Class	no activity

RWCC

As a member of International Space Environment Serve (ISES), Regional Warning Center of China (RWC-China) consists of four centers: Beijing solar-geophysics prediction center, space environment prediction center,

### Links

[Space Environment Center](#)

[Huairou Solar Observing Station](#)

[Big Bear Solar Observatory](#)

[SCOSTEP](#)

[Solar Physics Division](#)

[SOHO](#)

[ISCS](#)

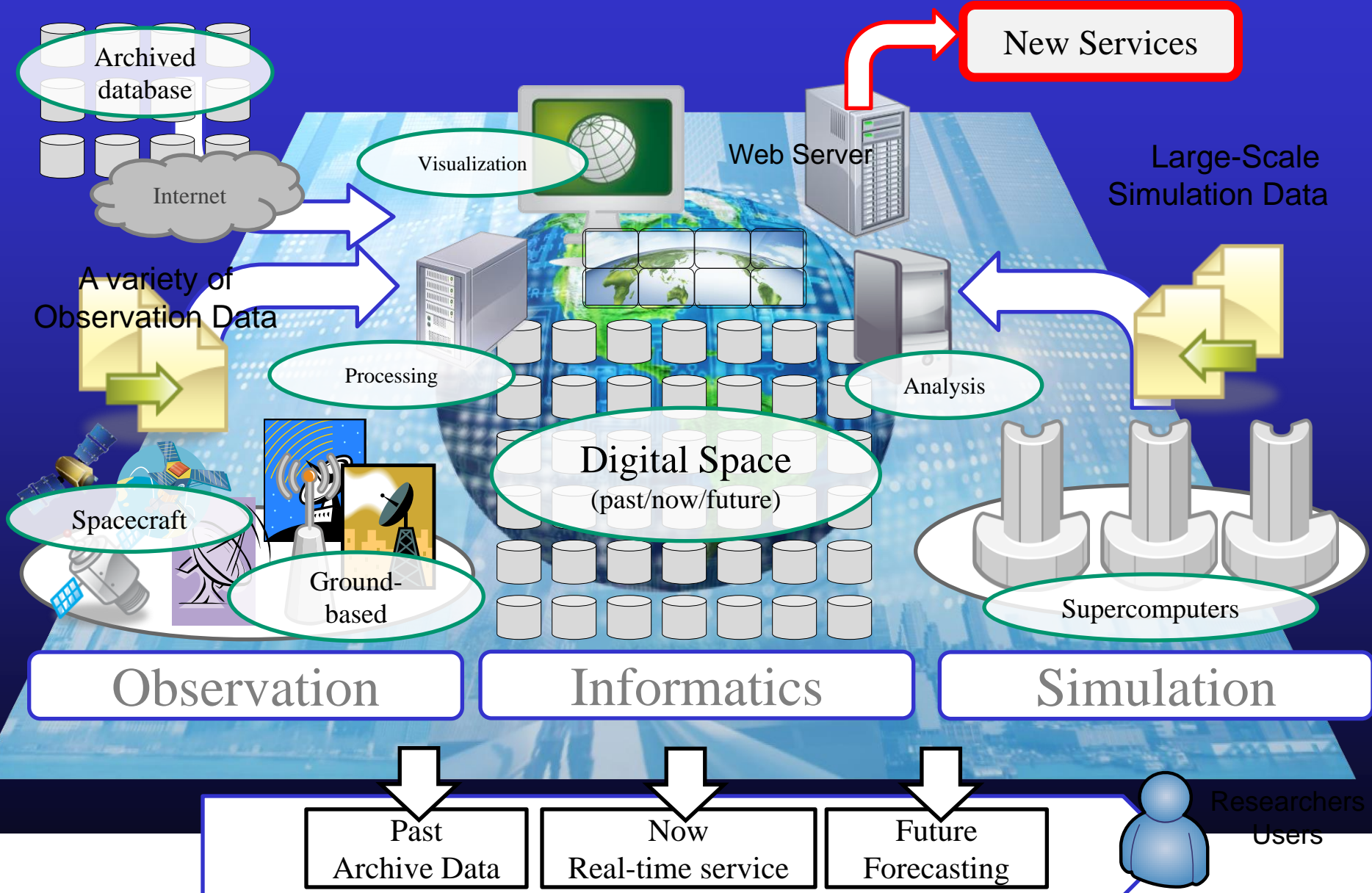
[YOHKOH SXT](#)  
[SCIENCE NUGGETS](#)



1. Occurrence recorded at the National Astronomical Observatory from Jan. 1-15, 2009:

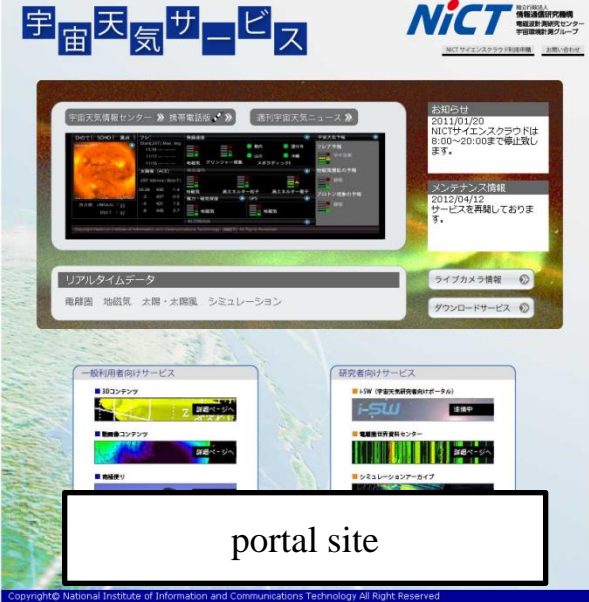
# A New Concept at RWC, Japan

## Space Weather **Cloud Service**





# NICT e-SW (Space Weather) Services



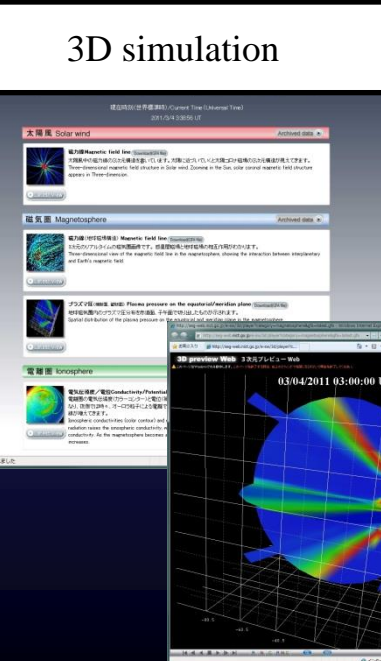
portal site



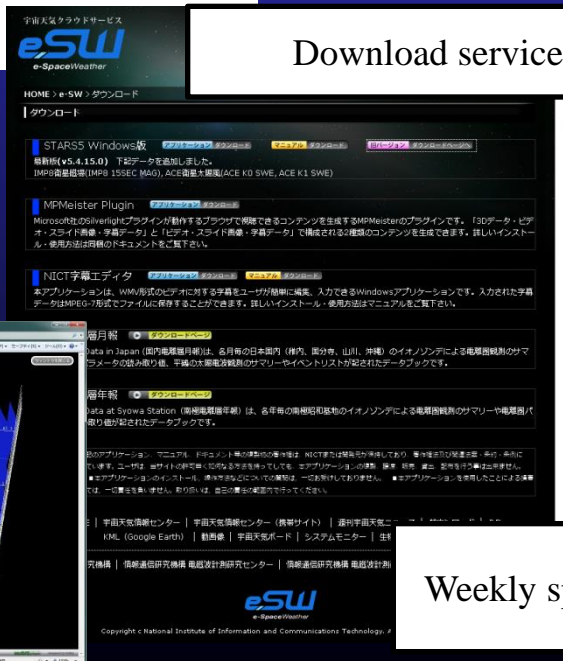
e-SW (for general people)



Space weather information



3D simulation



Download service



Weekly space weather news

Space weather information for mobile phone

<http://www.asiaoceania.org/aogs2011>

### Session Details

Section	ST - Solar & Terrestrial Sciences
Session Title	<b>Collaborative Researches and Operations of Space Weather Forecasting in Asia-Oceania region</b>
Main Convener(s)	Dr. Tsutomu Nagatsuma (National Institute of Information and Communication, Japan), <a href="mailto:tnagatsu@nict.go.jp">tnagatsu@nict.go.jp</a>
Co-convener(s)	Dr. Dave Neudegg (IPS Radio & Space Services, Australia), <a href="mailto:dave.n@ips.gov.au">dave.n@ips.gov.au</a> Dr. Ryuho Kataoka (Tokyo Institute of Technology, Japan), <a href="mailto:ryuho.kataoka@gmail.com">ryuho.kataoka@gmail.com</a>
Session Description	<p>The solar activity controls coupling physical processes from the Sun to the Earth's upper atmosphere, and occasionally causes strong space weather phenomena. Space weather phenomenon impacts human activities, such as communications, navigation, satellite operations, human activities in space, aviation systems, and electric power systems. It is expected that space weather forecasting minimizes the hazard by them.</p> <p>We are now in the ascending phase of 24th solar cycle; several strong space weather phenomena will occur in several years. Recently, several countries in Asia-Oceania region have started to conduct their own national space weather programs. Since the space weather is global phenomenon, local and regional collaborations in observations are significantly important. It is also crucial to exchange information and results of space weather researches and operations, in order to formulate international collaborations in the Asia-Oceania region. This session provides a good opportunity to discuss the recent progress of research and operational activities of space weather forecasting.</p>
Expected Duration of Session	1/2 days





