

Brief description of activities of UN, WMO, SWW, ISES, ESWW, and AOSWA

Ken T. MURATA

National Institute of Information and Communications Technology
Applied Electromagnetic Research Institute
Space Weather and Environment Informatics Laboratory
4-2-1 Nukui-kita, Koganei 184-8795 JAPAN



Outline

- What's Space Weather ?
- Activities of UN, WMO, SWW, ISES, ESWW, and AOSWA
- Examples of Recent Big Events of Space Weather
 - X class flares in 2012
 - Radiation belt prediction
 - Galaxy 15 malfunction
 - Impact on ionosphere caused by big earthquake



太陽
Sun

フレア
Flare

CME

コロナホール
Coronal hole

高エネルギー粒子線
Energetic particles

地球到達時間
Delay time

30 min ~ 2 days

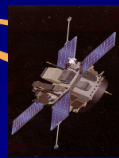
フレア X線放射
Flare X-rays

8 min

太陽風
Solar wind

太陽風じょう乱
Solar wind disturbance

2 ~ 3 days



衛星障害
Satellite anomaly

放射線帯変動
Changes in radiation belt

衛星軌道変動
Satellite orbit fluctuation

熱圏じょう乱
Thermospheric disturbance

オーロラ活動
Auroral activity

地磁気じょう乱
Geomagnetic storms

電離圏
Ionosphere

地球
Earth

電離圏じょう乱
Ionospheric disturbance

誘導電流
Current induction

放射線帯
Radiation belt

衛星被曝
Satellite exposure

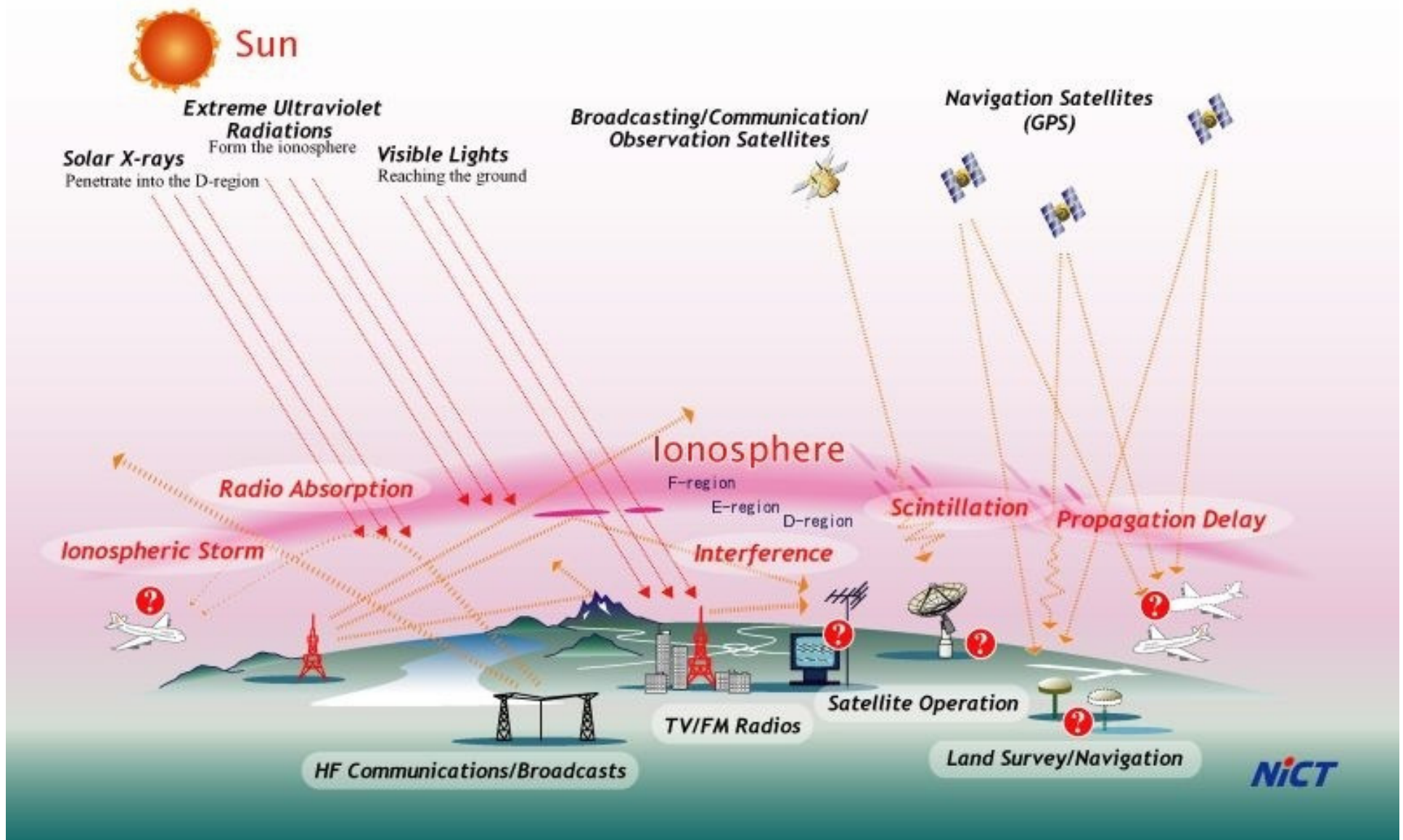
宇宙飛行士被曝
Astronaut exposure

通信障害
Communications trouble

磁気圏
Magnetosphere

Space weather: cause and effect 宇宙環境擾乱の発生と障害

Ionospheric Effects on Radio Applications



International, Regional and Domestic

International Organization

Research Institute

collaborations

宇宙空間長期的持続の視点から宇宙天気に関する議論⇒外務省を通じてNICTからの意見を提案

UN (COPOUS: Committee on the Peaceful Uses of Outer Space)

WMO / International Coordinate Team for Space Weather

WMO (世界気象機構) 内部に宇宙天気事務局設置目標⇒現状は予算化が困難・NICTは気象庁と議論を進めている

情報交換 (運用協力)
NICTは国際競争も視野に⇒4ヶ国間予報精度評価比較開始 (過去1年間でフレア予報1位・地磁気擾乱予報2位)

ISES (International Space Environment Service) Asia-Oceania Region

Advanced Countries

Developing Countries

Advancing Countries

太陽・磁気圏・電離圏での基礎物理研究と予報技術研究 (①協力と②競争) ⇒ ①NICTで観測できないデータ (特に衛星データ) の収集と基礎的地球科学研究協力、②NICTが世界最高水準である研究 (アジア域観測網と世界最大GPS-TECデータベース、世界初の電離圏・大気圏融合モデル、衛星軌道のインジェクションや放射線帯高エネルギー粒子モデル) の重点的推進と世界最大規模のサイエンスクラウドの活用



SW research and Operation

地磁気観測・客観解析データ利用などの協力体制構築⇒所掌による住み分け (宇宙天気はNICTが行う)



Asia-Oceania Space Weather Alliance
領域的協力体制構築 (データ交換・共同観測) ⇒ 運用のコストダウンと効率化

International Research Institutes

Domestic Research Institutes

NICT Research Laboratories

予報 (現業) をNICTが担当⇒情報やモデルの提供や交換により各組織 (省庁) の目的に応じた活用を行う。

JAXA, Space Weather Group

ENRI (Ministry of Land, Infrastructure, Transport and Tourism: MLIT)

Meteorological Bureau

Science Council of Japan (STPP sub-committee)

Business Companies

宇宙天気に関するNICT/JAXA/大学の意見交換⇒民間との連携の場・COPOUS提言とりまとめ

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International Operation Institute

Domestic Organization (Governmental, Business)

International, Regional and Domestic

International Organization

Research Institute

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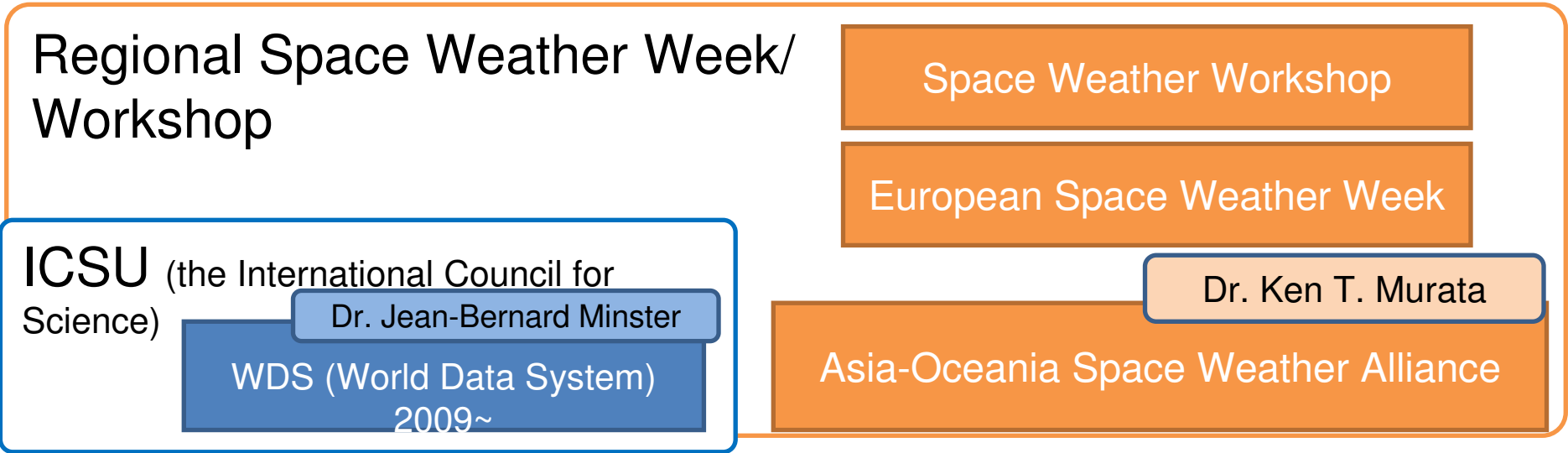
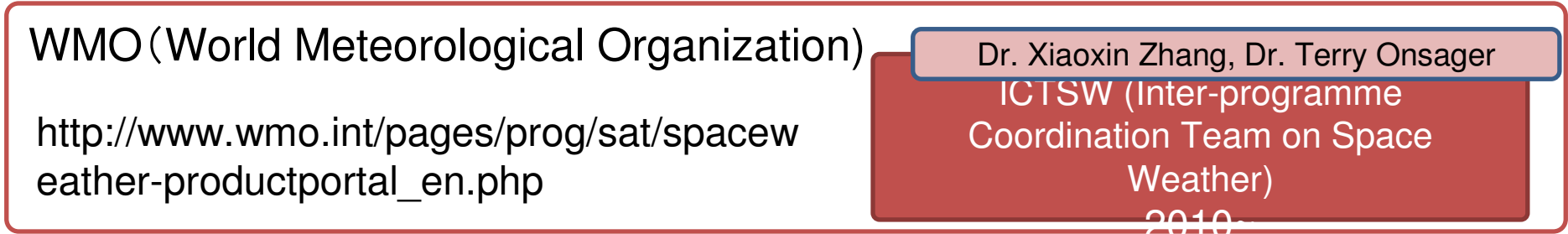
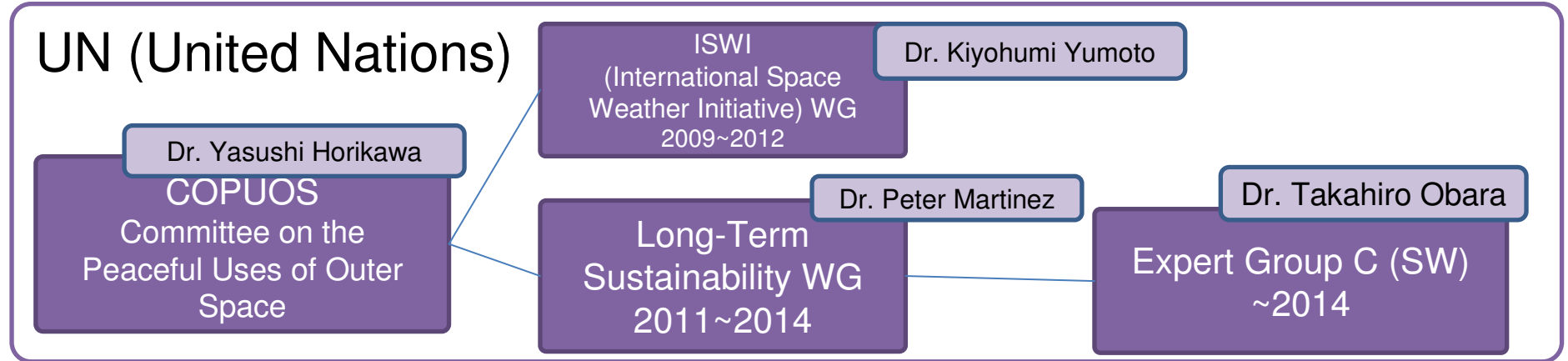
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Domestic Organization (Governmental, Business)

International Activities





World Data Center (WDC)

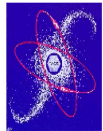
- 1957年に国際地球観測年(IGY)を期に設立(ICSU)
- 分野横断型国際データ組織の先駆
- 政治形態に捉われないデータの国際共有
- 品質管理されたデータの長期保全と提供
- 12ヶ国50ヶ所(主に天文・地球科学分野)
- **Full and Open Access** をモットー



WDC+FAGS→WDS

- 個々のデータセンターやサービスが個別に活動。
- 全体を束ねるシステムが無い。
- 活動方針の決定など、ガバナンスが機能していない。
- 天文・地球科学系分野に偏重

2009



Federation of Astrophysical and Data Analysis Services (FAGS)

- 1957年、国際地球観測年(IGY)を期に設立(ICSU)
- 再解析データ、指数などの提供、研究プロジェクトの推進
- データセンター機能は持たない
- 13項目のサービス(天文、地球物理、電波科学分野)
- **NICTの宇宙天気情報センターはInternational Space Environmental Service の一環**

ISES

WDS-SC

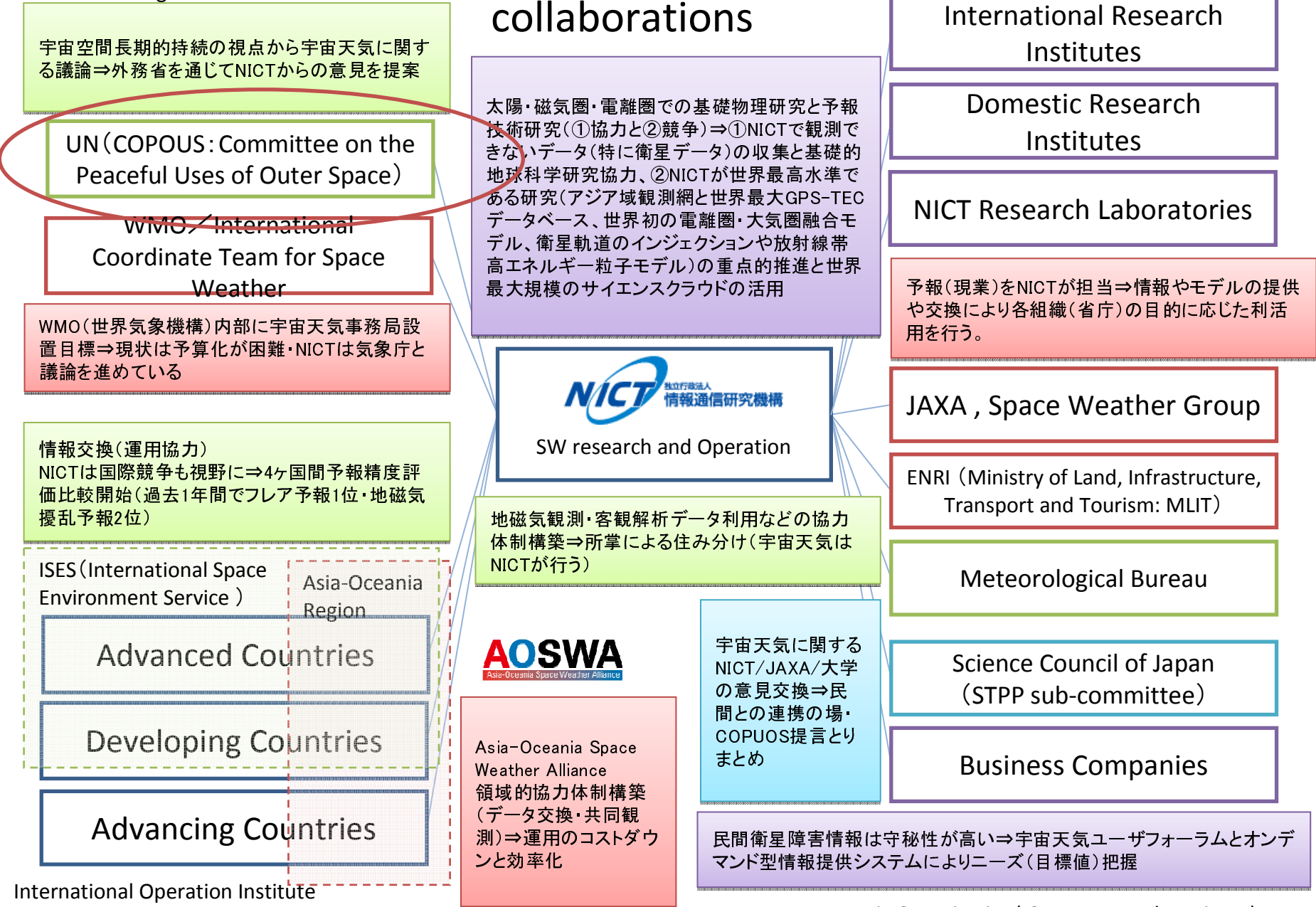
IPO

WDS facilities

International, Regional and Domestic collaborations

International Organization

Research Institute



Domestic Organization (Governmental, Business)

UNCOPUOS Working Group on the Long-term Sustainability of Outer Space

Chair: Peter Martinez (South Africa)



UN
Vienna, Austria
Feb. 2011



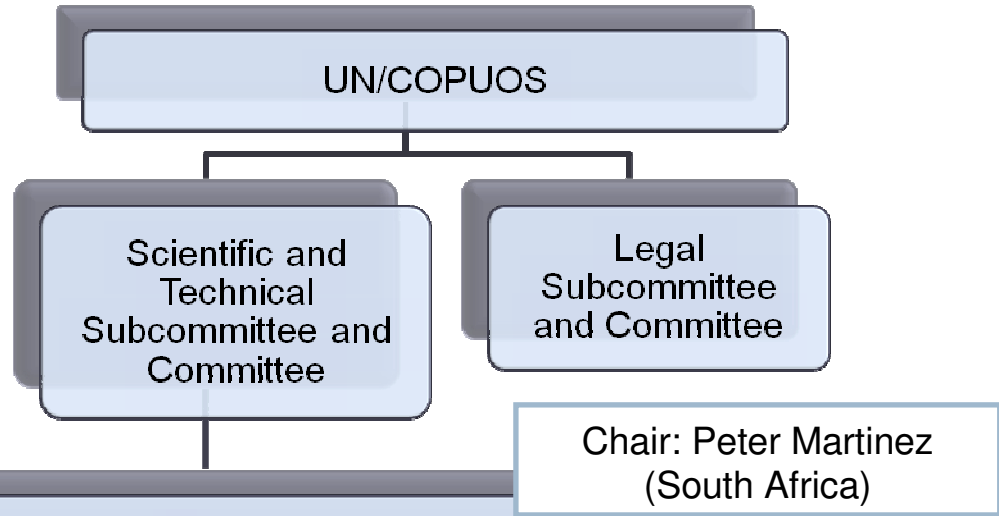
Formal meeting
(regular/scheduled)



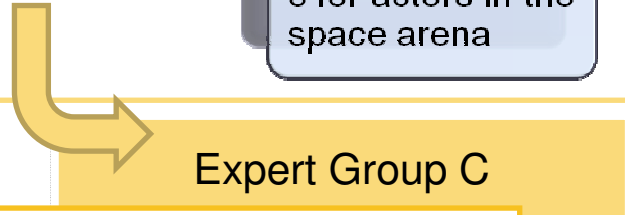
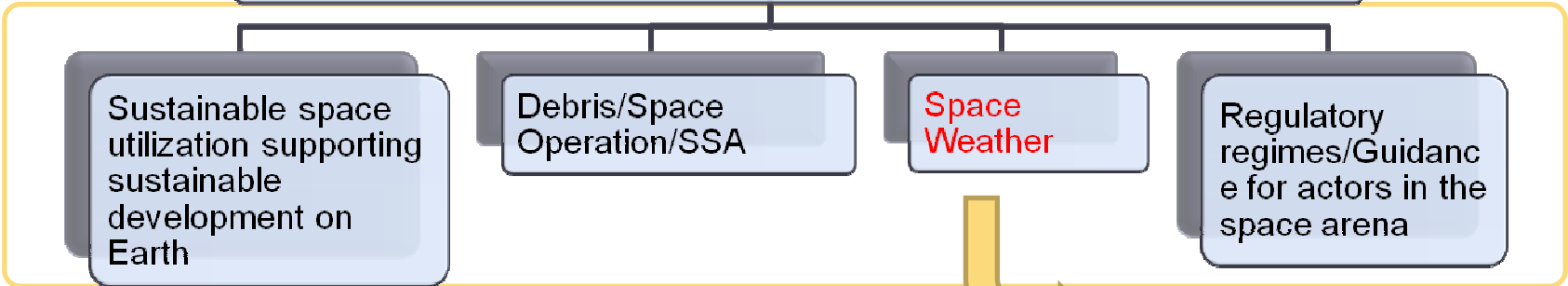
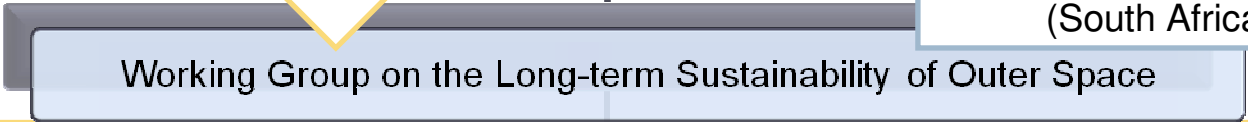
Informal meeting
(irregular)

Working Group on the Long-term Sustainability of Outer Space

- (a) Sustainable space utilization supporting sustainable development on Earth:
- (b) Space debris:
- (c) **Space weather:**
- (d) Space operations:
- (e) Tools to support collaborative space situational awareness:
- (f) Regulatory regimes:
- (g) Guidance for actors in the space arena:



13 WGs in all



Chair: Prof. Obara (Tohoku Univ.)



L.307 ToR

Working Group on the Long-term Sustainability of Outer Space #22

The Working Group may decide to establish **expert groups** to focus on one or more of each of the agreed areas of work in order to expedite the work of the Working Group as a whole. The expert groups would work intersessionally and would meet on the margins of the sessions of the Scientific and Technical Subcommittee and the Committee, and at one other agreed time. **Member States** and **intergovernmental organizations** with permanent observer status with the Committee would be invited to nominate experts to participate in the activities of the expert groups. Each expert group would select its own Chair (from among the participating member States) to lead its work. The expert groups would provide information to support the deliberations of the Working Group, which would consider inputs received and make any necessary decisions regarding those inputs.

#23. The proposed workplan under the item “Long-term sustainability of outer space activities” for the period 2011-2014 would be as follows:

2011 Develop terms of reference, method of work and workplan. Identify a point of contact for each member State represented in the Working Group. Review the work done to date on this issue and prioritize future tasks. Invite member States and organizations having permanent observer status with the Committee and experience in space activities to provide information in 2012 on their experiences and established practices in the conduct of sustainable space activities. **Begin to engage with other entities in the commercial sector and non-profit sector on this issue.**

#23. The proposed workplan under the item “Long-term sustainability of outer space activities” for the period 2011-2014 would be as follows:

2012 Hold a general exchange of views among States members of the Committee and intergovernmental and **non-governmental organizations** having permanent observer status with the Committee on the topics encompassed within the scope of work. Hold a workshop at which States members of the Committee and intergovernmental and non-governmental organizations having permanent observer status with the Committee provide information on their experiences and practices in the conduct of sustainable space activities (presentations and discussions to be conducted in the official languages of the United Nations). Hold consultations with member States and with intergovernmental and international organizations having experience in space activities and those considering or initiating involvement in space activities to provide information on established practices and proposed measures to enhance the long-term sustainability of space activities. Commence consolidation of information gathered. Develop a draft outline of the report to be produced by the Working Group.

International, Regional and Domestic

Research Institute

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Domestic Organization (Governmental, Business)

International Coordinate Team for Space Weather/WMO

← → × www.wmo.int/pages/prog/sat/spaceweather-intro_en.php Print | Save as PDF | Text-only version | Send by e-mail | Bookmark **Currently 183 Member States**





World Meteorological Organization
Working together in weather, climate and water

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Space Weather 

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Space Weather impacts

Space Weather encompasses the conditions and processes occurring in space, including on the sun, in the magnetosphere, ionosphere and thermosphere, which have the potential to affect the near-Earth environment. The effects of Space Weather can range from damage to satellites arising from charged particles to disruption of power grids on Earth during geomagnetic storms, radio black-out on trans-polar aircraft routes, or disturbance of satellite positioning systems.

Space Weather monitoring, study and applications are more and more important with the increasing use of space in day-to-day life for telecommunications, observation and navigation.



Programme Overview

- Home
- Activities and objectives
- Structure and Governance
- News and External Announcements
- Calendar of Events
- Contact Information
- ⇒ **Space-based GOS**
- ⇒ **Data access & use**
- ⇒ **Awareness & Training**
- ⇒ **Space Weather**
- Regional Activities**
- Information Resources**
- Partners**
- CGMS 
- GOS
- WIGOS
- WIS

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Domestic Organization (Governmental, Business)

Gm... x JGN... x ww... x GMC... x LAP... x ラバ... x Spa... x

www.fin.ucar.edu/UCARVSP/spaceweather/index.php



Space Weather Workshop

The Meeting of Science, Research, Applications, Operations, and Users

April 27-30, 2010 • Boulder, Colorado

Welcome to the Workshop's Online Registration System

The Workshop will be held April 27 - 30 at the Millennium Hotel, 1345 28th St., Boulder, CO 80302. The registration fee for the full conference is \$275.00, or \$100.00 per day.

Registration and Abstract deadline: Friday

Online Registration
Please note: you must first register before you can submit a

If you registered last year:



Space Weather Workshop @USA

Gmail - 読... x JGN2plus... x www.jgn.... x GMC 26 Ja... x LAPAN, B... x esww7 - H... x S

sidc.oma.be/esww7/



Seventh European Space Weather Week

15-19 November, 2010 - Brugge, Belgium

The seventh European Space Weather Week will take place in Brugge, Belgium, from Monday 15th November to Friday 19th November 2010.

This meeting is being jointly organised by the Belgian Solar-Terrestrial Center of Excellence (STCE), ESA, the Space Weather Working Team and the COST ES0803 communities. The local organisation is done by the STCE and the Royal Observatory of Belgium (ROB). This event will build on the advances made during previous European Space Weather Weeks and preceding ESA Space Weather Applications Workshops.

The ESWW will again adopt the central aim of bringing together diverse communities working on all aspects of space weather from key research developments through to end user needs. Recent space weather related actions in the framework of the ESA Space Situational Awareness programme and the EC's 7th Framework Programme will be a key topic, as will targeted sessions covering spacecraft environments and effects, recent advances in space weather modelling, new space weather products and tools and new observing strategies for heliospheric phenomena.

MORE NEWS

The debate:

- HOME
- PROGRAM
- SPECIAL EVENTS
- COMMITTEES
- REGISTRATION
- LOCAL INFORMATION
- SOCIAL PROGRAM
- ESWW3
- ESWW4
- ESWW5
- ESWW6

Space Weather Week @Europe

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Domestic Research Institutes

NICT Research Laboratories

予報(現業)をNICTが担当⇒情報やモデルの提供や交換により各組織(省庁)の目的に応じた活用を行う。

JAXA, Space Weather Group

ENRI (Ministry of Land, Infrastructure, Transport and Tourism: MLIT)

Meteorological Bureau

Science Council of Japan (STPP sub-committee)

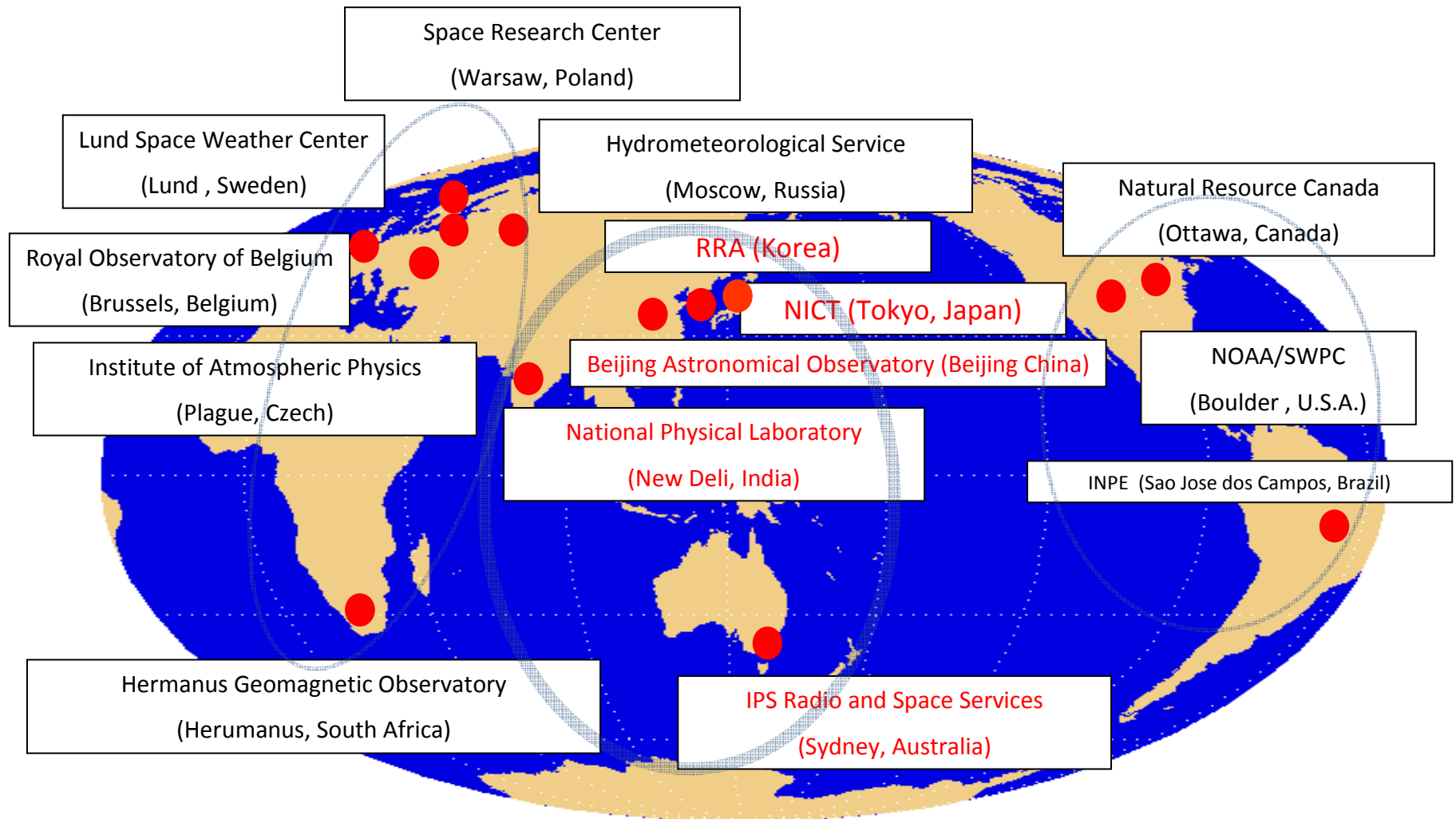
Business Companies

宇宙天気に関するNICT/JAXA/大学の意見交換⇒民間との連携の場・COPOUS提言とりまとめ

民間衛星障害情報は守秘性が高い⇒宇宙天気ユーザフォーラムとオンデマンド型情報提供システムによりニーズ(目標値)把握

Domestic Organization (Governmental, Business)

Space Weather Regional Warning Centers of International Space Environment Service (ISES)



The 1st AOSWA Kick-off meeting
12/03/2010 Bandung – Indonesia
Japan, Indonesia, Australia, India, and Malaysia



The main objective of the AOSWA is to make a regional linkage of information of space weather for operations and researches.

