Japanese Operational Space Weather Activities
- Current and Future -

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Space Environment Group

National Institute of Information and Communications Technology

About NICT

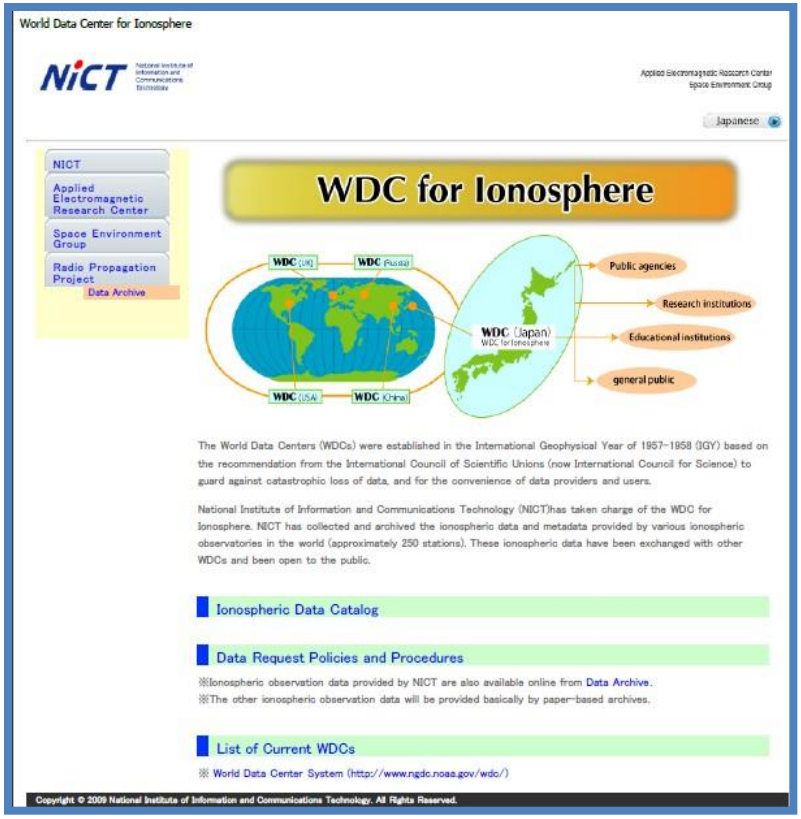
- Location：Koganei, Tokyo + several branches in Japan
- Number of staff: ~800 including 300 of permanent researchers and 300 of Post Doc. (~20 staffs in space environment group)
- The Only national institute in Japan for Information Technology (basically research organization)
- The originality of our institute was in ionospheric observations for monitoring short wave propagations
- Our study fields expand not only narrow meaning of IT, but also wide areas.

ISES / Regional Warning Center Tokyo, Japan

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

WDC for Ionosphere

- Established on IGY year 1957
- Archiving mainly ionospheric vertical soundings of four Japanese and 141 worldwide stations.
- Items of ionospheric data
  - Ionospheric vertical soundings
  - Todside soudings
  - Oblique Incidence Soundings
  - Absorption
  - Ionospheric drifts and backscatter
  - Whistlers and VLF
  - Atmospheric Radio Noise



Space Weather Cloud

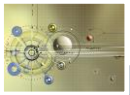
技術開発 → 技術活用

Space Weather Observation

・宇宙天気観測

Space Weather Simulation

・宇宙天気数値計算



Space Weather Informatics

・宇宙天気情報処理

Space Weather Data Analysis

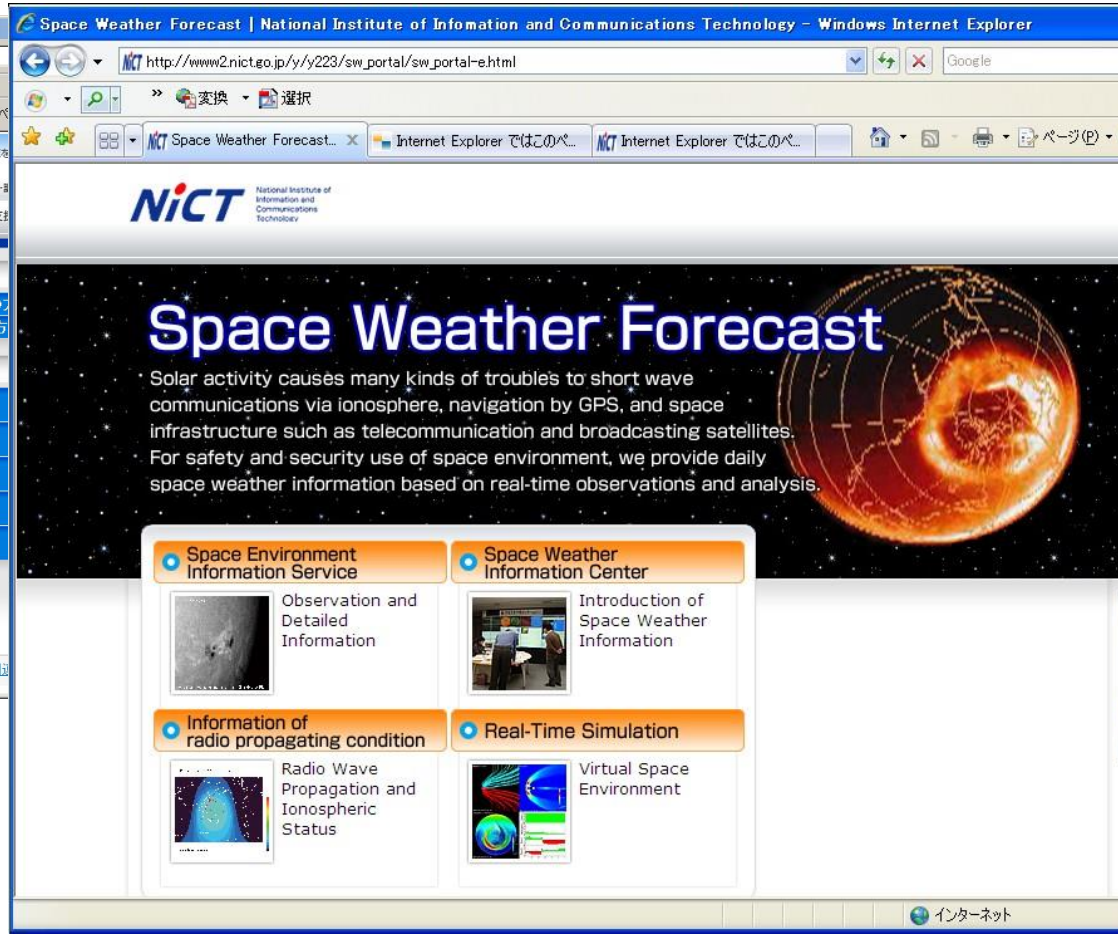
・宇宙天気理解

Decision Making Support

Space Weather Forecasting
宇宙天気予報

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

http://www.nict.go.jp



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

New product for publicity and education
- Weekly Space Weather News (trial version)-

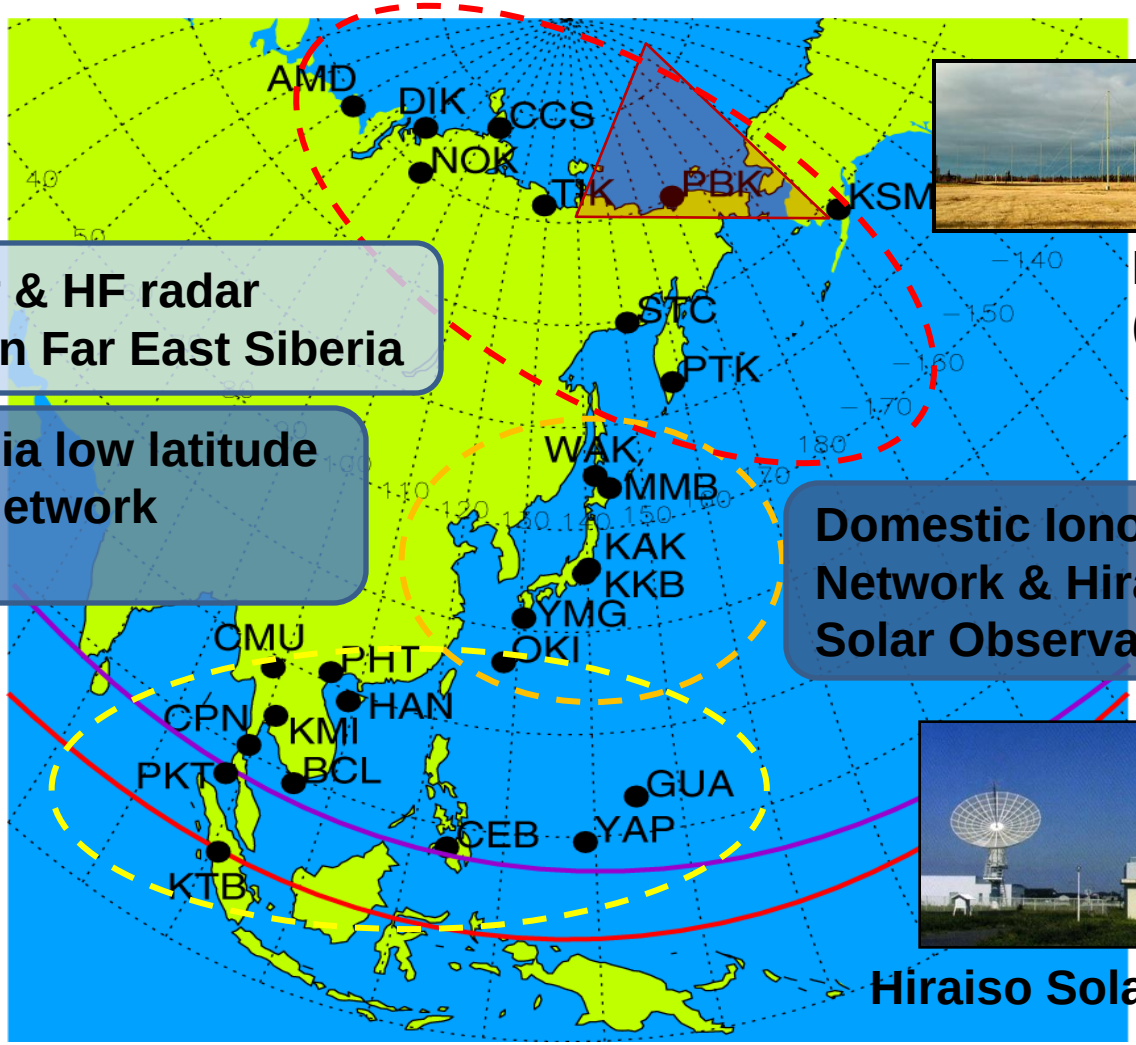
NICT Space Weather Monitoring Networks (NICT-SWM)