# HF Systems

Looking for something?  Site Search

Home > HF Svstems

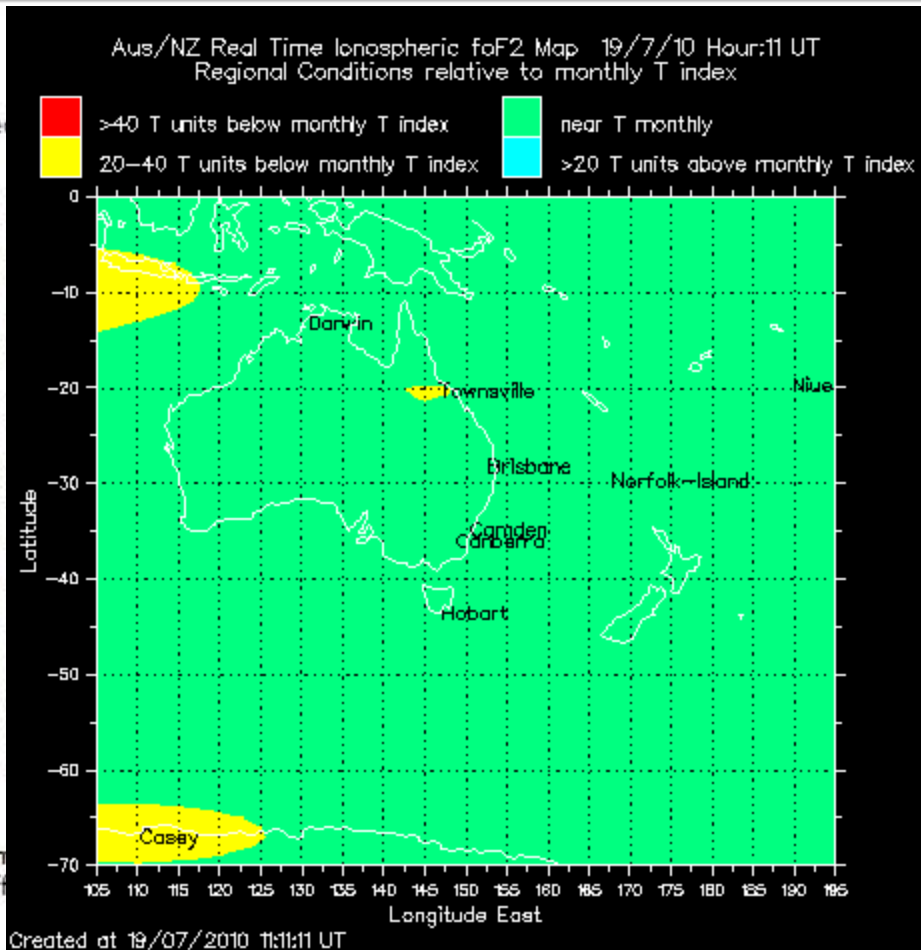
Monday, Jul 19 2010 11:18 UT

Online Tools

## Prediction Tools

IPS provides the following online pre

- HF Systems Tool
- Hourly Area Prediction
- Min-Max (Area of Coverage) HAP
- URSL
- GRAFEX Prediction
- Air Route Chart
- RAAF Air Route Chart
- Local Area Mobile Prediction
- HF Network Frequency Selection
- Digital HF Prediction



Click on the tools "Help" button for n  
website modifications by emailing off

the optimum working  
 frequency in the set, for a given  
 secondary and Lower (URSL)  
 each hour, and take-off  
 aircraft from a list of routes.  
 in 1000km of a selected  
 frequencies for long term HF  
 request additional HAP charts or

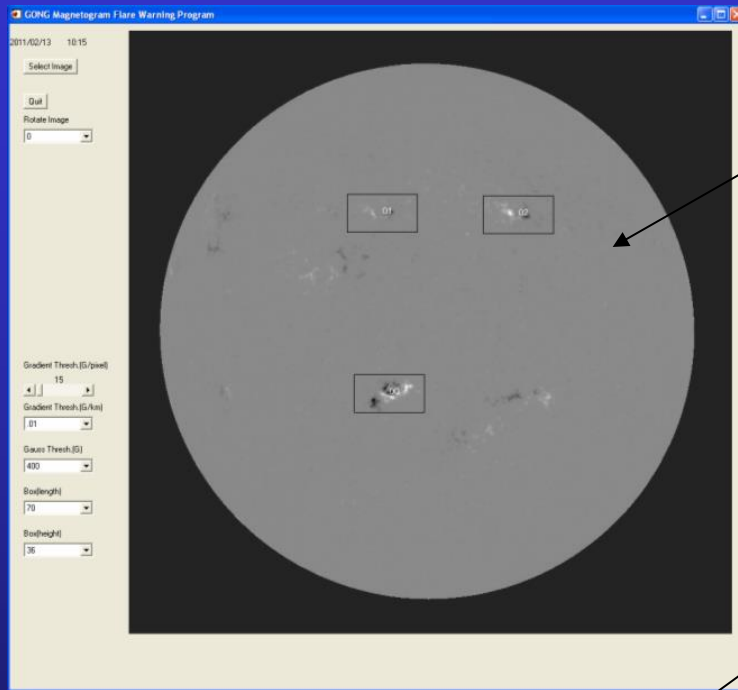
For more detailed HF predictions including field strength predictions, you can purchase the IPS Advanced Stand Alone Prediction System for AUD375. The IPS Ground Wave prediction System (GWPS), which estimates ground wave range values under specified ground and operating conditions is also available for purchase for AUD54. For more details on these software packages see:

# Data Sources

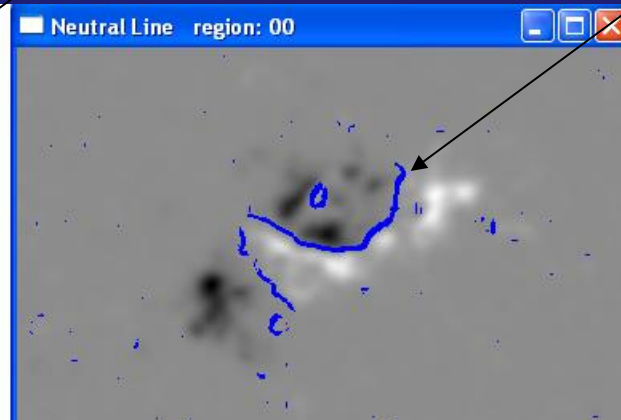
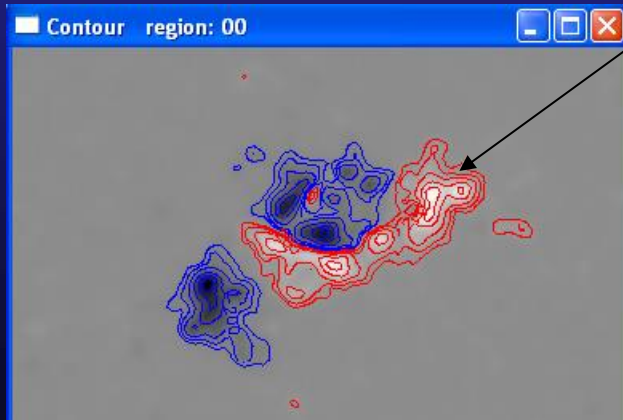




# New ASFC Capabilities - Flarecast



- The main window of Flarecast. The magnetogram shown was obtained at Learmonth on 14 February 2011 at 04:53 UT.
- Further Windows show the corresponding contour plot
  - (blue and red colors correspond to negative and positive polarities, respectively)
- and neutral line found (blue color).



# 5<sup>th</sup> International Verification Methods Workshop

December 1–7, 2011  
Bureau of Meteorology, Melbourne, Australia



Australian Government  
Bureau of Meteorology

Home

Program

Registration

Travel/Venue

Hotel/Accommodation

Contacts

## Tutorial Session: December 1-3, Scientific Workshop: December 5-7

The 5th International Verification Methods Workshop will highlight recent advances in the theory and practice of verification of weather and climate forecasts worldwide. The workshop welcomes participants from operational, research, and forecast user communities to discuss how to more effectively measure and convey the accuracy and utility of forecasts and warnings.

The workshop will include both a tutorial session (December 1-3) and a scientific program (December 5-7). The scientific workshop will include keynote addresses as well as contributed talks and posters on new verification techniques and issues related to the practice of forecast verification.