AOSWA office @NICT/Japan

- NICT Space Weather Office
 - Director
 - Ken T. Murata
 - Administrative Officer
 - Shinichi Watari
 - Programme Officer
 - Tsutomu Nagatsuma
 - Secretariat
 - Motokazu Shikatani
- Mail Address
 - sw-project-office@ml.nict.go.jp
- Others
 - NICT is in charge of “temporal” office
 - 4(5) organizations from ISEC/RWC will be the round-robin office?

Join Us!

Associates (so far)

<http://aoswa.nict.go.jp/associates.html>

AOSWA mailing list
<AOSWA@ml.nict.go.jp>

Top	Introduction	Workshop	40GS	Associates	Event	Application
-----	--------------	----------	------	------------	-------	-------------

Associates of AOSWA

- Number of Associates: 16 (10 countries)
- Number of Mailing List Member

Australia	2
China	4
India	2
Indonesia	10
Japan	25
Malaysia	2
Pakistan	1
Philippines	1
South Korea	7
Taiwan	1
Thailand	9
USA	1
Vietnam	2
Total	67

10 Countries
16 Organizations

Associates

Australia

- Inospheric Prediction Service (IPS) / RWC Australia

China

- Center for Space Science & Applied Research (CSSAR)
- National Astronomical Observatories, Chinese Academy of Sciences (NAOC)

India

- Radio & Atmospheric Sciences Division, National Physical Laboratory (NPL) / RWC India

Indonesia

- National Institute of Aeronautics and Space (LAPAN)

Japan

- National Institute of Information and Communications Technology
- Research Institute for Sustainable Humanosphere
- Solar-Terrestrial Environment Laboratory

Malaysia

- National Space Agency of Malaysia (ANGKASA)
- Universiti Kebangsaan Malaysia (UKM)

Pakistan

- Pakistan Space & Upper Atmosphere Research Commission (SUPARCO) New

South Korea

- Korea Astronomy and Space Science Institute
- Korean Space Weather Center (KSWC), National Radio Research Agency (NRRA) / RWC Korea
- Kyung Hee University

Thailand

- International Civil Aviation Organization, Asia and Pacific Office (ICAO APAC Office) New

Vietnam

- Institute of Geophysics, Vietnam Academy of Science and Technology

AOSWA Associates

- Australia
 - Ionospheric Prediction Service (IPS) / RWC Australia
- China
 - Center for Space Science & Applied Research (CSSAR)
 - National Astronomical Observatories, Chinese Academy of Sciences(NAOC)
- India
 - Radio & Atmospheric Sciences Division, National Physical Laboratory (NPL) / RWC India
- Indonesia
 - National Institute of Aeronautics and Space (LAPAN)
- Japan
 - National Institute of Information and Communications Technology
 - Research Institute for Sustainable Humanosphere
 - Solar-Terrestrial Environment Laboratory
 - Tohoku University
 - Kyushu University
- Malaysia
 - National Space Agency of Malaysia (ANGKASA)
 - University Kebangsaan, Malaysia (UKM)
- Pakistan
 - Pakistan Space & Upper Atmosphere Research Commission (SUPARCO)
- South Korea
 - Korea Astronomy and Space Science Institute
 - Korean Space Weather Center (KSWC), National Radio Research Agency (RRA) / RWC Korea
 - Kyung Hee University
- Thailand
 - International Civil Aviation Organization, Asia and Pacific Office (ICAO APAC Office)
- Vietnam
 - Institute of Geophysics, Vietnam Academy of Science and Technology

AOSWA meetings

2010.12 - LAPAN workshop

- The first kick-off meeting between Japan, Indonesia, Australia, India, and Malaysia

2010.01.2 - SEALION workshop @Thailand

- Indonesia, Vietnam, Taiwan, USA, Brazil, Thailand, Laos, Philippine , China and Japan
- 2nd Kick-off meeting of the AOSWA

2011.04 @NOAA, USA

- Space Weather Workshop @NOAA, USA & ISES meeting 2011
- Local meeting between A-O ISES countries

2011.08 - AOGS @Taiwan

- AOGS; “Collaborative Researches and Operations of Space Weather Forecasting in Asia-Oceania region”
- 3rd kick-off meeting of the AOSWA

2012.02 AOSWA 1st Workshop @Chiang Mai, Thailand

- 10 countries, 25 organizations, 77 participants!

2012.08 AOGS2012 @Singapore

- Asia-Oceania Space Weather Alliance: AOSWA session
- AOSWA informal meeting

2013 AOSWA 2nd Workshop

- To be in China in 2013

The 1st AOSWA Workshop 22-24 Feb. 2012



AOSWA
Asia-Oceania Space Weather Alliance
Preparatory Committee

Top | Introduction | Workshop | AOSW | Associate | Event | Application | Education | Contact | Link

Workshop Information

- Foreword
- Important Dates
- Abstract Submission & Registration
- Schedule
- Program Overview
- Abstract
- Organization & Management
- Conference Venue
- Excursion

The 1st AOSWA Workshop 22-24 February, 2012

Imperial Mae Ping Hotel, Chiang Mai, Thailand.

➤ Foreword

▶ From the General Chair

The Asian-Oceania Space Weather Alliance (AOSWA) was established in 2010 with 17 associated organizations from 7 countries. AOSWA has two major objectives: to make progress in collaborative research and practical applications of space weather forecasting.



10 countries, 30 organizations, 76 participants, 41 oral presentations, 21 poster presentations, 1 tutorial lecture, an excursion, and business meeting.

Forecasting, Data Preservation
(Application and Stewardship)

Workshop/Collaboration/
Data Exchange

Industrial Use/
Practical Use

Research Works



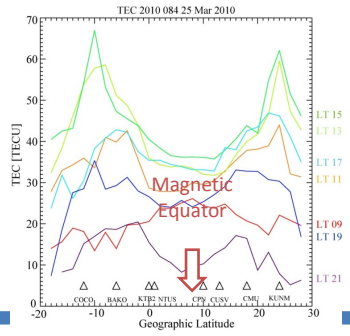
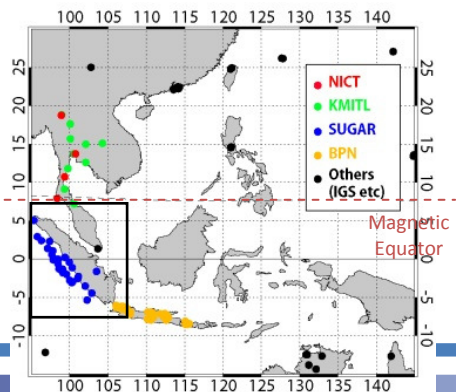
Four functions

International
Activities

Education/
Capacity Building

Information Exchange
(Web site/News Letter)

Supporting/Consulting of SW
operation to New Comers



International, Regional and Domestic

Research Institute

International Organization

宇宙空間長期的持続の視点から宇宙天気に関する議論⇒外務省を通じてNICTからの意見を提案

UN (COPOUS: Committee on the Peaceful Uses of Outer Space)

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WMO(世界気象機構)内部に宇宙天気事務局設置目標⇒現状は予算化が困難・NICTは気象庁と議論を進めている

情報交換(運用協力)
NICTは国際競争も視野に⇒4ヶ国間予報精度評価比較開始(過去1年間でフレア予報1位・地磁気擾乱予報2位)

ISES (International Space Environment Service)

Asia-Oceania Region

Advanced Countries

Developing Countries

Advancing Countries

International Operation Institute

collaborations

太陽・磁気圏・電離圏での基礎物理研究と予報技術研究(①協力と②競争)⇒①NICTで観測できないデータ(特に衛星データ)の収集と基礎的地球科学研究協力、②NICTが世界最高水準である研究(アジア域観測網と世界最大GPS-TECデータベース、世界初の電離圏・大気圏融合モデル、衛星軌道のインジェクションや放射線帯高エネルギー粒子モデル)の重点的推進と世界最大規模のサイエンスクラウドの活用



SW research and Operation

地磁気観測・客観解析データ利用などの協力体制構築⇒所掌による住み分け(宇宙天気はNICTが行う)



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Domestic Organization (Governmental, Business)

NICT space weather users forum

Provision of information and countermeasure of solar activities. Grasp of needs and requirement from users on space weather forecasting.



研究室紹介 研究プロジェクト サービス 社会貢献・広報活動

イベント

2009年12月21日

宇宙天気ユーズフォーラム

NICT本部本館国際会議室において宇宙天気ユーズフォーラムを開催し、衛星航法関係者や衛星運用者からアマチュア無線家や中高生まで、多様な分野から60名を超える参加がありました。

フォーラムでは、NICT側からは宇宙天気情報利用の説明と最近の太陽活動状況の報告を行い、参加者側からは海域電磁気観測利用、衛星運用利用、宇宙飛行士被曝限界、航空航法での衛星航法利用、アマチュア無線利用、電離層の地球観測衛星や宇宙太陽発電所（SPS）への影響など、宇宙環境について幅広い講演があった。さらに会場では、宇宙天気情報Webの紹介、150インチスクリーンによるシミュレーションデータの連続再生デモ、Google Earthを利用した観測データ可視化や衛星データによる太陽の3次元可視化の展示を行うとともに、タイトルディスプレイ（TDW）、オーロラドーム、宇宙天気予報室の見学会を実施しました。

本フォーラムでは、活発な質疑応答やアンケートを通じて現在の予報サービスの有効性・有用性を確認できましたが、その一方で、長期予測データ提供、低軌道衛星での宇宙環境情報提供、SAR観測データの補正のための高空間分解の全電子数の提供、衛星航法での情報利用など具体的な要望も多く挙がり、有意義なフォーラムとなりました。(画像をクリックすると大きな画像が開きます。右上にマウスを持っていくと次画像に移る一が現れます)



Space Environment Information users forum (5 times from 2003 to 2007)



Space Weather users forum
#1 12 Dec. 2009 @NICT
#2 27 Jun. 2011 @NICT
Participants: 30-50



#3 NICT space weather users forum
2012 @NICT (Dec.2012)
focusing on complete investigation of
user requirement and solutions

Space Weather users forum Web

<http://www-seg.nict.go.jp/SpaceWeather/forum.html>

宇宙天気ユーザーズフォーラム

宇宙天気ユーザーズフォーラム2009

日時:平成21年12月21日(月)10:00~17:25

場所:情報通信研究機構国際会議室

(講演内容)

- 宇宙環境計測グループの概要
- 電離圏情報の活用法について
- 宇宙天気情報サービスの活用法について
- 最近の宇宙環境について
- 宇宙天気クラウドサービスについて
- 海域電磁気観測における宇宙天気の利用について
- 衛星帯電について
- 宇宙飛行士の被ばく限界について
- 航空航法における衛星航法の利用と電離圏の影響
- アマチュア無線での利用について
- ALOS/PALSARによる電離層異常の観測
- 宇宙太陽発電所(SPS)と電離圏について
- (その他)
- 討論
- ポスター発表

宇宙天気ユーザーズフォーラム2011

日時:平成23年6月27日(月)13:00~17:00

場所:情報通信研究機構国際会議室

(講演内容)

- NICTが提供する新しい宇宙天気情報サービス
- 最近の宇宙天気の状況について
- 航空機での宇宙天気情報の利用方法
- 物理探査での宇宙天気情報の利用方法
- 無線通信(アマチュア無線含む)での宇宙天気情報の利用方法
- 衛星測位での宇宙天気情報の利用方法
- 衛星運用での宇宙天気情報の利用方法
- 宇宙天気リアルタイムシミュレーションの利用方法
- (施設見学等)
- 予報センター見学
- 宇宙天気情報利用に関するご相談
- NICT宇宙天気アプリケーションに関するデモと個別のご相談

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Domestic Organization (Governmental, Business)

NICT Space Weather Activities



20120129(CX)



20120125(TBS)

TV news broadcasting

Space Weather Forecast Meeting
@NICT

Broadcasting of S.W. news
on the Internet
<http://swc.nict.go.jp/>

swc.nict.go.jp/contents/index_e.php

NICT Space Weather Information Center

RSS Links Japanese

HOME Current Data of Space Weather Space Weather Forecast Contact us

HOME

DeskTopViewer(760 X 260) 2012/03/12 21:58:36 UT

Hinode	SOHO	SunSpot	Flare	Radio communications
Hinode/XRT			Start(UT) Max. Imp. 03/12 11:55 C1.7 0.00 03/12 01:31 C2.4 0.15	Waknani Kokunnji Yamagawa Okinawa Sporadic E
			Solar wind(ACE) UT V (km/s) Bz (nT) 21:26 665 -2.5 -2 703 -2.8 -4 693 3.5 -6 504 1.9	Satellite Operation
SSN(NOAA) : 103 F10.7 : 131			Mag. Storm	High-energy Protons
			Mag. Storm	High-energy Electrons
			Mag. Storm	GPS
			Mag. Storm	Aviation
			Mag. Storm	

Space Weather Forecast

Flare Activity	Proton Event	Geomagnetic Activity
Active	Major storm	Event in progress

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Topics

Weekly SW news



and the activity was enhanced from the 15th through 16th.

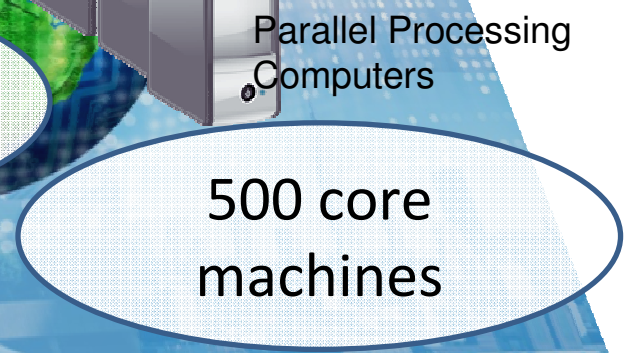
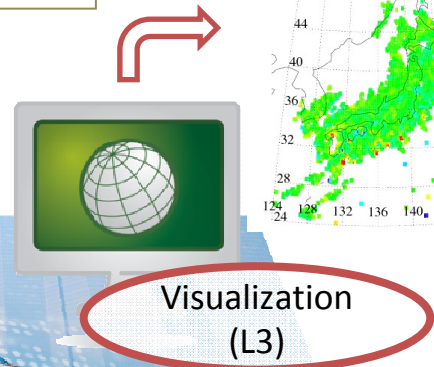
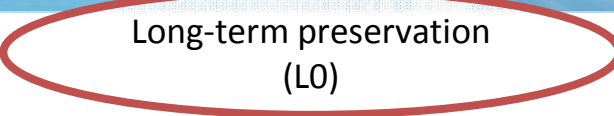
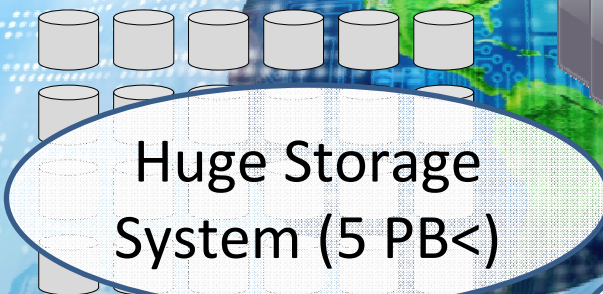
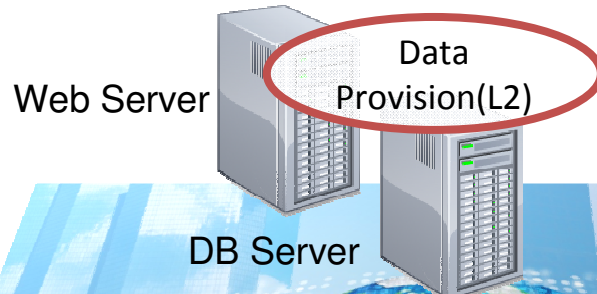
Concept of the Space Weather Cloud @NICT



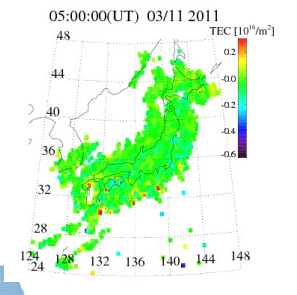
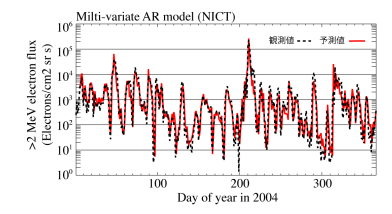
Asia-Oceania Observatories

A variety of Observation Data

Application Web

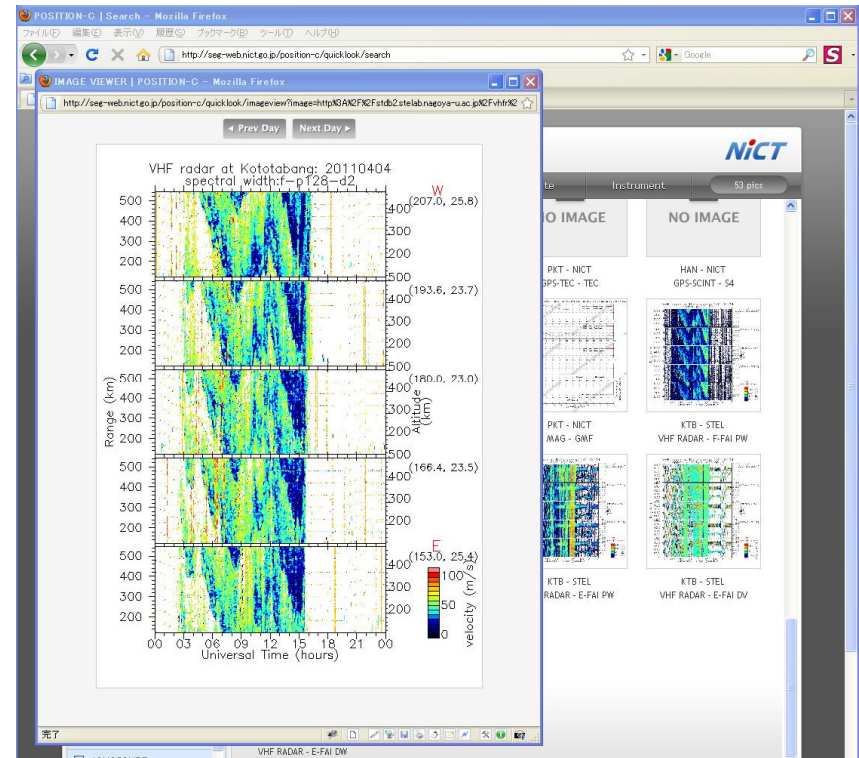
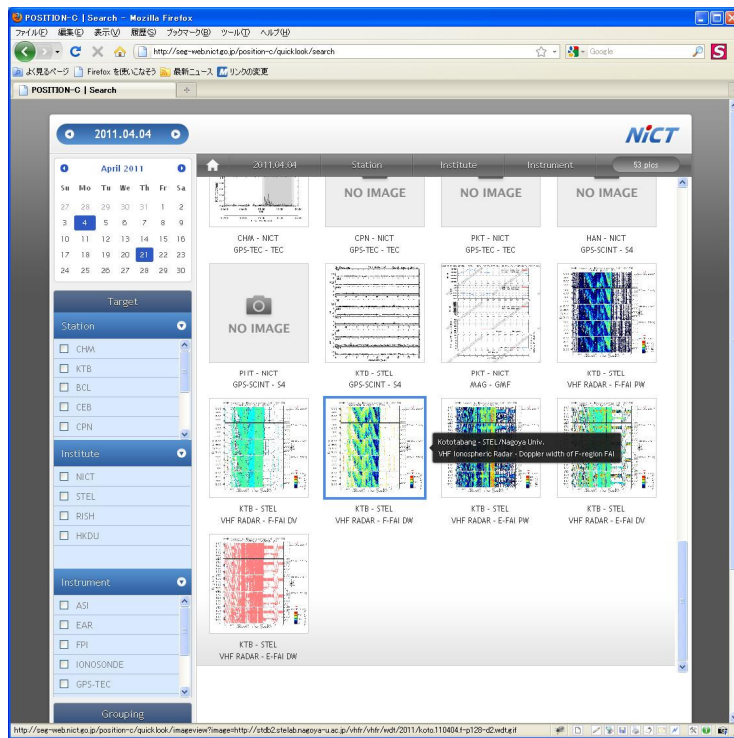


PiSAR data (30TB)
SMILES data (1TB)

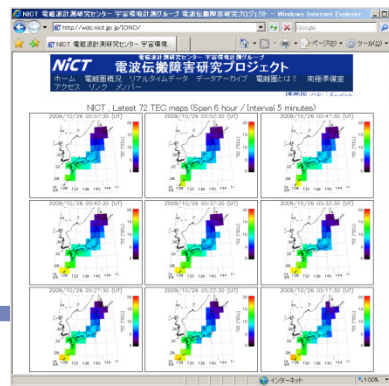
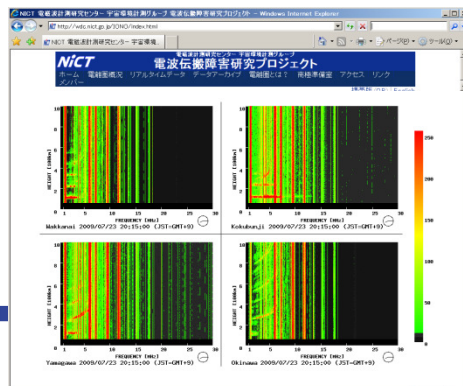


Quick View of Ionospheric Observation Data in East Asia

<http://seg-web.nict.go.jp/position-c/>



Ionosonde

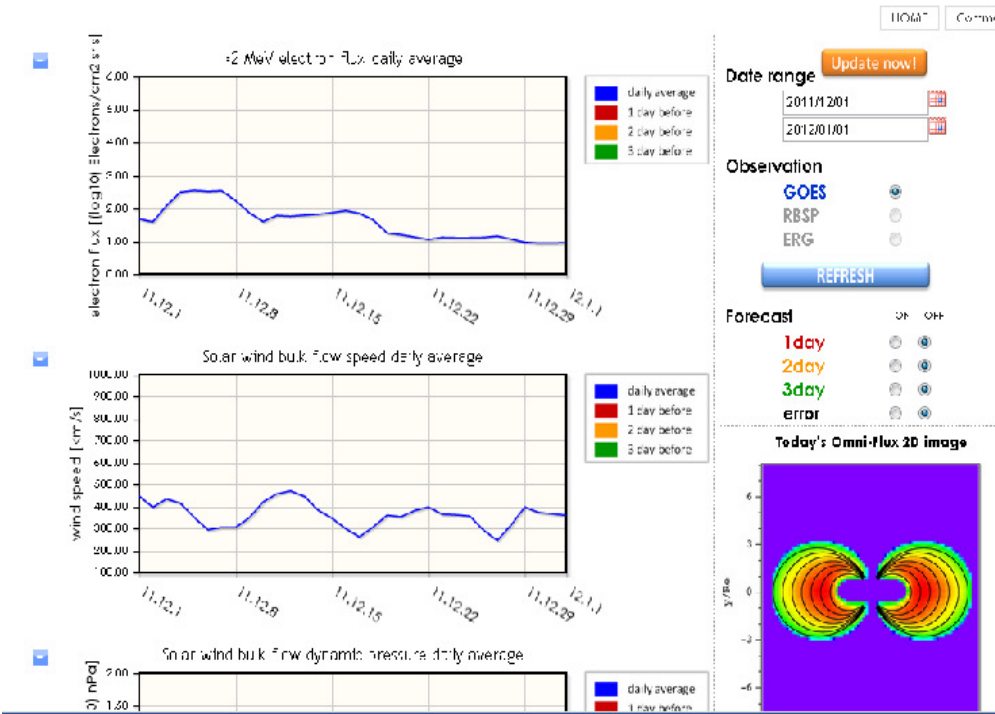


MAP of GPS-TEC (Total Electron Content) over Japan

New space weather prediction Web

Relativistic Electron Flux Prediction

NICT High-Speed Electromagnetic Research Institute Space Weather and Environment Information Laboratory



Prediction web of radiation belt energetic particles



オーロラ予報



Aurora Alert (for general users)



NICT Space Weather Data & Product

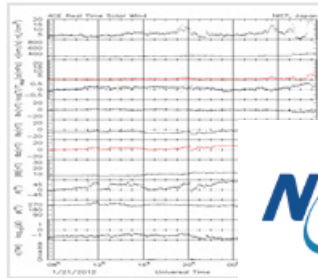
Applied Electromagnetic Research Institute
Space Weather and Environment Informatics Laboratory

<http://www.seg.nict.go.jp>
(to be open soon)

[Japanese](#) / [English](#)

Solar / Solar Wind
HiRAS
Ha
ACE
STEREO
Solar-Terrestrial Activity Chart
Magnetosphere
Geomagnetic Index
Geomagnetic Observation
HF Radar
Ionosphere
Regular Ionosonde Observations in Japan
Ionosonde Observations at Syowa Station

Solar Wind Observation by ACE



Plots of the real-time solar wind data from the ACE spacecraft which has observed solar wind continuously at the Lagrangian point one (L1). NICT transmitted the ACE real-time data under the



NICT Space Weather Data & Product

Applied Electromagnetic Research Institute
Space Weather and Environment Informatics Laboratory

[Japanese](#) / [English](#)

ACE Real Time S

Solar / Solar Wind
HiRAS
Ha
ACE
STEREO
Solar-Terrestrial Activity Chart
Magnetosphere
Geomagnetic Index
Geomagnetic Observation
HF Radar
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Ionosonde Observations at Syowa Station

SEALION (SouthEast Asia Low-latitude IOnospheric Network)



SEALION (SouthEast Asia Low-latitude IOnospheric Network) is an ionospheric observation network in Southeast Asia. It has been conducted by NICT since 2003 for the purpose of monitoring and forecasting equatorial ionospheric disturbances, especially plasma bubbles. SEALION is a unique ionospheric observation network in having the conjugate observational points in the northern and southern hemispheres and around the magnetic equator.

- ▶ [SEALION Ionogram Viewer](#)
- ▶ [ALL FMCW sites latest ionogram](#)
- ▶ [Summary Plots of SEALION Ionograms](#)
- ▶ [KML for SEALION Ionosonde Data](#)
- ▶ [S4 index at Phu Thuy](#)

NICT Data Download Site

<http://seg-stars-s01.nict.go.jp/STARS-DLWeb>

The screenshot shows the NICT Data Download Site interface. At the top, there is a browser address bar with the URL seg-stars-s01.nict.go.jp/STARS-DLWeb/default.aspx. Below the address bar, there is a "Login" button and the text "Guest account for a visitor". The main heading is "NICT Data Download Site" with the NICT eSW logo and "STARS Download Web" text on the right.

Search filters include "Start(UT)" set to "2012/01/01 00:00" and "End(UT)" set to "2012/02/22 00:00". There is a "Search" button and a "Change download path" button.

On the left, a file tree shows various data categories, with "Ionogram-Image_OK426(9596)" selected. Below the tree, the selected data's details are shown: "Data: Ionogram-Image_OK426", "URL: <http://wdc.nict.go.jp/openDB/index.html>", and "Attribute: Ionogram-Image at Okinawa."

On the right, a table displays the search results. The table has columns for "Data Name", "Start(UT)", "End(UT)", "Files", "Size(Estimated)", and actions. The total number of files is 2455 and the total size is 21G Byte. There are "Download" and "List Clear" buttons above the table.

Data Name	Start(UT)	End(UT)	Files	Size(Estimated)	Update	Delete
NICT-seg -> NICT-Simulation -> M	2012/01/01 00:00	2012/02/22 00:00	1173	796M	Update	Delete
NICT-seg -> NICT-GeoSpace -> K	2012/01/01 00:00	2012/02/22 00:00	40	209M	Update	Delete
NICT-seg -> NICT-Simulation -> M	2012/01/01 00:00	2012/02/22 00:00	1242	20G	Update	Delete
NICT-seg -> NICT-Ionosphere -> :	2012/01/01 00:00	2012/02/22 00:00	0	0	Update	Delete
NICT-seg -> NICT-Ionosphere -> :	2012/01/01 00:00	2012/02/22 00:00	0	0	Update	Delete

SW board (Web Application)

Make your original "Space Weather board" on your PC!

The screenshot displays the eSW web application interface. It features several data visualization components:

- Hinode XRI:** A large image of the Sun showing active regions.
- GOES 15 Wxv (X-ray flux):** A line plot showing X-ray flux in 10^{-6} W/m² over time.
- GOES 15 Proton Flux (6.0-10 MeV):** A line plot showing proton flux on a logarithmic scale over time.
- Short-Wave Fadeout / NICT:** A map of the Earth showing ionospheric disturbances.
- Ionoqram (Wakkanai):** A vertical plot showing ionospheric data for the Wakkanai station.

On the right side, there is a control panel with the following elements:

- NICT eSW 宇宙天気ボード**
- 2011/08/12 05:06:13 UTC**
- 2011/08/12 14:06:13 JST**
- Buttons for **登録** (Register), **削除** (Delete), and **クリア** (Clear).
- 配置図** (Configuration Diagram) section.
- コンポーネントリスト** (Component List) section, which includes a **Data list (thumbnail)** for various components like NICT, Ionoqram (Wakkanai), and Ionoqram (Kukuburiji).

