Japan's Contribution to Space Weather -Research and Applications-

Takahiro Obara, Prof. Dr.

Japan Aerospace Exploration Agency
Tohoku University

Takahiro Obara, Prof. Dr.

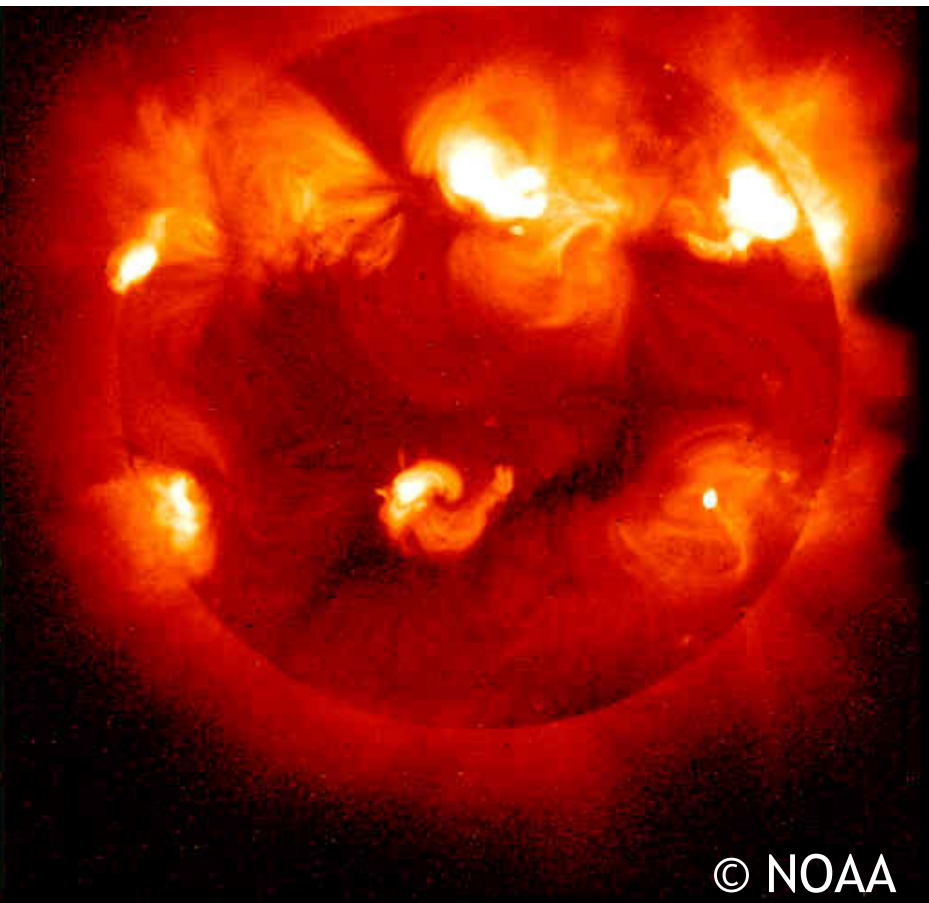
Satellite observations of
the Earth's Magnetosphere

Chair of COSPAR Space Weather Panel
2006-2008

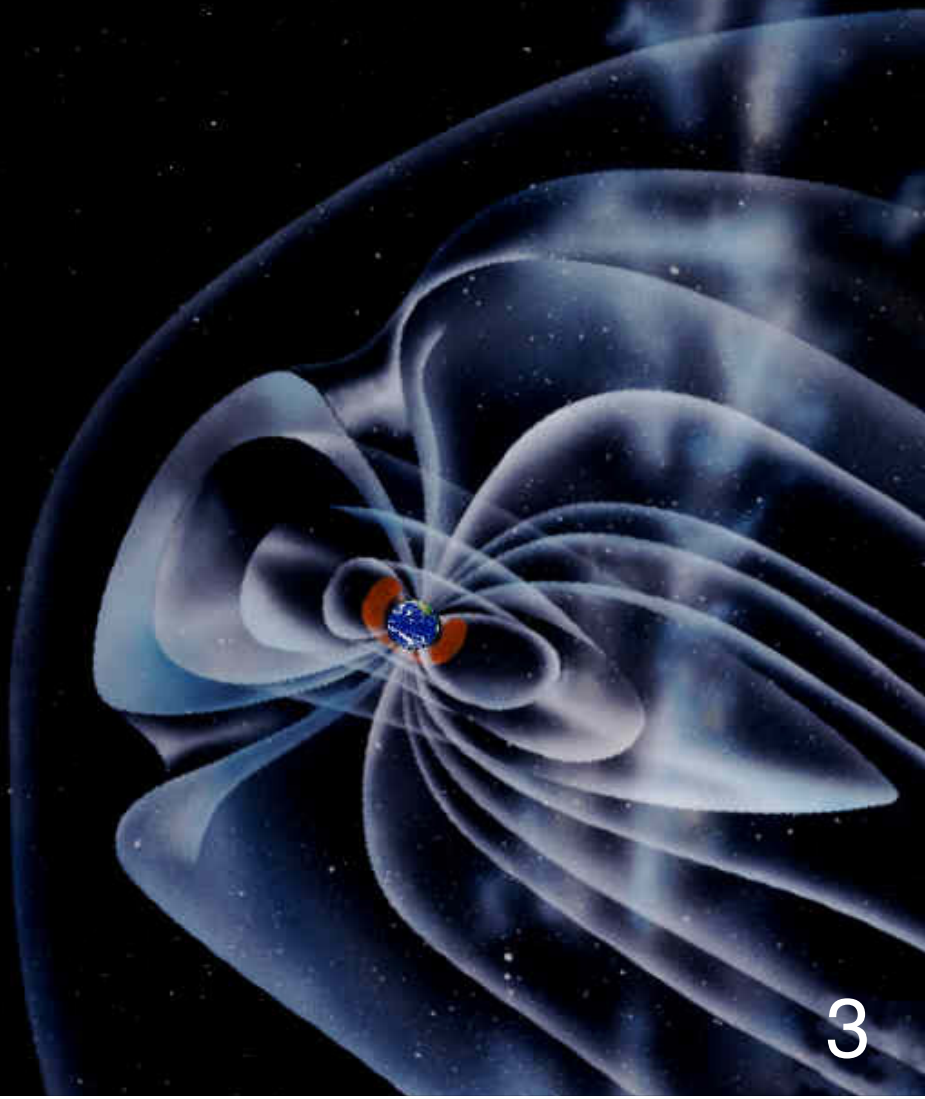
Vice-chair of COSPAR Space Weather Panel
2002-2006 and 2008-2016