Topics will include:

- Verification of high impact weather forecasts and warnings
- Verification of ensembles and probability forecasts
- Spatial forecast verification
- Seasonal forecast verification
- Climate projection evaluation
- Propagation of uncertainty
- User issues including communicating verification to decision makers
- Verification tools

The tutorial session will include lectures and hands-on laboratory sessions using the [R statistical language](#). Participants are invited to bring their own datasets and verification problems. The tutorial will introduce:

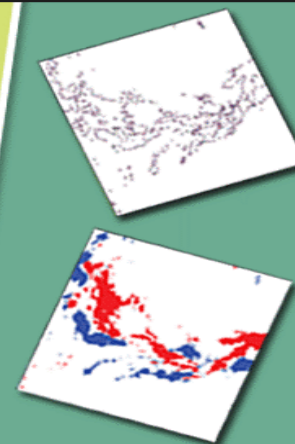
- Basic verification concepts
- Standard verification methods for deterministic and ensemble forecasts from short to seasonal scales
- Spatial forecast verification
- Climate projection evaluation
- Statistical inference
- Brief introduction to operational verification systems

### Important Dates

- **15 August 2011:** Tutorial applications due
- **9 September 2011:** Abstracts for scientific workshop due
- **31 October 2011:** Workshop registration deadline

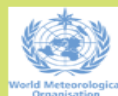
Please note that there are a limited number of places for the tutorial.

For further information contact: [Dr. Elizabeth Ebert](#)  
**CAWCR website:** [www.cawcr.gov.au](http://www.cawcr.gov.au)



## Organising Committee

Beth Ebert (BOM, Australia)  
Barb Brown (NCAR, USA)  
Barbara Casati (Ouranos, Canada)  
Caio Coelho (CPTEC, Brazil)  
Anna Ghelli (ECMWF, UK)  
Martin Göber (DWD, Germany)  
Simon Mason (IRI, USA)  
Marion Mittermaier (Met Office, UK)  
Pertti Nurmi (FMI, Finland)  
Joel Stein (Météo-France)  
Laurie Wilson (CMC, Canada)  
Yuejian Zhu (NCEP, USA)



<http://cawcr.gov.au/events/verif2011/>



# ISES Regional Warning Centre for Africa

Cape Town to Pretoria: 20 July 2010

arning



Information  
Comments or

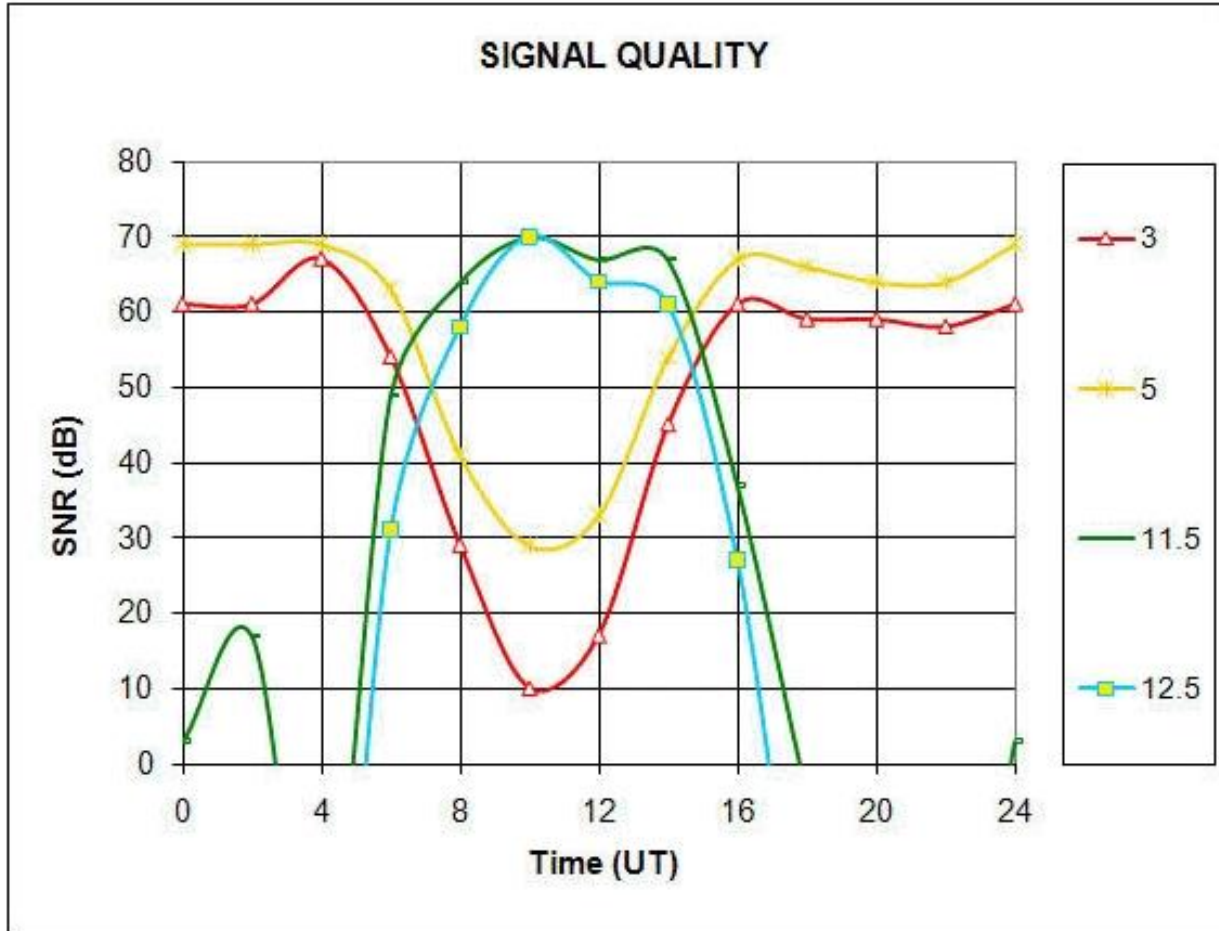
spheric data

conditions are  
possible HF

/ average HF



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Contributors Wel

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# Migration to SANSA

On **1 April 2011** the Hermanus Magnetic Observatory (**HMO**) migrated from the National Research Foundation (**NRF**) to the South African National Space Agency (**SANSA**)

**HMO became SANSA Space Science**

CEO: Dr Sandile Malinga

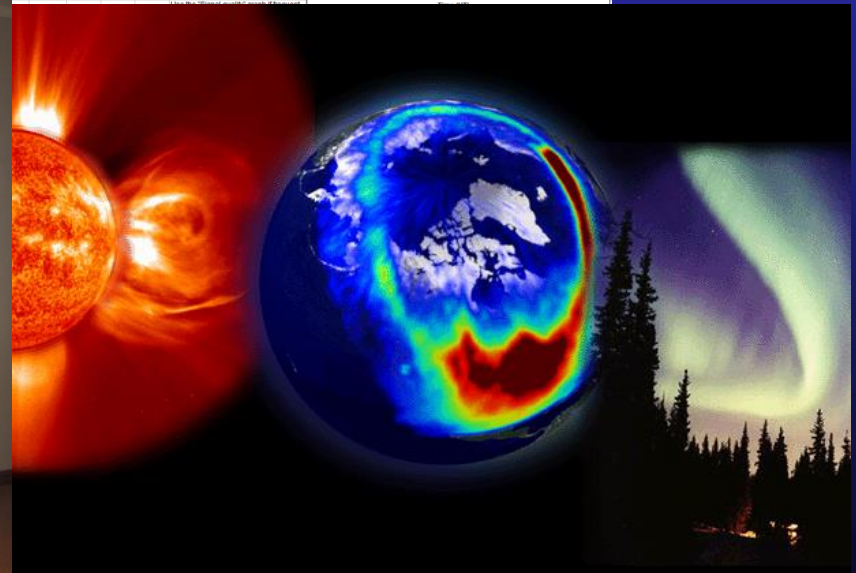
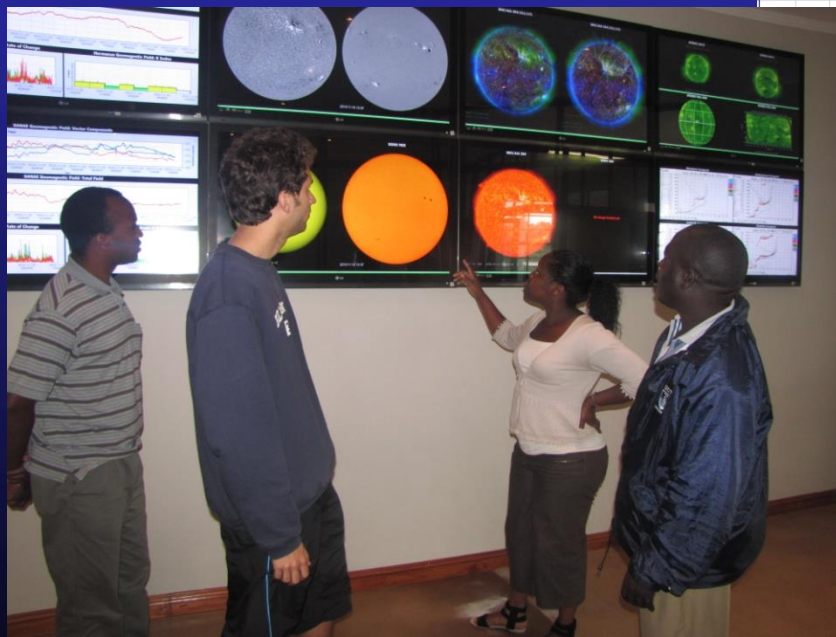
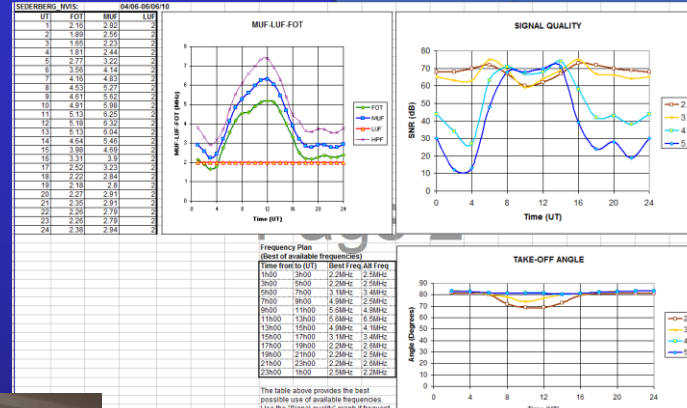
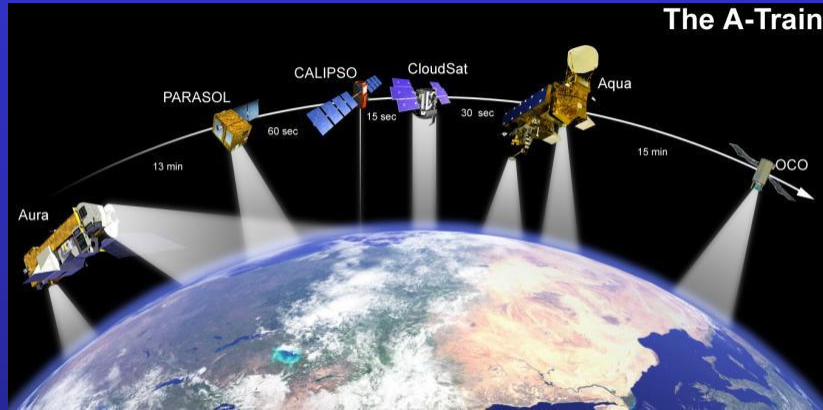
Acting MD Space Science: Dr Lee-Anne McKinnell