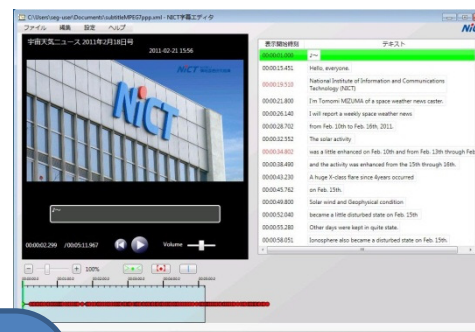
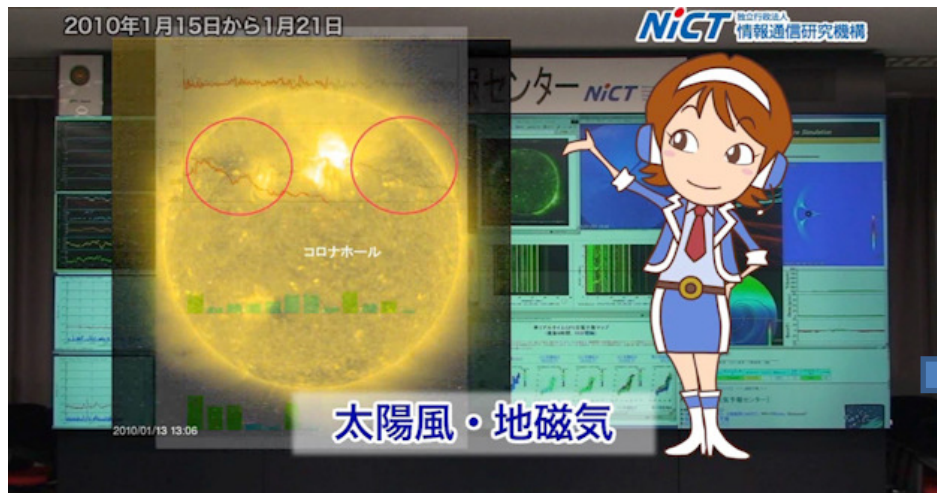
Annotations on the image:

- A red circular arrow points to the GOES 15 Proton Flux plot with the text: **Data plot automatically updated (as original updated)**.
- A red arrow points from the 'Drop data' text to the Ionoqram (Wakkanai) plot.

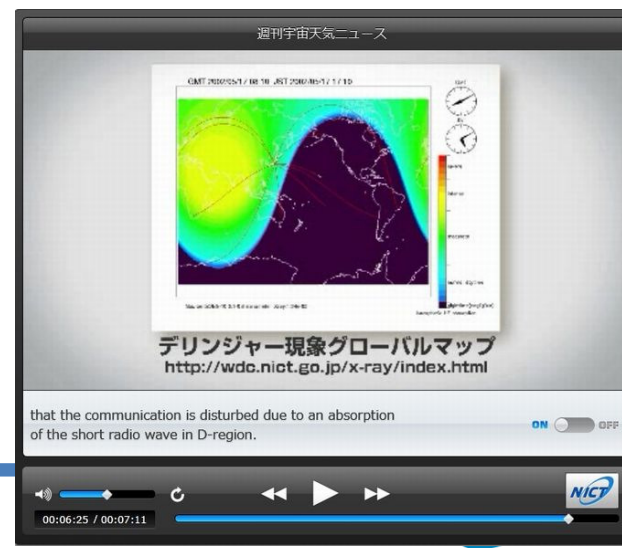
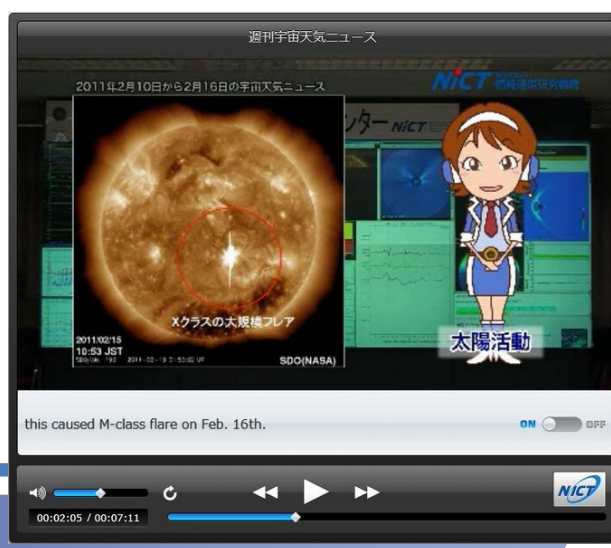
Weekly Space Weather News (Contents)

Weekly Space Weather News: A 5 min. movie provided by NICT everyday.

Editor (to create English caption)



Weekly Space Weather News with English Captions



International, Regional and Domestic collaborations

Research Institute

International Organization

宇宙空間長期的持続の視点から宇宙天気に関する議論⇒外務省を通じてNICTからの意見を提案

UN (COPOUS: Committee on the Peaceful Uses of Outer Space)

WMO / International Coordinate Team for Space Weather

WMO(世界気象機構)内部に宇宙天気事務局設置目標⇒現状は予算化が困難・NICTは気象庁と議論を進めている

情報交換(運用協力)
NICTは国際競争も視野に⇒4ヶ国間予報精度評価比較開始(過去1年間でフレア予報1位・地磁気擾乱予報2位)

ISES (International Space Environment Service)

Asia-Oceania Region

Advanced Countries

Developing Countries

Advancing Countries

International Operation Institute

collaborations

太陽・磁気圏・電離圏での基礎物理研究と予報技術研究(①協力と②競争)⇒①NICTで観測できないデータ(特に衛星データ)の収集と基礎的地球科学研究協力、②NICTが世界最高水準である研究(アジア域観測網と世界最大GPS-TECデータベース、世界初の電離圏・大気圏融合モデル、衛星軌道のインジェクションや放射線帯高エネルギー粒子モデル)の重点的推進と世界最大規模のサイエンスクラウドの活用



SW research and Operation

地磁気観測・客観解析データ利用などの協力体制構築⇒所掌による住み分け(宇宙天気はNICTが行う)



Asia-Oceania Space Weather Alliance
領域的協力体制構築(データ交換・共同観測)⇒運用のコストダウンと効率化

International Research Institutes

Domestic Research Institutes

NICT Research Laboratories

予報(現業)をNICTが担当⇒情報やモデルの提供や交換により各組織(省庁)の目的に応じた活用を行う。

JAXA, Space Weather Group

ENRI (Ministry of Land, Infrastructure, Transport and Tourism: MLIT)

Meteorological Bureau

Science Council of Japan (STPP sub-committee)

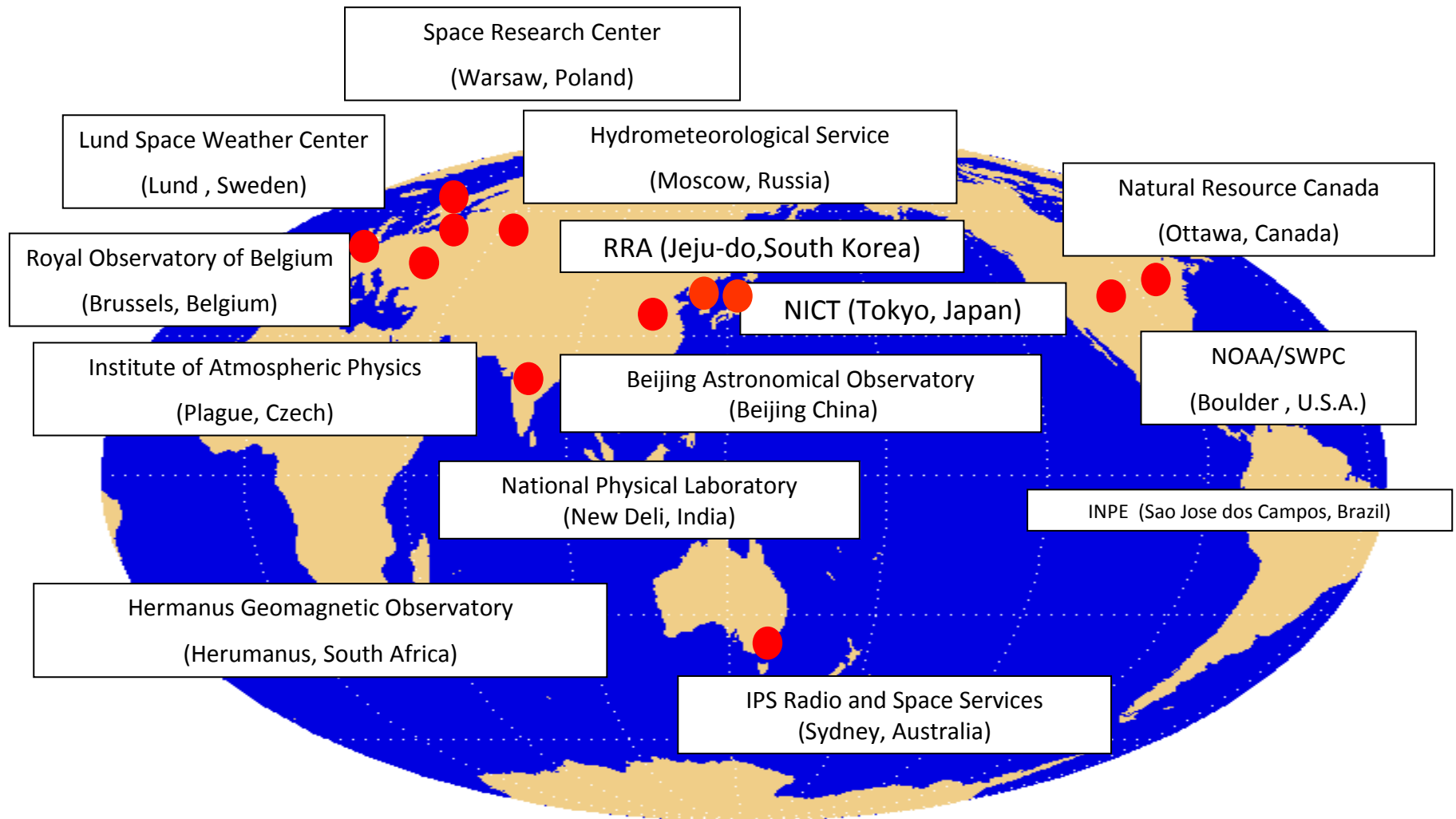
Business Companies

宇宙天気に関するNICT/JAXA/大学の意見交換⇒民間との連携の場・COPOUS提言とりまとめ

民間衛星障害情報は守秘性が高い⇒宇宙天気ユーザフォーラムとオンデマンド型情報提供システムによりニーズ(目標値)把握

Domestic Organization (Governmental, Business)

Space Weather Regional Warning Centers of International Space Environment Service (ISES)



RWC Australia in Sydney

RWC Australia is operated by IPS Radio and Space Services. This center has a specialty on ionosphere and provides various products for HF systems. This center also has a long history of solar radio spectrum observation.

The screenshot shows the homepage of the IPS Radio and Space Services website. At the top, it features the Australian Government Bureau of Meteorology logo and the title 'IPS Radio and Space Services'. A navigation bar includes links for Space Weather, Satellite, Geophysical, Solar, HF Systems, Products and Services, Educational, and World Data Centre. The main content area is divided into several sections:

- Today's Space Weather:** A large image of the Sun is shown on the left. The text indicates 'Thursday 31 May' and 'last updated 30/2357UT'. The forecast states: 'Low solar flare activity, with a chance of low to moderate activity. Light to moderate solar wind. Geomagnetic conditions at quiet levels. Short-wave radio fadeouts possible. High-frequency radio communications normal with isolated degraded conditions at low latitudes.' Below this are links for 'Detailed forecast', 'Current conditions', and 'Explanation'.
- Site News:** A list of recent news items with dates: '31/05/12 FORECAST SOL: Moderate ☀ MAG: Normal 🟩 ION: Moderate 🟡', '30/04/12 New interactive movie tool for ionospheric Total Electron Content (TEC) maps', '30/04/12 New ionospheric Total Electron Content (TEC) map accuracy estimate available', and '17/04/12 Large Coronal Mass Ejection around the Solar limb'. A link for '[Site News in full]' is also present.
- Transit of Venus:** Text describes the event on June 6th, 2012, and mentions a 'live broadcast' from the Culgoora solar telescope. A small image shows the transit of Venus across the Sun.
- What's Inside:** A section with a radio tower icon and text: 'On-line prediction tools for radio communications - HF to UHF, includes point to point predictions, air route charts, signal loss and more. Java required'. A 'Go there' link is provided.

At the bottom, there is a footer with navigation links: 'About IPS | Feedback | Contact Us | Site Help | Site News | Careers | Site Map | Site search | Acknowledgments | Subscribe | Hosted Groups'. Below the footer is a copyright notice: '© Copyright Commonwealth of Australia 2012. All rights reserved. IPS site usage disclaimer, accessibility and privacy statement.'



<http://www.ips.gov.au>



RWC Belgium in Brussels

RWC Belgium is operated by Solar Influences Data Analysis Center (SIDC) in Royal Observatory of Belgium and provides international sunspot number. This center works as local organizing committee of European Space Weather Week.

★ ★ ★ ★ ★
★ ★ ★ ★ ★

SIDC - Solar Influences Data Analysis Center


Stons: Quiet Predicted 10CM Flux: 104 Predicted AP index: 006

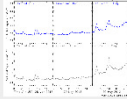
Home
General info
Jobs and Students
Projects
Publications
Sunspots
Software
Educational
Local Solar Observations
Space Weather services
Real Time Data
Seminars
eswww9




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.

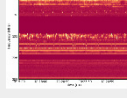
INFO FROM SIDC - RWC BELGIUM 30 May 2012, 0849UT

The Sun has produced one C1.1 flare in the past 24 hours, with GOES X-ray flux peak at 8:52 UT. More C flares are possible. The Earth is currently inside an intermediate speed solar wind stream with velocities between 300 and 480 km/s, and the IMF has varied between 5 and 10 nT. The geomagnetic field was at quiet levels (Dourbes K between 1 and 3; NOAA Kp between 1 and 2) during the past 24 hours. Quiet levels (K Dourbes < 4) are expected for May 30 and 31, and for June 1st.

Latest SWAP image 

Latest LYRA curve 

Latest USET H-alpha image 

Latest Callisto Observations 

Most recent alerts

2012 May 27 0830 UTC
An eruption in Catania sunspot group 36 (NOAA AR 1482) that is currently [\[more\]](#)

2012 May 17 2117 UTC
A halo or partial-halo CME was detected with the following characteristics: [\[more\]](#)

2011 Jun 30 1308 UTC
END OF ALL QUIET ALERT The SIDC - RWC Belgium expects [\[more\]](#)

Latest News

May 21, 2012 : PROBA2 viewed the solar eclipse, up to 4 times!

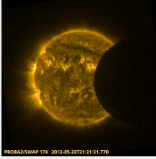
Apr 23, 2012 : The annual STCE meeting

Mar 22, 2012 : LYRA: the alternative to GOES flare monitoring

Mar 09, 2012 : Space and Earth on March 09 - the story continues

Mar 07, 2012 : Solar Activity continues on March 7, 2012

[click here for all SIDC news items](#)



<http://sidc.oma.be/>

RWC Brazil in São José dos Campos

RWC Brazil is operated by INPE and has a specialty on equatorial ionosphere because of its location. The Brazilian space weather program started at INPE in 2007 and this center is established under this program. This center provides ionospheric information in equatorial region.

The screenshot shows the EMBRACE website, titled "Estudo e Monitoramento Brasileiro do Clima Espacial". The header includes the INPE logo and the text "Ministério da Ciência e Tecnologia" and "BRASIL". The main navigation bar contains links for Home, INPE, BULLETIN, WORKSHOP, and WORKGROUP. The left sidebar lists various sections: The Program (Introduction, Definition, Structure, Equipment, Satellites), Real Time Monitoring (Sun, Interplanetary Middle, Magnetic Field, Earth, Panel), Utilities (Geophysics Data, Magnetic and Solar Indices, Glossary, CDAW), BULLETIN, Links (Financiers, Workgroup, Partners), Useful Information, Contact (Location, Contact Us), and INPE contact details. The main content area features a grid of links to "Sun", "Interplanetary Middle", "Geomagnetic Field", "Earth / Ionosphere", "CDAW", and "Daily Bulletin". Below this is a "NEWS" section with video thumbnails for "Flare Blowout - 2010-07-20", "The Sun performs for SDO - AIA", "AIA 304 Movie - 2010-04-19", and "Plasma Rain". The right sidebar includes "News", "Images Preview", and "Follow us" with social media icons. The footer contains the copyright notice: "Copyright 2006 © INPE - National Institute for Space Research. All rights reserved."

<http://www.inpe.br/climaespacial/index.php>



RWC Canada in Ottawa

RWC Canada is operated by Natural Resources Canada (NRC) and has a specialty on geomagnetic activity in high latitude and Geomagnetically Induced Current (GIC). This center has various products of geomagnetic activity and GIC.

The screenshot shows the Space Weather Canada website interface. At the top, there are logos for the Government of Canada and the Canadian Space Agency, along with the text 'Space Weather Canada' and the URL 'www.spaceweather.gc.ca'. A navigation bar includes links for 'Français', 'Home', 'Contact Us', 'Help', 'Search', and 'canada.gc.ca'. The main content area is titled 'Space Weather Canada' and features a 'Current Geomagnetic Field Conditions at' section with a date of '2012-05-31 Time : 04:00 UT'. Below this is a table showing activity levels for different zones.

Zones	Activity
Polar	Quiet
Auroral	Quiet
Sub-Auroral	Quiet

Below the table, there is a paragraph explaining that the Canadian Space Weather Forecast Centre in Ottawa is operated by Natural Resources Canada (NRC) with support from the Canadian Space Agency (CSA). It is a Regional Warning Centre (RWC) of the International Space Environment Service (ISES, formerly IUWDS). The ISES global network monitors a variety of parameters that help to characterize the conditions on the Sun, in space between the Sun and Earth, and on the Earth. The data are used by Regional Warning Centres and others to develop Space Weather warnings and alerts.

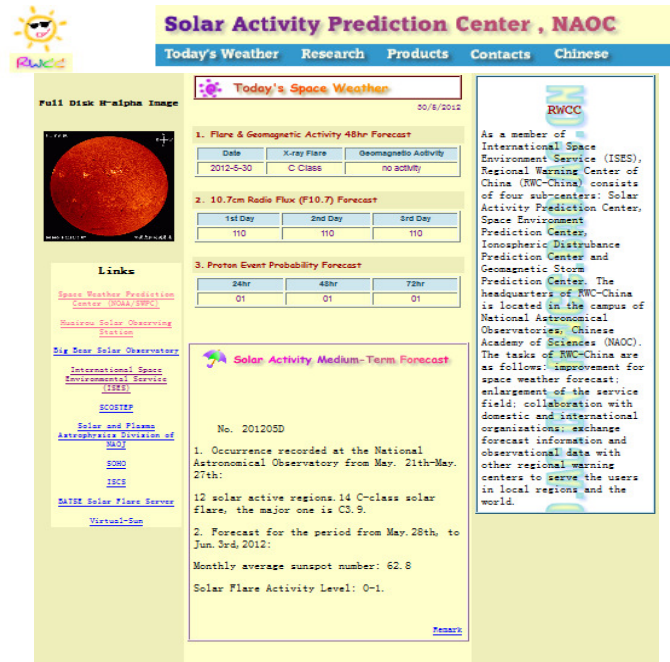
On the right side of the page, there are several sections: 'Information' with links for 'What is Space Weather?', 'Space Weather Research in Canada', 'Space Weather Links', and 'RSS Feeds'; and 'Regional Warning Centres' with a list of locations: Beijing, Boulder, Brussels, Delhi, Hermanus, Lund, Moscow, Ottawa, Prague, São José dos Campos, Sydney, Tokyo, and Warsaw.

<http://www.spaceweather.gc.ca/index-eng.php>



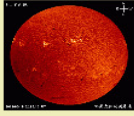
RWC China in Beijing

RWC-China consists of four sub-centers: Solar Activity Prediction Center, Space Environment Prediction Center, Ionospheric Disturbance Prediction Center, and Geomagnetic Storm Prediction Center. National Astronomical Observatories, Chinese Academy of Sciences (NAOC) works as the headquarter of RWC-China. NAOC has a specialty on the Sun and operates a solar vector magnetograph instrument.



Solar Activity Prediction Center, NAOC
Today's Weather Research Products Contacts Chinese

Today's Space Weather 00/0/2012

Full Disk H-alpha Image


1. Flare & Geomagnetic Activity 48hr Forecast

Date	X-ray Flare	Geomagnetic Activity
2012-5-30	C Class	no storm

2. 10.7cm Radio Flux (F10.7) Forecast

1st Day	2nd Day	3rd Day
110	110	110

3. Proton Event Probability Forecast

24hr	48hr	72hr
01	01	01

Solar Activity Medium-Term Forecast

No. 201205D

- Occurrence recorded at the National Astronomical Observatory from May. 21th-May. 27th:
- Forecast for the period from May.28th. to Jun. 3rd, 2012:

Monthly average sunspot number: 62.8
Solar Flare Activity Level: 0-1.

Links

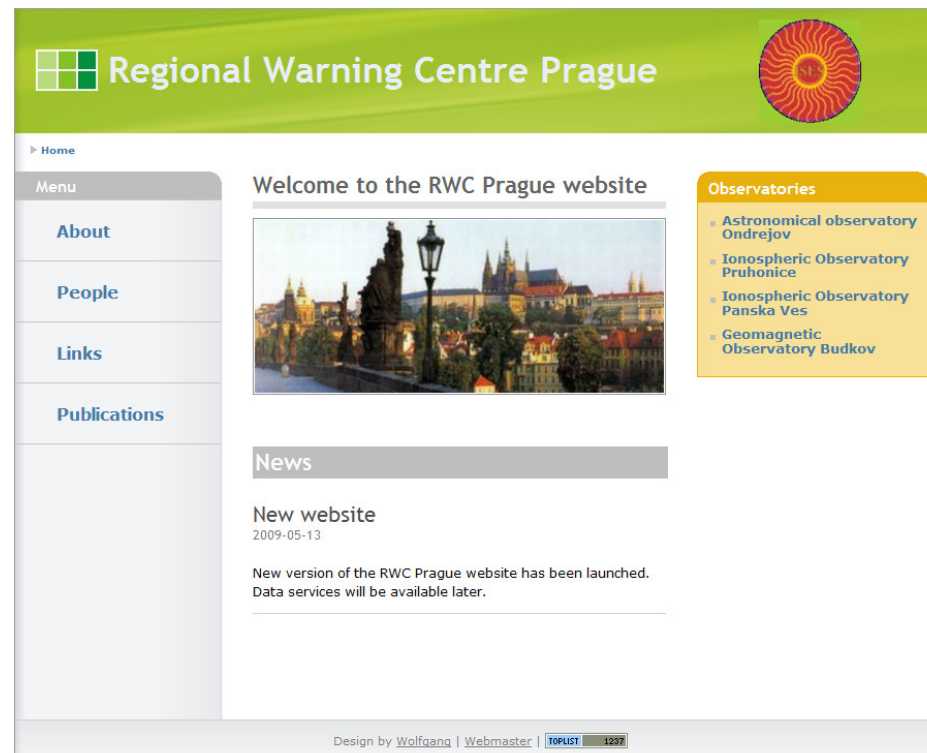
- [Space Weather Prediction Center \(SWPC/SPRC\)](#)
- [National Solar Observing Station](#)
- [Big Bear Solar Observatory](#)
- [International Space Environmental Service \(ISES\)](#)
- [SCOSTEP](#)
- [Solar and Plasma Astrophysics Division of SOO](#)
- [SOMP](#)
- [ISCC](#)
- [NATIE Solar Flare Server](#)
- [Virtual-Sun](#)

As a member of International Space Environment Service (ISES), Regional Warning Center of China (RWC-China) consists of four sub-centers: Solar Activity Prediction Center, Space Environment Prediction Center, Ionospheric Disturbance Prediction Center and Geomagnetic Storm Prediction Center. The headquarters of RWC-China is located in the campus of National Astronomical Observatories, Chinese Academy of Sciences (NAOC). The tasks of RWC-China are as follows: improvement for space weather forecast; enlargement of the service field; collaboration with domestic and international organizations; exchange forecast information and observational data with other regional warning centers to serve the users in local regions and the world.

<http://rwcc.bao.ac.cn/>

RWC Czech Republic in Prague

RWC in Czech Republic is operated by the Solar Department of the Astronomical Institute, the Department of Climatology and Aeronomy of the Institute of Atmospheric Physics, and the Geomagnetic Department of the Geophysical Institute of the Academy of Sciences of the Czech Republic (AS CR). The Geophysical Institute of Atmospheric Physics works as a delegate of the ISES.



The screenshot shows the homepage of the Regional Warning Centre Prague. The header is green with the text "Regional Warning Centre Prague" and a logo of a sun with rays. Below the header is a navigation menu with links for "Home", "About", "People", "Links", and "Publications". The main content area features a "Welcome to the RWC Prague website" message with a photograph of Prague's skyline. To the right, there is a yellow box titled "Observatories" listing four locations: Astronomical observatory Ondrejov, Ionospheric Observatory Pruhonice, Ionospheric Observatory Panska Ves, and Geomagnetic Observatory Budkov. Below this is a "News" section with a "New website" announcement dated 2009-05-13, stating that a new version of the website has been launched and data services will be available later. The footer contains the text "Design by Wolfgang | Webmaster | TOPLIST 1237".

<http://rwcprague.ufa.cas.cz/>

RWC India in New Delhi

RWC India is operated by National Physical Laboratory and has a specialty on ionosphere of low latitude. This center provides ionospheric prediction models, TEC prediction model for Indian zone, ionospheric scintillation information, and so on.

REGIONAL WARNING CENTRE & CENTRE FOR GLOBAL CHANGE

National Physical Laboratory, New Delhi

HOME | CONTACT US | ADDRESS BOOK | SITEMAP

SECTIONS :
RWC-India
Special Program

Visitor's View

Dr. R.C. Budhani
Director, NPL

Dr. B.C. Arya
Head, RAGD

Dr. MYSN Prasad
Chief Scientist, RAGD

Dr. C. Sharma
Principal Scientist, RAGD

Today's Space Weather :

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

Overview - Regional Warning Centre ::

Introduction | Main Activities

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 for users within the country and around the globe. A data exchange schedule operates with each centre providing and relaying data for 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.

International Space Environment Services (ISES) OPERATES 12 REGIONAL WARNING CENTRES GLOBALLY

ISES REGIONAL WARNING CENTRES

Main Activities :

- Daily RWC Forecast (URSIGRAM): Solar geophysical observed data and next 24-48 hrs predictions which is broadcast by IMD
- Solar Activity & Cycles Predictions
- Ionospheric Predictions : Point to Point Link & Area Predictions for HF Communication
- TEC Prediction Model for Indian Zone

Related Links

- International Space Environment Service

List of 12 RWC's managed by ISES worldwide :

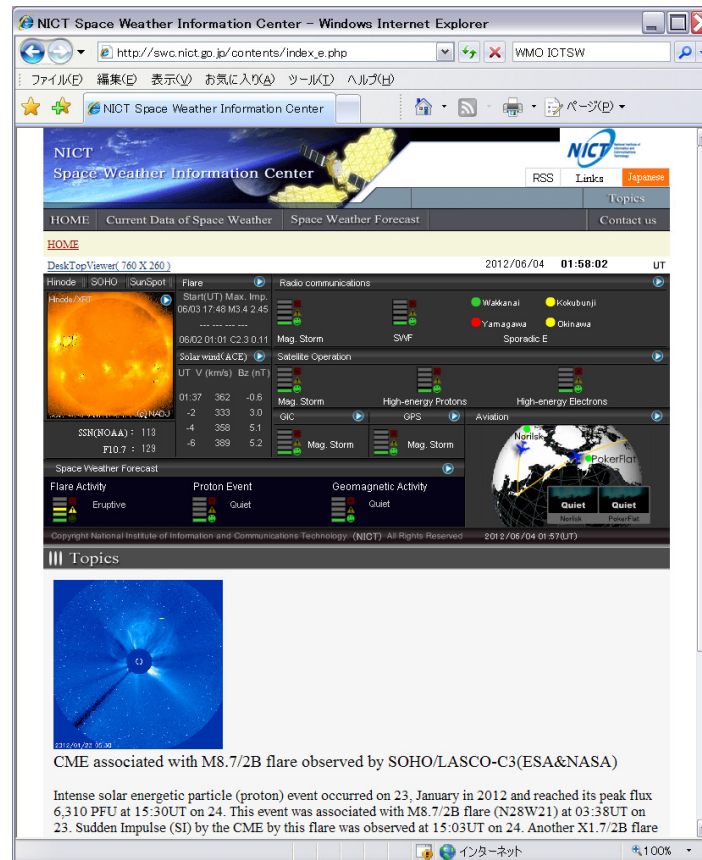
- India (New Delhi)
- USA (Boulder)
- Russia (Moscow)
- China (Beijing)
- Canada (Ottawa)
- Czech Republic (Prague)
- Japan (Tokyo)
- Australia (Sydney)
- Sweden (Lund)
- Belgium (Brussels)
- Poland (Warsaw)
- The European Space Agency (Noordwijk)



http://www.npl-cgc.ernet.in/atul/cgc/rwc/INTRUDUCTION4_BuIn.htm

RWC Japan in Tokyo

RWC Tokyo is operated by National Institute of Information and Communications Technology (NICT) and has a long history as a center of ISES. This center is responsible for ionospheric observation in Japan and developed world's first realtime-simulation model. Now, this center tries to space weather information services using informatics technology.



http://swc.nict.go.jp/contents/index_e.php

RWC Korea in Jeju Island

RWC Korea is operated by the Radio Research Agency and became a member of the ISES last November. This center contributes to real-time solar wind data as one of the ACE ground stations.