Magnetometer

Magnetometer & HF radar observations in Far East Siberia

South-East Asia low latitude IOnospheric Network (SEALION)

Ionosonde



HF radar (SuperDARN)

Domestic Ionosonde Network & Hiraiso Solar Observatory

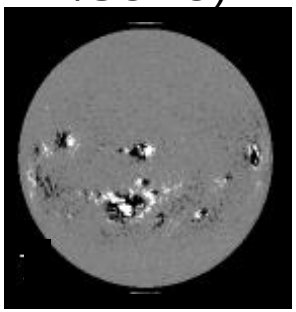
Hiraiso Solar Observatory

(Under National / International collaborations)

NICT Real-Time Space Weather Simulator

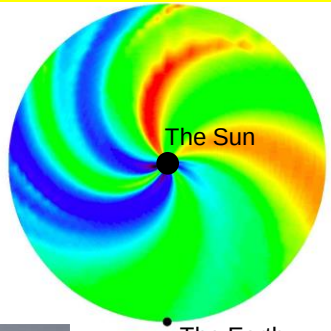
ACE Satellite
(Solar Wind Data)

Magnetic Field data
(MDI/SOHO)

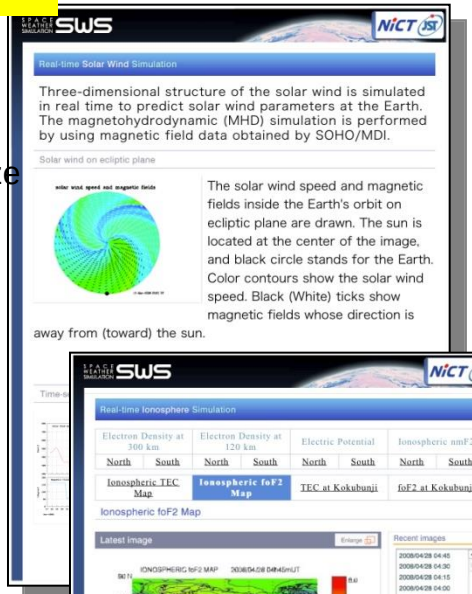


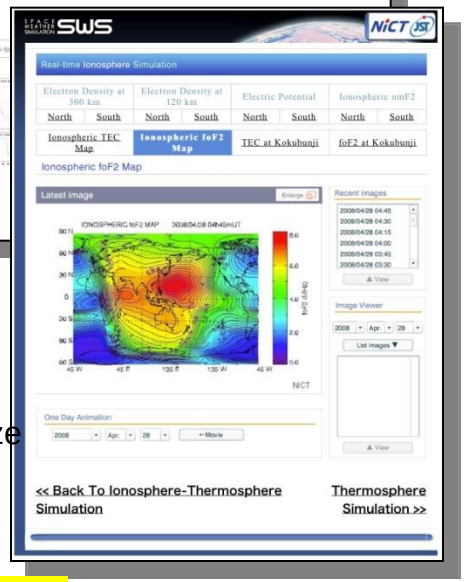
Input

The Sun and Solar Wind Model



Visualize

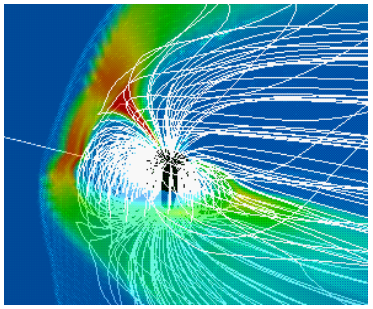




Super Computer

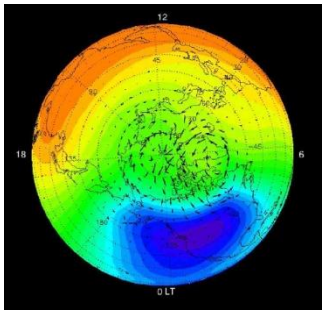
Antenna

Input



Magnetosphere Model

Input



Ionosphere and Thermosphere Model

Visualize

Web Page

Space Weather User's Forum (2009/12/21)

Topics:

- Tutorials from Space Environment Group
- Geomagnetic survey on the sea ground (JAMSTEC)
- SAR interferences due to plasma bubble (JAXA)
- Satellite charging (JAXA)
- Airplane navigation (MSAS:ENRI)
- Astronauts radiation effect (NIRS)
- Usage of space weather forecast by radio amateur (JARL)
- Solar power satellite and ionosphere (RISH)

Participants: more than 70

User / Customer's needs

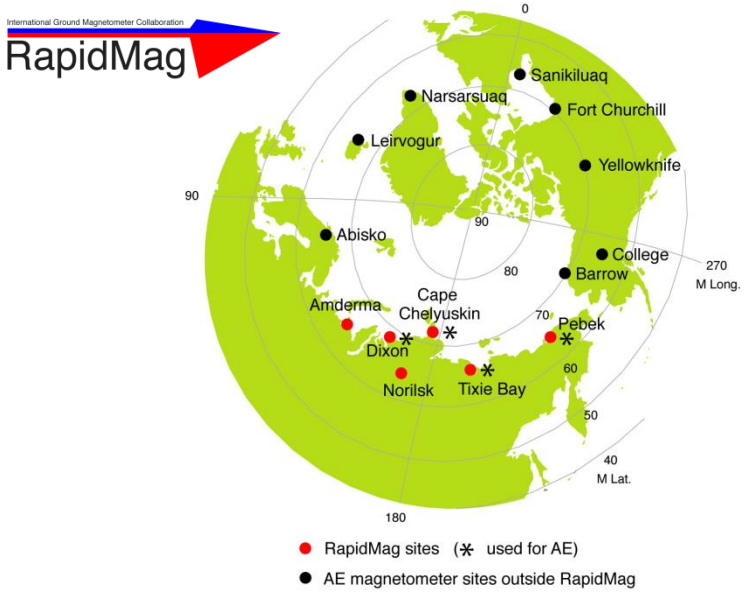
Major request

- Nowcast / Forecast of solar/geomagnetic activity.
- Nowcast / Forecast of space environment around GEO and LEO.
- Nowcast / Forecast of inosospheric scintillation and TEC map over Japan.

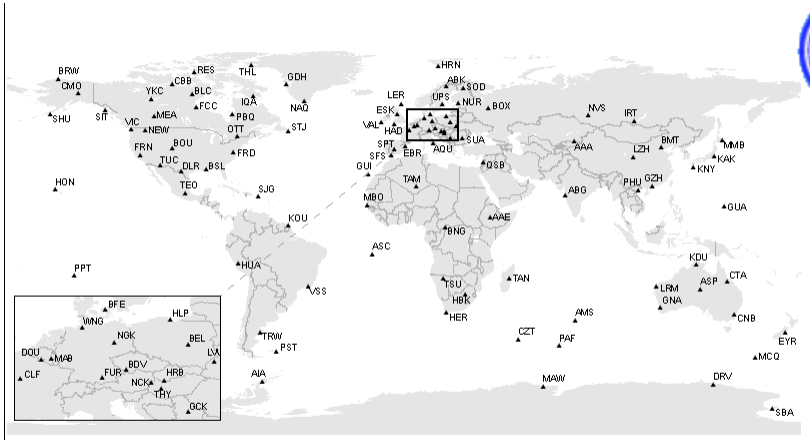
- Collecting practical needs of users / customers with educating space weather effect.
- Now we are building a close relationship with JAXA, and JMA, etc.

Questions?