**Space Weather falls under Space Science and is a recognised service that SANSA will provide.**

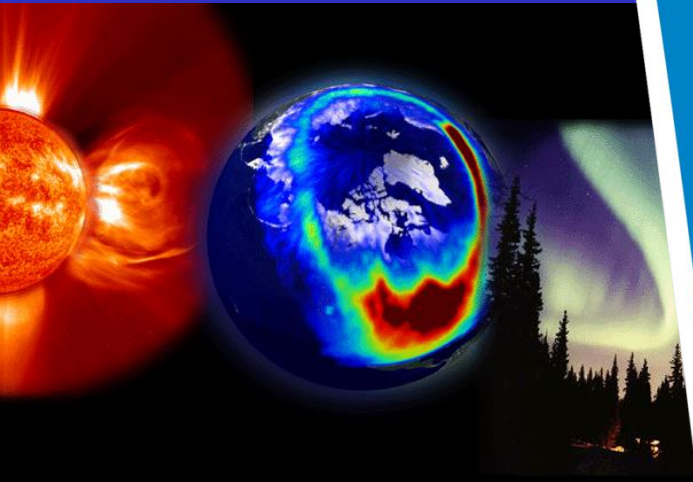
The RWC mandate under ISES has been transferred to SANSA as part of the migration.



# SPACE WEATHER OPERATIONS CENTER







# Opening of Space Weather Center in Hermanus was opened officially by Mrs Naledi Pandor, South African Minister of Science and Technology on 10 December 2010.

A first public Space Weather open day was held in the center on 4 April 2011.

Real time data and information is displayed from both satellite and ground based stations.



# EMBRACE

## Estudo e Monitoramento Brasileiro do Clima Espacial



INÍCIO

INPE

BOLETIM

WORKSHOP

EXECUTORES



**O Programa**

Introdução

Definição

Estrutura

Equipamentos

Satélites

**Monitoramento Tempo Real**

Sol

Meio Interplanetário

Campo Magnético

Terra

Painel

**Utilidades**

Dados Geofísicos

Índices Magnéticos e

Solares

Glossário

CDAW

BOLETIM

**Links**

Ag. Financiadores

Executores

Colaboradores

Links Úteis

**Contato**

Localização

Fale conosco



**Sol**

Imagens e Indicadores de Atividades Solar - SOHO / SSN



**Meio Interplanetário**

Atividades de Raios Cômicos



**Campo Geomagnético**

Índice de Perturbação Geomagnética



**Terra / Ionosfera**

Cintilação e Ionogramas



**CDAW**

CDAW images, movies and datas



**Boletim Diário**

Boletim Diário

**News**

Área destinada para um sumário de notícias periódicas

**Resumo Boletim**

Sol: Existem duas regiões ativas (NOAA 1084 e 1086) na superfície visível do Sol, a primeira de co...

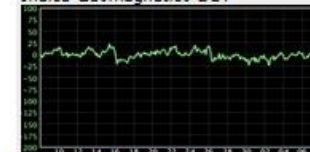
Meio Interplanetário: O meio entre o Sol e a Terra não apresenta grandes perturbações. O vento s...

Terra: A ionosfera e a magnetosferas estão com comportamento de períodos calmos. A base da camada ...

**Images Previous**



**Índice Geomagnético DST**



**Follow us (Breve)**



**DESTAQUES**

AIA 304 Movie - 2010-04-19

**Plasma Rain**

The Sun performs for SDO - AIA

First Light - Solar Dynamics Observatory [HD]

**FIRST LIGHT**  
Solar Dynamics Observatory

**INPE**

MINISTÉRIO DA CIÊNCIA E TECNOLOGIA  
INSTITUTO NACIONAL DE PESQUISAS ESPACIAIS

Sede:

Av. dos Astronautas, 1.758  
Jd. Granja - CEP: 12227-010  
São José dos Campos - SP  
Brasil

Tel.: 55 (12) 3700-6000



# INPE's Solar Radio wave Monitoring

## INPE/MACKENZIE

Itapetinga Radio Telescope (Atibaia)