Korean Space Weather Center
RRA NATIONAL RADIO RESEARCH AGENCY
Regional Warning Center for International Space Environment Service

HOME | FAQ | SITE MAP | KOREAN
May 31 (Thu) 2012 (KST)
13:22:18 (KST) = 4:22:18 (UT+09:00)

Alerts & Forecasts | Real Time Data | Space Weather and Effects | Instruments | About the Center

View the Space Weather Scale
Space Weather Conditions

Category	-48hr	-24hr	Current
Radio Blackouts	R0 NO EFFECT	R0 NO EFFECT	R0 NO EFFECT
Solar Radiation Storms	S0 NO EFFECT	S0 NO EFFECT	S0 NO EFFECT
Geomagnetic Storms	G0 NO EFFECT	G0 NO EFFECT	G0 NO EFFECT

View the explanation of forecast scales
Forecasts
Updated 2012.05.31. KST

• Radio Blackouts

	0-24hr	24-48hr	48-72hr
R1 Minor	20%	20%	20%
R3 Strong	1%	1%	1%

• Solar Radiation Storms

	0-24hr	24-48hr	48-72hr
S1 Minor	1%	1%	1%

• Geomagnetic Storms (Mid-latitudes)

	0-24hr	24-48hr	48-72hr
G1 Minor	1%	1%	1%
G2 Moderate	1%	1%	1%

Space Weather Board
Situation display for current space weather conditions

The Sun now

Sunspot
Sunspot number 78 | F10.7: 111

Geomagnetic activity
Current: Kp=3 (No Effect)
24 hours max: Kp=3 (No Effect)

Interplanetary magnetic field
B Total: 9.29 nT | Bz: 7.49 nT

Solar wind
Speed: 418.52 km/s | Density: 3.51 protons/cm³

Contact Us | Location

Korean Space Weather Center
RRA NATIONAL RADIO RESEARCH AGENCY
199-6, Gwideok-ro, Hallim-eup, Jeju-si, Jeju-do 695-922 Korea
☎ +82-64-787-7031 | email : spaceweather@kcc.go.kr
Copyright © 2011 Korean Space Weather Center. All rights reserved.

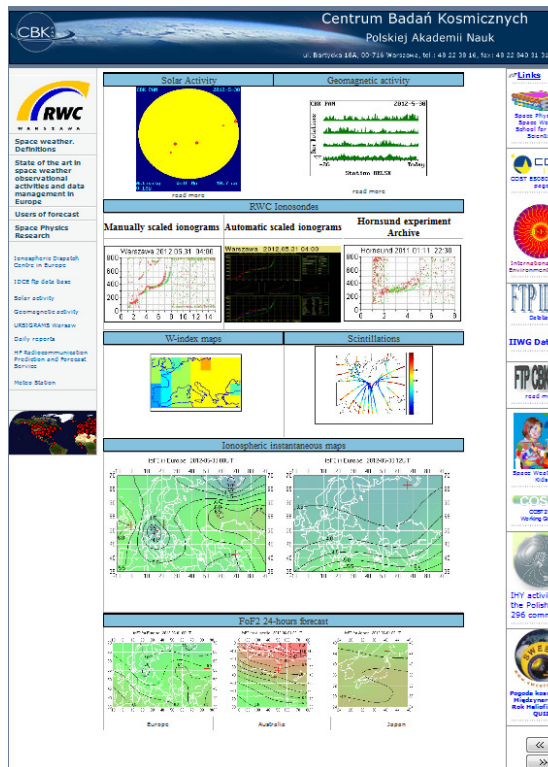
Go to the institutes



<http://www.spaceweather.go.kr/>

RWC Poland in Warsaw

RWC Poland is operated by Space Research Center and has a specialty on ionosphere. This center provides information on HF radio communications.



<http://www.cbk.waw.pl/rwc/rwc.html>

RWC Russia in Moscow

RWC Russia is operated by the Hydrometeorological Service, Institute of Applied Geophysics and has a specialty on ionosphere. This center provides ionospheric data in Russia.

The screenshot displays the website of the Federal Service for Hydrometeorology and Environmental Monitoring, Institute of Applied Geophysics named after E.K. Fedorov (IPG). The page is organized into several sections:

- Главная (Home):** Includes navigation links like Главная, Новости, О нас, and a sidebar with "Службы" (Services) and "Направления" (Directions).
- Обзор космической погоды в период с 23.05.2012 по 29.05.2012:** A text-based summary of space weather conditions.
- Геоматематическая обстановка:** A bar chart showing geomagnetic activity for May 2012.
- Значение K-индексов:** A bar chart showing K-index values for St. Petersburg, with a value of 33603.
- Геомагнитная обстановка:** A line graph showing geomagnetic data for May 2012.
- Данные КА "Интерпол-М1":** A line graph showing data from the Interpol-M1 satellite.
- Данные SOFET:** A circular image showing a solar disk.
- Данные РАДИО-600:** A line graph showing radio frequency data.
- События:** A list of recent events and news items.
- Новости (News):** A section with several news items, including "Защита диссертаций" (Defense of dissertations) and "Прощальный салют группы 1476" (Farewell salute to group 1476).
- Архив (Archive):** A date selector for 01.05.2012.
- Информация (Information):** A section with logos for "Планета" (Planet), WMO, OASD RIAN, and ITU "Тайфун".
- К 100-летию академика Е.К. Федорова:** A portrait of E.K. Fedorov and a commemorative message.

<http://ipg.geospace.ru/>



RWC South Africa in Hermanus

RWC South Africa is operated by Hermanus Magnetic Observatory known as one of Dst geomagnetic stations and a specialty on ionosphere. This center provides ionosphere information in South Africa using ionosonde and TEC observations.

ISES Regional Warning Centre for Africa

open all | close all

- Real Time Data
- Geomagnetic Data
- Ionospheric Data
- Warnings & Predictions
- General Information

The Hermanus Magnetic Observatory is one of twelve Regional Warning Centres globally that forms part of the ISES (International Space Environment Service) Regional Warning Centre network. Specifically, the HMO is appointed as the Regional Warning Centre for Africa.

ISES REGIONAL WARNING CENTRES

Please visit the [Hermanus Magnetic Observatory](#) for more information.

For real-time space weather predictions and warnings, please visit <http://spaceweather.co.za>.

Current Space Weather Conditions

Geomagnetic Conditions | **Ionospheric (Ionosonde)**

Parameter	Station #1	Station #2
Station	HER	SNA
Date	2012-05-31	2012-05-31
Time	04:37:00 UTC	04:34:00 UTC
Horizontal Field	10630.60 nT	19180.60 nT
Declination	-24.83 deg	-15.55 deg
Vertical Field	-23687.60 nT	-35854.50 nT
Rate of change	dx/dt	dx/dt
	0.09 nT	1.59 nT
	dy/dt	dy/dt
	0.20 nT	-1.37 nT
Preliminary K Index	2012-05-31	2012-05-31
	03:00:00 UTC	03:00:00 UTC
	1	1
	QUIET	QUIET

<http://spaceweather.hmo.ac.za/>

RWC Sweden in Lund

RWC Sweden is operated by Swedish Institute of Space Physics and a specialty on predictions using neural network. Using neural network, this center provides predictions of geomagnetic activity, geomagnetically induced current (GIC) and so on.

The screenshot displays the website for the Regional Warning Center Sweden of the International Space Environment Service. It features a header with the IRF logo and the center's name. A 'SPACE WEATHER' banner is prominent. A 'SUMMARY EXPLAINED' section lists key parameters like K_p , Dst , and AE . A detailed 'SUMMARY' box provides a 'Solar Activity News' section with bullet points on solar flares and coronal mass ejections, and a 'Status of Solar Activity' section with a scale from 1 to 5. Below this is a 'CURRENT SOLAR AND SPACE WEATHER' section with five circular indicators for Sunspot, Solar magnetic field, Solar Storm, Coronal Mass Ejection, and Coronal Hole, each with a color-coded status and a link to more information. At the bottom, there are two time-series plots: one for the solar magnetic field and another for geomagnetic activity indices.



<http://www.lund.irf.se/rwc/>

RWC USA in Boulder

RWC USA is the headquarter of the ISES and is operated by NOAA/SWPC. This center contributes data of solar soft X-ray flux, solar energetic particle, and high-energy electron flux of geostationary orbit by GOES satellites and hosts the Space Weather Workshop in the USA since 1996.

National Weather Service
Space Weather Prediction Center

www.weather.gov

Site Map News Organization Search [] Submit

Search SWPC [] Go

NCEP Quarterly Newsletter

SWPC Home Page

Current Conditions
Alerts/Warnings
Space Weather Now
Today's Space Wx
Data and Products
Alerts & Forecasts
Reports/Summaries
Space Wx Models
Solar/Geo. Indices
Measurements

Support Services
About Us
Staff
Email Products
Space Wx Workshop
Education/Outreach
Customer Services
News & Media Info.

Contact Us
Contact Us
Webmaster
Feedback

Top News of the Day:

The Office of the Federal Coordinator for Meteorology and the National Space Weather Program will host the 2012 Space Weather Enterprise Forum on June 5, 2012, at the National Press Club in Washington, DC. This year's theme is Solar Maximum 2013 – How Space Weather Will Affect You! To learn more and register, please visit the SWEF web site at http://www.nswp.gov/swe/swef_2012.html.

Curious to learn more about space weather and its impacts? Follow this link.
[Sign up for Emails of Space Weather Alerts, Warnings, Watches, and Forecasts.](#)

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

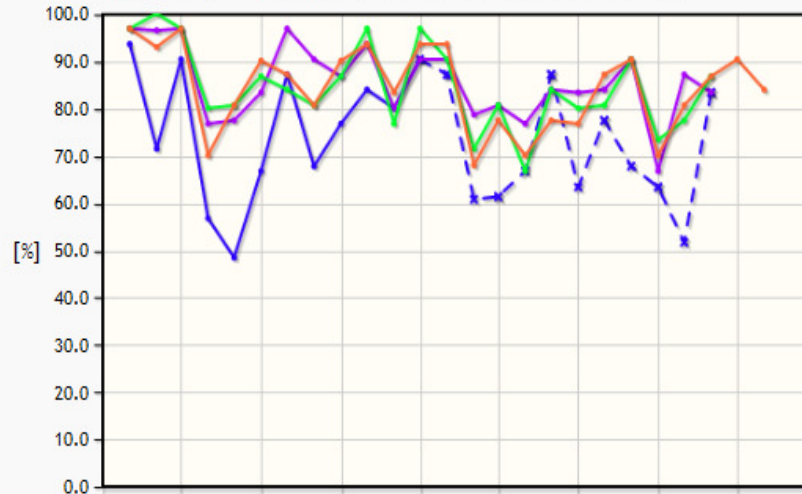
Space Weather Topics:
[Alerts / Warnings](#), [Space Weather Now](#), [Today's Space Wx](#), [Space Weather Now](#), [Today's Space Wx](#), [Data and Products](#), [About Us](#),
[Email Products](#), [Space Wx Workshop](#), [Education/Outreach](#), [Customer Services](#), [Contact Us](#)



<http://www.swpc.noaa.gov/>

Prediction Score Web by 4+1 RWCs

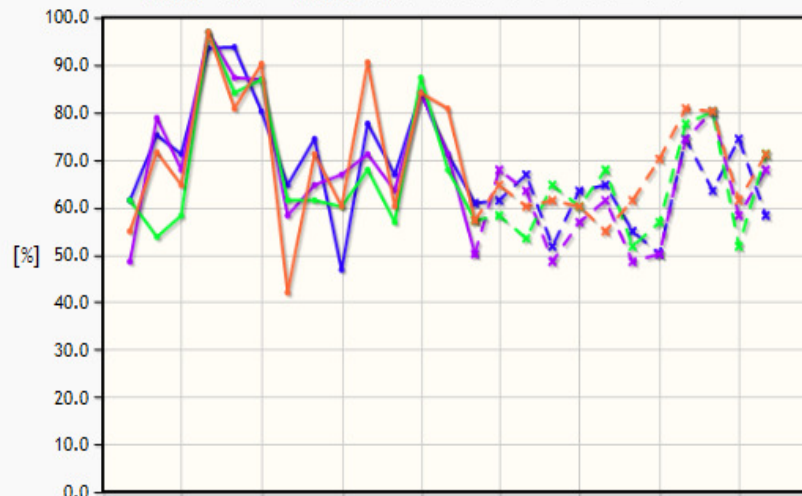
2010年1月～2012年1月 月別地磁気擾乱予報適中率



Score of Magnetic Disturbances

- SYDNEY (85.6% 1位)
- BOULDER (84.5% 2位)
- NICT (84.3% 3位)
- BRUSSELS (73.9% 4位)

2010年1月～2012年1月 月別フレア予報適中率



Score of Solar Flare

- NICT (69.1% 1位)
- BRUSSELS (68.0% 2位)
- SYDNEY (66.8% 3位)
- BOULDER (66.0% 4位)

2009/12 2010/03 2010/06 2010/09 2010/12 2011/03 2011/06 2011/09 2011/12 2012/03

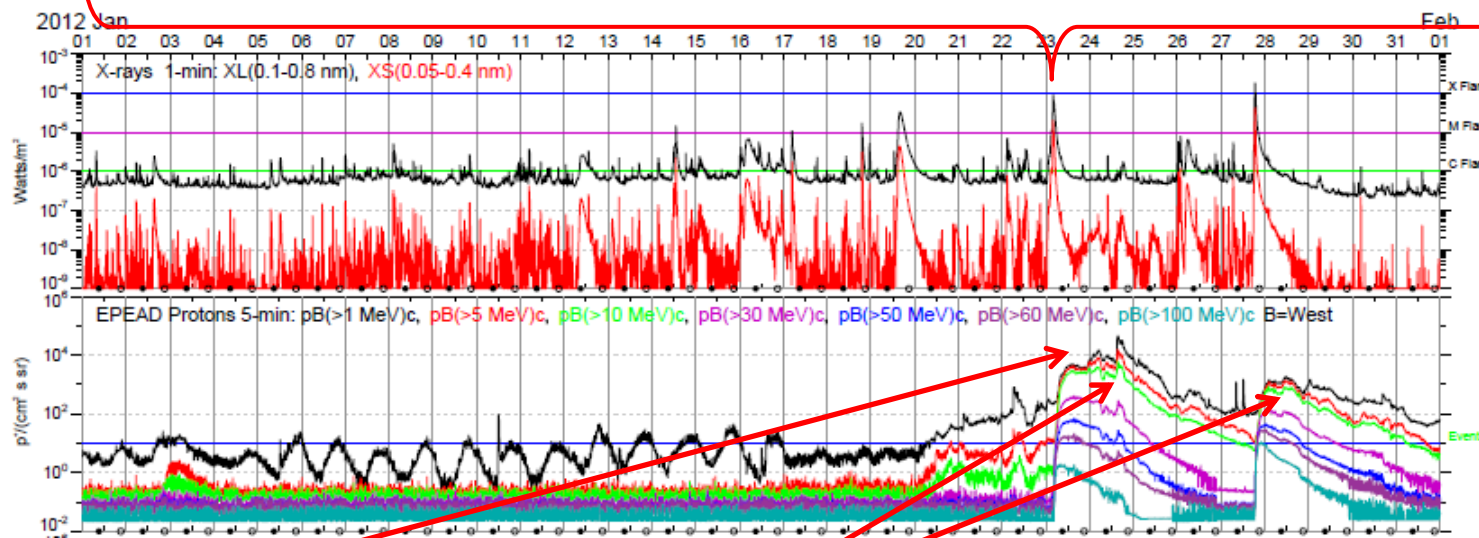
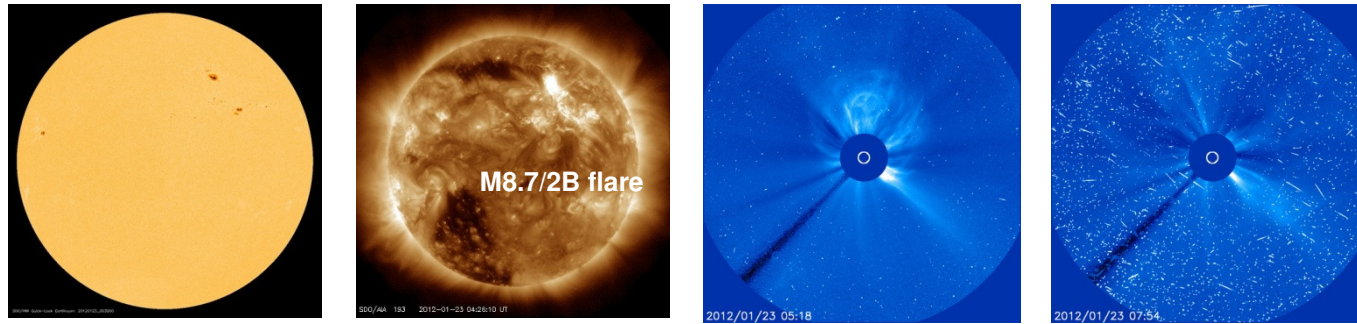
年/月



Examples of Recent Big Events of Space Weather X class flares in 2012

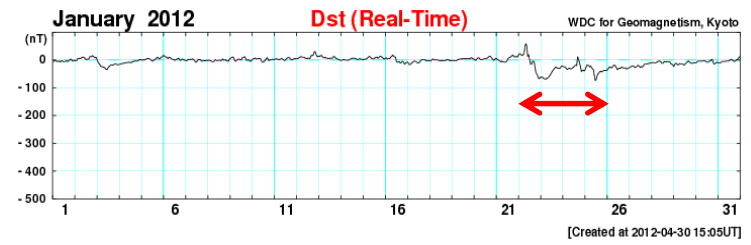
Space Weather Events in January and March 2012

Space storms in January 2012

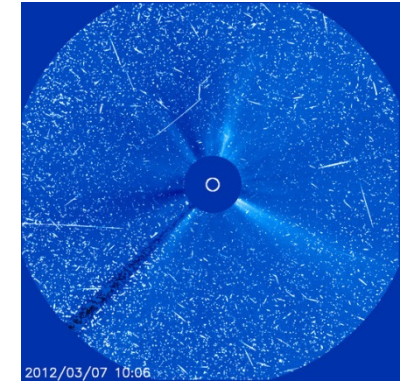
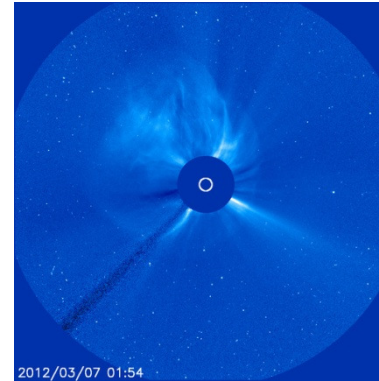
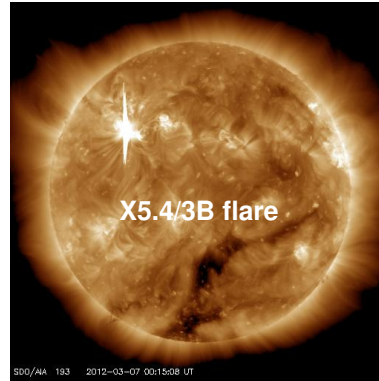
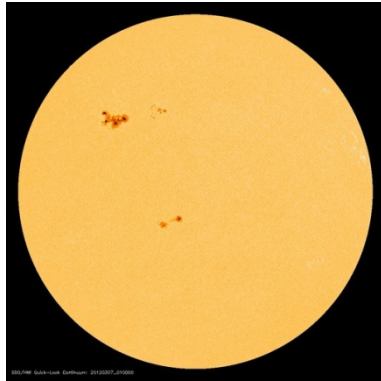


On 23 January, Akatsuki (Planet-C) experienced abrupt decrease of electric power of solar array.

On 24 and 28 January, approximately eight flights of Delta Air Lines were changed to non-polar routes.



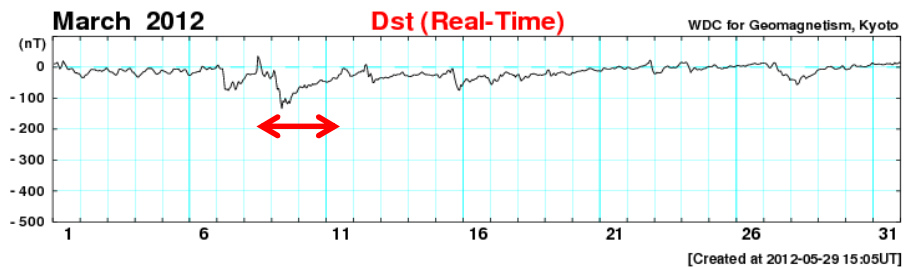
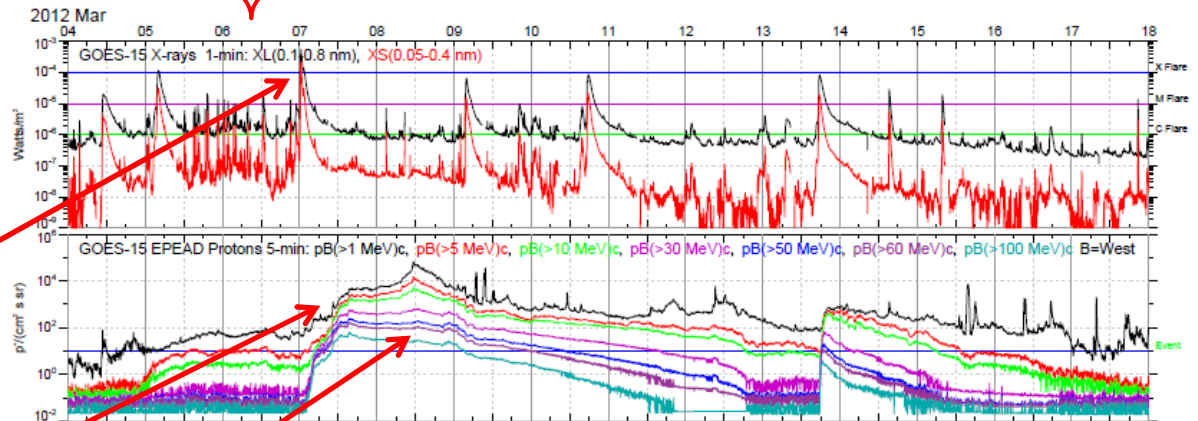
Space storms in March 2012



X class flare affected HF radio broadcast service of Radio Nikkei.

On 7 March 2012, SkyTerra 1 satellite suffered an outage because solar energetic particles affected its attitude sensors and made the satellite safe mode

On 8 and 9 March, approximately eight flights of Delta Air Lines were changed to non-polar routes or southern polar routes.



Examples of Recent Big Events of Space Weather

Radiation belt prediction

Space Weather and Environment Informatics Laboratory

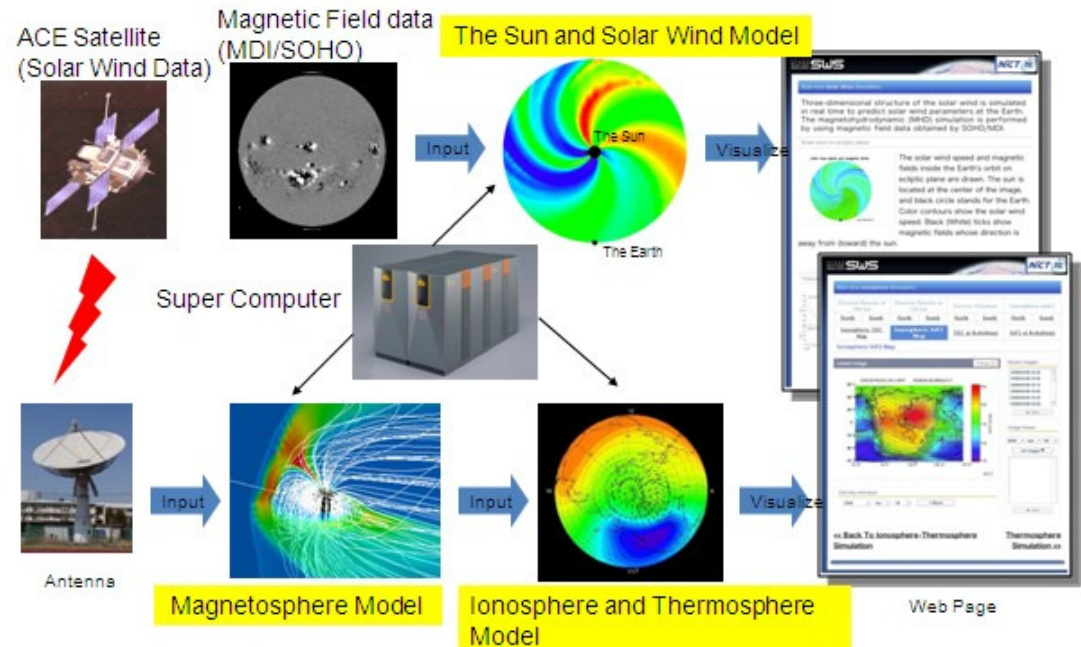


ISES RWC Tokyo

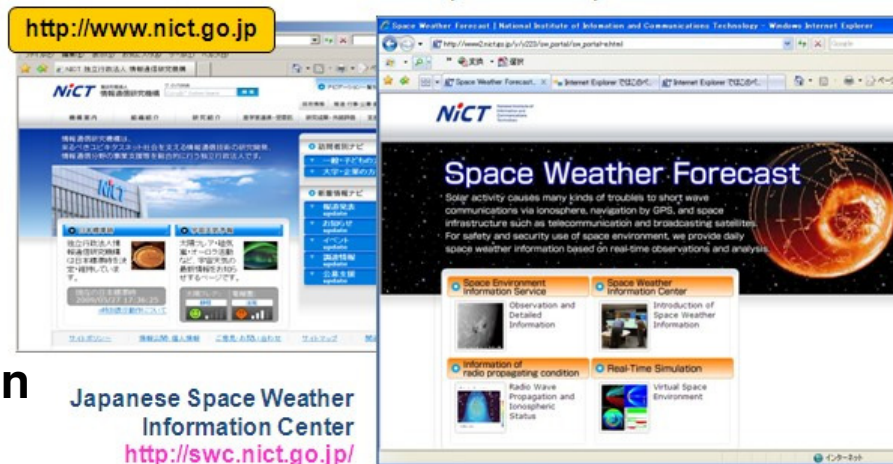


Every afternoon, we make a daily forecast by the meeting.

Broadcasting of SWx information on the Web, e-mail, etc.



Real-time space weather simulator

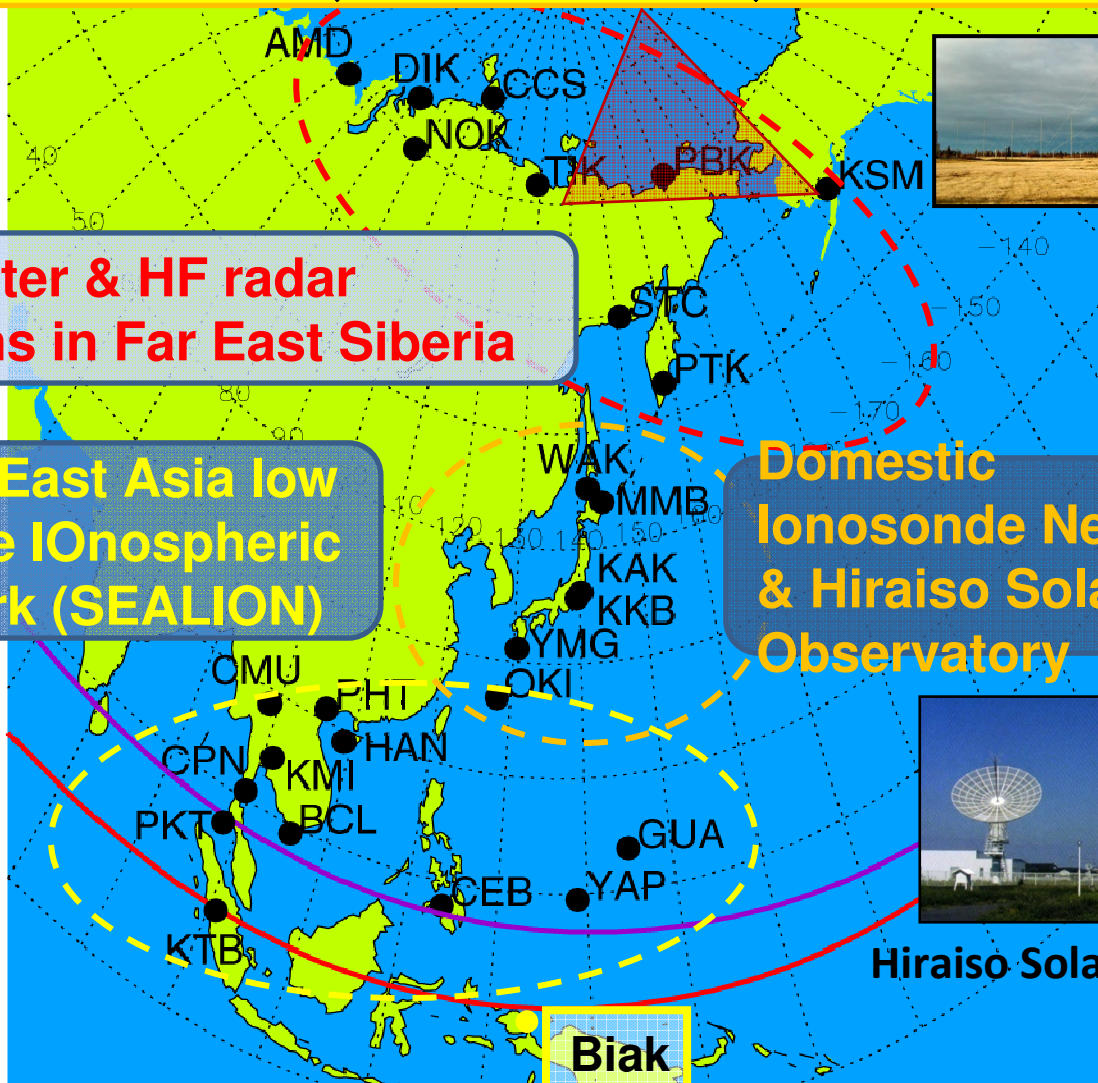


Japanese Space Weather Information Center <http://swc.nict.go.jp/>

NICT's Space Weather Monitoring Networks (NICT-SWM)



Magnetometer



Magnetometer & HF radar observations in Far East Siberia



HF radar



Ionosonde

South-East Asia low latitude Ionospheric Network (SEALION)

Domestic Ionosonde Network & Hiraizo Solar Observatory

Ionospheric observation at Syowa Station



Hiraizo Solar Observatory

Biak

Space Weather and Environment Informatics Laboratory

The 3rd 5-Year Plan (2011-2015)

Space Weather Research based on merging among observation, simulation and informatics

Prediction of space environment around GEO

Development of relativistic electron environment prediction model and high-precision Global MHD simulation
⇒ Prediction of space environment (keV~MeV particles) around GEO

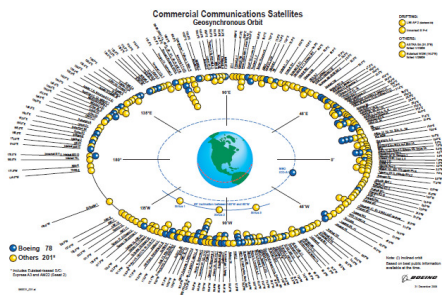
Prediction of ionospheric disturbances

Development of near-real time prediction system for generation and propagation of equatorial plasma bubble and high-precision ionospheric simulation including atmospheric and magnetospheric interactions
⇒ 1 hour ahead of Ionospheric disturbance forecast

Importance of predicting space environment around GEO

•More than 300 satellites exist in GEO

•24 Japanese satellites in GEO



GEO is important for communications, broadcasting, and meteorological monitoring

Numbers of satellite anomalies in GEO during 1987 ~ 1994 (from NOAA database)

400~500

More than 60 satellite anomaly events happened in each year

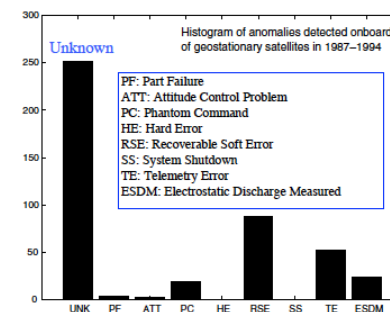
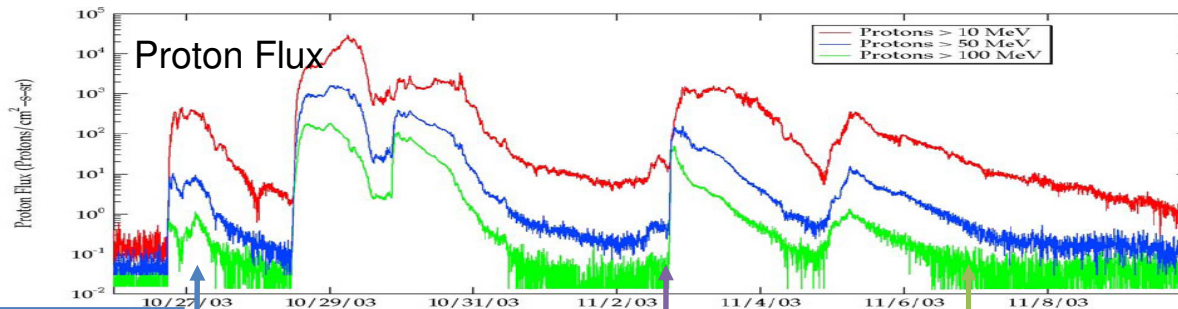


Fig. 1. Distribution of number of anomalies according to their classification (whenever possible).