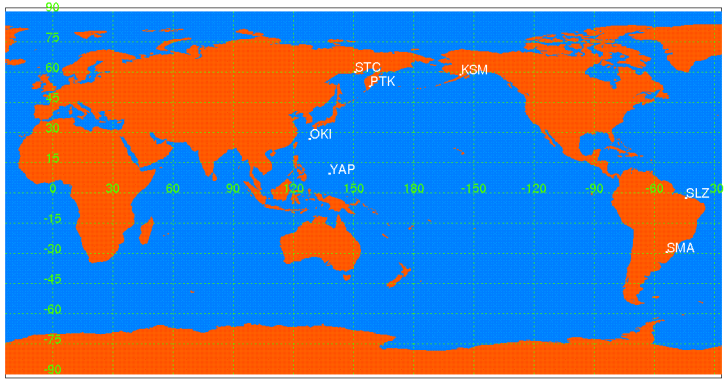
Magnetometer & HF radar observations



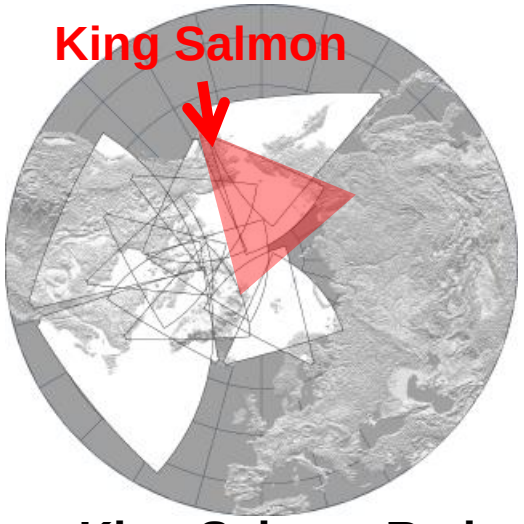
RapidMAG



INTERMAGNET



NICT_MAG

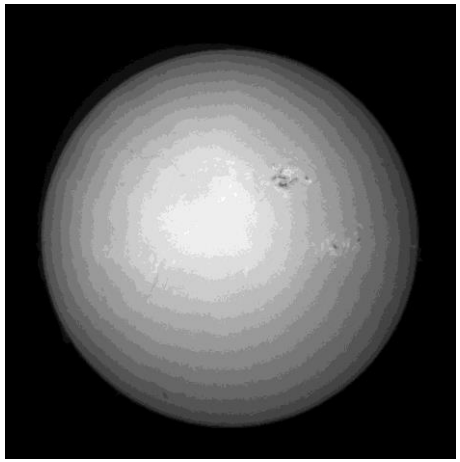


King Salmon Radar
（SuperDARN）

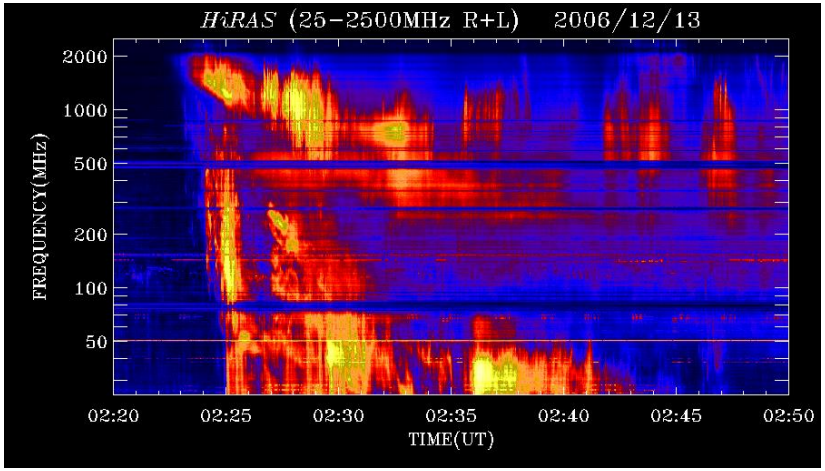
Solar Radio / Optical Monitoring (Hiraiso)

Hα observation

Solar radio observation: HIRAS



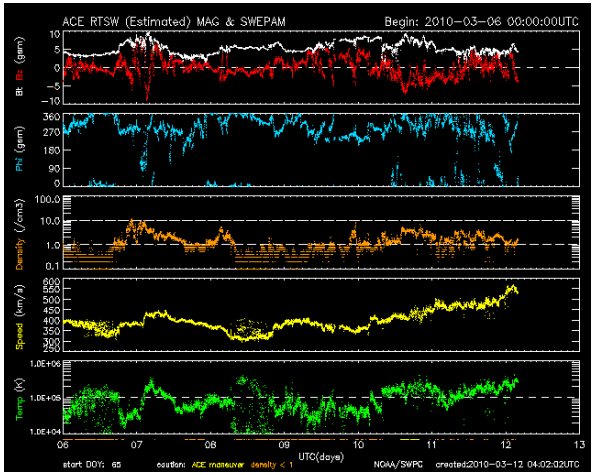
Log-Peri. Antenna:
25-50MHz
10-meter Antenna:
50-500MHz
6-meter Antenna:
500-2500MHz
2-meter Antenna:
2800MHz



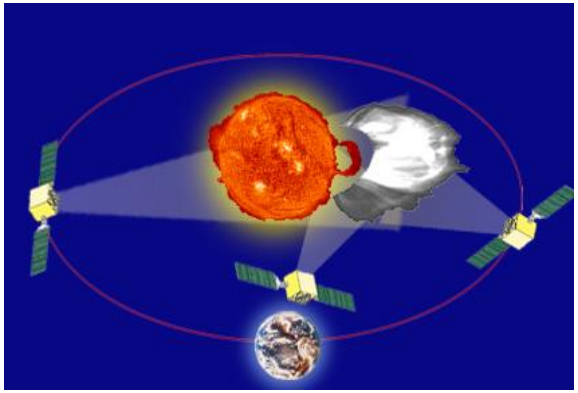
Real-time beacon receiving (Solar and solar wind monitoring)