21-90 GHz



7 GHz

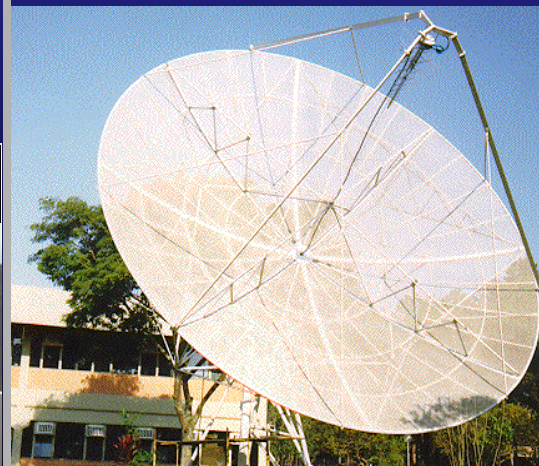


SPUA - 12 GHz



## INPE Brazilian Decimetric Array (Cachoeira Paulista)

1.2, 1.7, 2.8, 5.6 GHz



BSS 1000-2500MHz

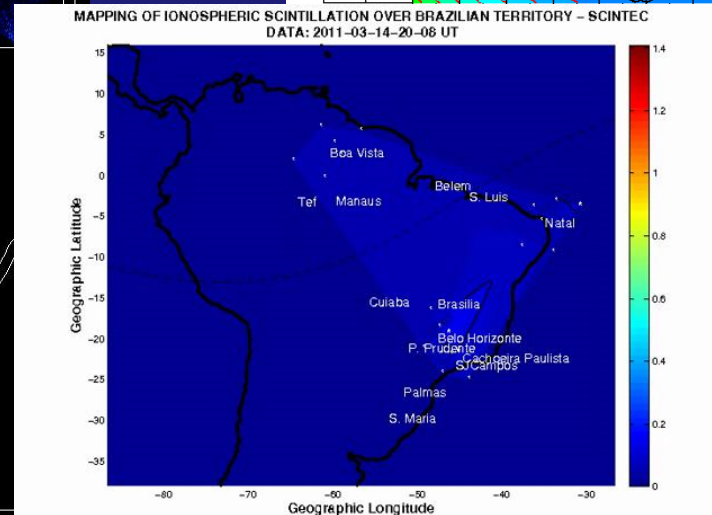
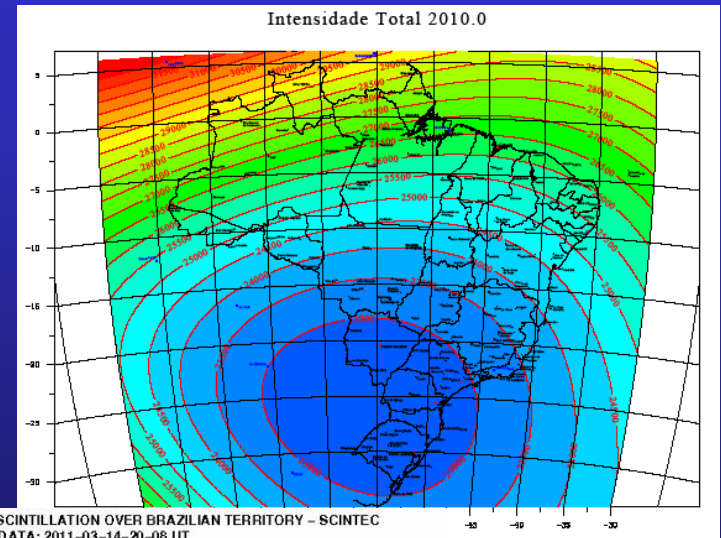
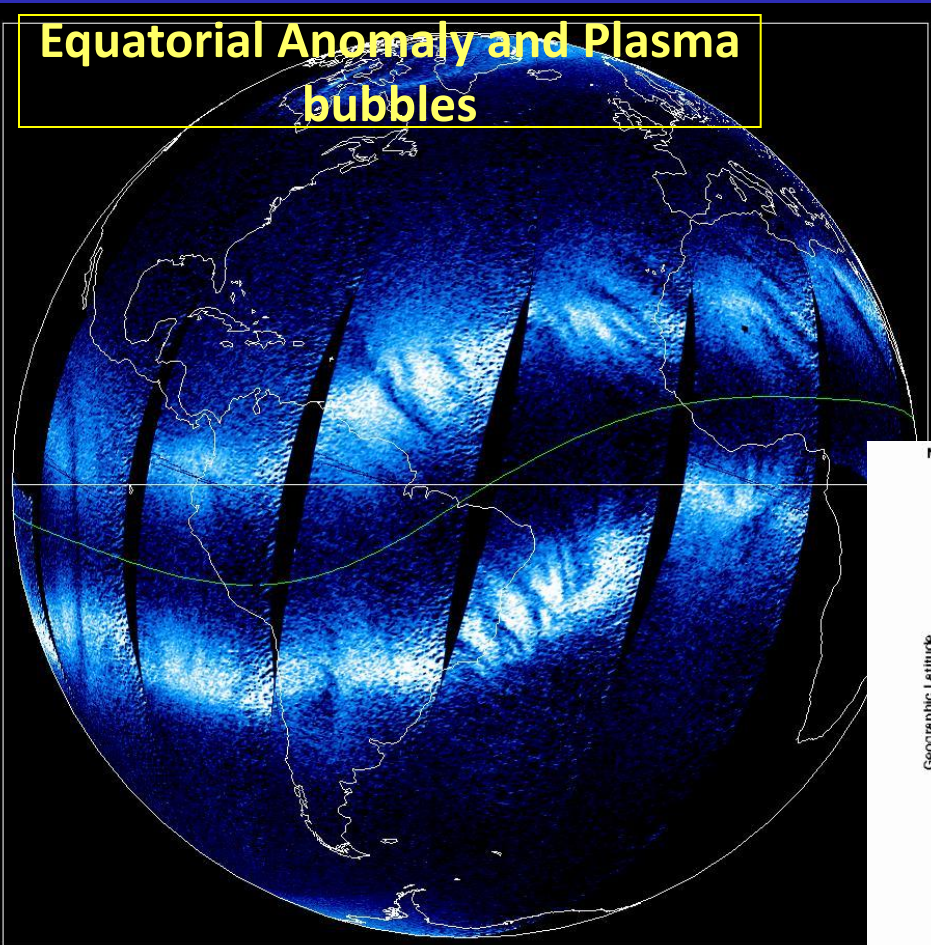
SPECMM 1-40 GHz



# Space Weather: South America's singularity

1. Equatorial Ionosphere (Anomaly (TEC) and plasma bubbles (Scintillation))
2. South Atlantic geomagnetic Anomaly (high energy particle precipitation)

## Equatorial Anomaly and Plasma bubbles







# Space Weather Canada

www.spaceweather.gc.ca

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[Contact Us](#)

[Help](#)

[Search](#)

[canada.gc.ca](#)

[Home](#) > [Current Space Weather](#) > [Short Term Magnetic Forecasts](#) > [Map - Three Zone Forecast](#)

## Space Weather

[Home](#)

[Current Space Weather](#)

### Forecasts

[Regional Conditions](#)

[Short Term](#)

[Tabular 3 zone](#)

[Map 3 zone](#)

[Graphic 3 zone](#)

[Graphic multi station](#)

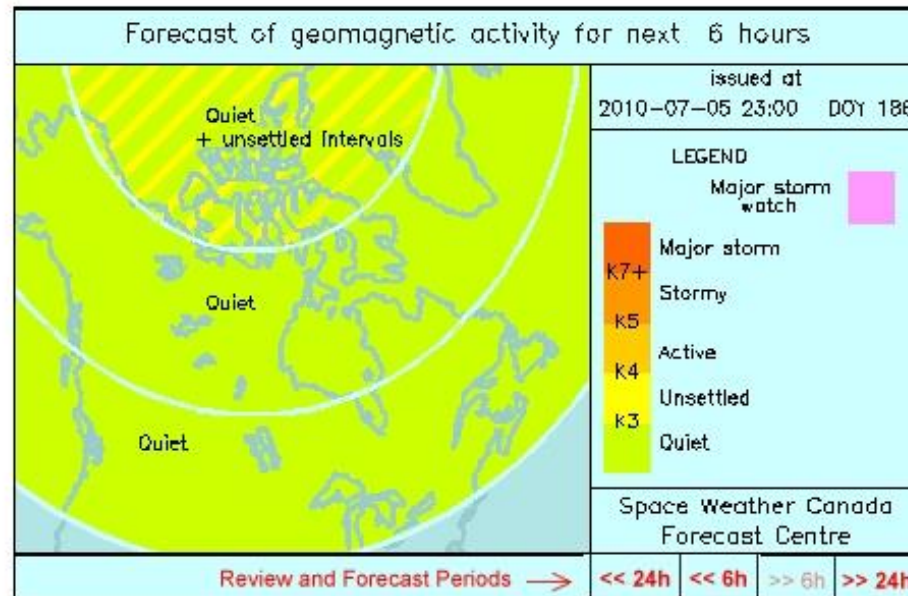
[Text Version](#)

[Long Term](#)

[Fluence](#)

## Space Weather Canada

### Map - Three Zone Forecast

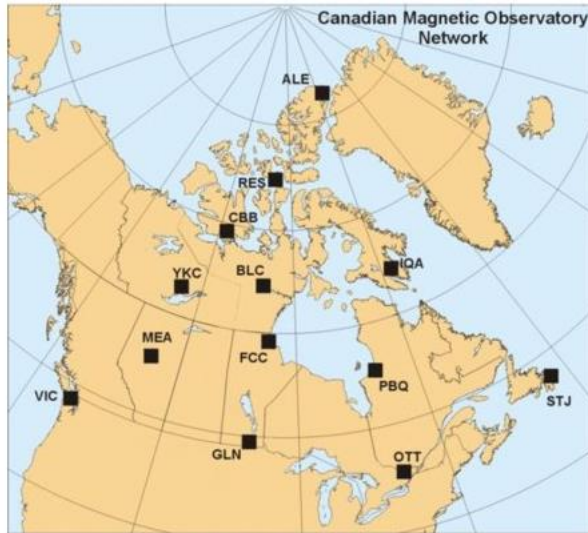


# Space Weather Service for Pipelines

Français	Contact us	Help	Search	Canada Site
<a href="#">Home</a>	<a href="#">Current Space Weather</a>	<a href="#">Effects on</a>	<a href="#">NRCan</a>	
<a href="#">Data</a>	<a href="#">Geomagnetism</a>	<a href="#">Technology</a>	<a href="#">CSA</a>	

## Spaceweather Canada - Pipeline Service

Select type of plot:  Then select location



[Back to the Pipeline Service Introduction page](#)

Last modified: 2005-03-7

[Important notices](#)



Français	Contact us	Help	Search	Canada Site
<a href="#">Home</a>	<a href="#">Current Space Weather</a>	<a href="#">Effects on</a>	<a href="#">Technology</a>	<a href="#">NRCan</a>
<a href="#">Data</a>	<a href="#">Geomagnetism</a>	<a href="#">Technology</a>	<a href="#">CSA</a>	

## Spaceweather Canada - Pipeline Service

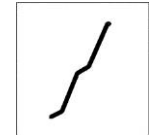
Date:

Observatories:

Pipeline type:  Test Point:  km

Scale:  Lower CP:  Upper CP:

Hours Range (Start/End):