Co-chair of expert group on space weather (EG C)
Long-term sustainability in outer space (LTS) WG
COPUOS, STSC
2011-2014

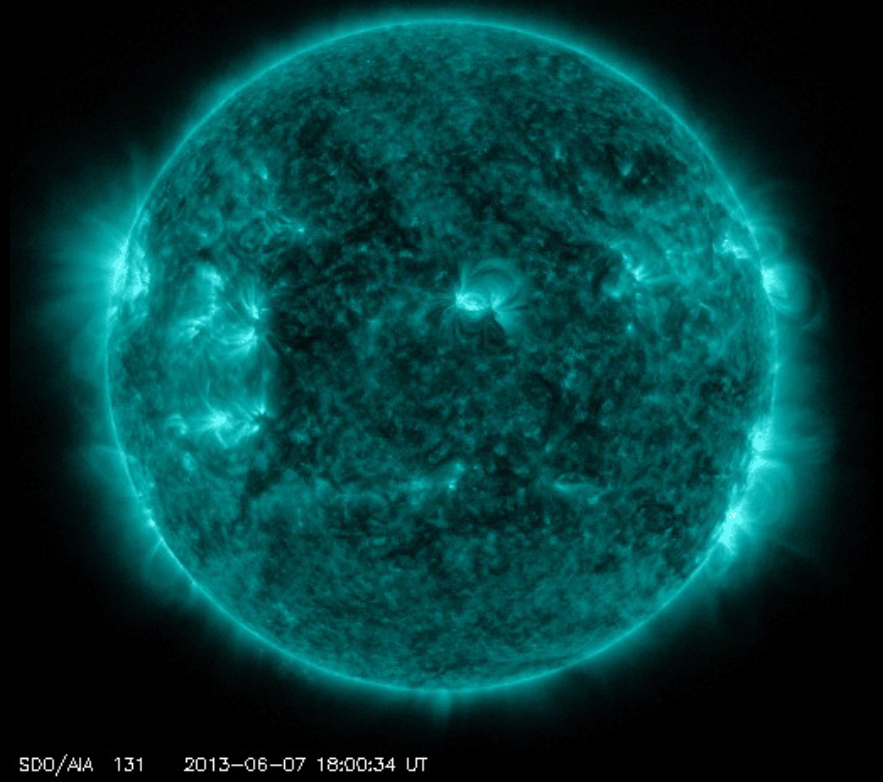
Space Environment

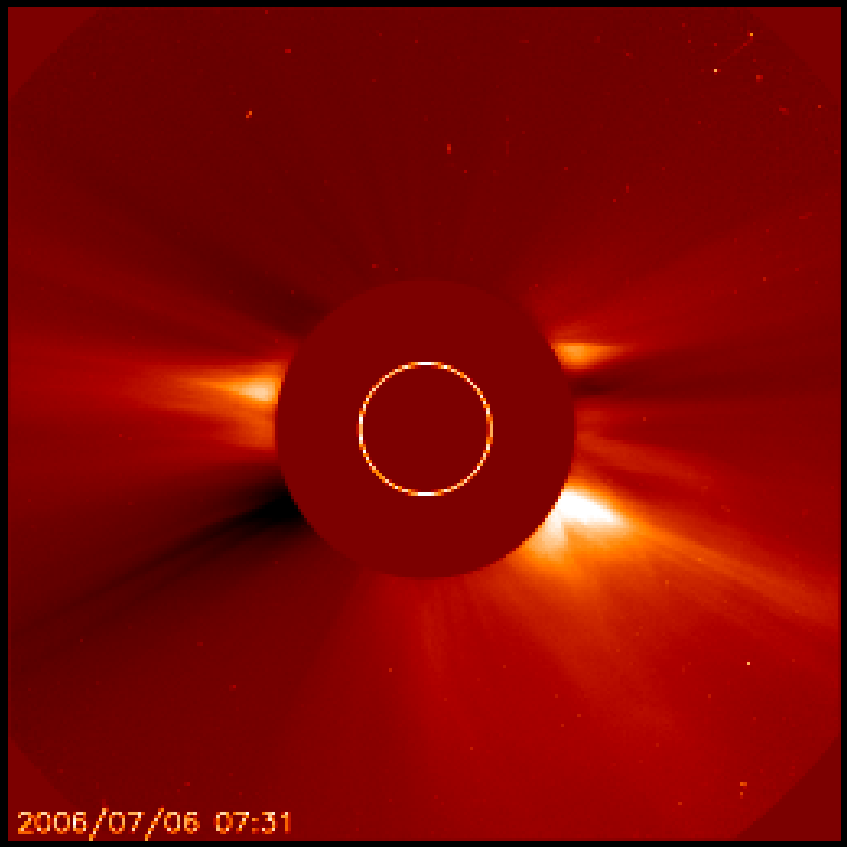


© NOAA



Space is not empty.
Solar wind travels through space and the magnetosphere is formed in the vicinity of the Earth.