ACE

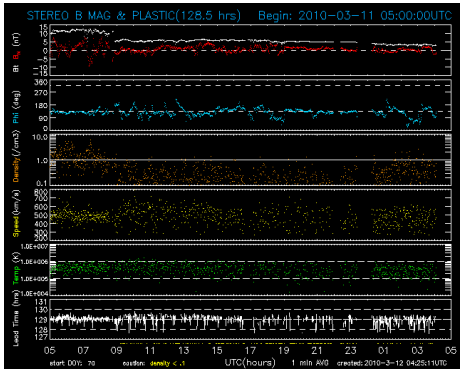
11-meter Antenna:
S-band



STEREO

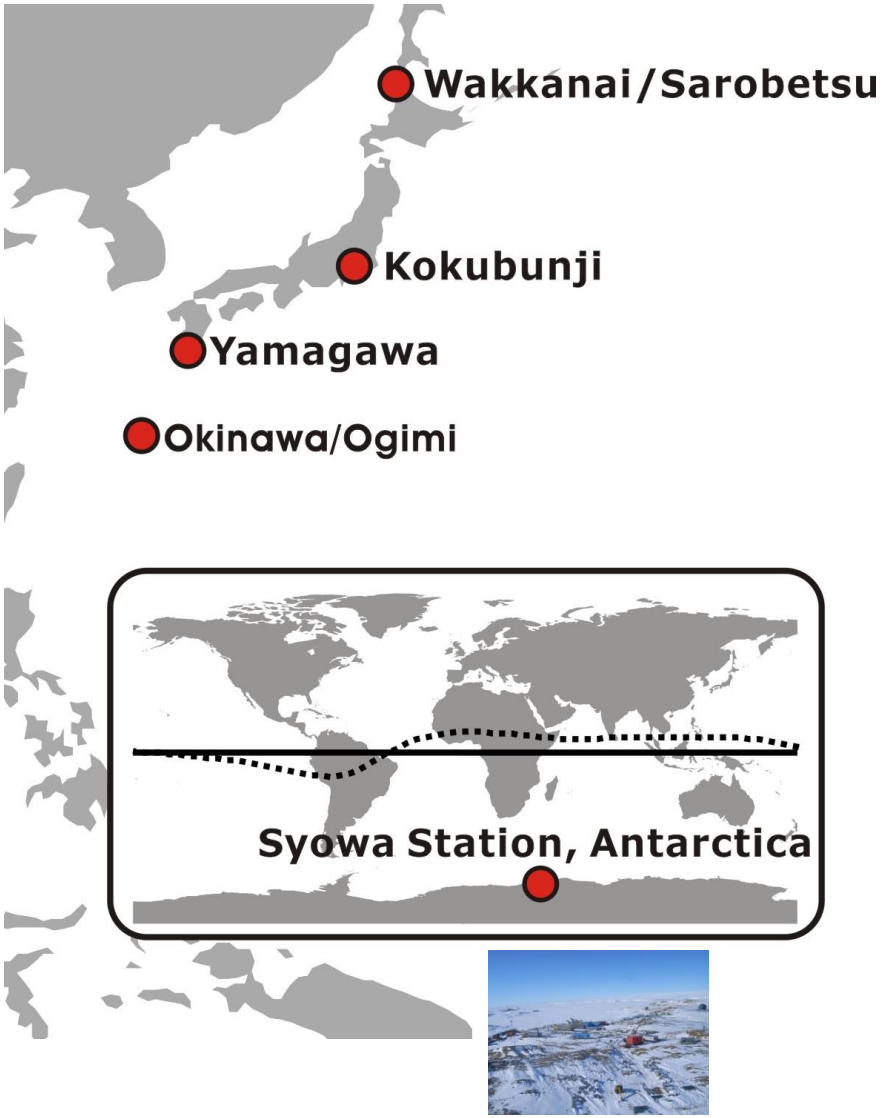


11-meter Antenna:
X-band



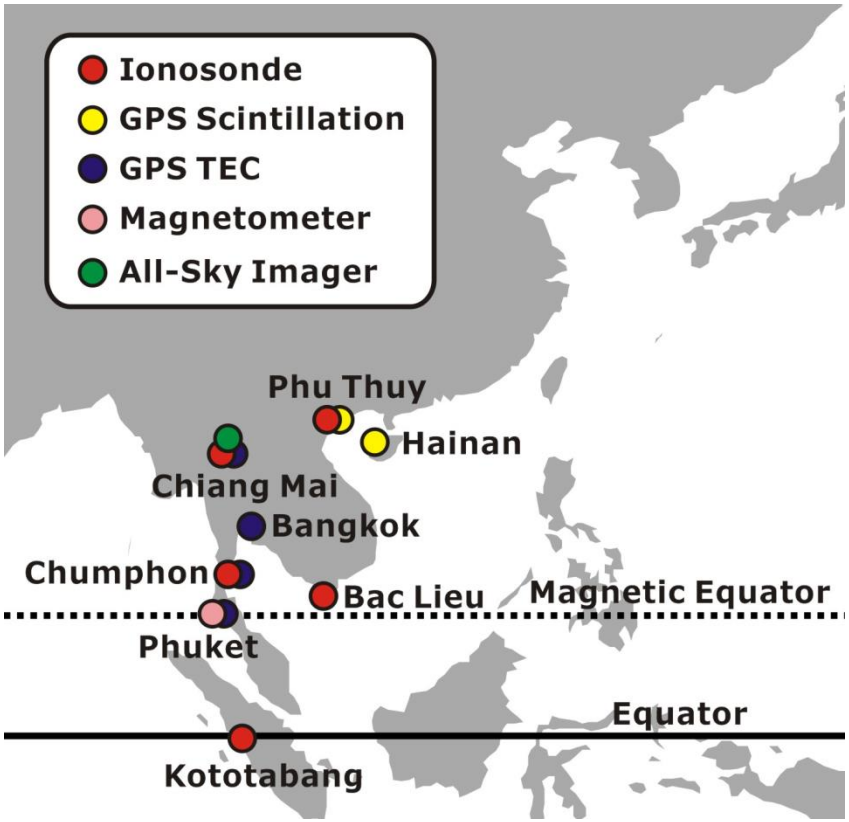
a future possibility of beacon receiving : RBSP?

Domestic Ionospheric Networks



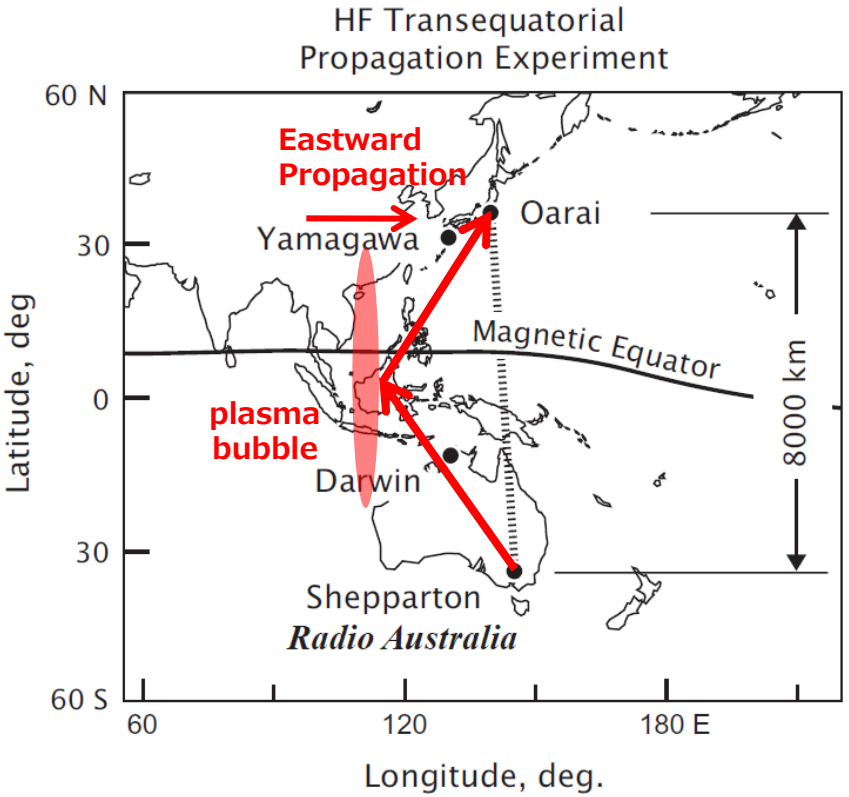
- Near real-time observations at four ionosondes in Japan (Wakkanai, Kokubunji, Yamagawa, Okinawa) and one ionosonde in Syowa Station, Antarctica.
- Observations routinely every 15 min (up to 1 min in special observations).

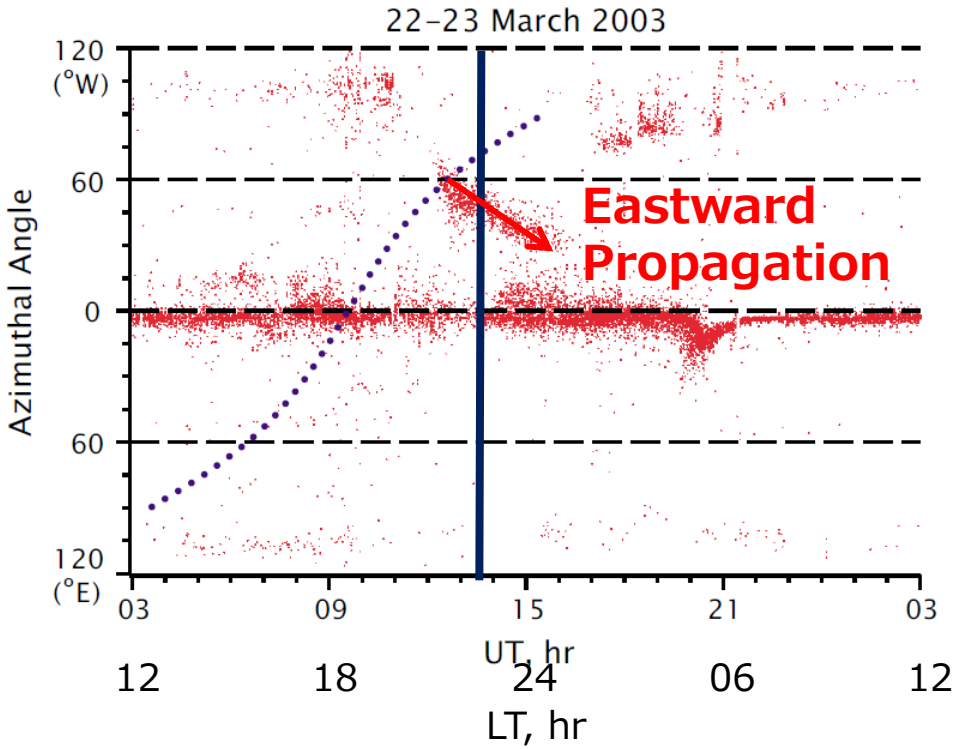
SEALION（South East Asia Low Latitude Ionospheric Network）



- Instruments: five FM-CW ionosondes, four GPS receivers, two GPS scintillation monitors, one magnetometer, and one all-sky imager.
- Collaborators: Kyoto univ., Nagoya univ. ENRI (Japan), VAST(Vietnam), CSSAR(China), KMITL, Chiang Mai Univ. (Thailand), LAPAN(Indonesia), San Carlos Univ.(Philippine)

High Frequency Trans-equatorial Propagation



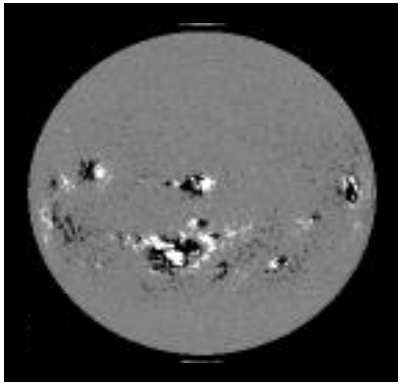


[*Maruyama and Kawamura*, AG, 2006]

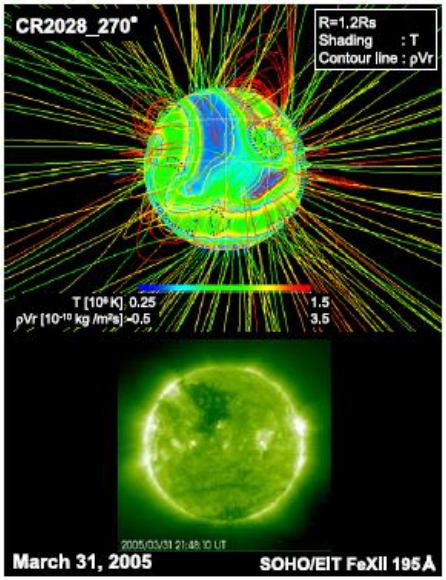
- High-Frequency Trans-equatorial Propagation (HF-TEP) Experiments between Oarai, Japan and Shepparton, Australia
- Oarai direction finder (ODF) consists of seven crossed-loop antennas 2 m in diameter that are located on a circle with a 60 m diameter.