Satellite anomalies during Halloween event



2003/10/28-30(その1)

- ・国際宇宙ステーションで放射線を防ぐためサービスモジュールに宇宙飛行士避難
- ・NOAA 17 機器障害
- ・ACE and Wind プラズマ観測不能
- ・GOES 静止軌道の電子観測が飽和
- ・Chandra 放射線のため自動的に観測停止(11/01に復旧)

- ・Kodama セーフモード(10/29)
- ・DMSP F14 SSM/T2センサーに障害、従系に切り換え(11/04に主系に切り換え)
- ・RHESSI CPUの自然リセット(10/28 and 10/29)
- ・CHIPS 衛星 18時間通信不能
- ・SOHO CDSをコマンドによりセーフモードにした。(10/28-30)
- ・Odyssey セーフモード 10/29 データダウンロード中にメモリエラー発生、10/31にコールドリポート MARIE 温度以上で電源オフ、故障(10/28)

2003/10/27

- ・GOES 8 障害

2003/10/28-30(その2)

- ・Mars Explorer Rover star trackerの異常によりSunアイドルモード
- ・SIRTf 高プロトンフラックスのため、科学観測機器をオフして地球指向に(10/28)
- ・X-ray Timing Explorer 二つの観測装置が自動的に停止
- ・Microwave Anisotropy Probe star trackerリセット
- ・GALEX 二つの紫外線観測器が停止
- ・Polar despunプラットフォームのロックを3度失う

2003/10/28-30(その3)

- ・Cluster プロセッサのリセット
- ・FedSat シングルイベントアップセット(SEU)
- ・Inmarsat 9機のうち2機でモーメンタムホイールの速度上昇
- ・NASAの地球科学ミッションオフィスがAQUA, Landsat, TERRA, TOMS, TRMMの五つの衛星で観測装置を停止させセーフモードに(10/29)
- ・ICESat GPSがリセット
- ・UARS 機器(HALOE)のオンを延期

2003/11/02

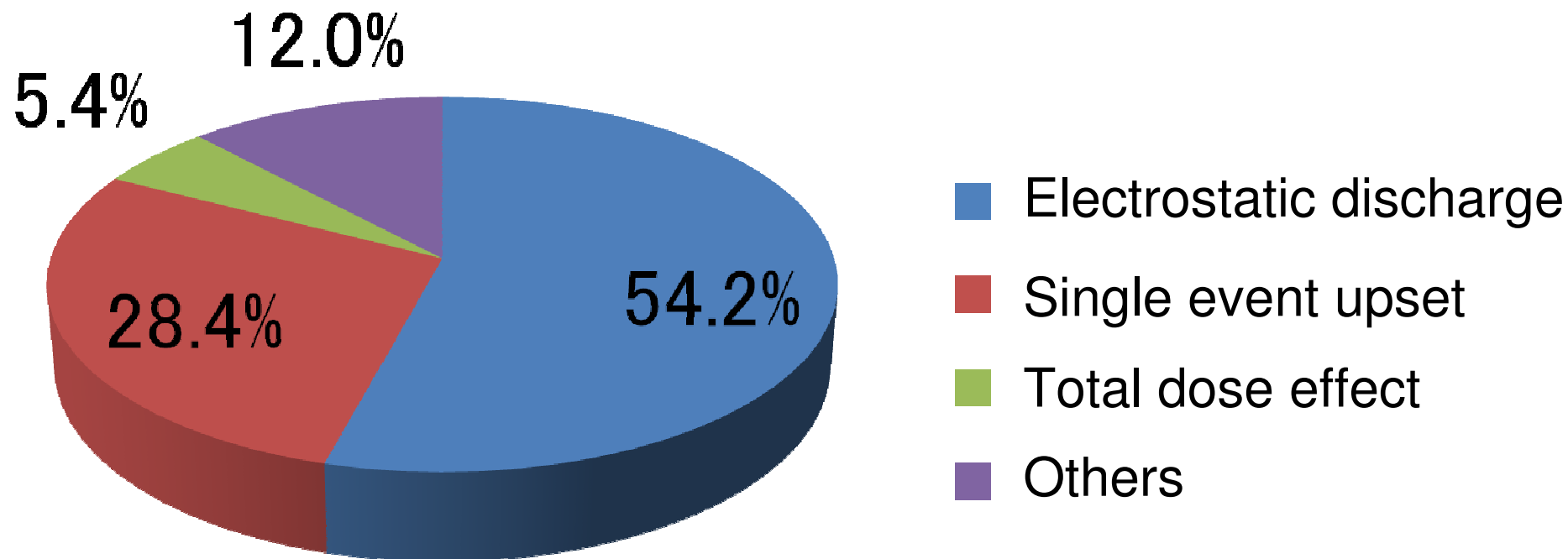
- ・Chandra 放射線により自動的に停止

2003/11/06

- ・Polar 機器(TIDE)がリセットし高圧電源disable
- ・Odyssey コマンドでセーフモードにして運用再開

Large number of satellite anomalies are occurred in extreme solar flare event

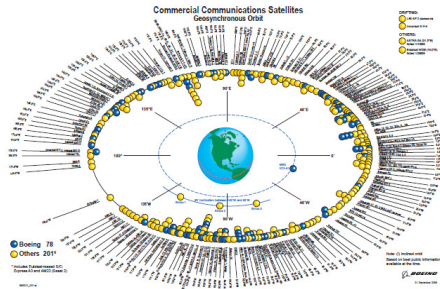
Classifications of Satellite Anomalies



Reference: Survey of spacecraft anomaly databases
(Space Architect Study: Koons et al., 1999)

More than half satellite anomalies are caused by electrostatic discharge (Surface charging + Deep dielectric charging)

satellite anomalies caused by electrostatic discharge



More than 300 satellites on the geo-synchronous orbit

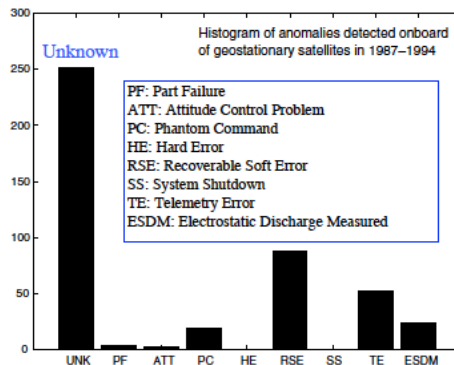


Fig. 1. Distribution of number of anomalies according to their classification (whenever possible).

Malfunctions on the geo-synchronous orbits reported between 1987 and 1994 (NOAA database)
Total number: 400~500

Surface charging

Plasma injection triggered by substorm (around midnight Local time)

Deep dielectric charging

Energetic particle acceleration of radiation belt

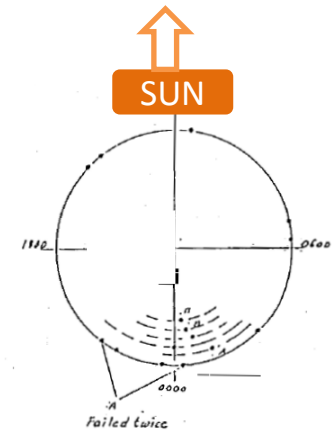
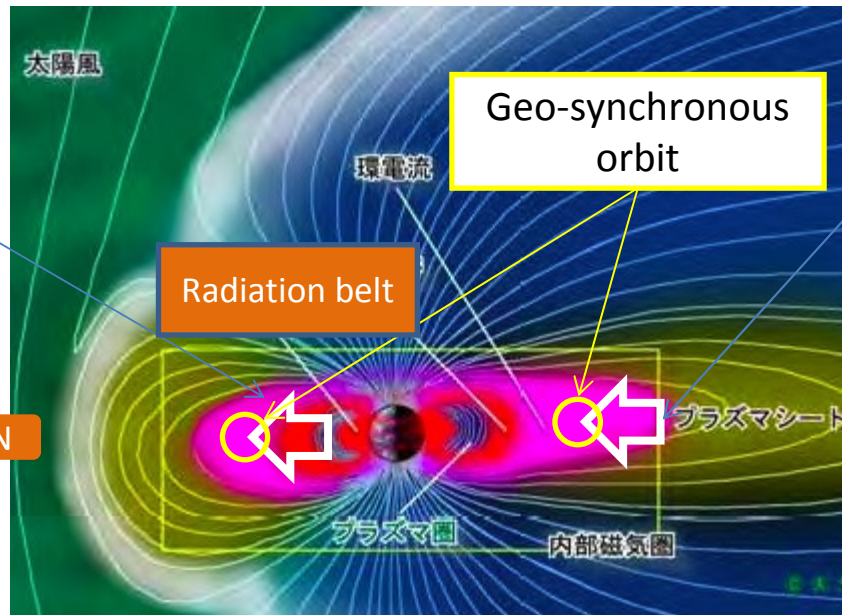


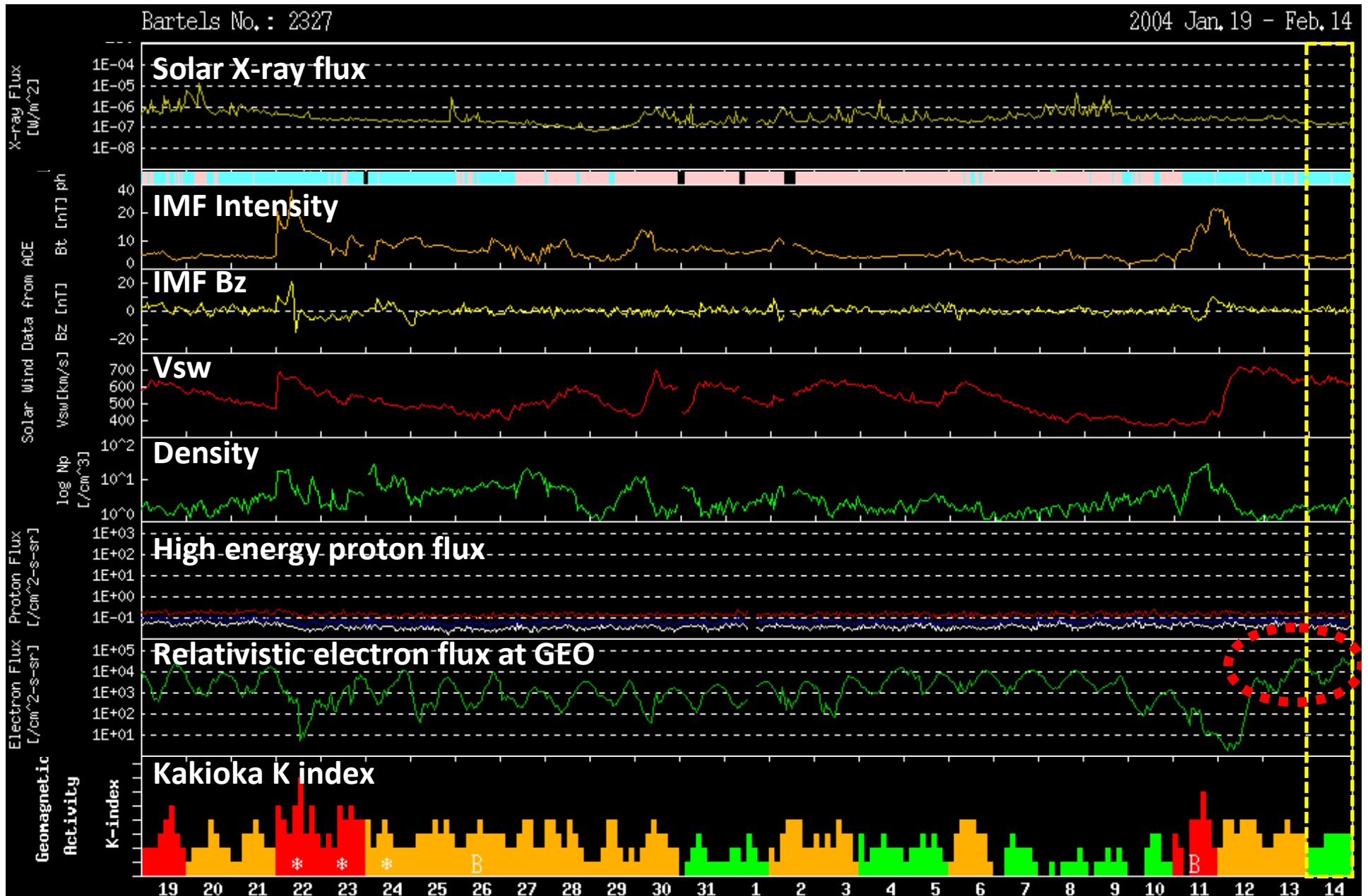
図1.3.8 米衛星の障害のローカルタイム分布

Japanese Satellite Anomalies after 2001

- 2001/09/25 (GEO-A) Anomalies of attitude control #Proton event SEU?
- 2001/11/07 (GEO-A) Anomalies of attitude control #Proton event SEU?
- 2003/10/24 (LEO-A) Anomalies #Auroral particle precipitation due to substorm
- 2004/02/14 (GEO-A) Anomalies of transponder #Relativistic electron enhancement?
- 2005/01/17 (GEO-F) Anomalies of thruster #Proton event?
- 2005/07/22 (GEO-F) Anomalies of attitude control #REE?
- 2005/08/19 (GEO-A) Anomalies of command receiver #REE?
- 2005/09/23 (GEO-D) Power shutdown of Camera #REE?
- 2006/04/16 (GEO-D) Anomalies of attitude control #REE?
- 2007/03/13 (GEO-D) Interference of telecommunication #Ionospheric disturbance?
- 2007/11/05 (GEO-E) Anomalies of attitude control #REE?
- 2008/09/11 (GEO-B) Anomalies of transponder #Long duration of REE?
- 2008/09/14 (GEO-B) Anomalies of transponder #Long duration of REE?
- 2009/11/11 (GEO-D) Attitude anomalies #Galactic cosmic ray?
- 2010/08/24 (GEO-C) Temporal attitude anomalies #unknown (High speed stream + geomagnetic activities)

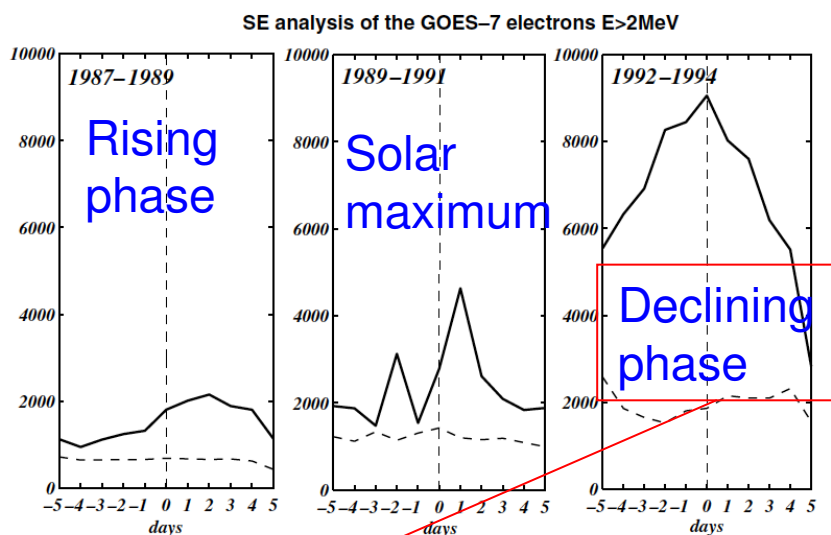
(REE: Relativistic Electron Enhancement)

Feb. 14, 2004 (GEO-A anomaly of broadcasting transponder) relativistic electron enhancement



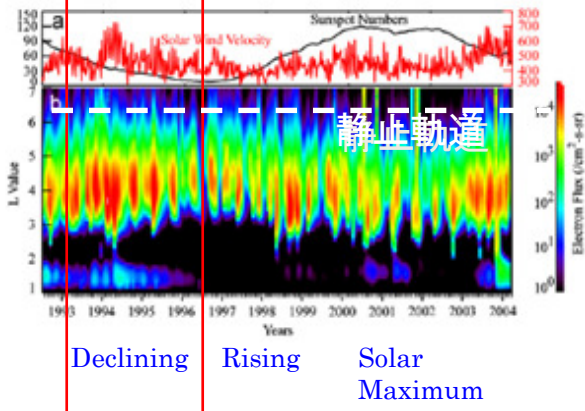
Relationship between satellite anomalies and relativistic electron flux

Thick line: anomaly period ± 5 days
 Dash line: average level

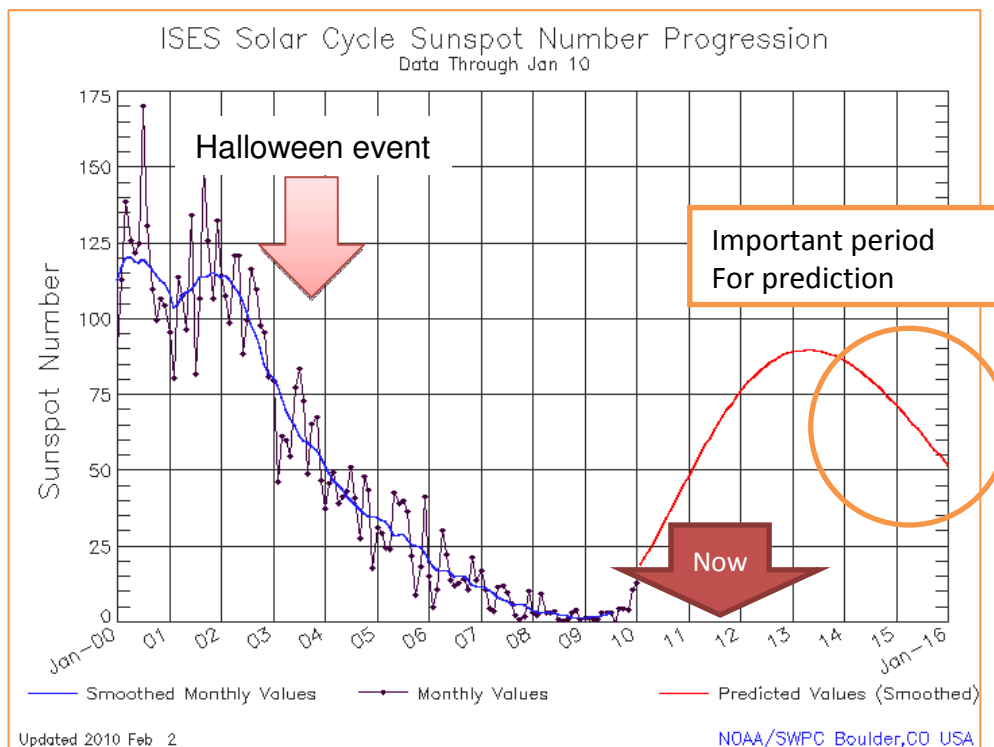


Solar activities (Black)

Relativistic electron flux



Radiation belt dynamics



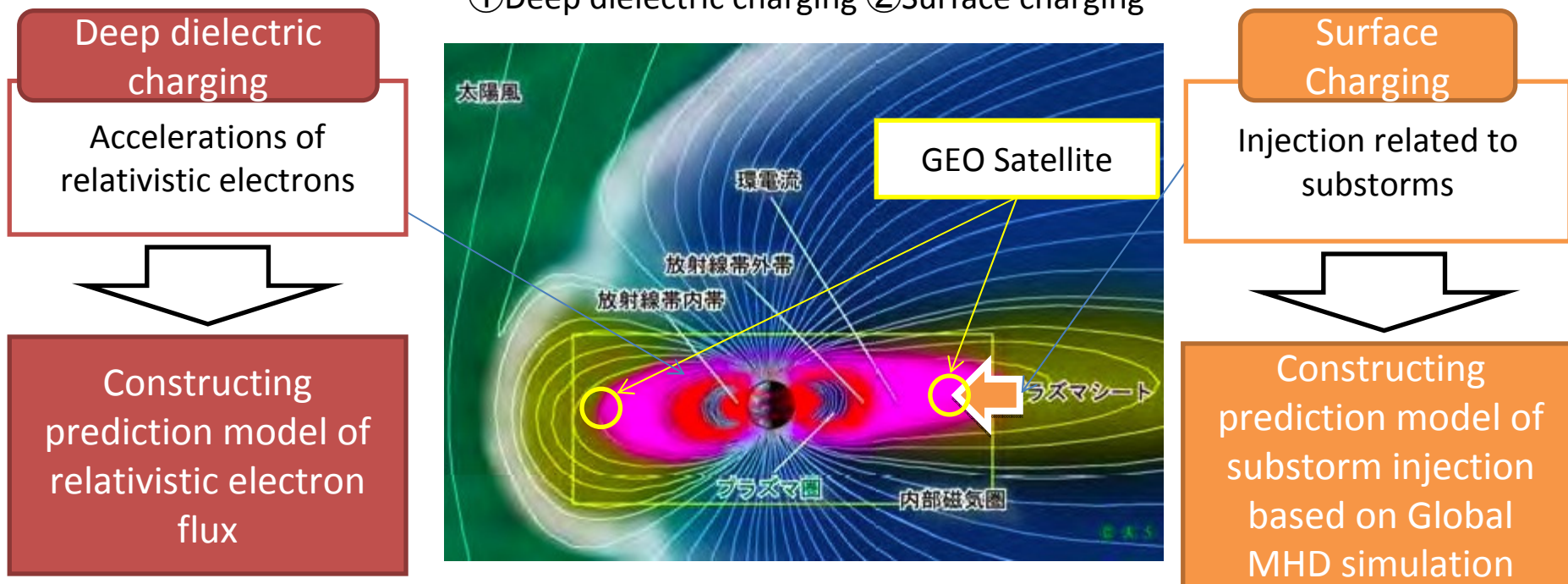
Cycle 23

Cycle 24

We must prepare now for mitigating serious damage caused by satellite anomalies.

Two major charging phenomena related to satellite anomaly

① Deep dielectric charging ② Surface charging



Requirement for NICT's space weather information by satellite operating companies

- Observation data and simulation results during previous satellite anomalies period are important for investigation
- Surface charging problem is improved for new-generation satellite. However, prediction of surface charging is still important for old-generation satellite.
- Prediction of deep dielectric charging is important for next declining phase of 24th solar cycle.

The goal of our project

- Constructing system for predicting three-dimensional distribution and variations of radiation belt particles
 1. **1-day average flux prediction for a few days ahead as near-real time information**
 - Particle Flux, pitch angle, energy, etc...
 2. Re-construct outer radiation belt distribution from our prediction
 3. **Advanced prediction for high time and spatial resolution for post-data analysis**

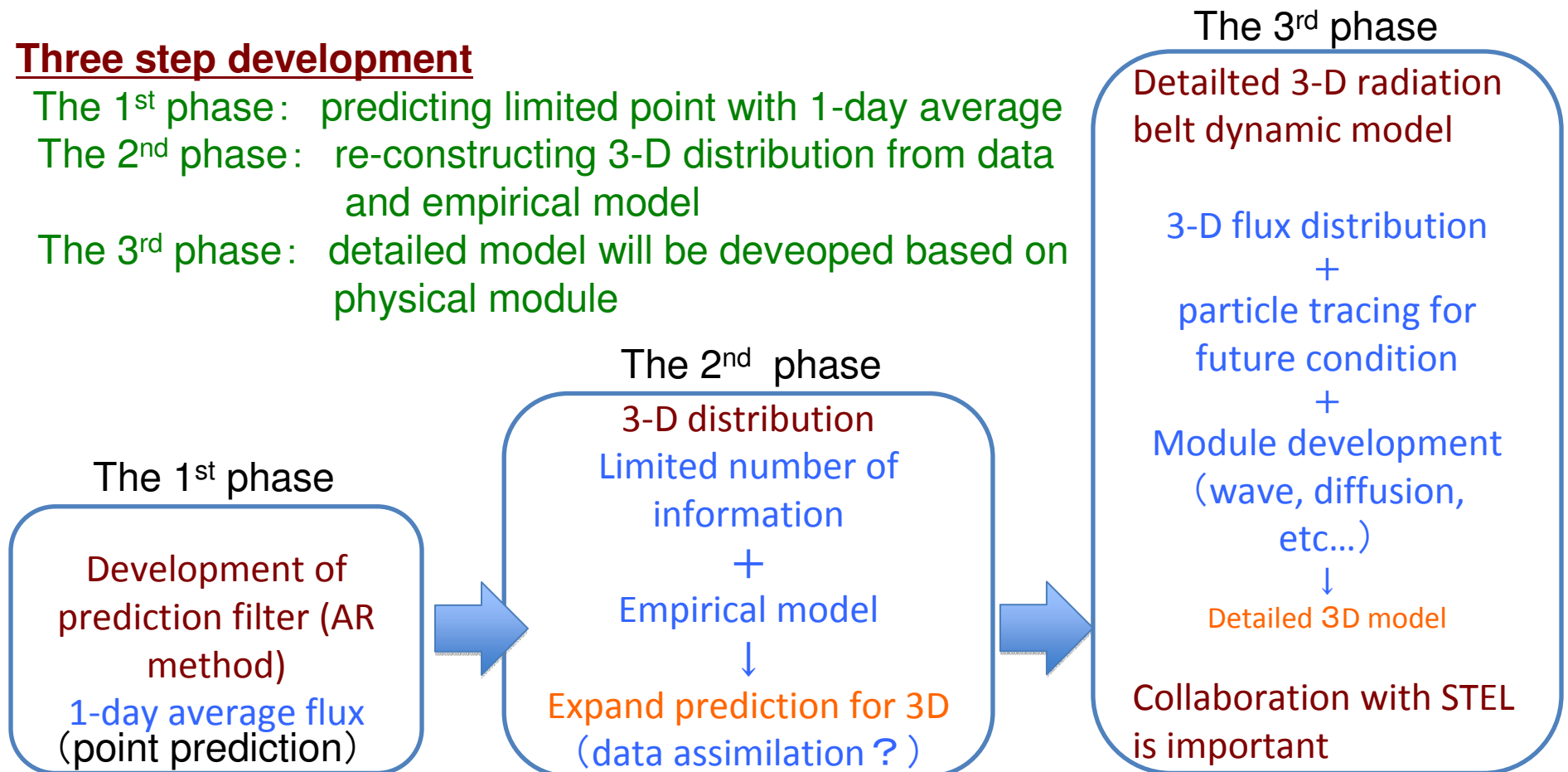
Roadmap for the development of our prediction model

Three step development

The 1st phase: predicting limited point with 1-day average

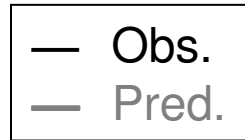
The 2nd phase: re-constructing 3-D distribution from data and empirical model

The 3rd phase: detailed model will be developed based on physical module

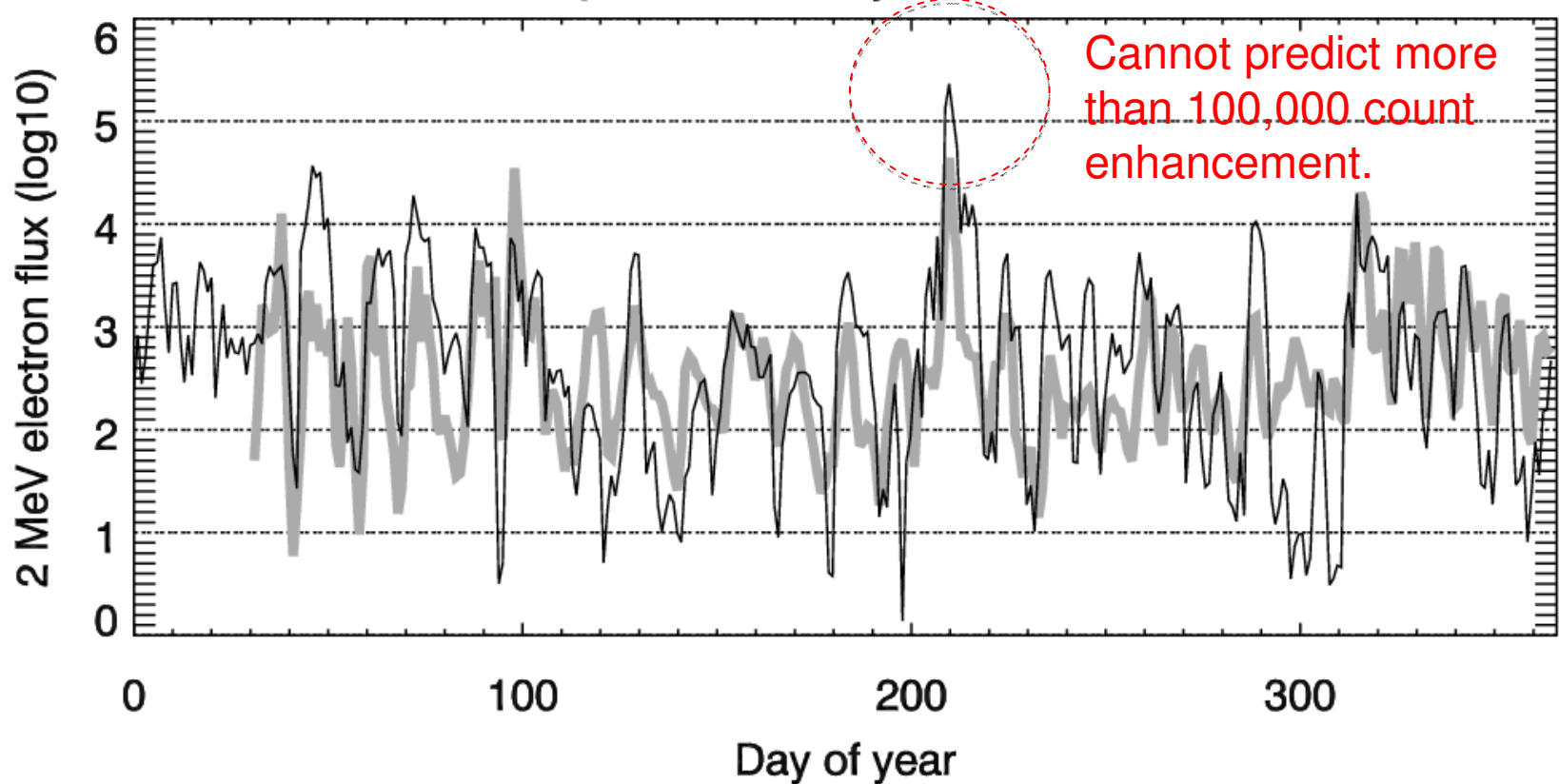


Results of linear Prediction filter (Input: Only Solar wind velocity)

Trend of variations can be predicted. But still lots of qualitative error.