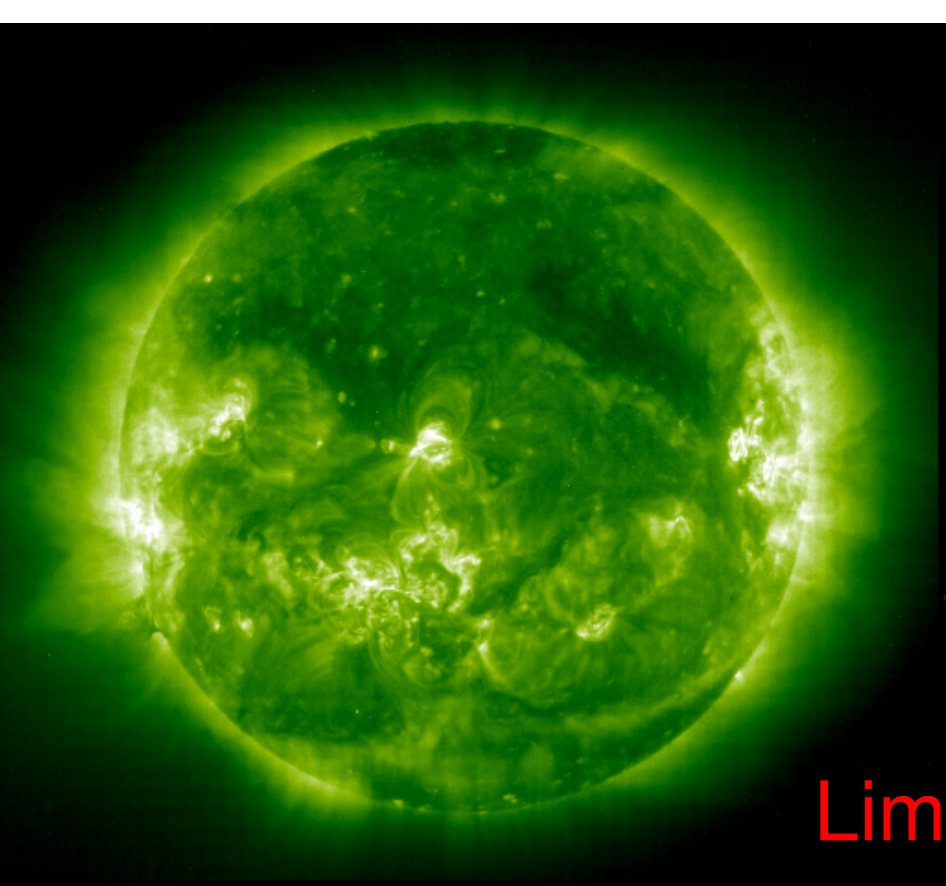


© NASA

© NASA/ESA

When the solar flare occurs, a large amount of corona gases are emitted from the Sun. They are called CME (coronal mass ejection) and some of them reach the Earth, causing magnetic storms.