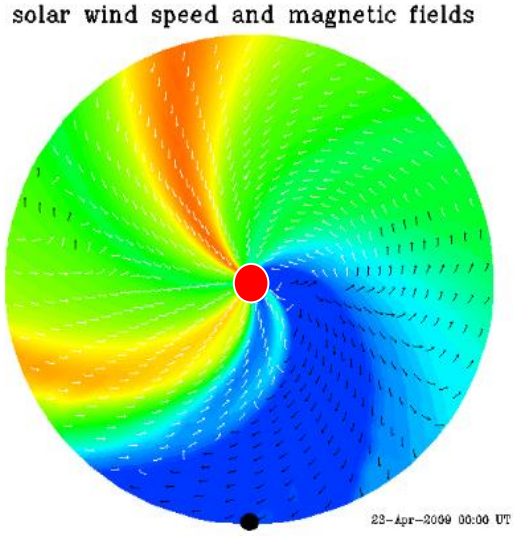
Computer simulation of the Sun and solar wind

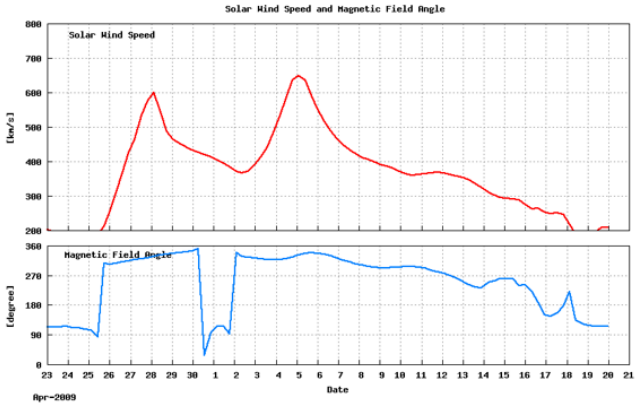
input

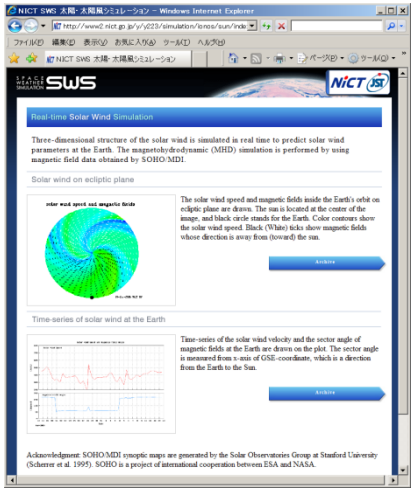


Magnetic field (solar surface) data via SOHO/MDI









Publication on Web

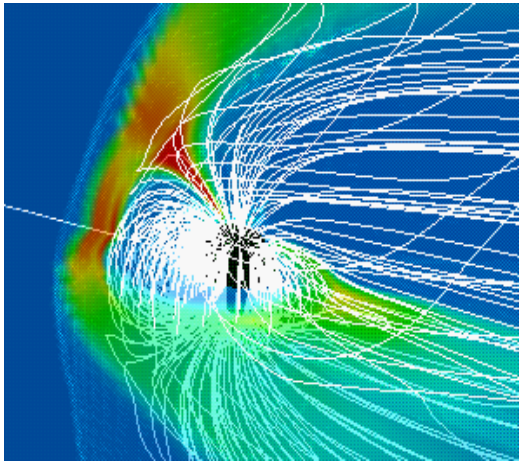
Computer simulation of Earth's magnetosphere

input

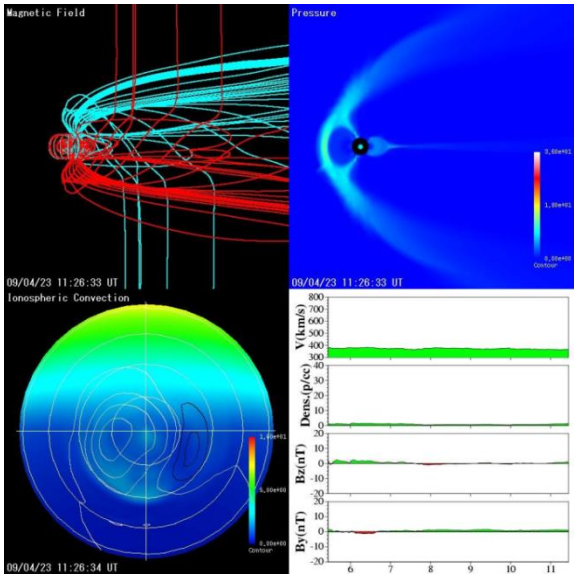
Real-time observation data of solar wind via ACE satellite

Real-time data receiving at NICT (Koganei)

Super computer（NEC SX-8R）@NICT (Koganei)



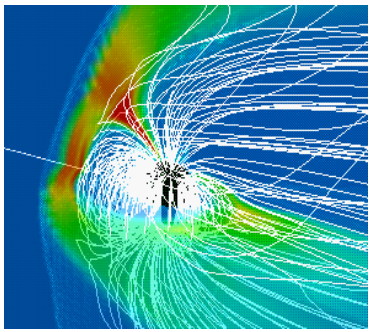
Visualization and database



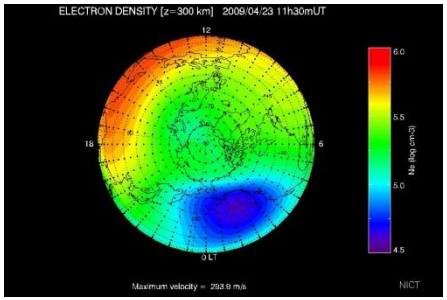
Publication on Web

Computer simulation of Ionosphere and Thermosphere

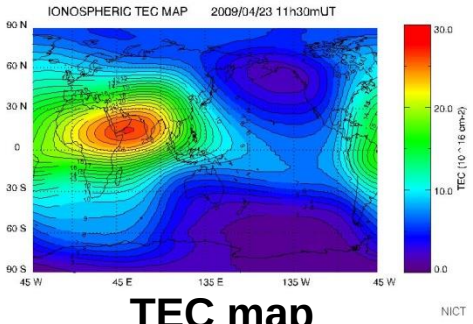
input



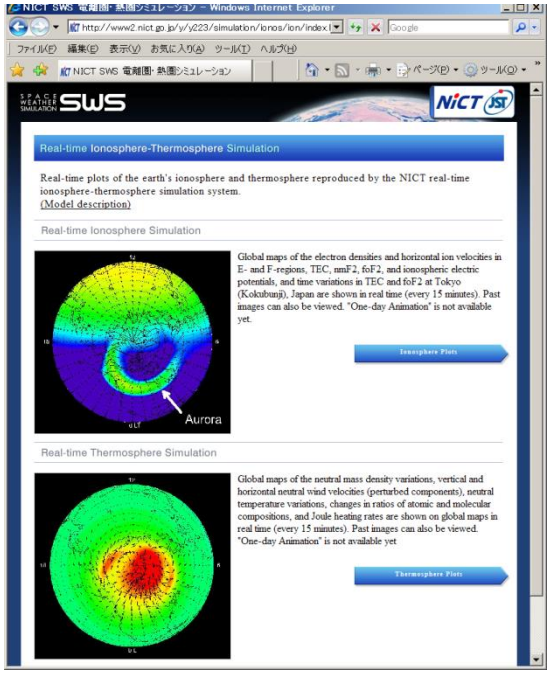
Simulation results from Magnetosphere simulation