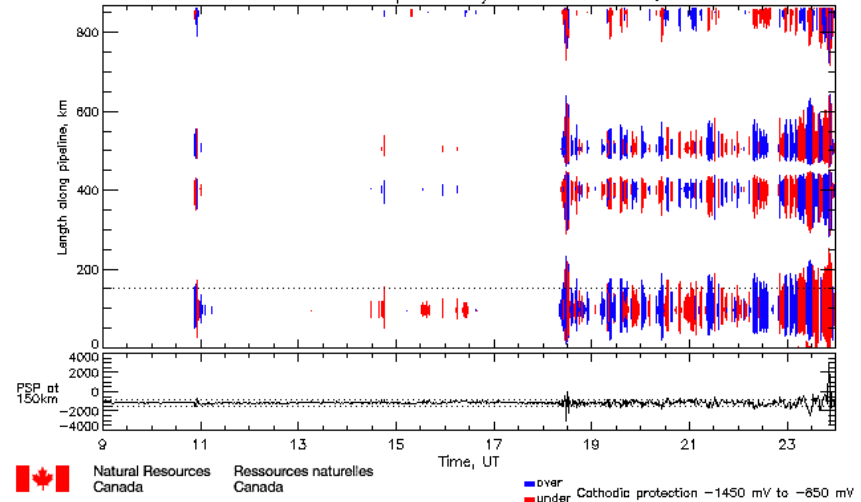
- [Geomagnetic Hazards](#)
- [Pipelines](#)
- [Pipeline Service](#)
- [Pipeline Service Options](#)
- [Geomagnetic field](#)
- [Geo-Electric field](#)
- [PSP variations for sample pipeline](#)
- [PSP variations for custom pipeline](#)

**Latest Forecast**

[HOME](#)

[Geomag HOME](#)

Ottawa 1-minute preliminary data November 7, 2004



Legend: ■ over ■ under Cathodic protection -1450 mV to -850 mV

To Download : [JPEG format](#) | [PNG format](#) | [Values](#)

Last modified: 2005-02-14

[Important notices](#)

Results based on this pipeline:





# National Weather Service Space Weather Prediction Center

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Top News of the Day: On 01 June 2010 Thule Neutron Monitor Data was discontinued in Space Weather Prediction Center products.

## Current Space Weather Conditions

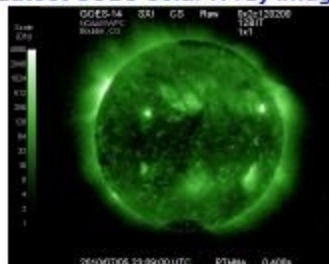
----- Satellite Displays -----



----- Popular Pages -----



### Latest GOES Solar X-ray Image

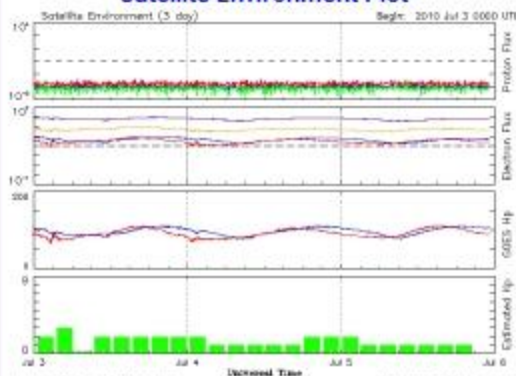


### NOAA Scales Activity

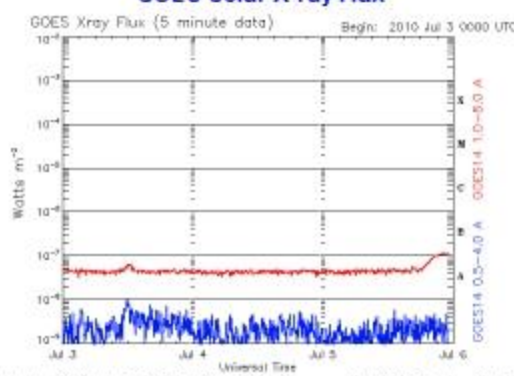
Range 1 (minor) to 5 (extreme)

NOAA Scale	Past 24 hours	Current
Geomagnetic Storms	none	none
Solar Radiation Storms	none	none
Radio Blackouts	none	none

### Satellite Environment Plot



### GOES Solar X-ray Flux

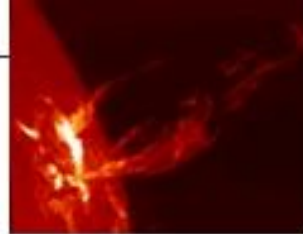


NOAA/SWPC Boulder, CO USA

NOAA/SWPC Boulder, CO USA



Spa



# Space Weather Alerts

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## Alerts

- Graphical Timelines -- [Past 7 days](#) -- [Currently in Effect](#)
- Text Format -- [Current month](#) -- [Previous month](#)
- [Archive](#) -- Graphical Timelines and Text Format from 2001
- Space Weather Alerts via [anonymous FTP server](#)
- [Table of Space Weather Alerts](#) -- Descriptions and Samples

## Related Displays and Data

- Indices and Event Reports
  - [Geomagnetic, Radio Flux, and Solar Indices Log](#)
  - [K-indices chart](#)
  - [A-indices chart](#)
  - [Solar Event Reports](#) x-ray flares, radio bursts and other reports
  - [Radio Burst Event Reports](#) and [Solar Radio Flux Lists](#)
  - [Solar Proton Events](#)
- Dynamic Plots
  - Solar X-ray Flux: [6-hour](#) (1-min data), [3-day](#) (5-min data)
  - [D-Region Absorption Prediction](#)
  - [Boulder-NOAA Magnetometer](#) k-indices and sudden impulses
  - [GOES Magnetometer](#)
  - [GOES Electron >2 MeV integral flux](#)
  - [GOES Proton >10 MeV and >100 MeV integral flux](#)
- Solar Images and Maps
  - [SXI Latest Images](#), [Movies](#)
  - [Solar Image Sites](#)
  - [Recent solar image with region number annotations\\*](#)
  - [Map of Active Solar Regions\\*\\*](#)
- Forecast -- [SWPC Report of Solar and Geophysical Activity and 3-day Predictions](#)
- Plots, Lists, and Web Pages
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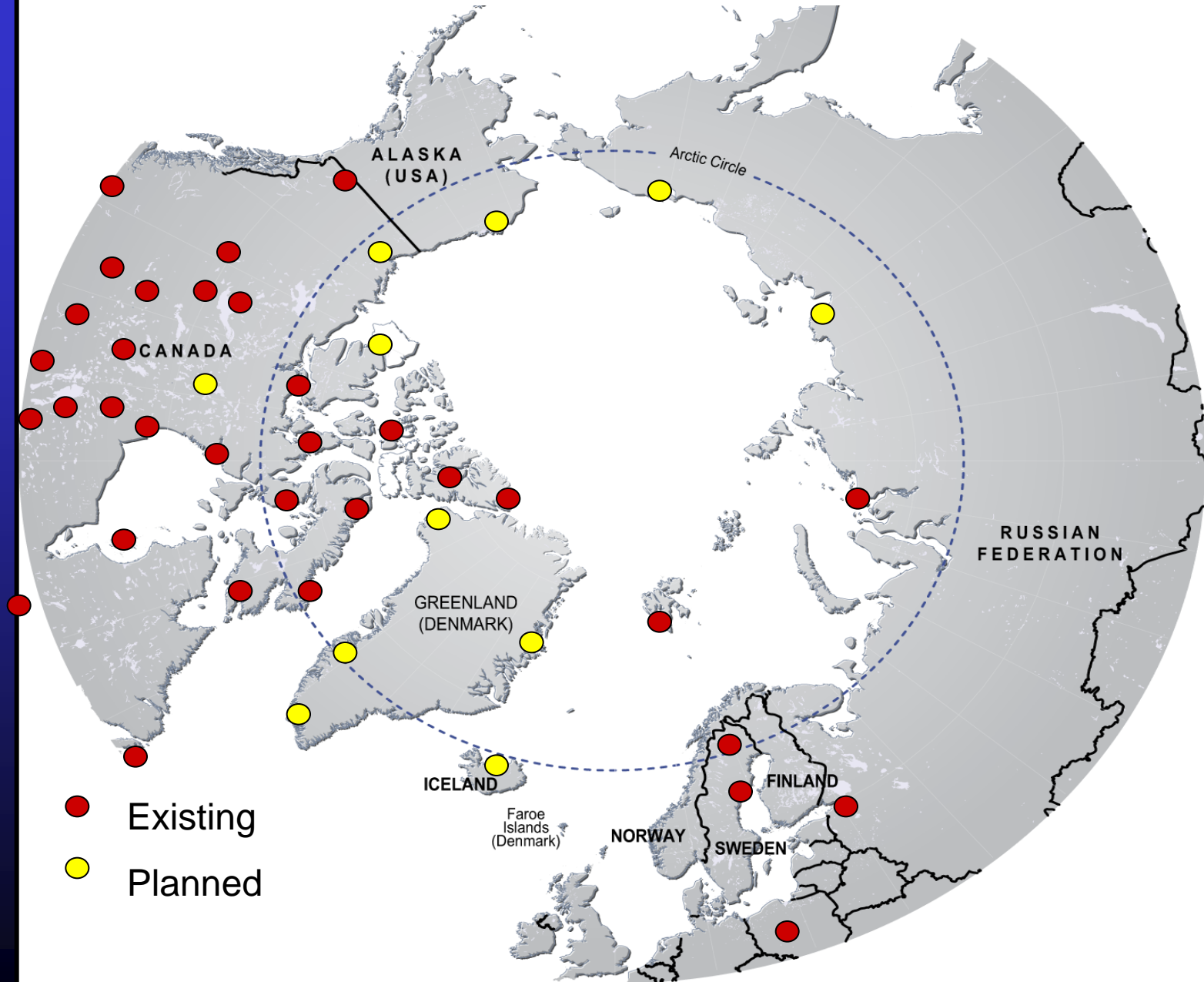