Solar Energetic Particle Access to Earth

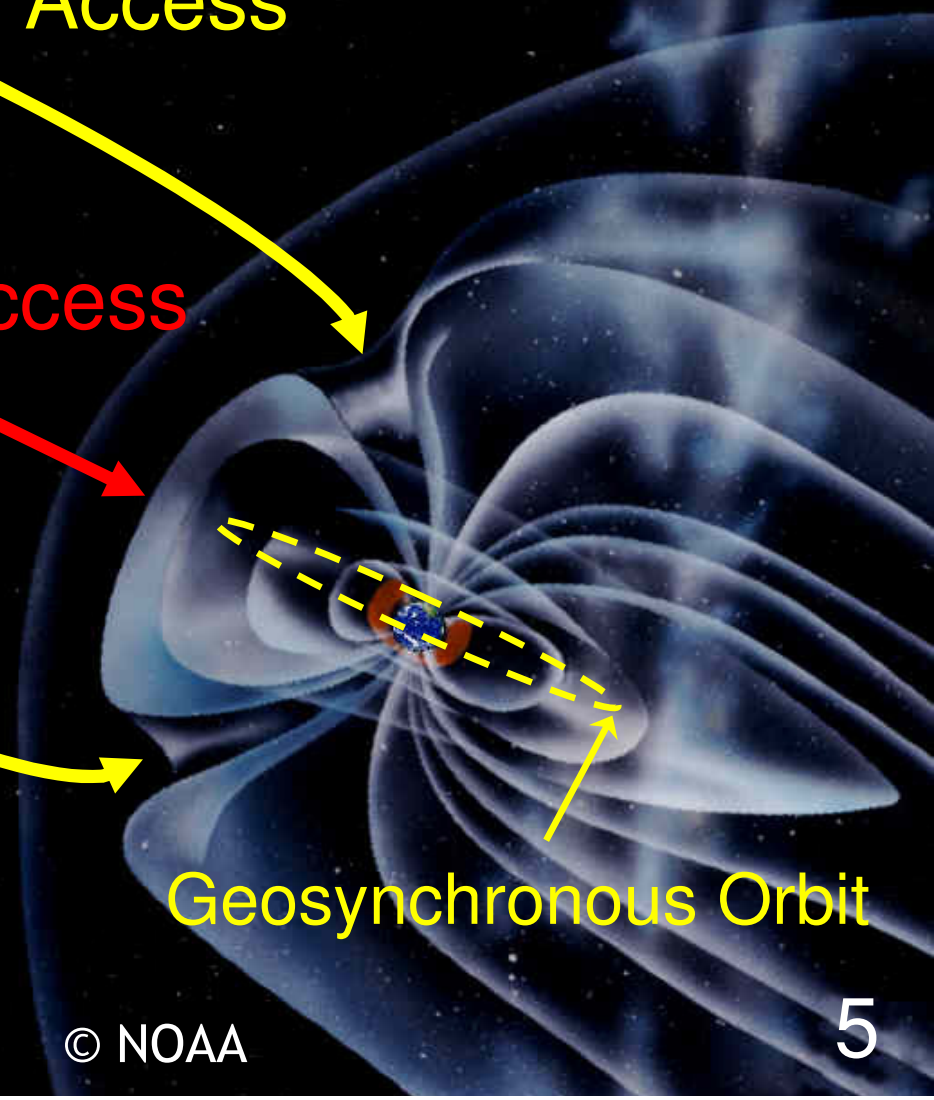


© NASA/ESA

Free Access

Limited Access

Free Access

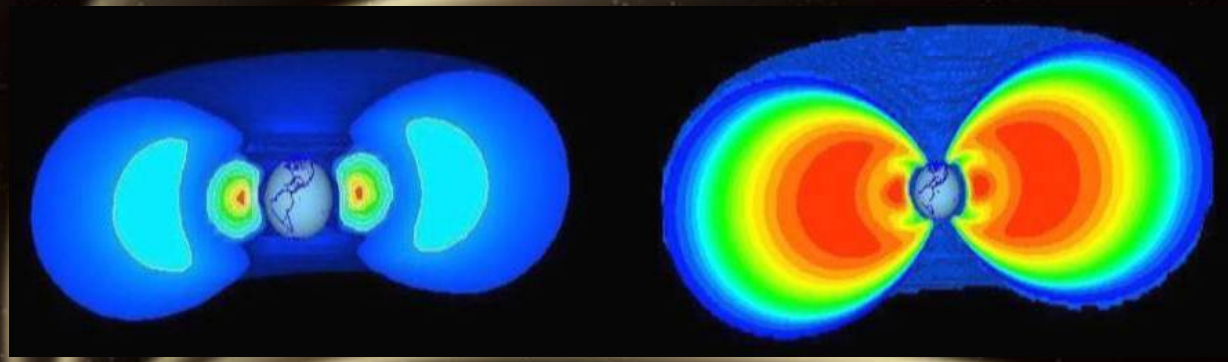


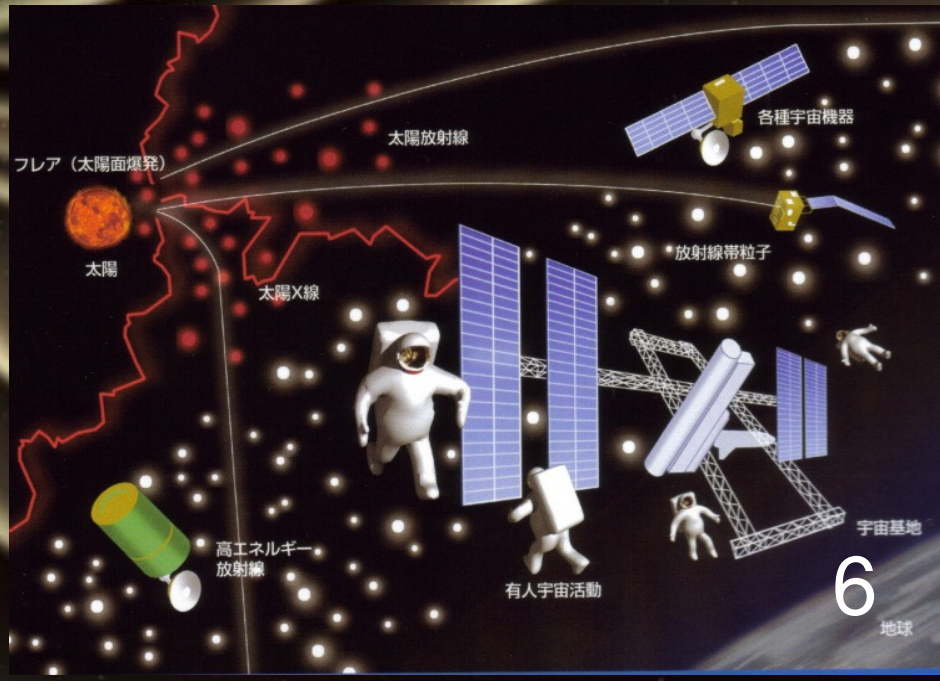
Geosynchronous Orbit

© NOAA

Highly energetic particles are produced in the active region and/or CME front.

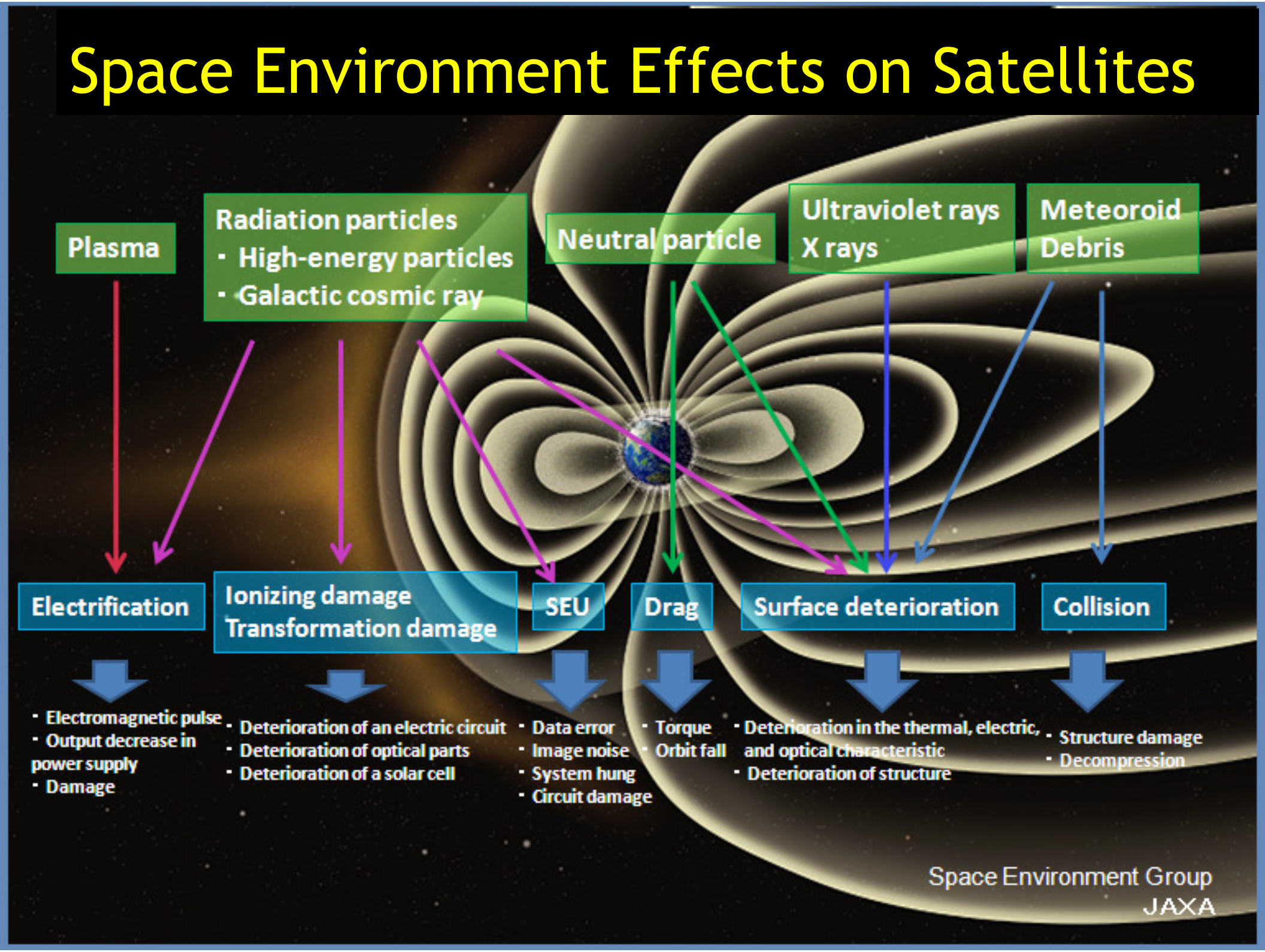
When a magnetic storm occurs, radiation belts are filled with plenty of highly energetic electrons especially in the outer belt region