Electron density

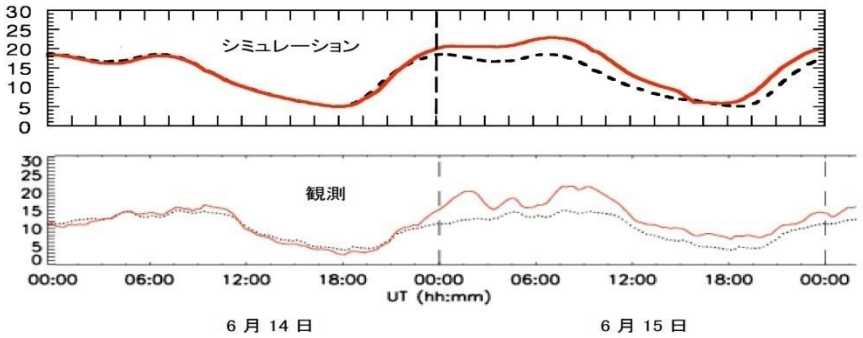


TEC map

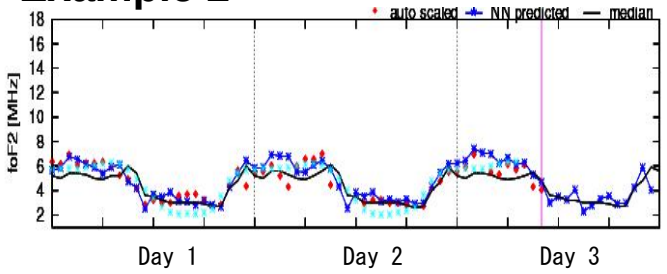


Publication on Web

Example 1

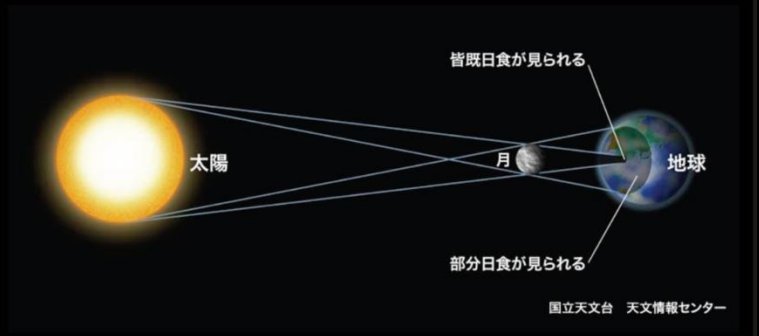


Example 2

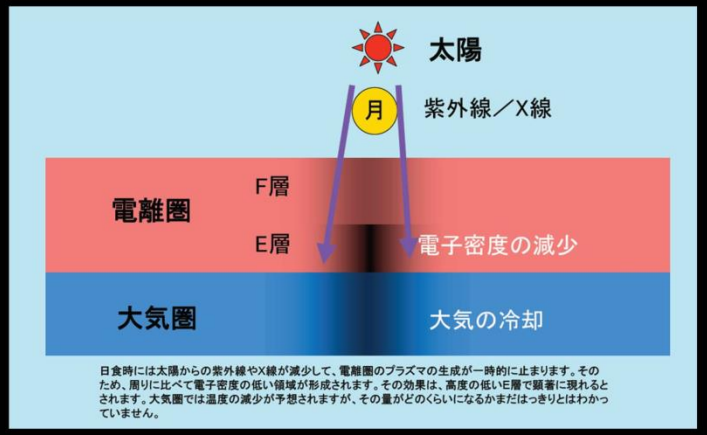


Example of Solar eclipse on 22th Jul, 2009

日食のしくみ

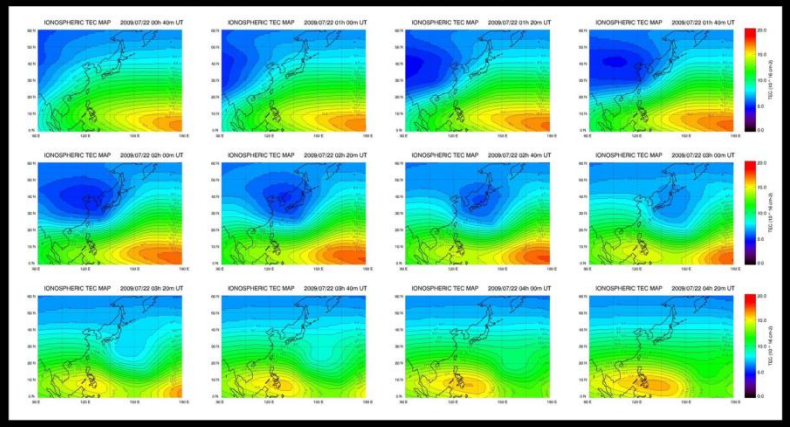


日食時の超高層大気現象



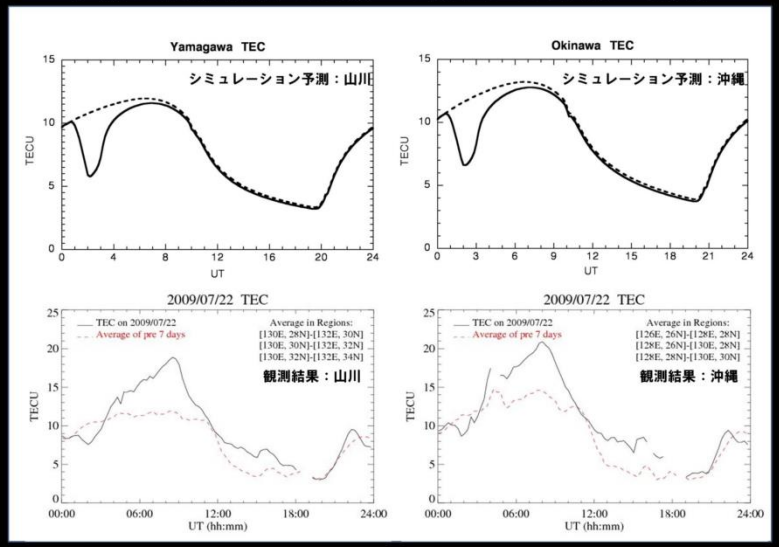
日食時には太陽からの紫外線やX線が減少して、電離圏のプラズマの生成が一時的に止まります。そのため、周りに比べて電子密度の低い領域が形成されます。その効果は、高度の低いE層で顕著に現れるとされます。大気圏では温度の減少が予想されますが、その量がどのくらいになるかまだはっきりとはわかっていません。

電離圏全電子数分布



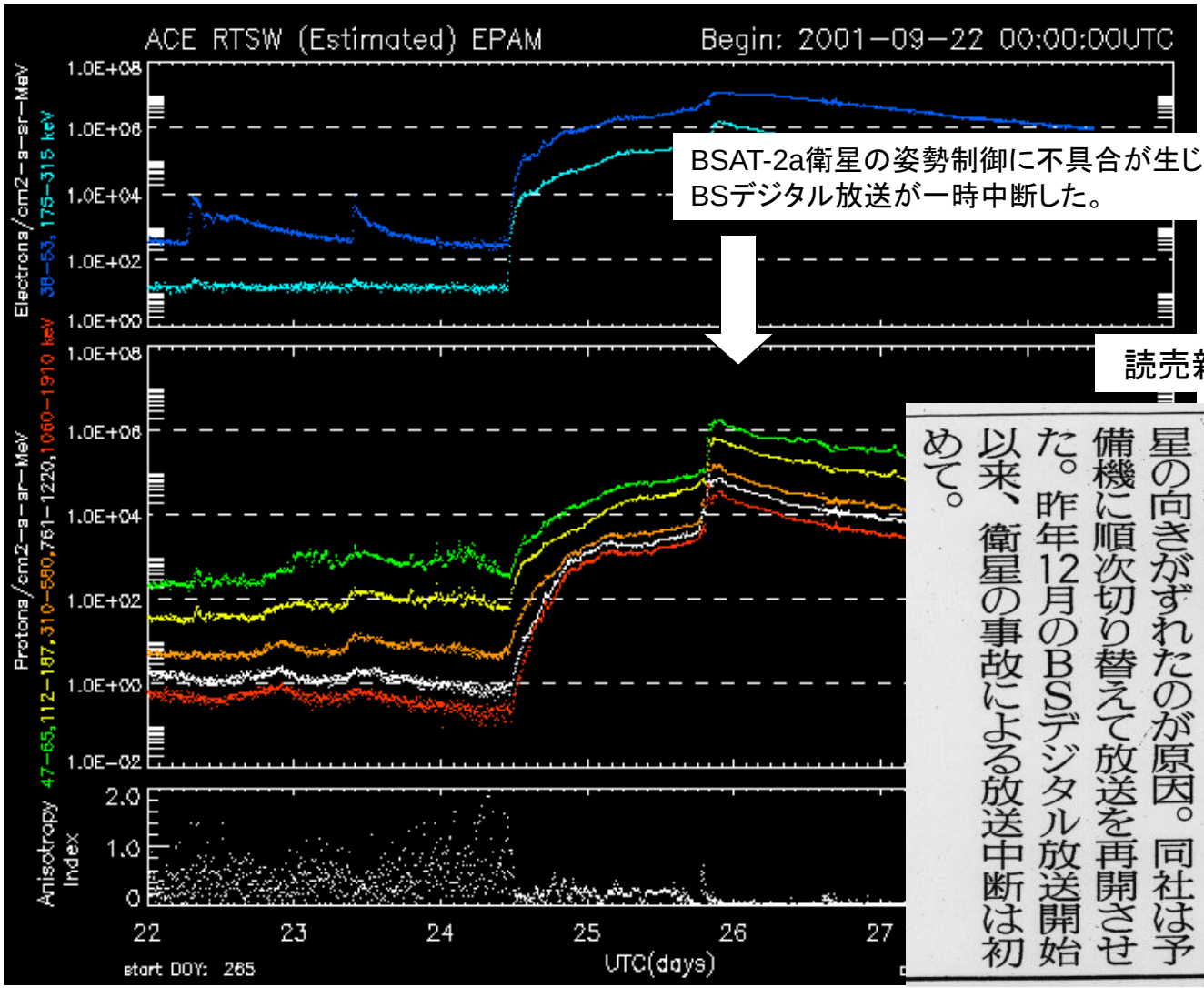
シミュレーションモデルで計算された日食時における電離圏の全電子数（TEC）の分布。青い領域が密度の低い部分。電離圏の上部（F層）では、電離圏が運動するので、皆既日食の場所でTECが最低になるとは限らない。