# SWPC's special role in international collaboration

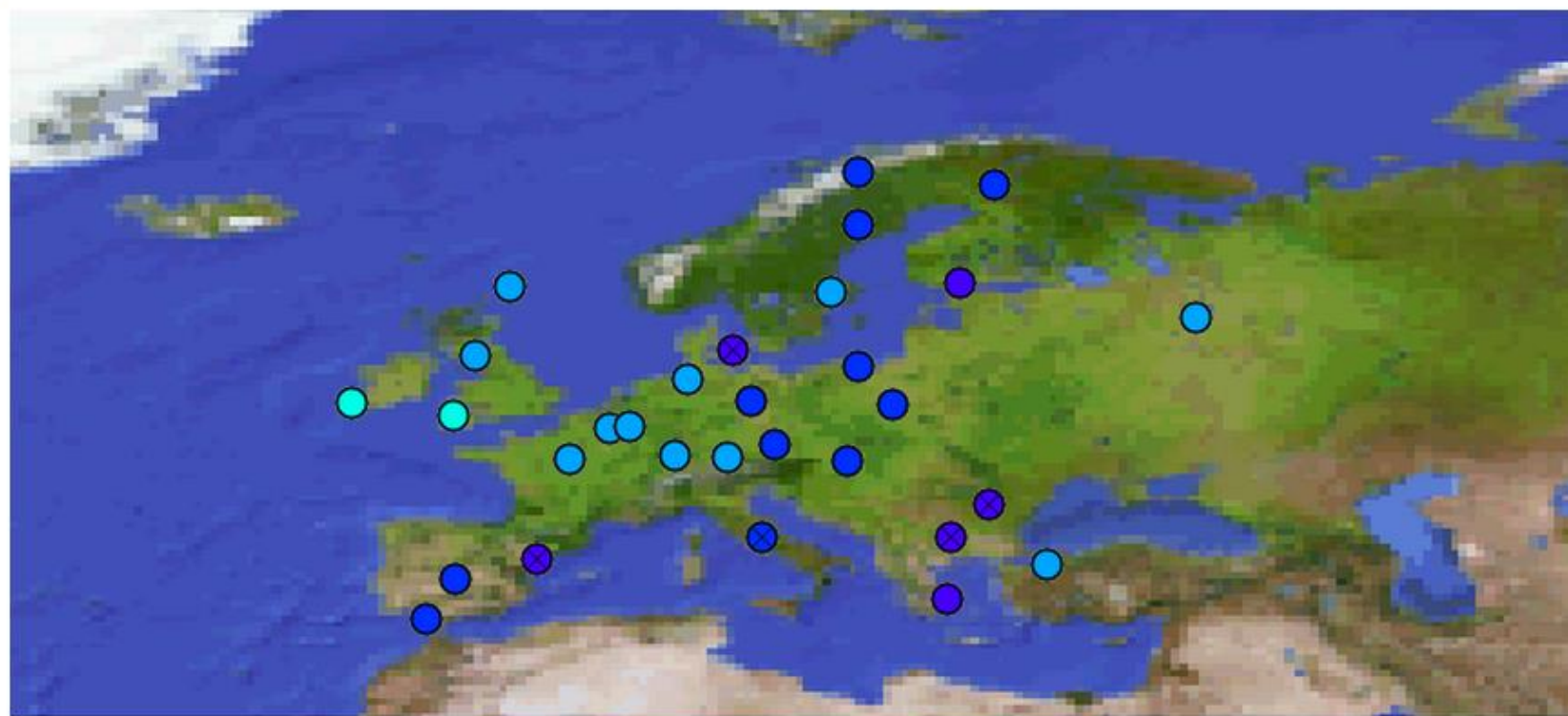
- Act as a “clearing house” for operational space weather data
- ACE data