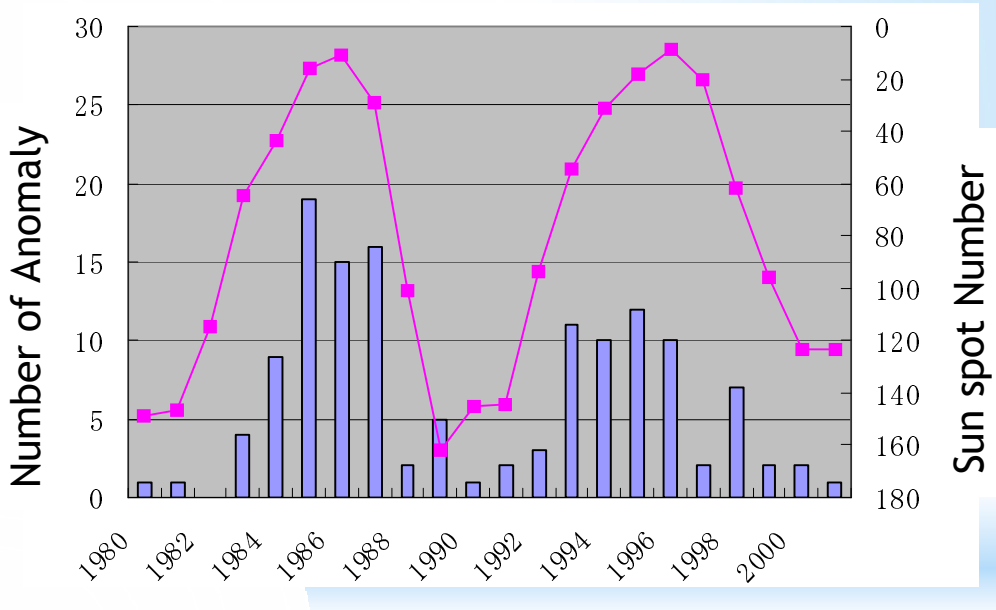
Storms create risks not only for satellites but also for astronauts.

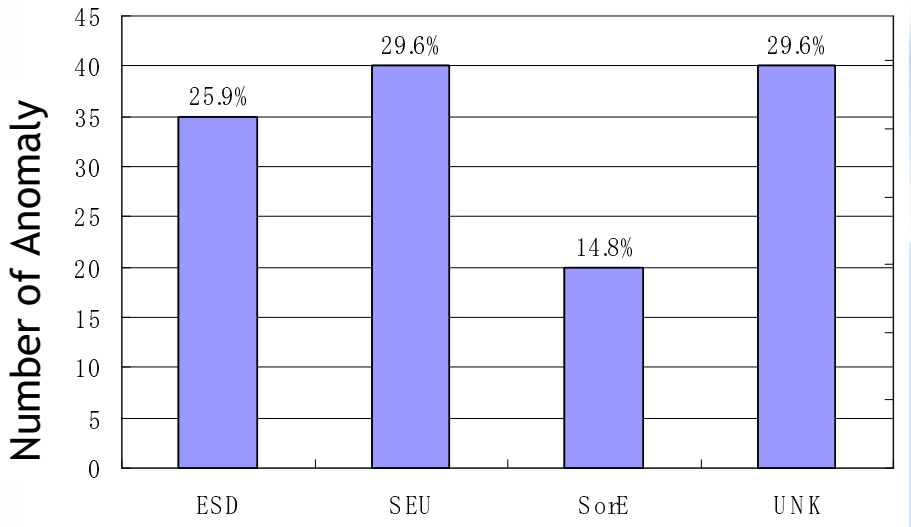
Space Environment Effects on Satellites



Space Environment Effects on Satellites

Environment	Effects
Vacuum	Contamination
Neutral	Aerodynamic drag Atomic oxygen attack
Plasma	Spacecraft charging Electrostatic discharge
Radiation	Internal charging Total Dose Effects Single Event Effects
Micrometeoroid/ Orbital Debris	Hypervelocity Impacts

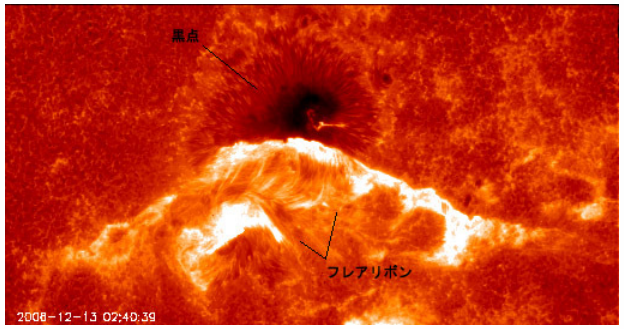




One example is given by JAXA. Electro static discharge and single event upset are two major causes of satellite anomaly.