予測と観測結果の比較：電離圏全電子数の変動



BS放送の中断

2001年9月24日のX2.6/2Bフレアに伴ってACE衛星により観測された高エネルギー粒子



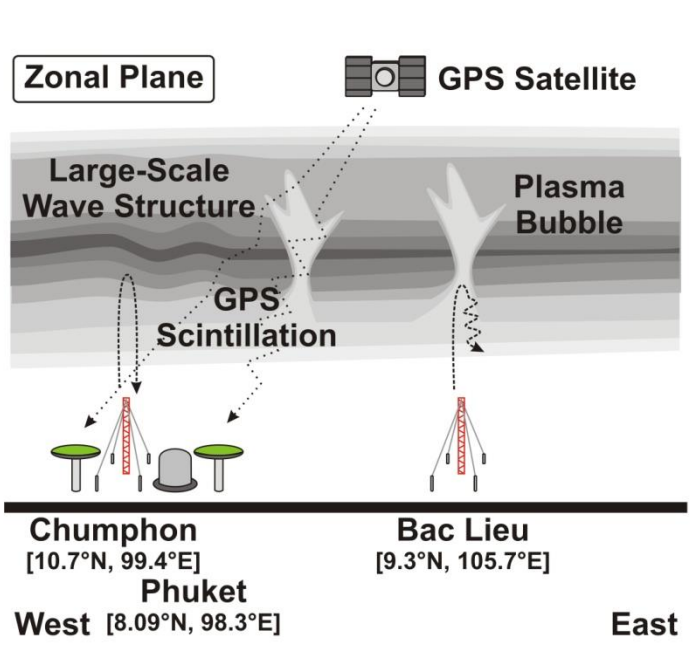
BSAT-2a衛星の姿勢制御に不具合が生じ、
BSデジタル放送が一時中断した。

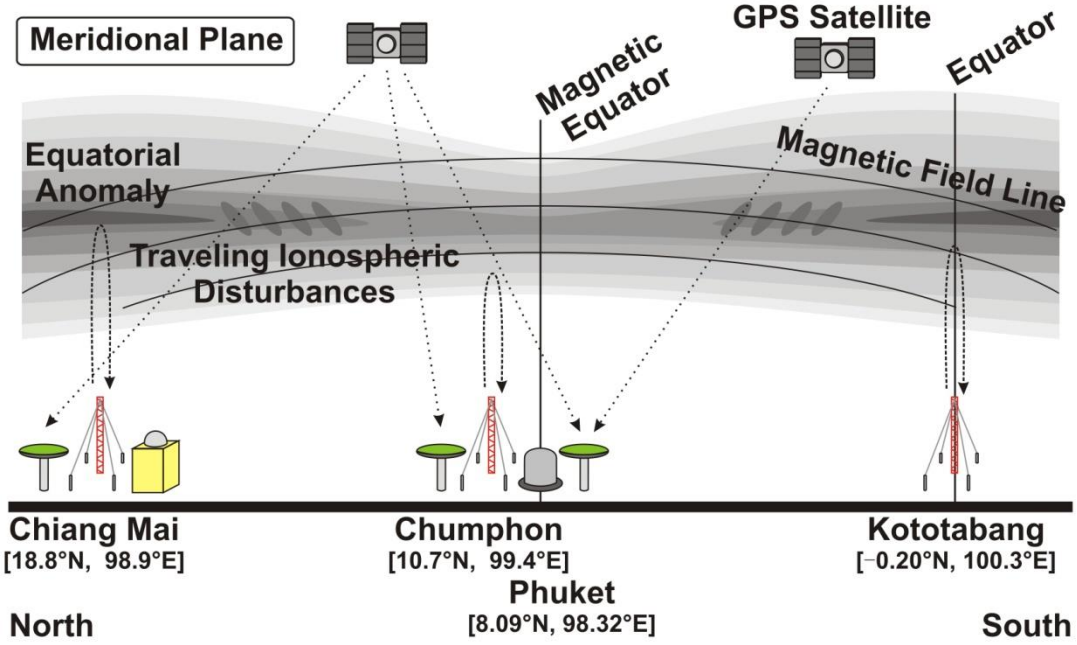
読売新聞2001年9月26日朝刊

◆BSデジタル一時中断　BSデジタル放送のテレビ、ラジオ、データ放送の全チャンネルが、25日午後4時17分ごろから、最大1時間にわたって受信不能となった。同放送に使用されている衛星「BSAT-2a」を運用している放送衛星システムによると、衛星の向きがずれたのが原因。同社は予備機に順次切り替えて放送を再開させた。昨年12月のBSデジタル放送開始以来、衛星の事故による放送中断は初めて。

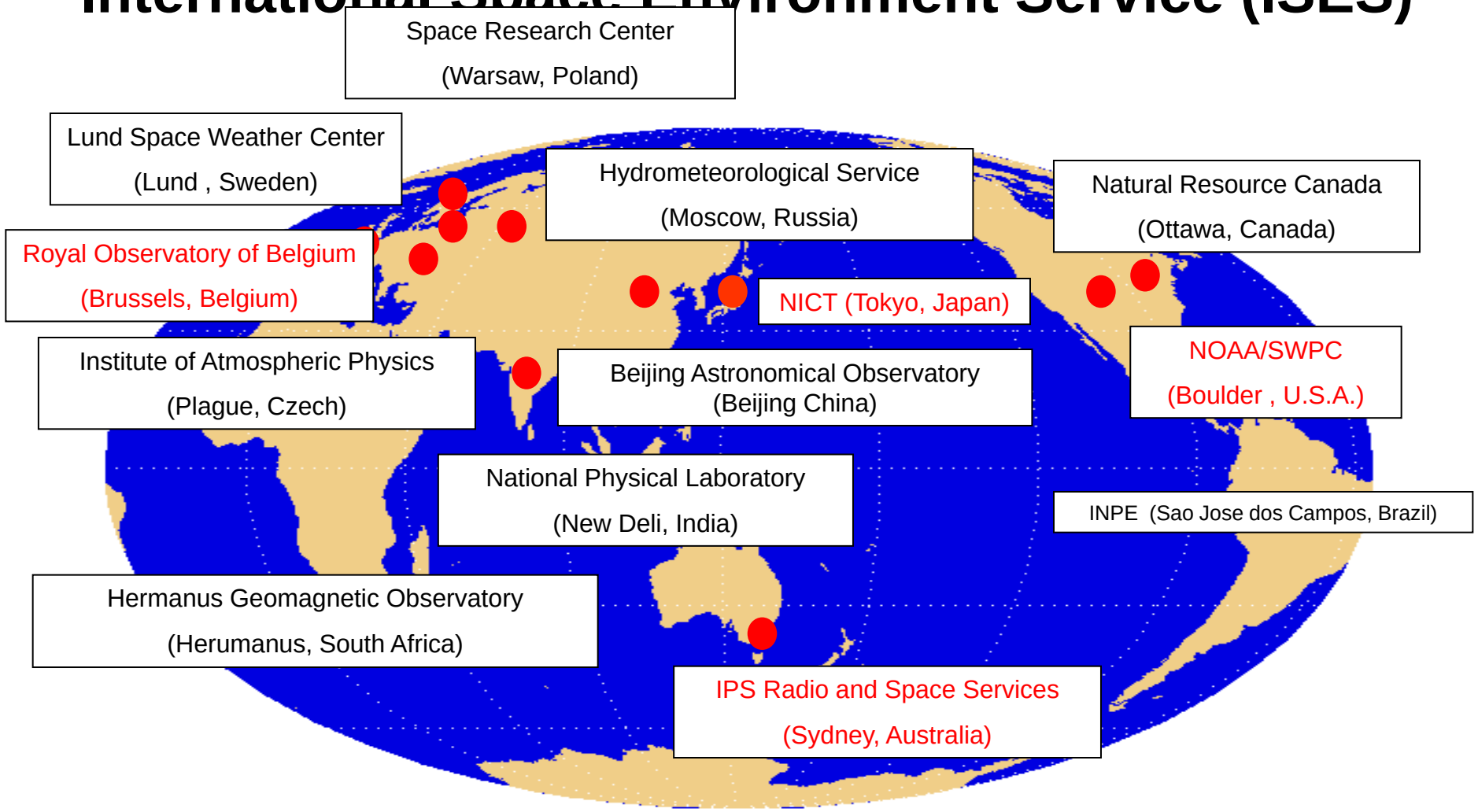
- In Japan, NICT (National Institute of Information and Communications Technology) has been in charge of space weather forecast services for more than 20 years. With help of geospace environment data exchanging among the international cooperation, NICT operates daily space weather forecast service every day to provide information on nowcasts and forecasts of solar flare, geomagnetic disturbances, solar proton event, and radio-wave propagation conditions in the ionosphere.
  For prompt reporting of space weather information, we also conduct our original observation networks from the Sun to the upper atmosphere: Hiraiso solar observatory to monitor the solar activity (solar flare, solar radio burst, etc.), domestic ionosonde networks, magnetometer & HF radar observations in far-east Siberia and Alaska, and south-east Asia low-latitude ionospheric network (SEALION). ACE and STEREO real-time beacon data are received using our antennae facilities to monitor the solar and solar wind conditions in near real-time. These information and related products are provided via the internet.
  We are also operating real-time computer simulations for solar and solar-wind, magnetosphere and ionosphere using a middle-class super-computer (NEC SX-8R). The three simulations are directly or indirectly connected each other based on real-time observation data to reproduce a virtual geospace on the super-computer.
  In the present talk, we introduce our current and future plan of the operational space weather activities.