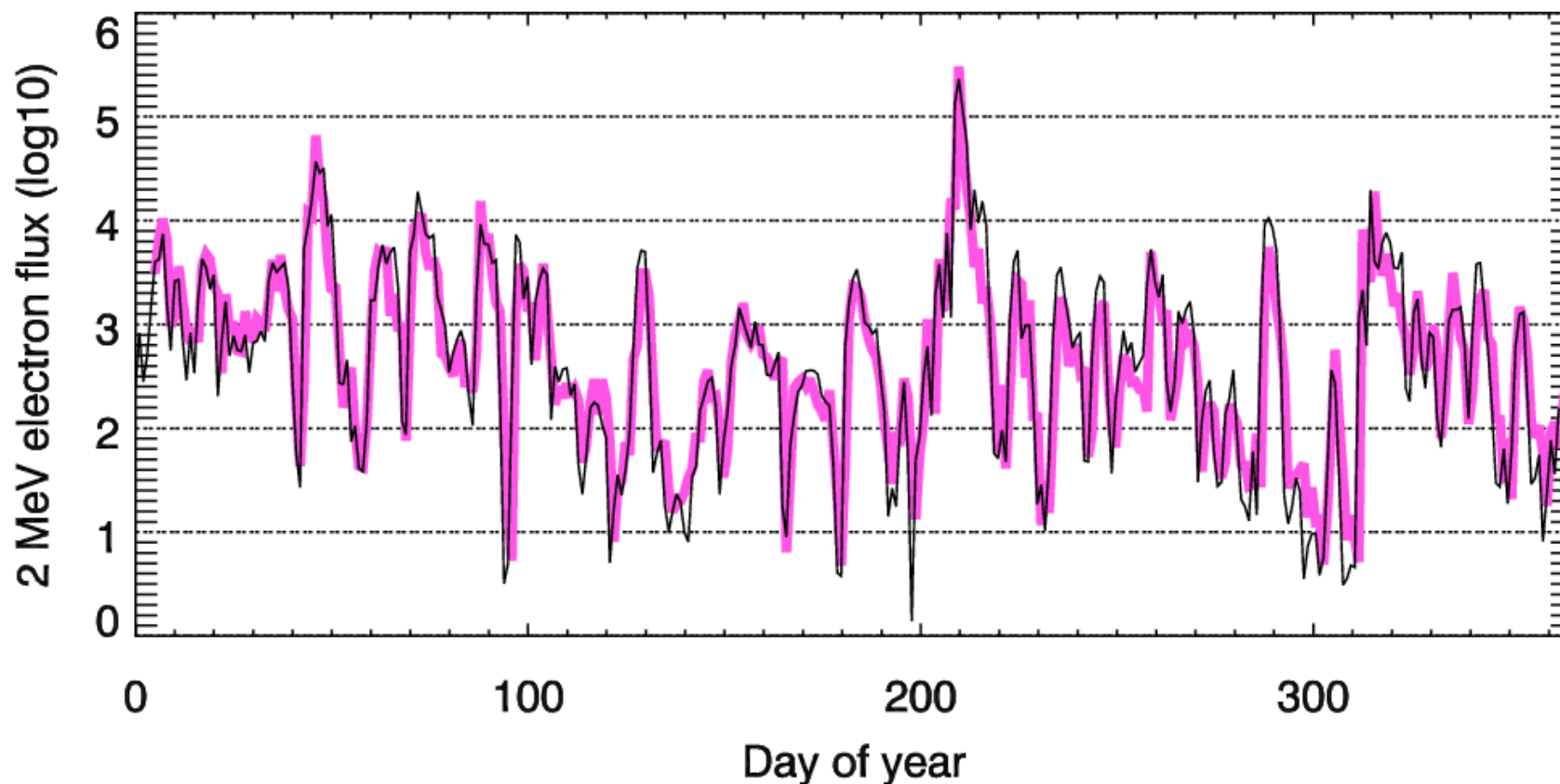
LPF prediction by SWV in 2004



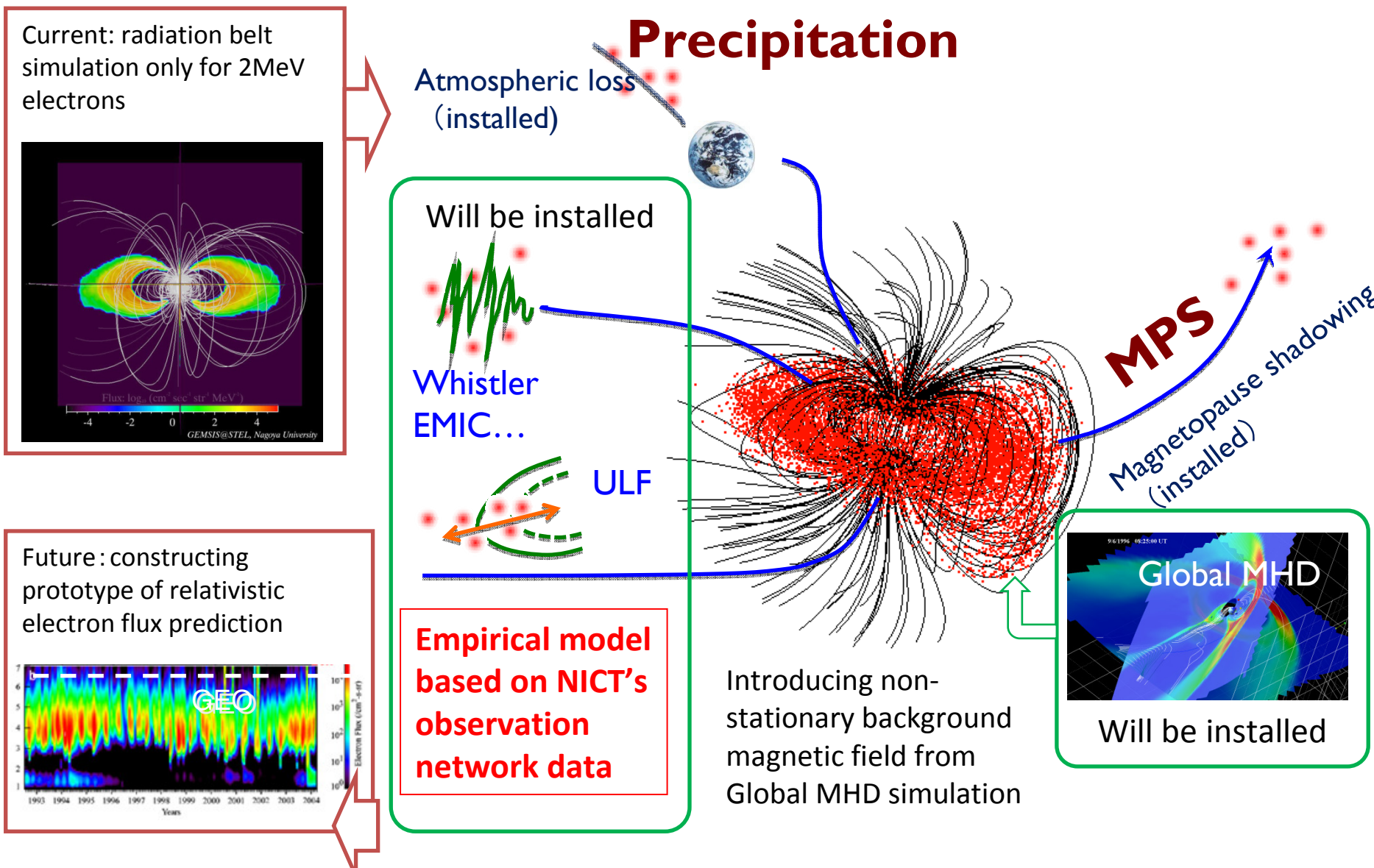
Multivariate AR Prediction (Input: + dyn. P, IMF Bz)

Precision of Prediction is qualitatively improved!!

Multivariate AR model, para4: E1 + SWV + IMFBz + SWPdyn in 2004



Research Plan of practical radiation belt model



Examples of Recent Big Events of Space Weather

Galaxy 15 malfunction

Examples of Recent Big Events of Space Weather

Galaxy 15 malfunction

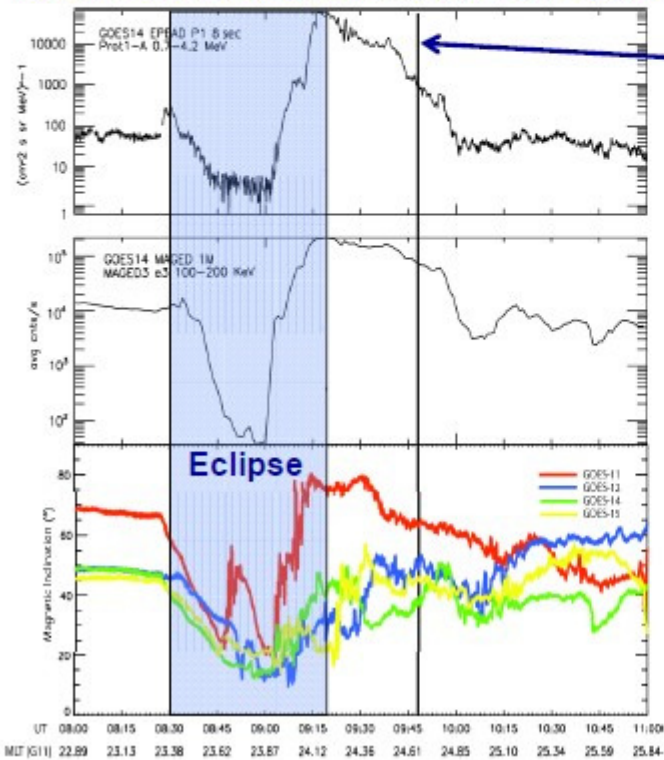


Space Weather Conditions

3. Local Environment At Galaxy 15 (1 of 4)

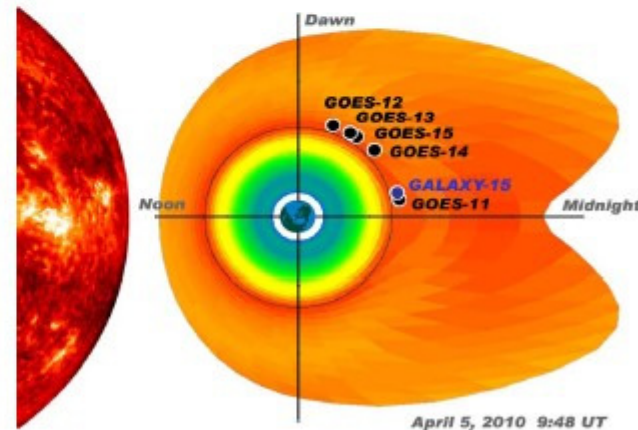


April 05 @ 09:00 UT: GOES magnetometers and particle instruments showed a major reconfiguration of the magnetosphere indicative of a substorm and injection of energetic particles into the nightside, near-earth space environment



Galaxy 15 (133 W) Anomaly 09:48 UT

Satellite Locations



Examples of Recent Big Events of Space Weather

Galaxy 15 malfunction

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04/30/10 05:34 PM ET

Galaxy 15, Still Adrift, Poses Threat to Its Orbital Neighbors

By Peter B. de Selding

    ShareThis

PARIS — An Intelsat satellite that stopped communicating with its ground controllers April 5 remains out of control and has begun moving eastward along the geostationary arc, raising the threat of interference with other satellites in its path, Intelsat and other industry officials said.

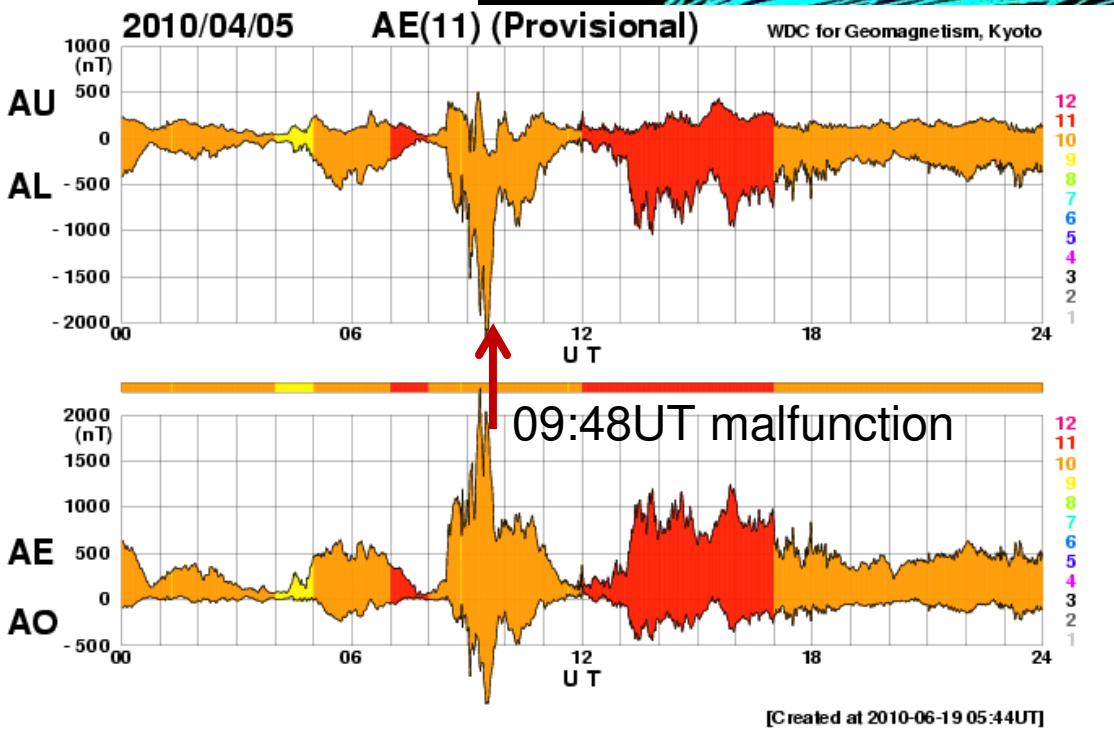
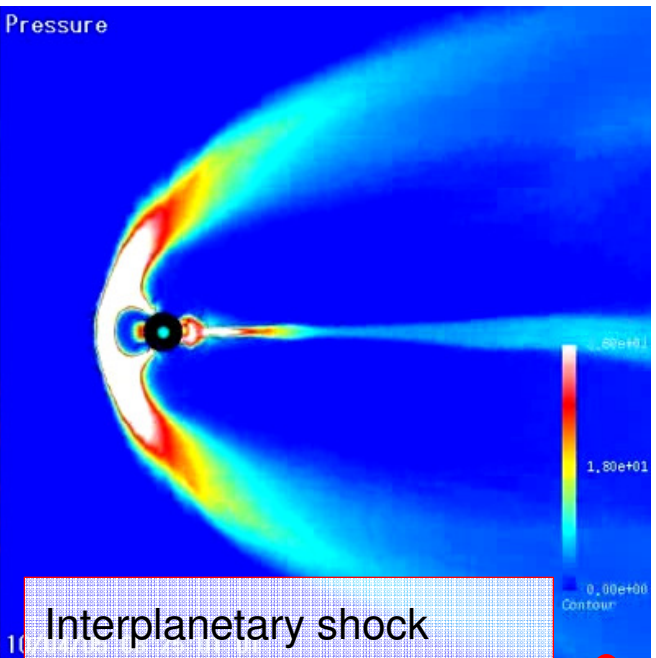
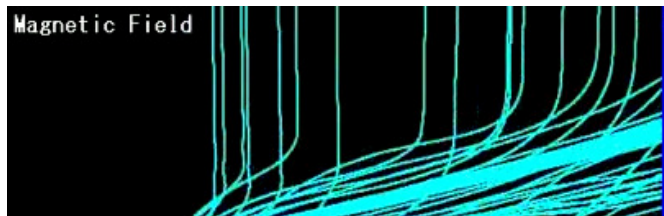
In what industry officials said is an unprecedented event, Intelsat's Galaxy 15 satellite has remained fully "on," with its C-band telecommunications payload still functioning even as it has left its assigned orbital slot of 133 degrees west longitude 36,000 kilometers over the equator.

The first satellite likely to face signal interference problems is the AMC-11 C-band satellite owned by SES of Luxembourg and stationed at 131 degrees west, just two degrees away from Galaxy 15's starting position.

Rob Bednarek, chief executive of the SES World Skies division, which operates AMC-11, said Intelsat and SES have been meeting since April 5 to coordinate how to minimize the Galaxy 15 impact on AMC-11's media customers.

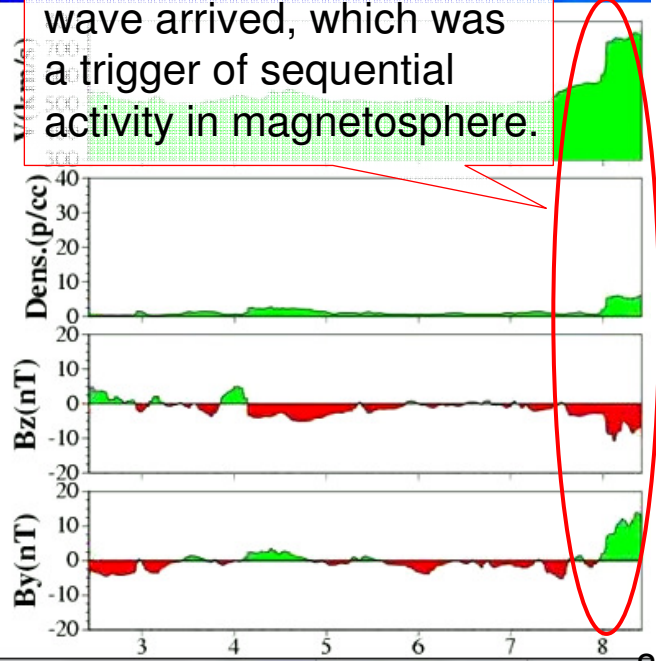
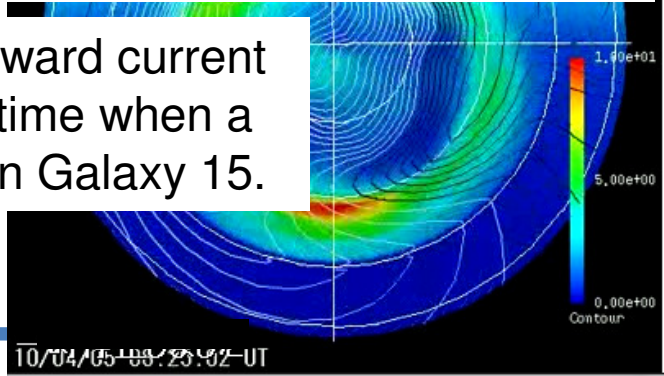


In an April 30 interview, Bednarek said that while it remains unclear



Interplanetary shock wave arrived, which was a trigger of sequential activity in magnetosphere.

The high intensity westward current existed just before the time when a malfunction occurred on Galaxy 15.

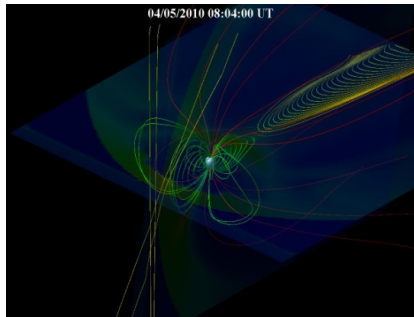


Examples of Recent Big Events of Space Weather

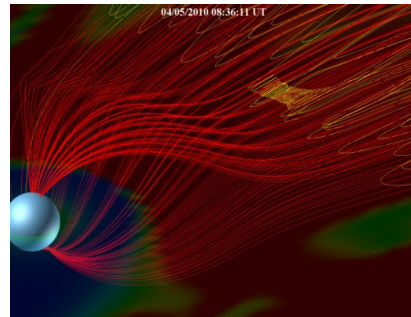
Galaxy 15 malfunction

MHD simulation

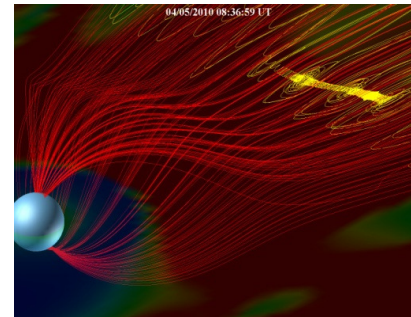
IMF Bz magnitude increase



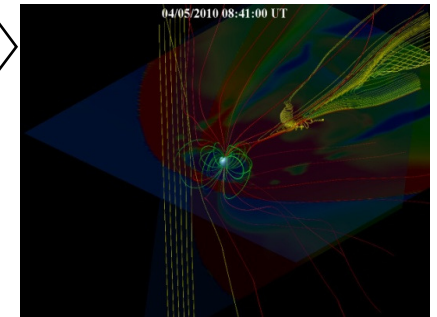
reconnection



Fluxrope generation



Released flux rope



Observation

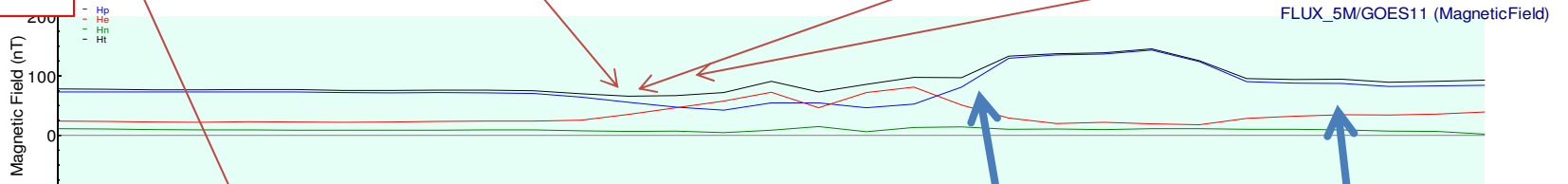
08:04UT

08:36:11 UT

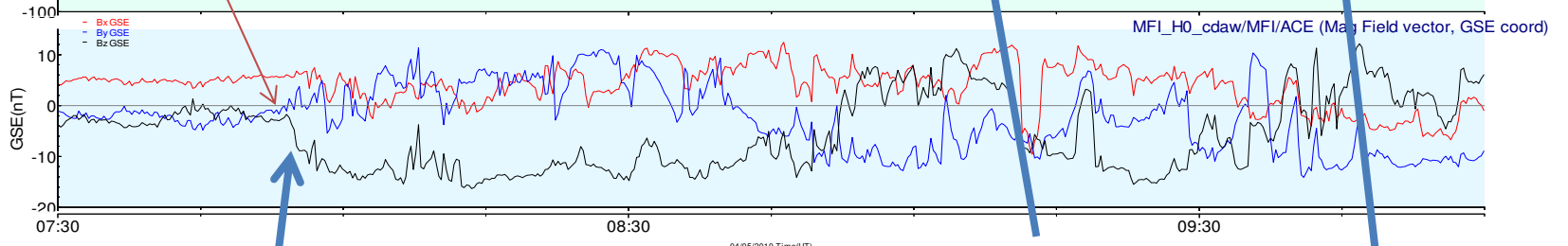
08:36:59 UT

08:41UT

GOES11
Magnetic field
(geosync. orbit)



ACE
Magnetic field
(solar wind)