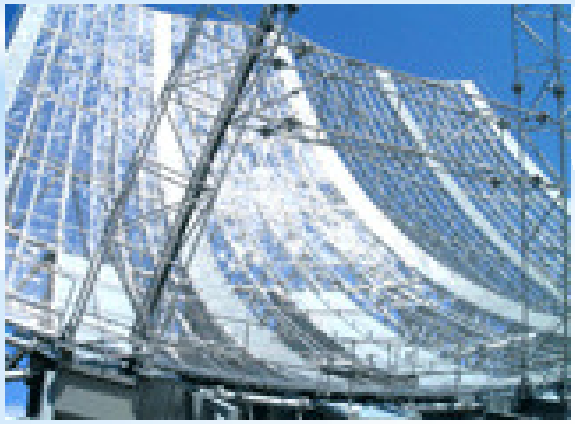
Basic research of space weather science

Hinode satellite
(JAXA/NAOJ)



Heliograph (NAOJ)

Hida Observatory
(Kyoto Univ.)



Solar Radio Burst
(Tohoku Univ.)

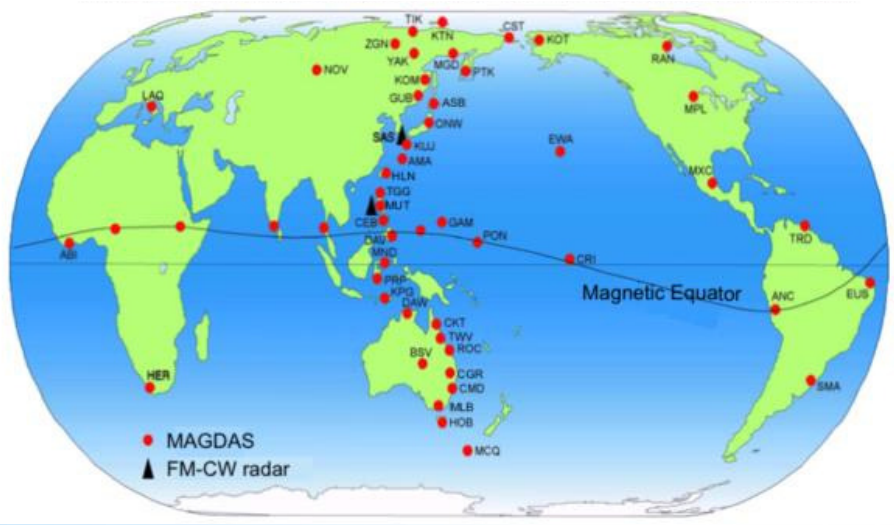
IPS (STEL/Nagoya Univ.)

Muon (Shinsyu Univ.)

Basic research of space weather science

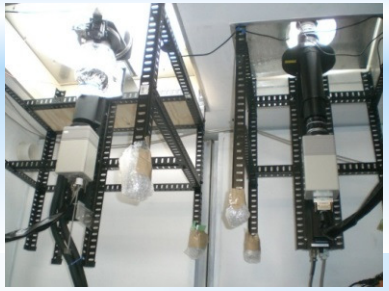
JAXA/ISAS satellites

HF radar
(STEL/Nagoya Univ.
NIPR, NICT)



Magnetometer chain (MAGDAS)
(Kyushu Univ.)

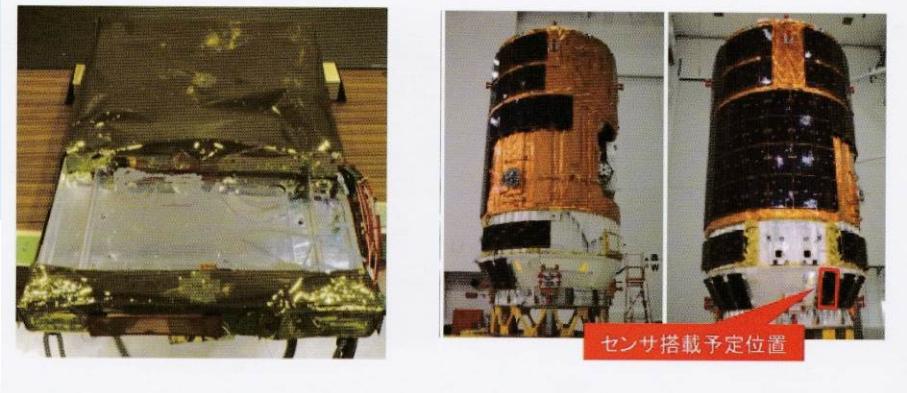
Now 71 stations



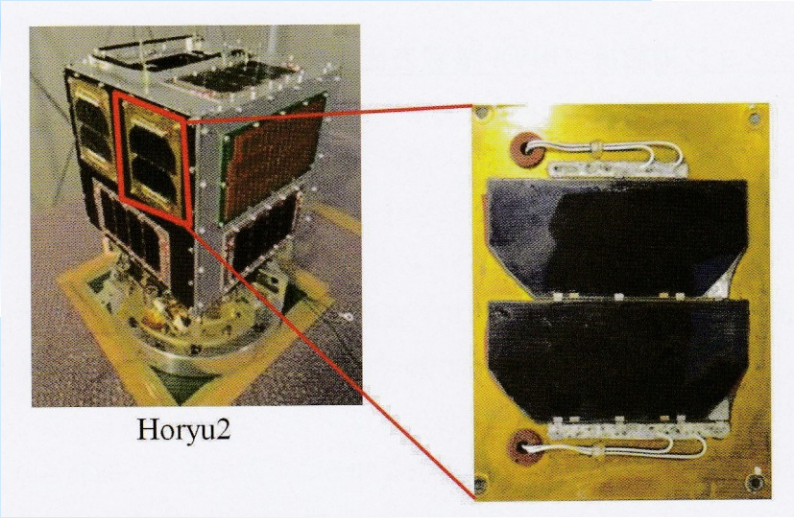
All-sky imager
(STEL/Nagoya Univ., NICT)