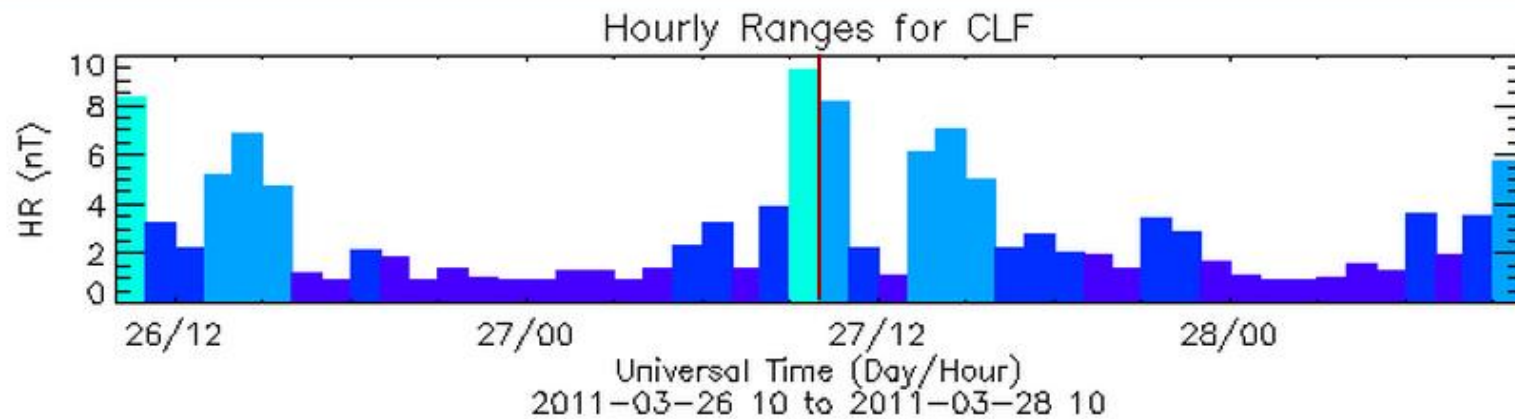
# ISES Circum-Polar Riometer Network

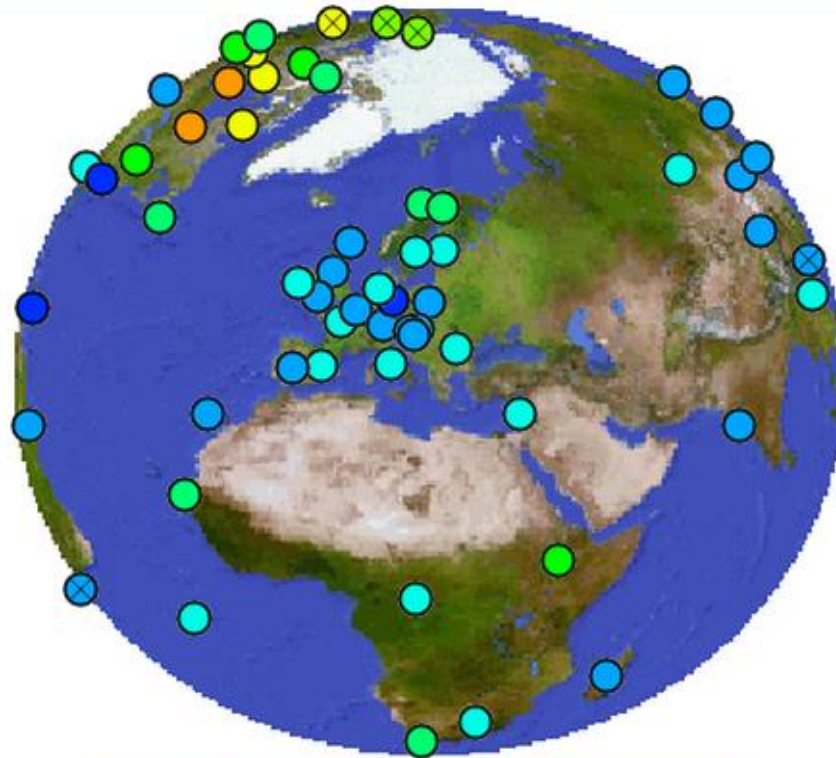


# Intermagnet data



2011-03-27 10:00

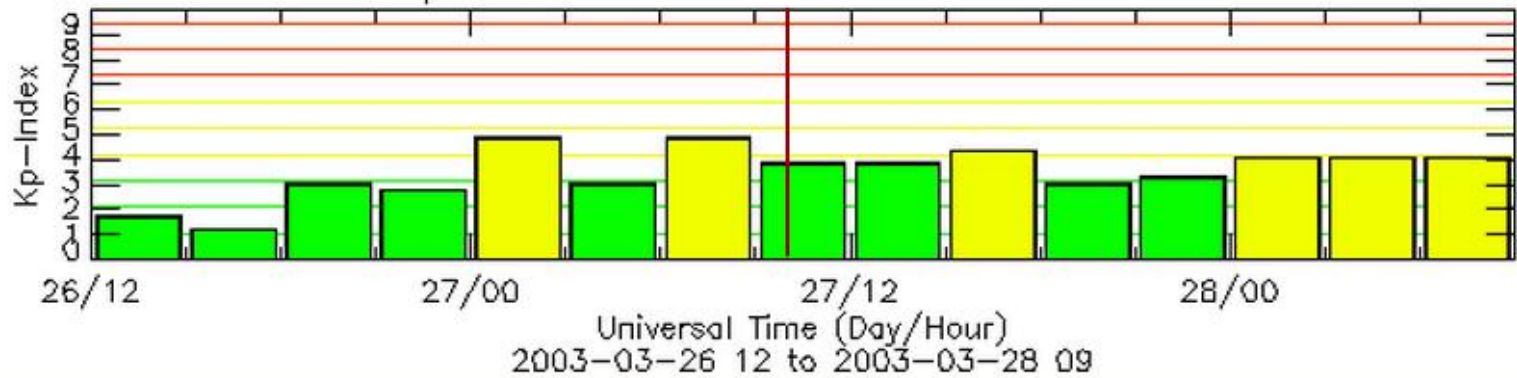




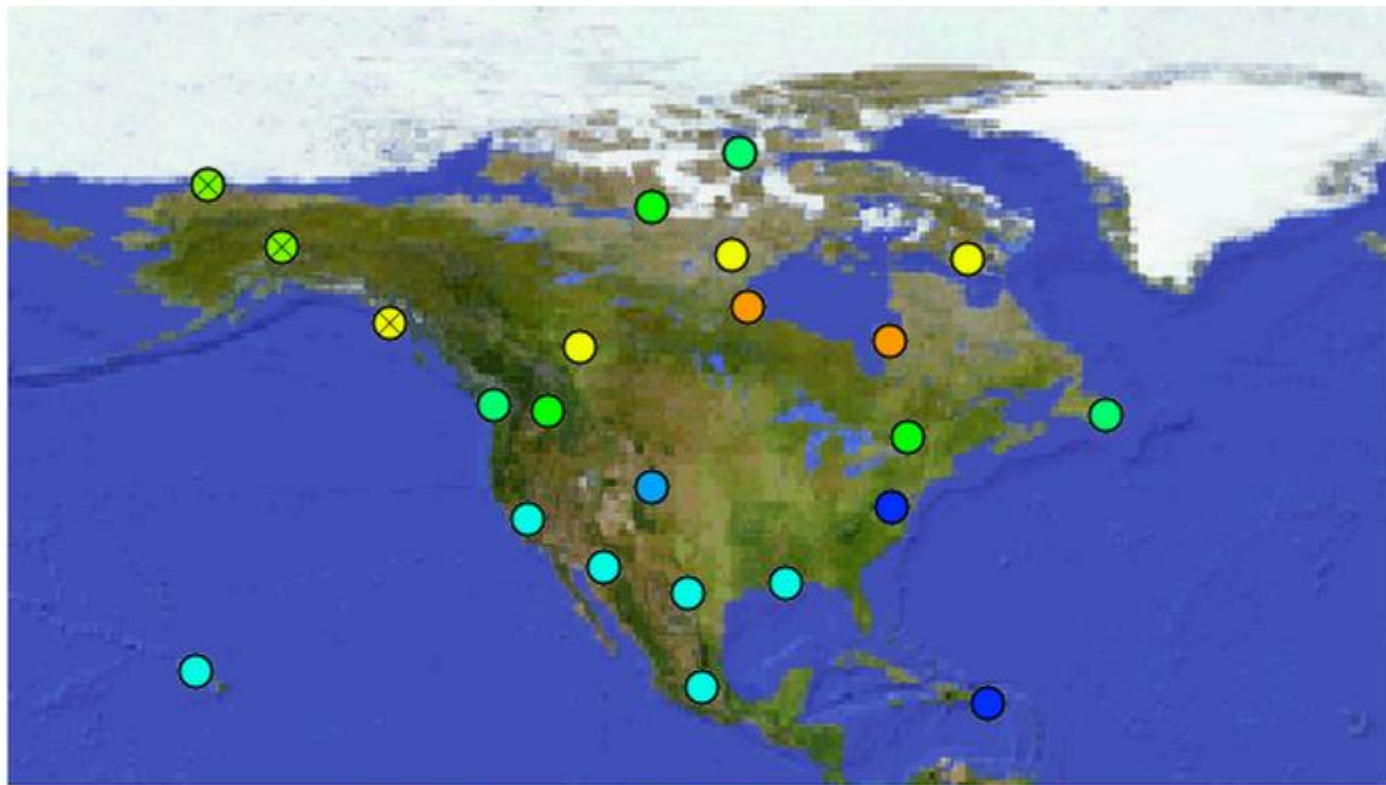
2003-03-27 10:00



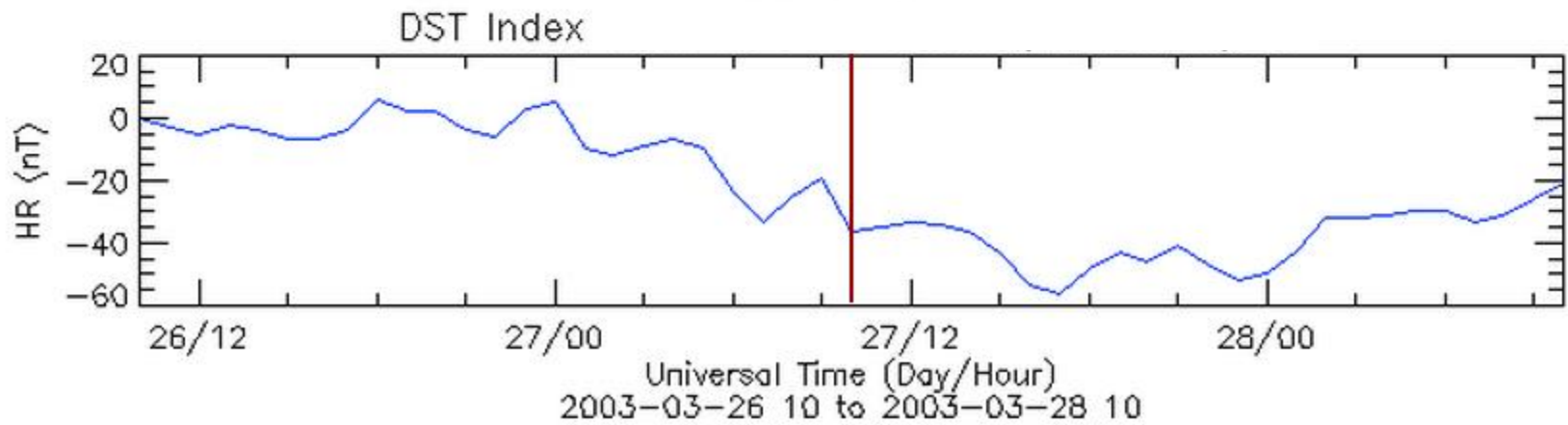
### Kp Index







2003-03-27 10:00



# Development of Space Weather Services

1. Need to talk to the Customers
2. Need to talk to the Customers
3. Customers don't always know what they need or what is possible
  - requirements can exceed capabilities
  - sometimes clients limit their expectations

# Development of Space Weather Services

- Industrial customers want to know how their system will be affected
- Need to understand and model their systems
- Meet local requirements (eg language)
- Look for what is really required
  - envelope of disturbance sometimes enough
- Does not have to be perfect to “have value”





# International Space Environment Service



[ISES](#) | [URSIgram Codes](#) | [Reports](#) | [Regional Warning Centres](#) | [Info](#) | [Geo-Calendar](#)

## Welcome to International Space Environment Service



### ISES

The International Space Environment Service (ISES) is a permanent service of the Federations of Astronomical and Geophysical Data Analysis Services (FAGS) under the support of the International Union of Radio Science (URSI) in association with the International Astronomical Union (IAU) and the International Union of Geodesy and Geophysics (IUGG).



### Regional Warning Centres

The data exchanged are highly varied in nature and in format, ranging from simple forecasts or coded information up to more complicated information such as images. An important strength of the data exchange system is that RWCs often have access to data from unique instrumentation available from the scientific community in its region.



### URSIgram Codes

The URSIgram codes were originally developed to facilitate the rapid exchange of information by telex. Nowadays, with the internet, compression of information for telex is no longer necessary. However, coded data are still useful as they are easier than text messages to ingest into automatic forecast programs.



### Spaceweather.org

Spaceweather.org is sponsored by ISES. It is a gateway to access the most updated space weather information, including HF radio frequency, Space weather in the solar system and much more.

[www.ises-spaceweather.org](http://www.ises-spaceweather.org)