Bz magnitude increase
(shock) 7:56 UT

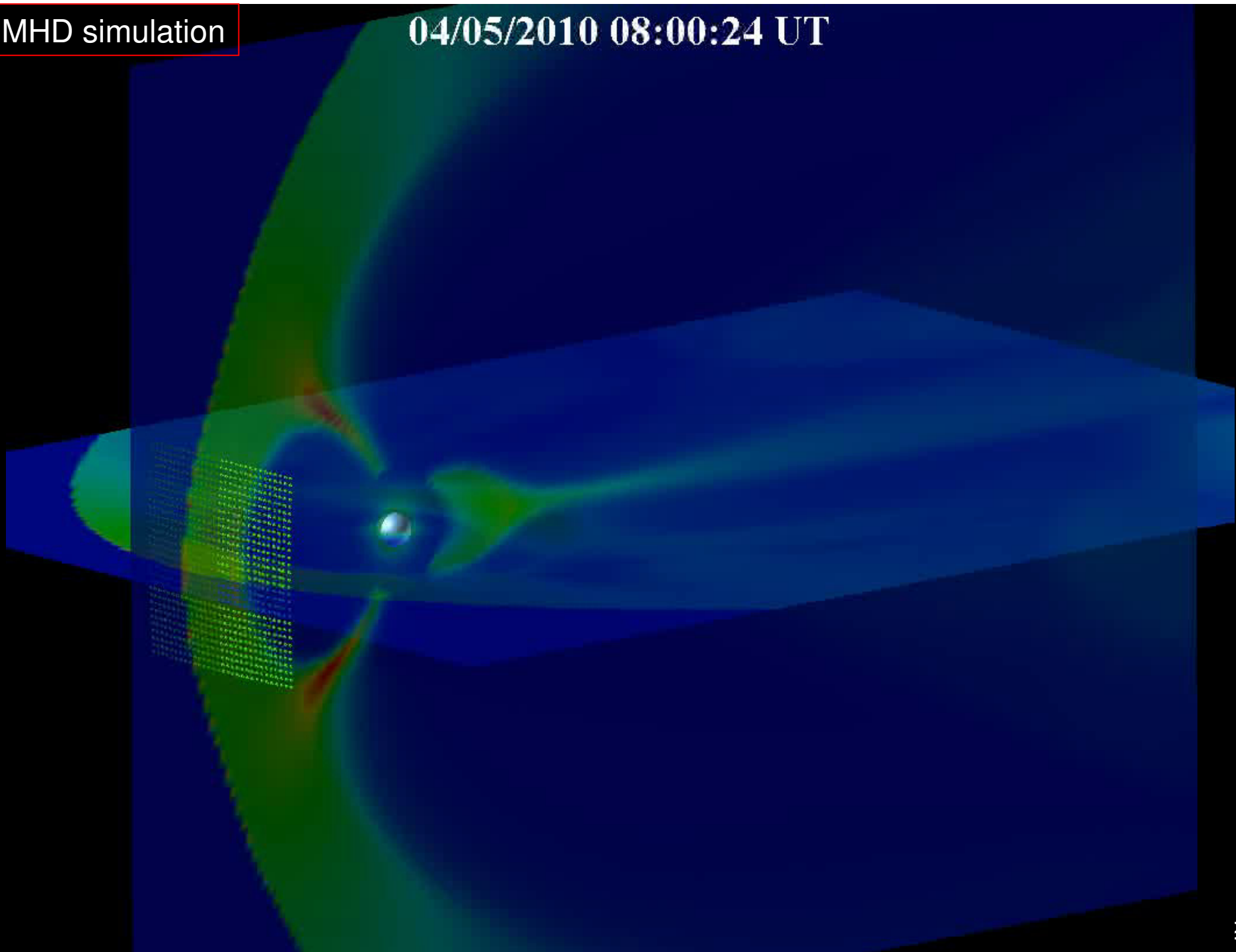
Dipolarization
9:06 UT

Malfunction
9:48 UT



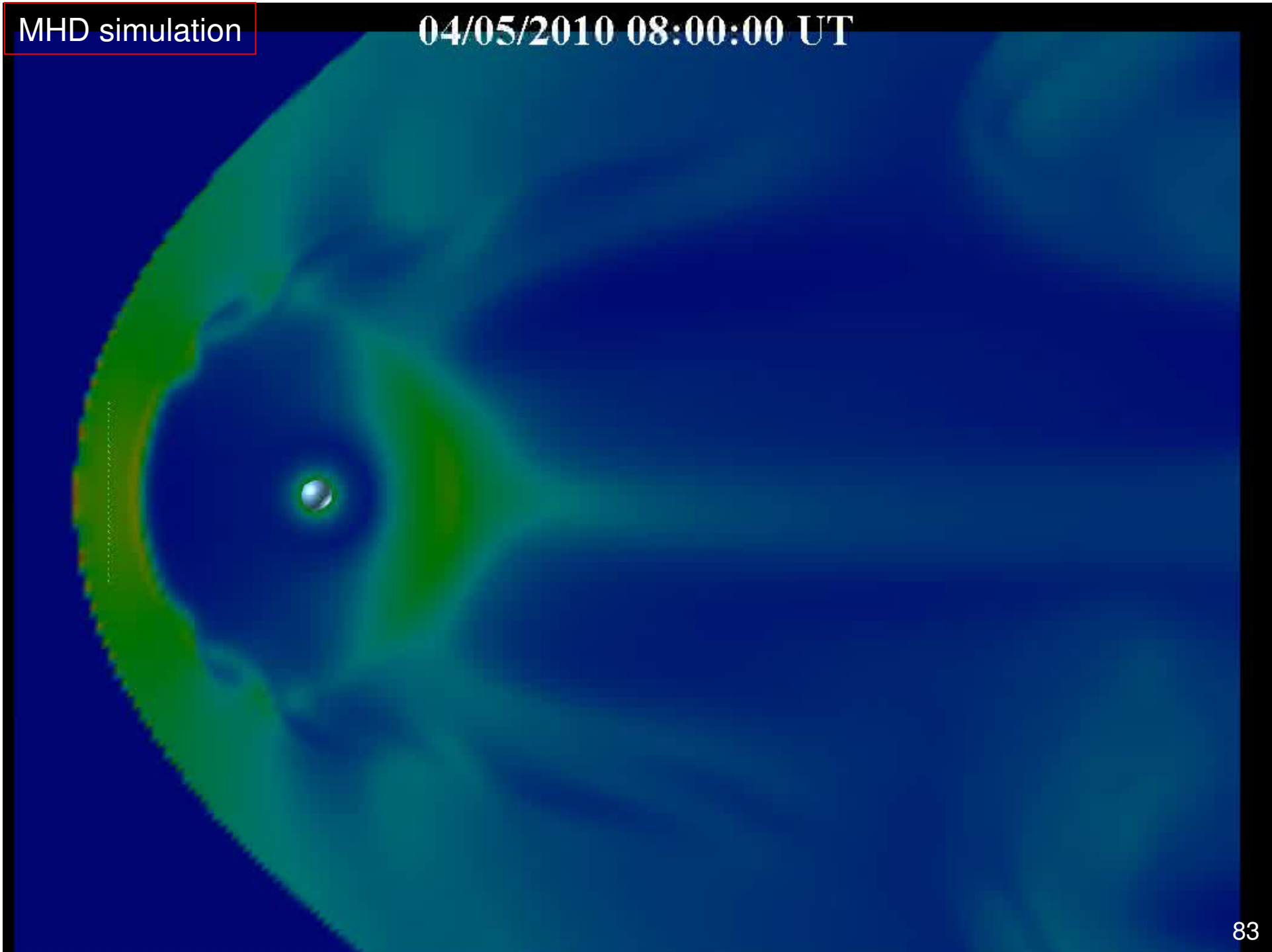
MHD simulation

04/05/2010 08:00:24 UT



MHD simulation

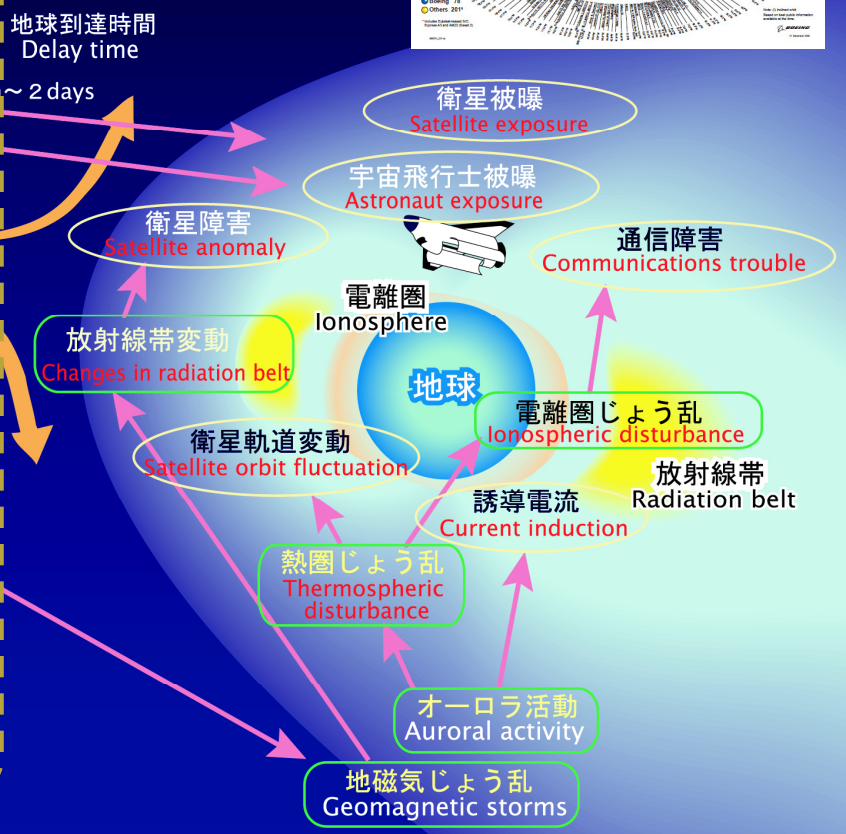
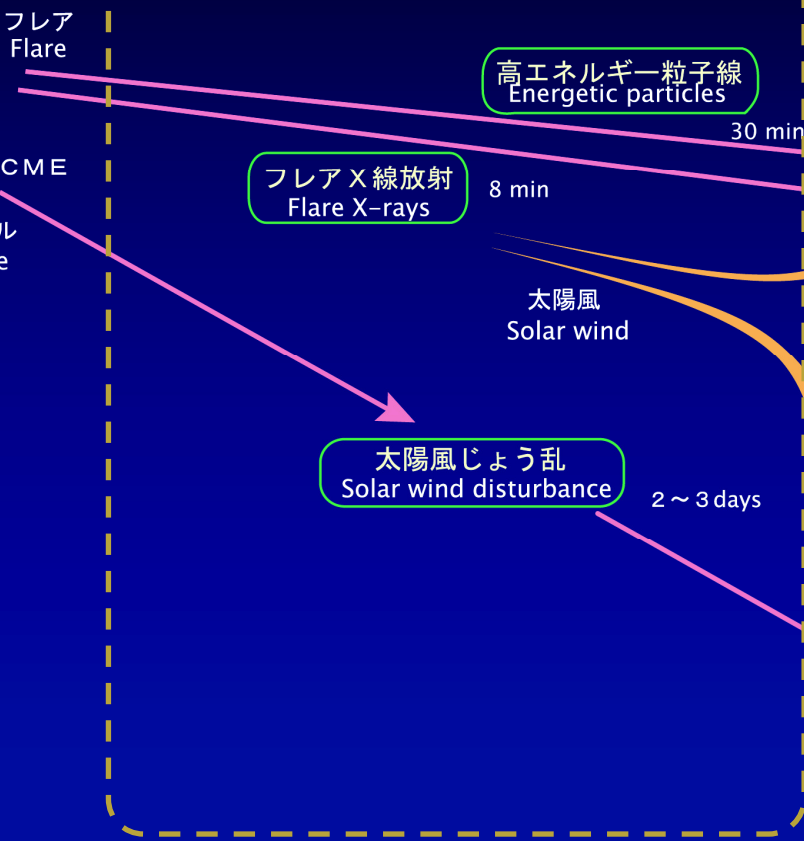
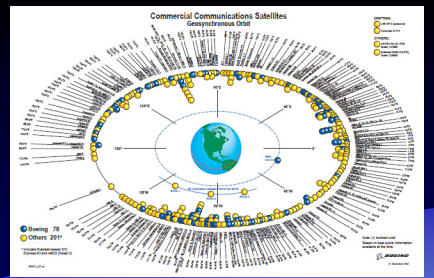
04/05/2010 08:00:00 UT



Examples of Recent Big Events of Space Weather

Numerical Prediction of CME

静止軌道上の衛星 (300以上)



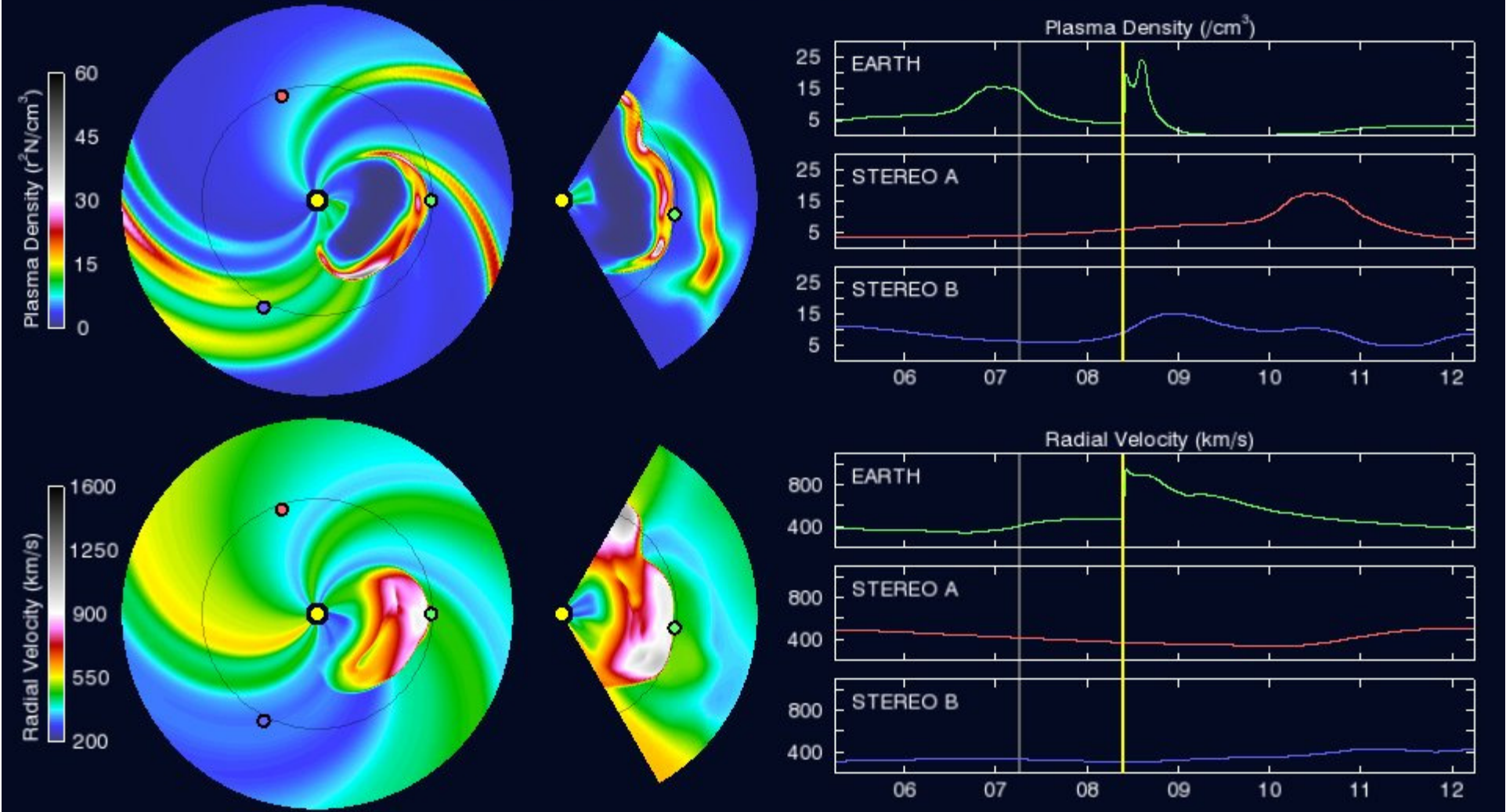
Space weather: cause and effect
宇宙環境擾乱の発生と障害

磁気圏
Magnetosphere

No Data in Interplanetary region

20120307 CME

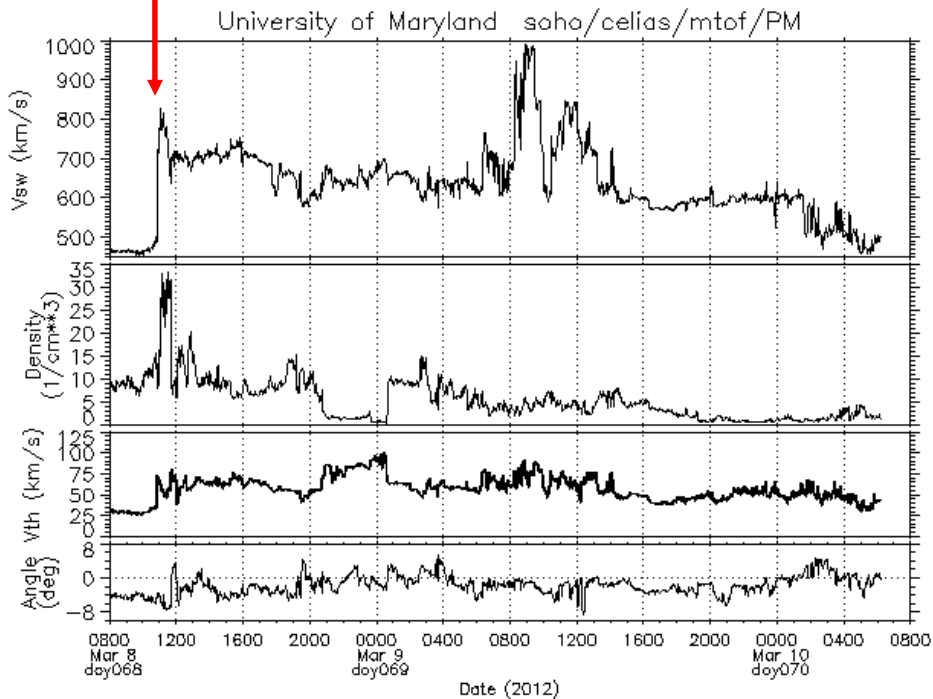
2012-03-08 09:00:00



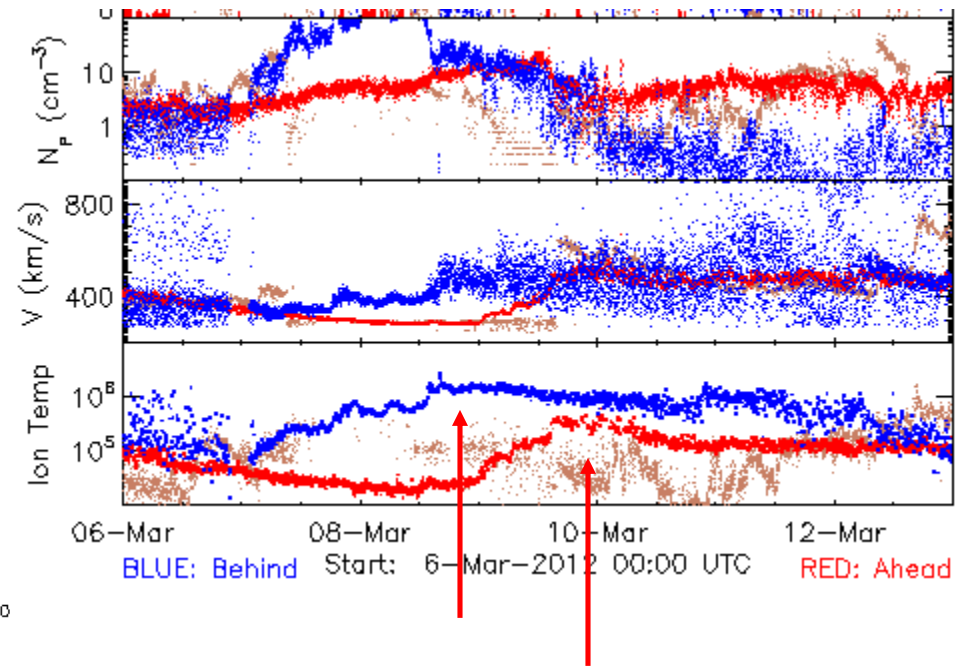
20120307 CME

	予想	概況
地球近傍(L1)	3/8 9時UT頃に衝撃波(~900km/s)到来	3/8 11時UT頃に衝撃波(~800km/s)到来
STEREO B	3/8-9に密度上昇	3/7-9に密度上昇
STEREO A	3/10に密度上昇	3/9-10に密度上昇

太陽風速度・密度@L1



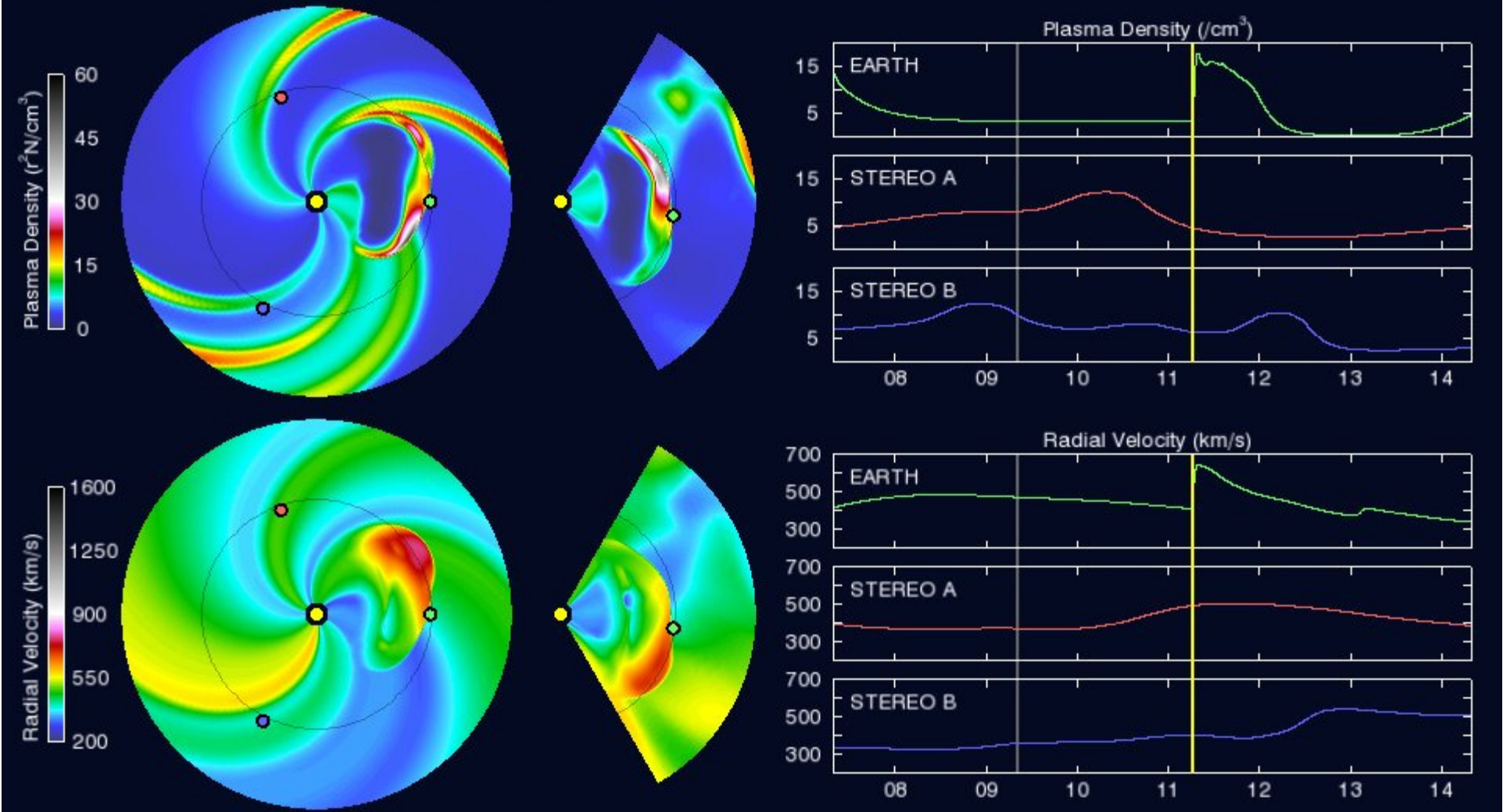
太陽風速度・密度@STEREO



(ACEは強いプロトン現象のため観測なし)

20120309 CME

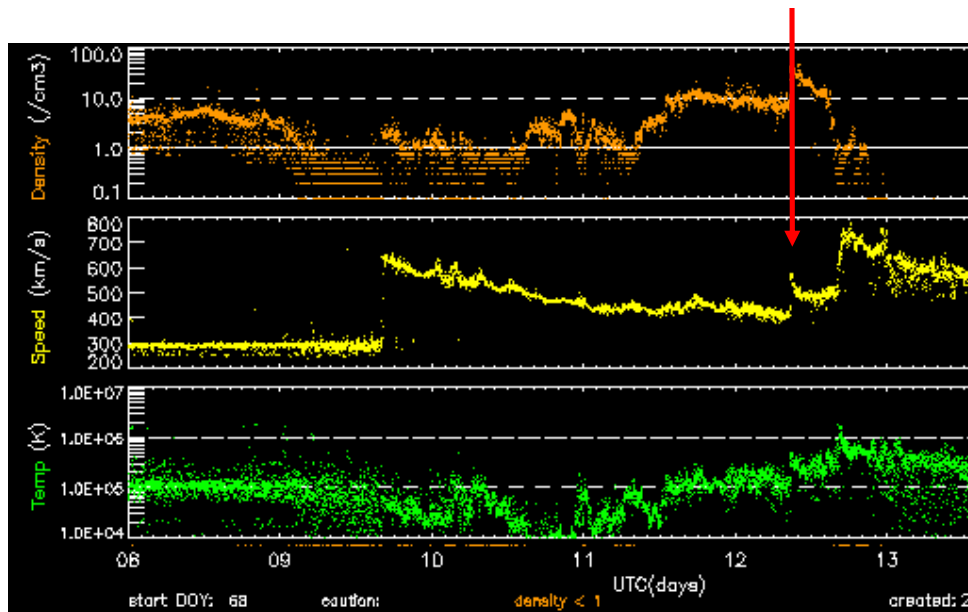
2012-03-11 06:00:00



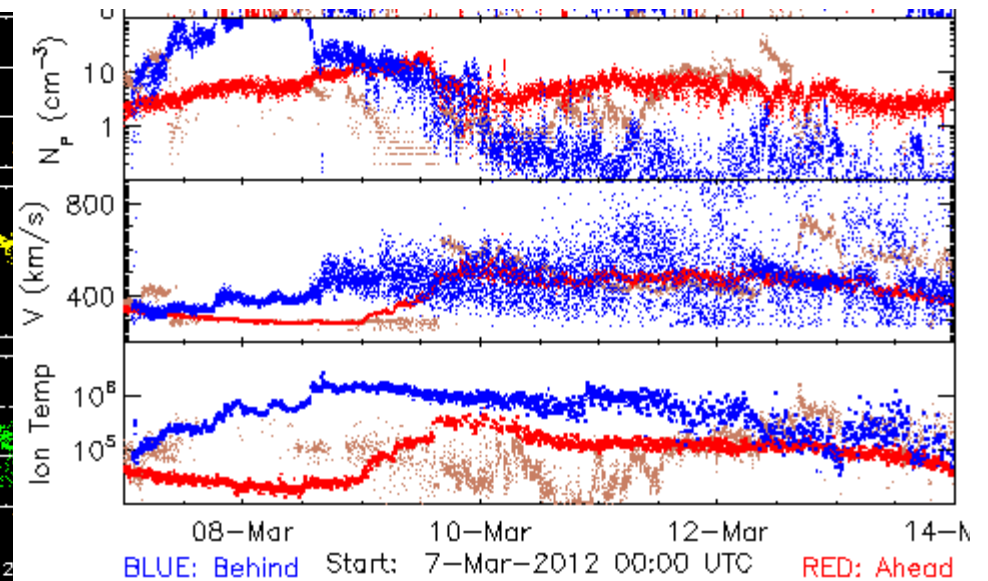
20120309 CME

	予想	概況
地球近傍(L1)	3/11 6時UT頃に衝撃波(～600km/s)到来	3/12 8時UT頃に衝撃波(～600km/s)到来
STEREO B	3/12-13に速度上昇	速度上昇せず
STEREO A	3/10-11に速度上昇	前CMEの影響と区別できず

太陽風速度・密度@L1

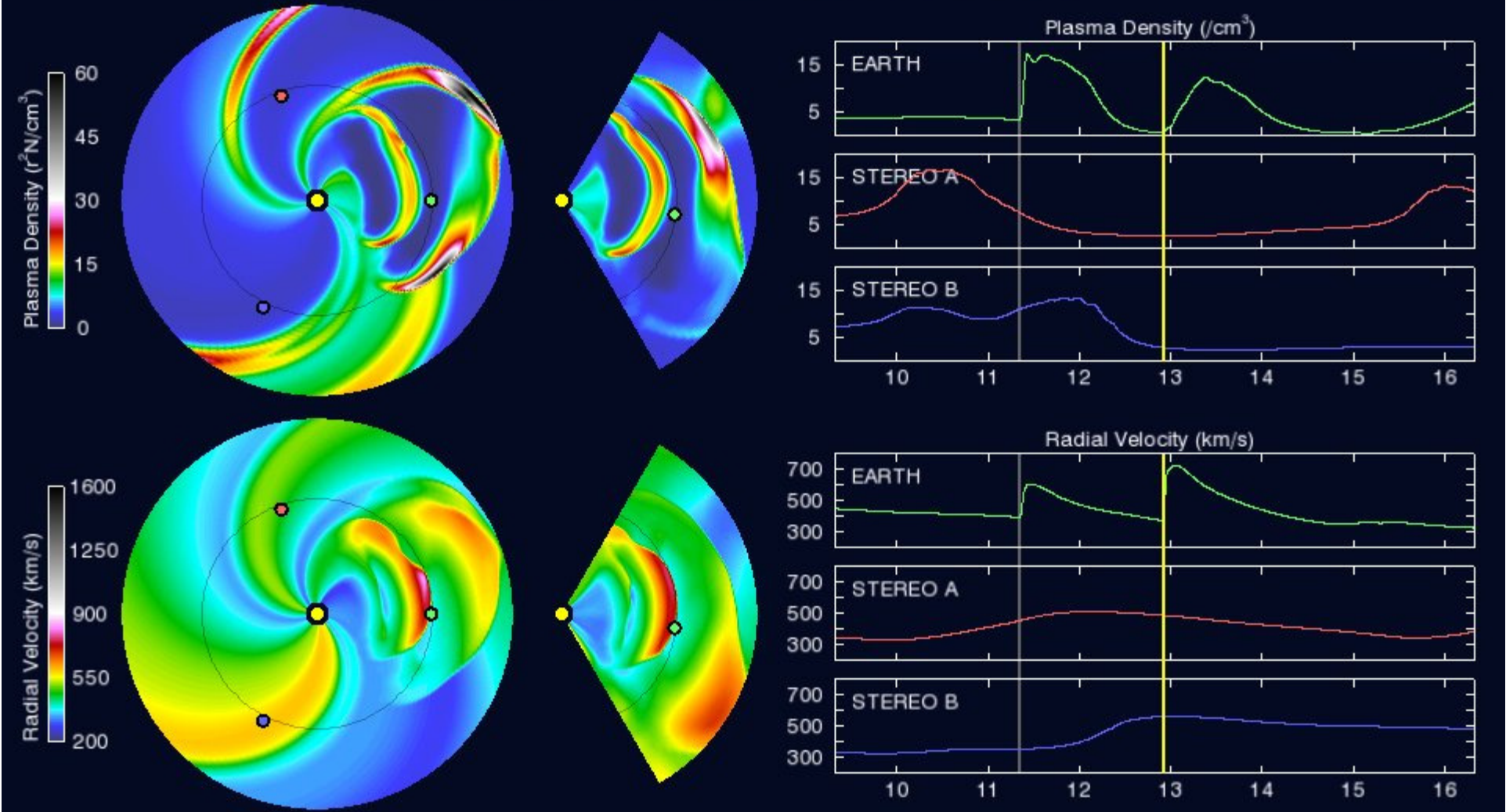


太陽風速度・密度@STEREO



20120310 CME

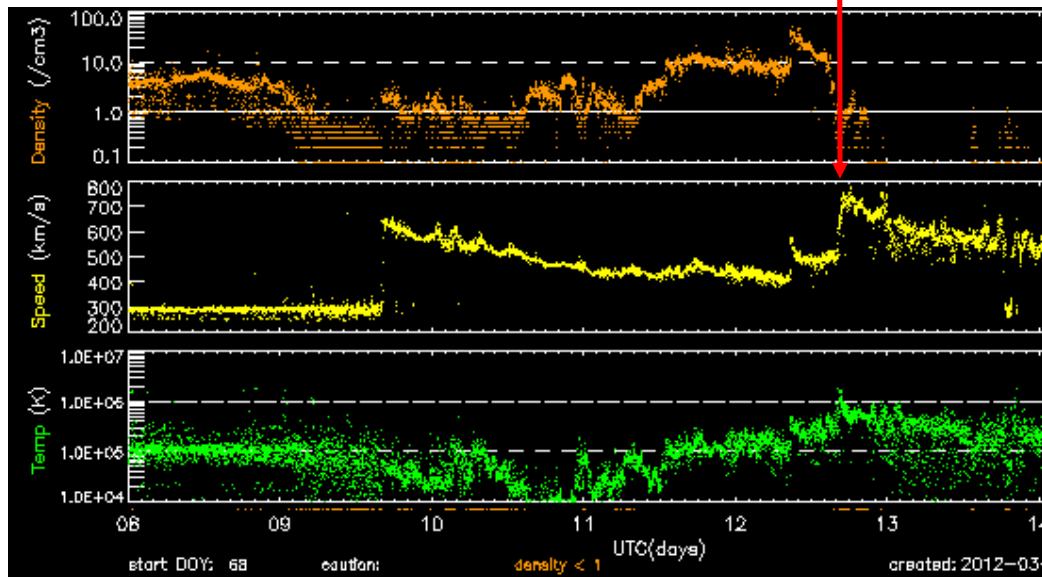
2012-03-12 22:00:00



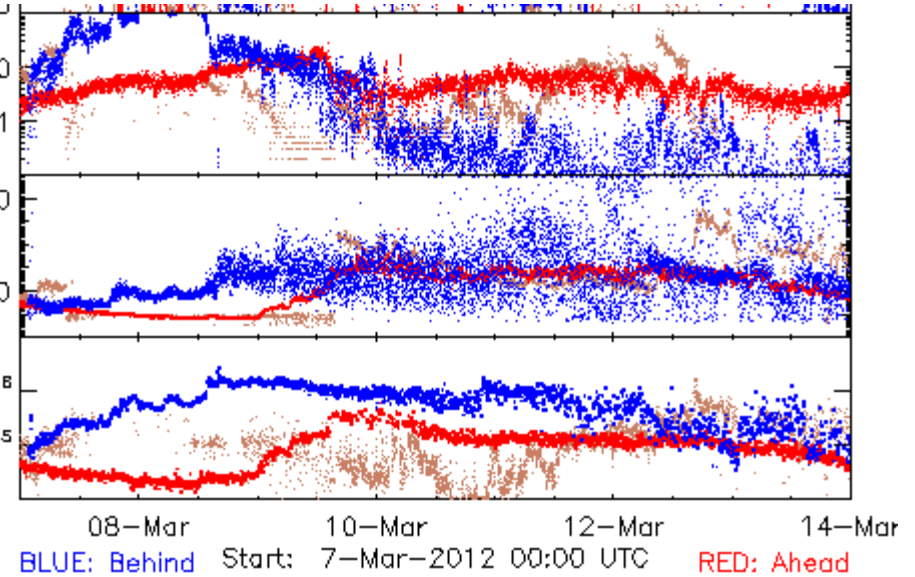
20120310 CME

	予想	概況
地球近傍(L1)	3/12 22時UT頃に衝撃波(～700km/s)到来	3/12 18時UT頃に衝撃波(～700km/s)到来
STEREO B	-	-
STEREO A	-	-