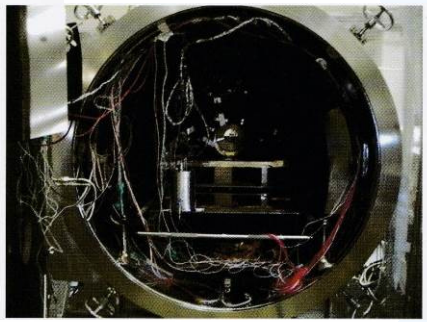
5 World Data Centers in Japan

Engineering approach for mitigating the impact of space

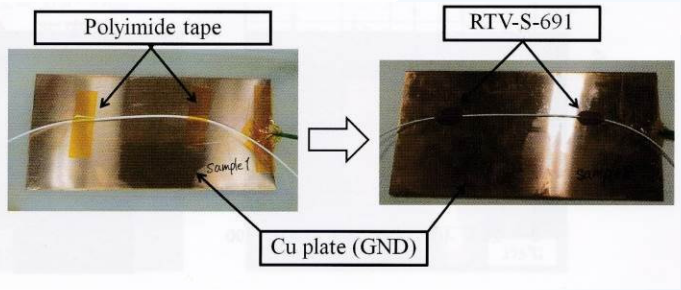


Laboratory of Space Environment Interaction Engineering, Kyushu Institute of Technology performs charging experiment on board JAXA HTV and KIT Horyu2.



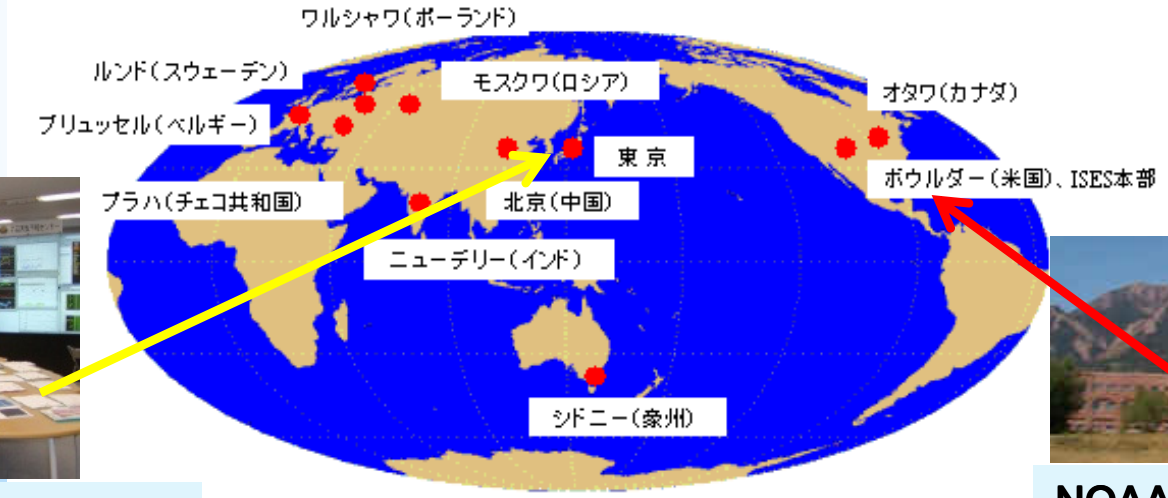


KIT is also developing new technology to avoid spacecraft charging.



Recent efforts to achieve better space weather forecasts

ISES

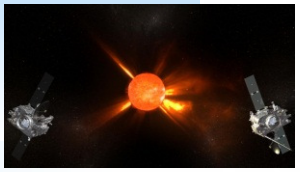


Prediction Items
- Solar activity
- Solar protons
- Magnetic activity

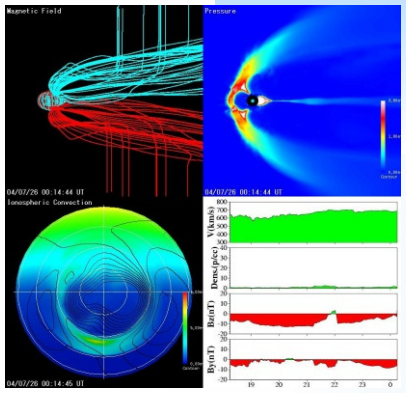
Space Weather Prediction Center in Japan (NICT)

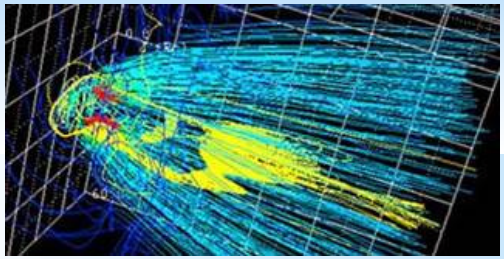
NOAA Space Weather Prediction Center (ISES HQ)