SEALION Research Targets





Space Weather Forecast Centers of International Space Environment Service (ISES)

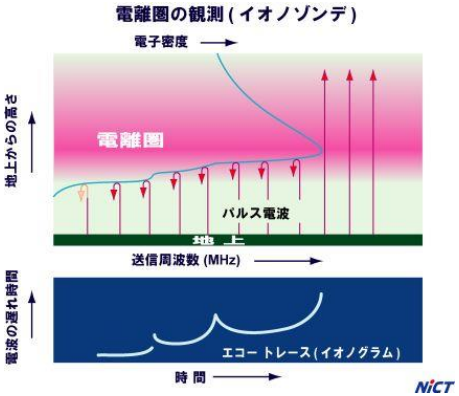


Ground-based monitoring/observation for space weather

- 観測、シミュレーション、インフォマティクスの紹介
- 宇宙天気ニュース
- 障害の事例（ひまわり、B-sat）

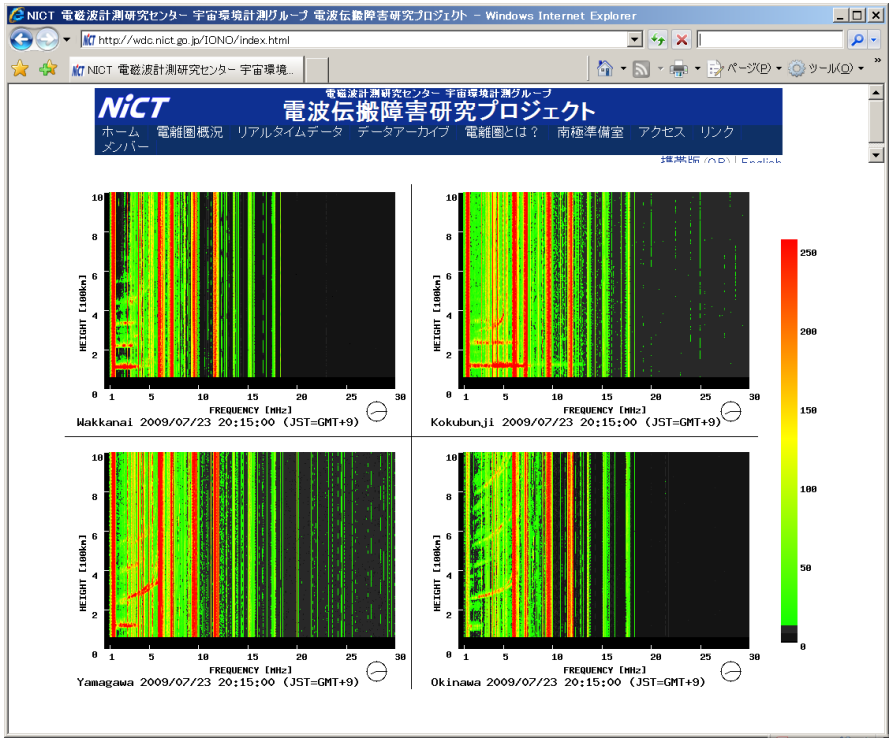
User’s needs

Information of Ionosphere via Ionosonde

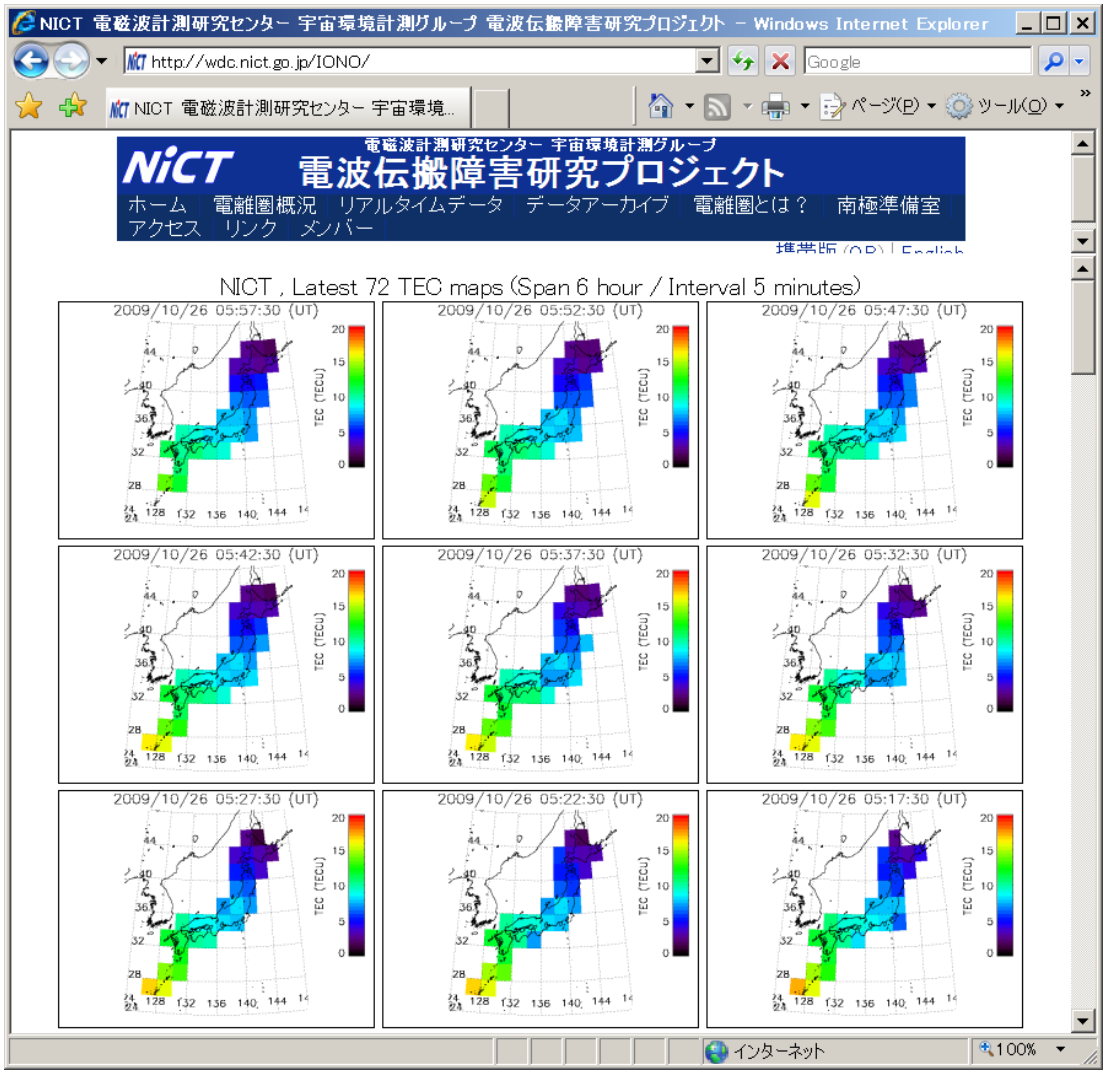


Ionosonde

http://wdc.nict.go.jp/IONO/

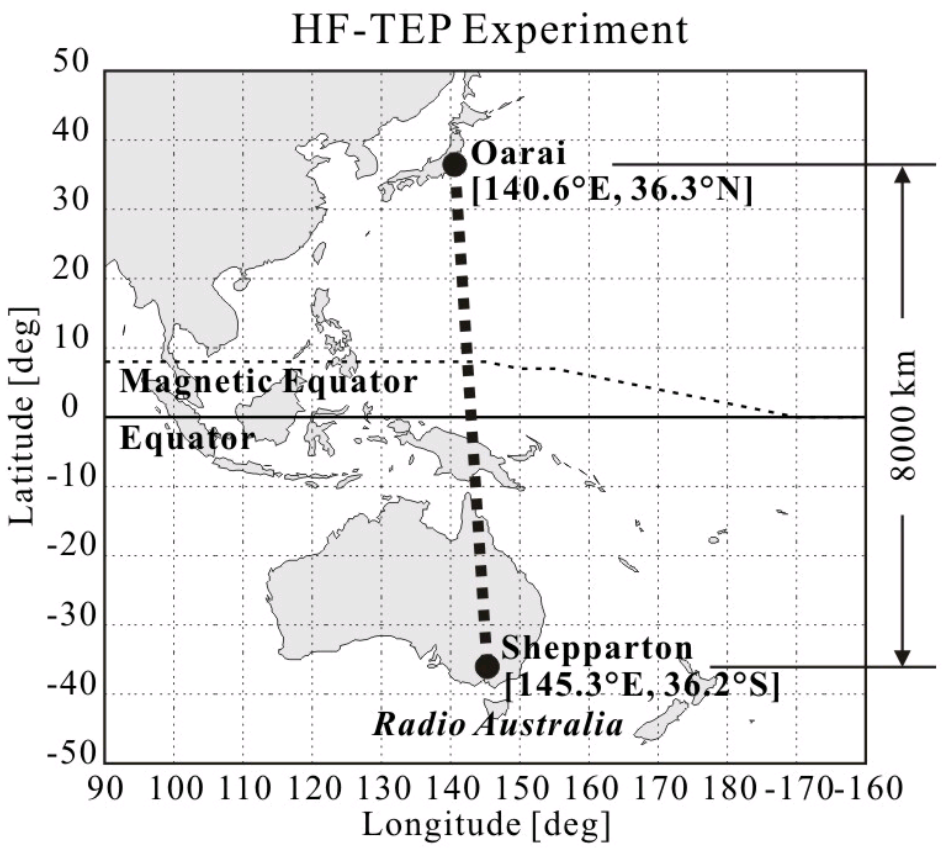


MAP of TEC (Total Electron Content) over Japan



Computer simulations via super Computer

High Frequency Transeqatorial Propagation



- High-Frequency Transequatorial Propagaion (HF-TEP) Experiments between Oarai, Japan and Shepparton, Australia
- Oarai direction finder (ODF) consists of seven crossed-loop antennas 2 m in diameter that are located on a circle with a 60 m diameter.