太陽風速度・密度@L1

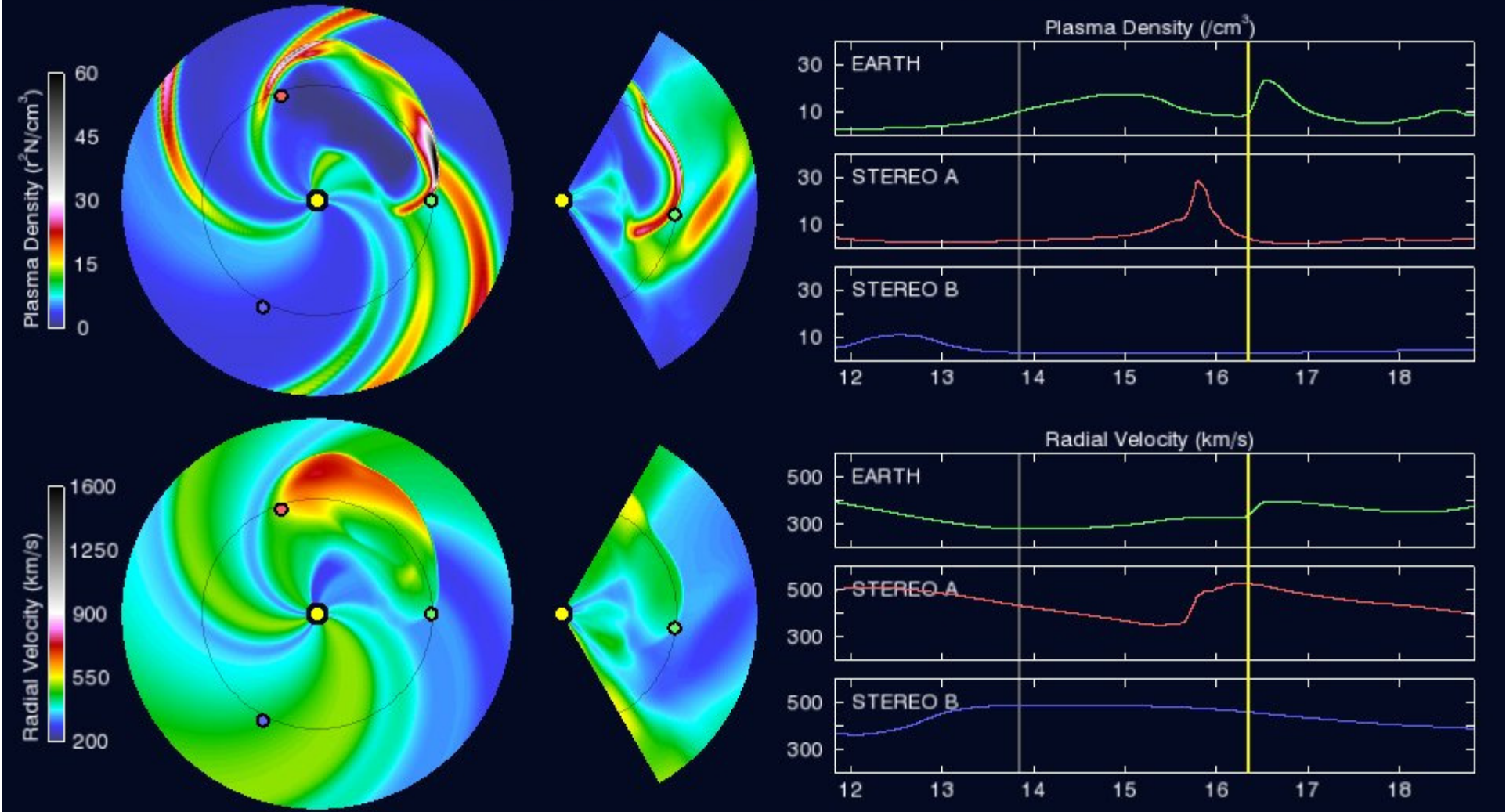


太陽風速度・密度@STEREO



20120313 CME

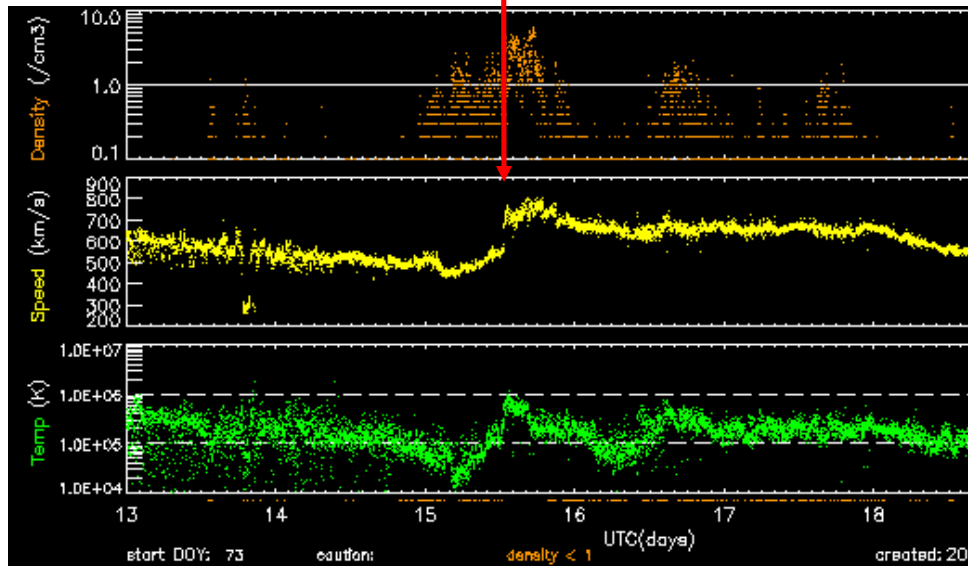
2012-03-16 08:00:00



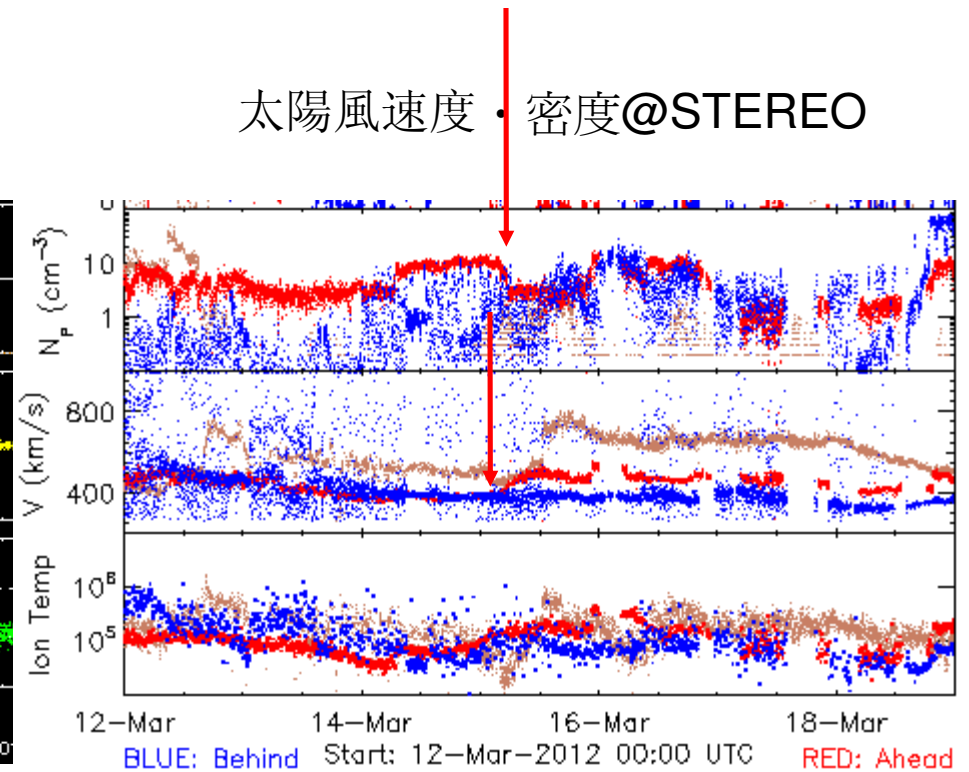
20120313 CME

	予想	概況
地球近傍(L1)	3/16 8時UT頃に速度/密度が上昇	3/15 12時UT頃に速度/密度が上昇
STEREO B	-	-
STEREO A	3/15 16時UT頃に速度/密度が上昇	3/15 6-8時UT頃に速度上昇/密度下降

太陽風速度・密度@L1

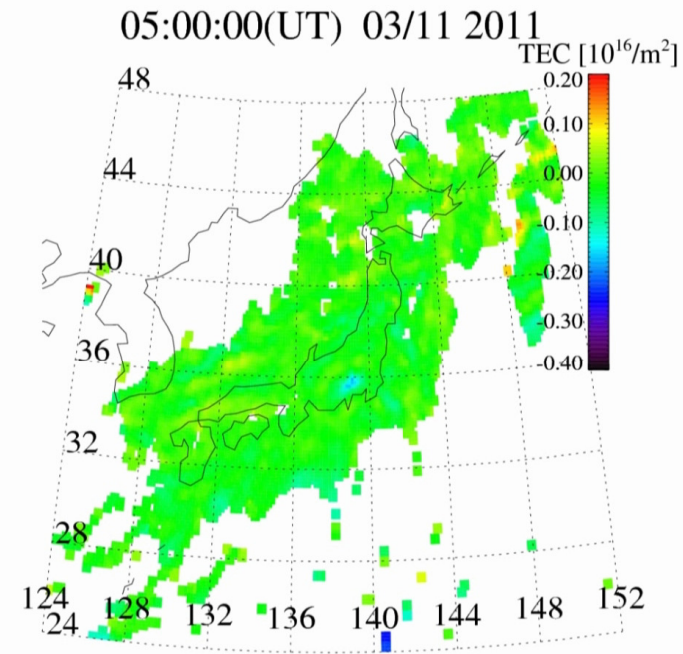
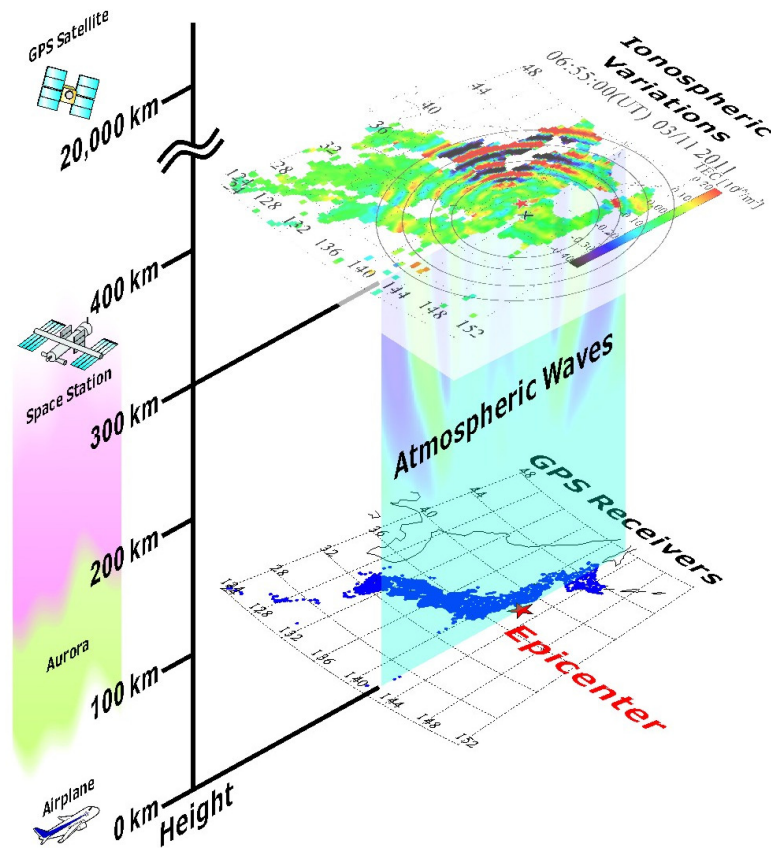


太陽風速度・密度@STEREO



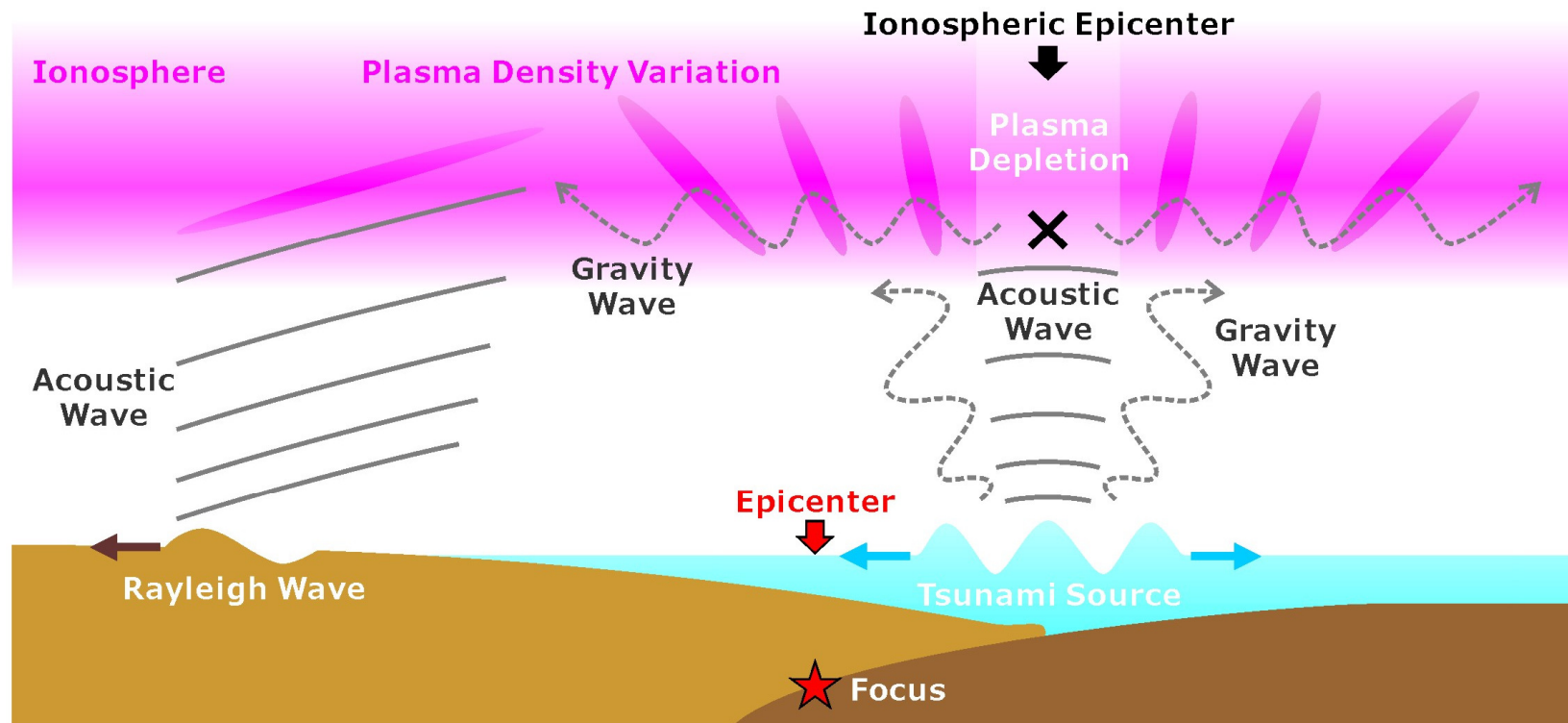
Examples of Recent Big Events of Space Weather
**Impact on ionosphere caused
by big earthquake**

Concentric waves appear at 300 km altitude after the 2011 Tohoku earthquake



- Ionospheric variations around 300 km altitude are observed using two-frequency GPS signals transmitted from satellites at about 20,000 km altitude and recorded by ground GPS receivers (GEONET, consisting of more than 1,200 stations).
- It is considered that the atmospheric waves were excited at sea surface in the vicinity of epicenter, propagated up to 300 km altitude, and generated the concentric structures in the ionosphere.

Generation mechanism of atmospheric waves and ionospheric variations after the earthquake

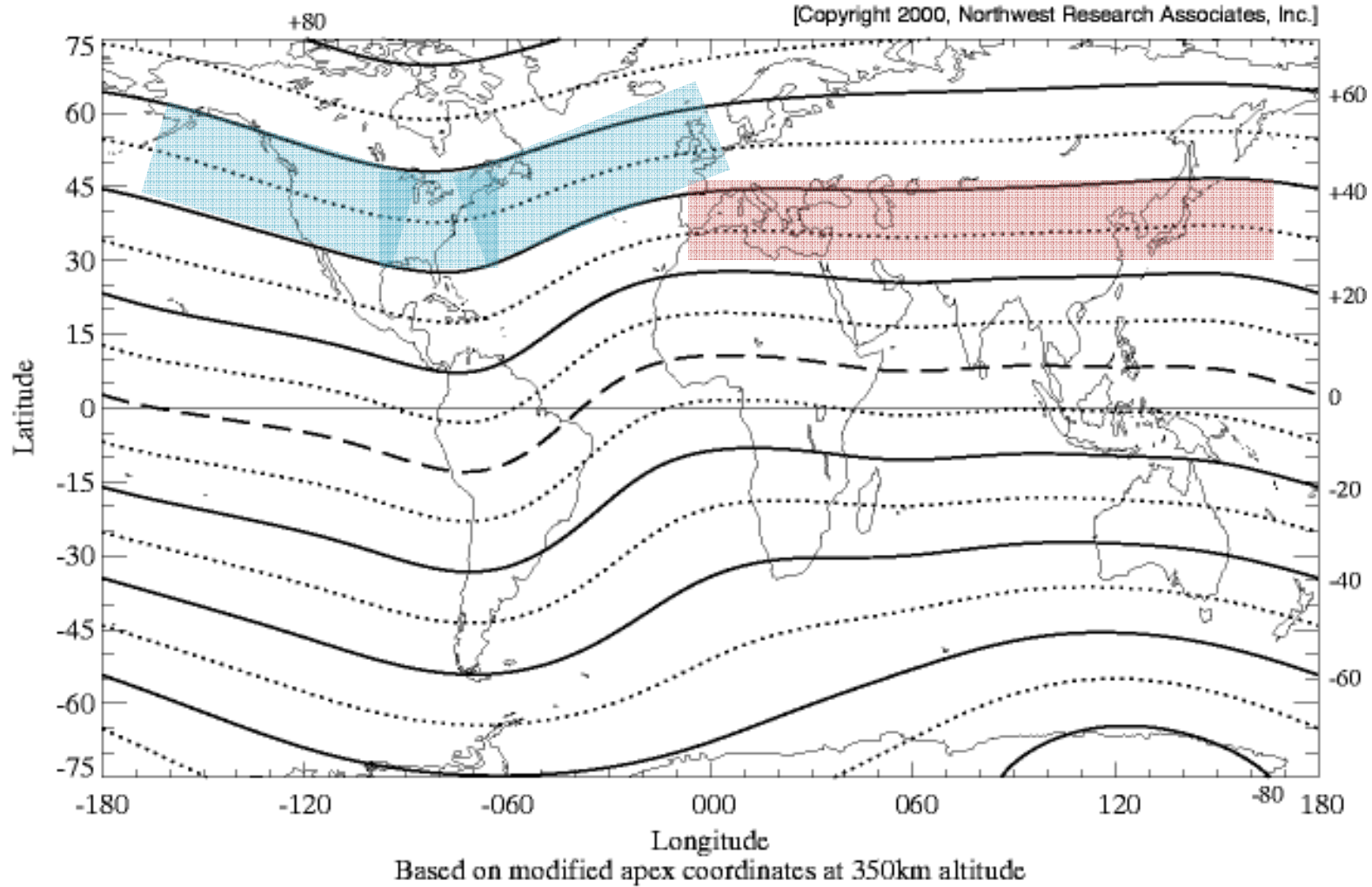


- It is considered that the first ionospheric concentric wave with the propagation velocity of about 3.5 km/s was caused by the acoustic wave generated from the propagating Rayleigh wave.
- The second and following concentric waves would correspond to the atmospheric gravity waves (AGW) propagating in the ionosphere. The AGWs could be generated mainly at the lower ionosphere by the acoustic wave launched at the sea surface around the tsunami source.

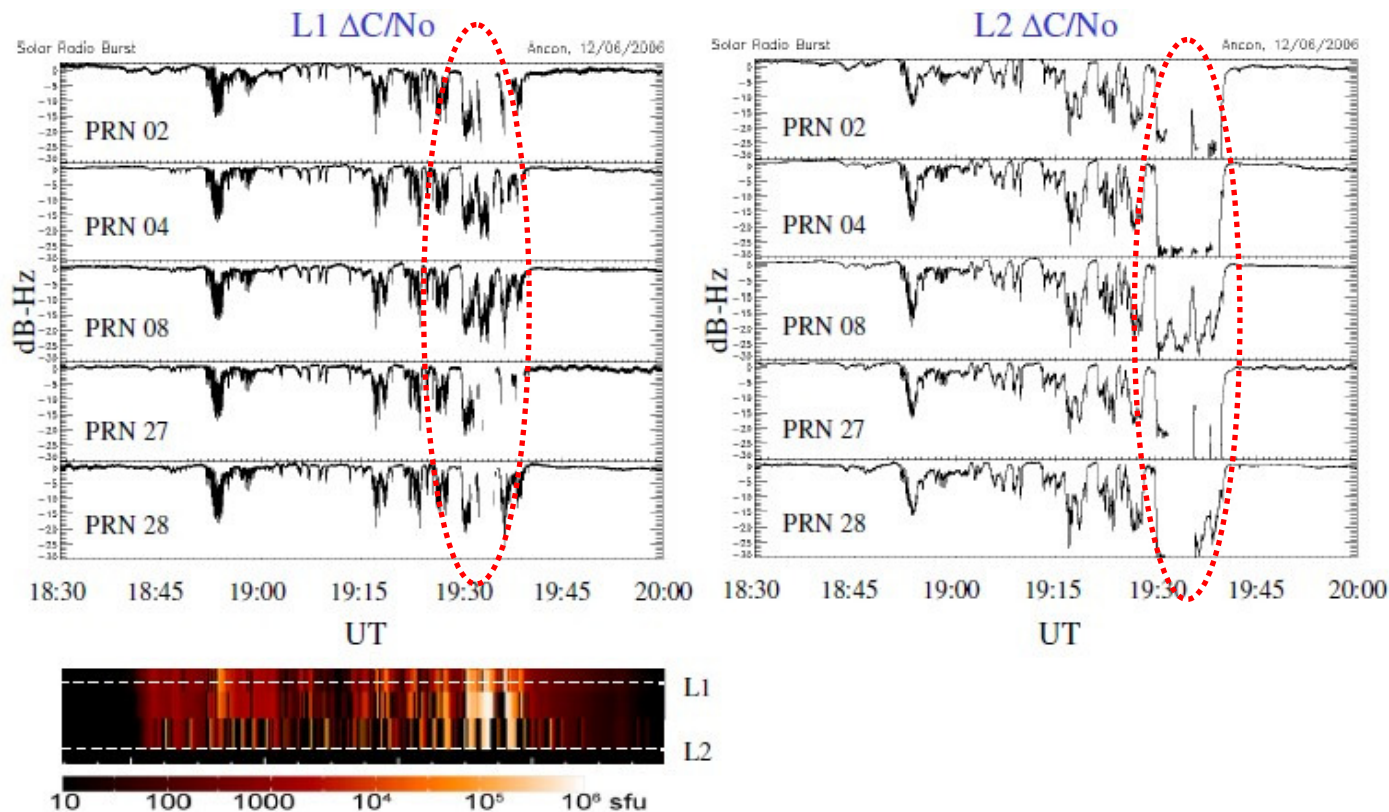
Examples of Recent Big Events of Space Weather
miscellaneous

Geographic Latitude/Geomagnetic Latitude

Geomagnetic (350km Apex) Latitudes



Loss of lock on GPS signals due to solar radio burst



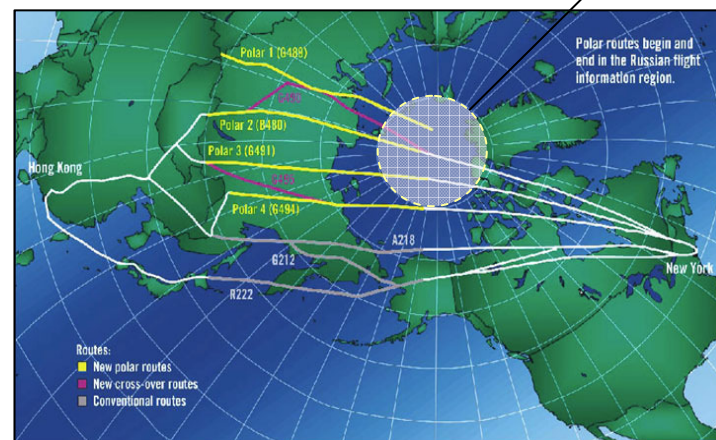
- 太陽フレアに伴う強力な電波バーストによって、GPS受信機に太陽電波が混信し、GPS衛星からの信号が受信できなくなった（2006年12月6日）。但し、このような現象は極めて稀である。

航空 - 極廻り航路への影響

通信

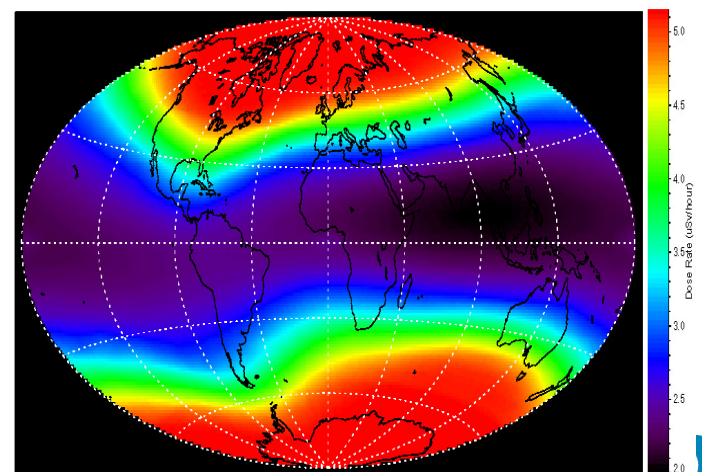
- 極付近では、衛星通信やVHF通信は使用できない。
- 緯度82度以上の円内では、3~30MHzのHF通信が極廻り航路における唯一の通信手段。
- プロトン現象は、数日間に亘るHF通信途絶を引き起こす(極冠電波吸収)。

短波通信のみが可能な領域

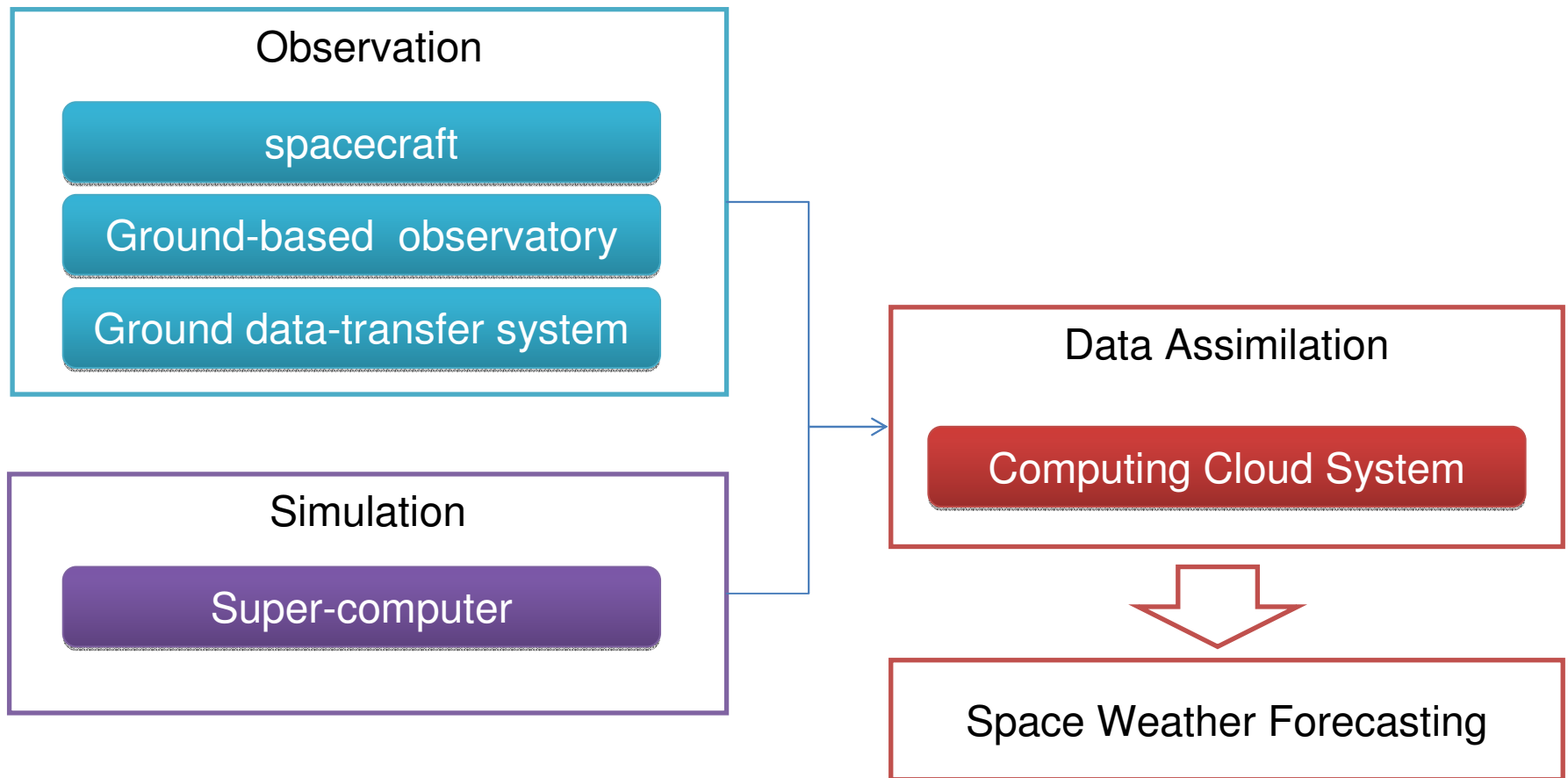


放射線被曝

- 被曝レベルはとても低い。2つの要因がある。
 - 銀河宇宙線 (常に存在し、避けられない。)
 - プロトン現象 (ごく稀に極めて被曝レベルが増加することがある。)
- 航空会社は放射線量の増加による極廻り航路の利用制限を導入。



Summary



“Science Cloud”: A facility for the 4th methodology