Solar Radio Observation



Satellite Data Reception



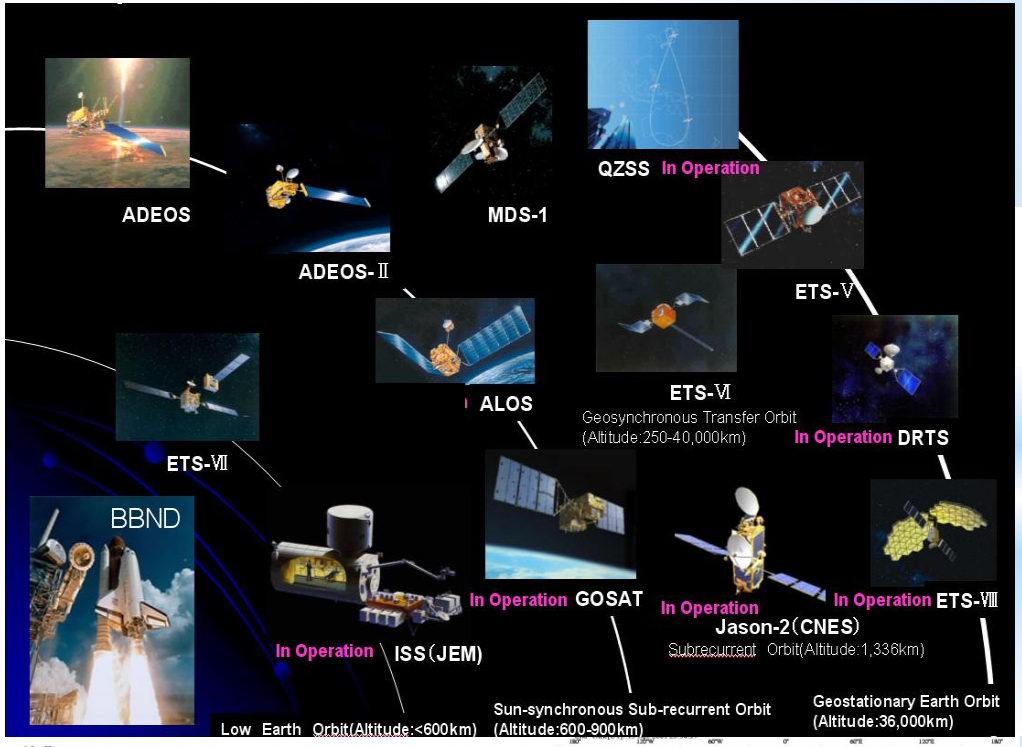


Real time simulation of magnetosphere

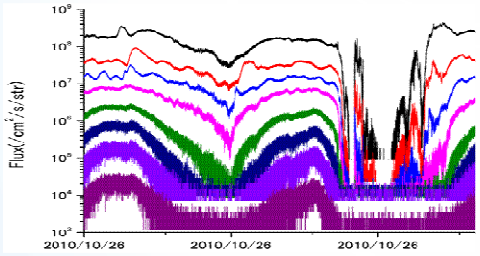
Recent efforts to achieve better space weather forecasts

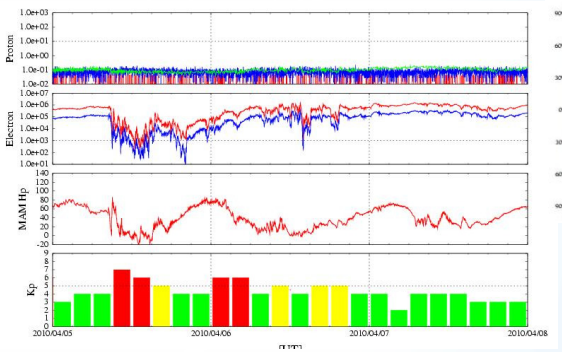
'Space Environment Now cast' by JAXA

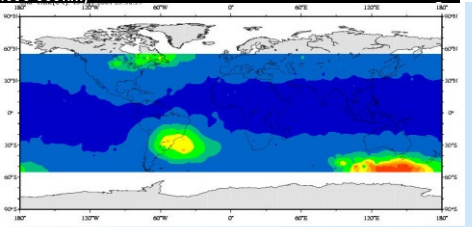
Satellite Name	Launch Data (Altitude)	Type
ETS-V	1987.8 (36000km)	GEO
ETS-VI	1994.8 (8000～38000km)	GTO
ADEOS	1996.8 (800km)	LEO
ETS-VII	1997.11 (500km)	LEO
STS-89	1998.1 (300km)	LEO
ISS	2001 (400km)	LEO
MDS-1	2002.2 (250～36000km)	GTO
DRTS	2002.9 (36000km) *	GEO
ADEOS-II	2002.12 (800km)	LEO
ALOS	2006.1 (700km)	LEO
ETS-VIII	2006.12 (36000km) *	GEO
Jason-2	2008.6 (1336km) *	LEO
GOSAT	2009.1 (700km) *	LEO
JEM/SEDA-AP	2009.5 (400km) *	LEO
QZS	2010 (Quasi Zanies Orbit) *	QZO



Real time plots are being provided by JAXA.







Capacity building for the education of young people

International Center for Space Weather Science and Education
Kyushu University
(formerly Space Environment Research Center)

ICSWSE

MAGDAS-9 magnetometer

Magnetometer installation and training

Daily space weather forecast

2013 ISWI & MAGDAS School in Indonesia

1st and 2nd Batch- Capacity Building

68 students from 10 countries; 27 lecturers from 14 countries !

ICSWSE Capacity Building Activity in 2012-

* April: Establishment of ICSWSE
* June: Declaration of Establishment at COPUOS
* September: UN/Data handling seminar in Graz, Austria
* September: ISWI/MAGDAS School in Bandung, Indonesia
* October: ISWI Workshop in Quito, Ecuador
* November: ICG7 in Beijing, China
* November: International Capacity Building 1 at ICSWSE
* January: International Capacity Building 2 at ICSWSE

ICSWSE

ISWI Newsletter:
Since 2009, the space weather newsletter has been published by Kyushu University.
The publisher is Professor K.Yumoto and the editor is George Maeda.
This newsletter was requested by UN Office for Outer Space Affairs.

Conclusion

- Brief report on space weather has been given, paying particular attention to observational, operational and educational points of view.
- STPP subcommittee of Science Council Japan agreed to work for the United Nations. Members of the subcommittee cover all the disciplines of space weather.
- We strongly hope that STSC's new agenda "Space Weather" will give us a good opportunity to interact with each other to achieve more progress for space weather research and applications.