



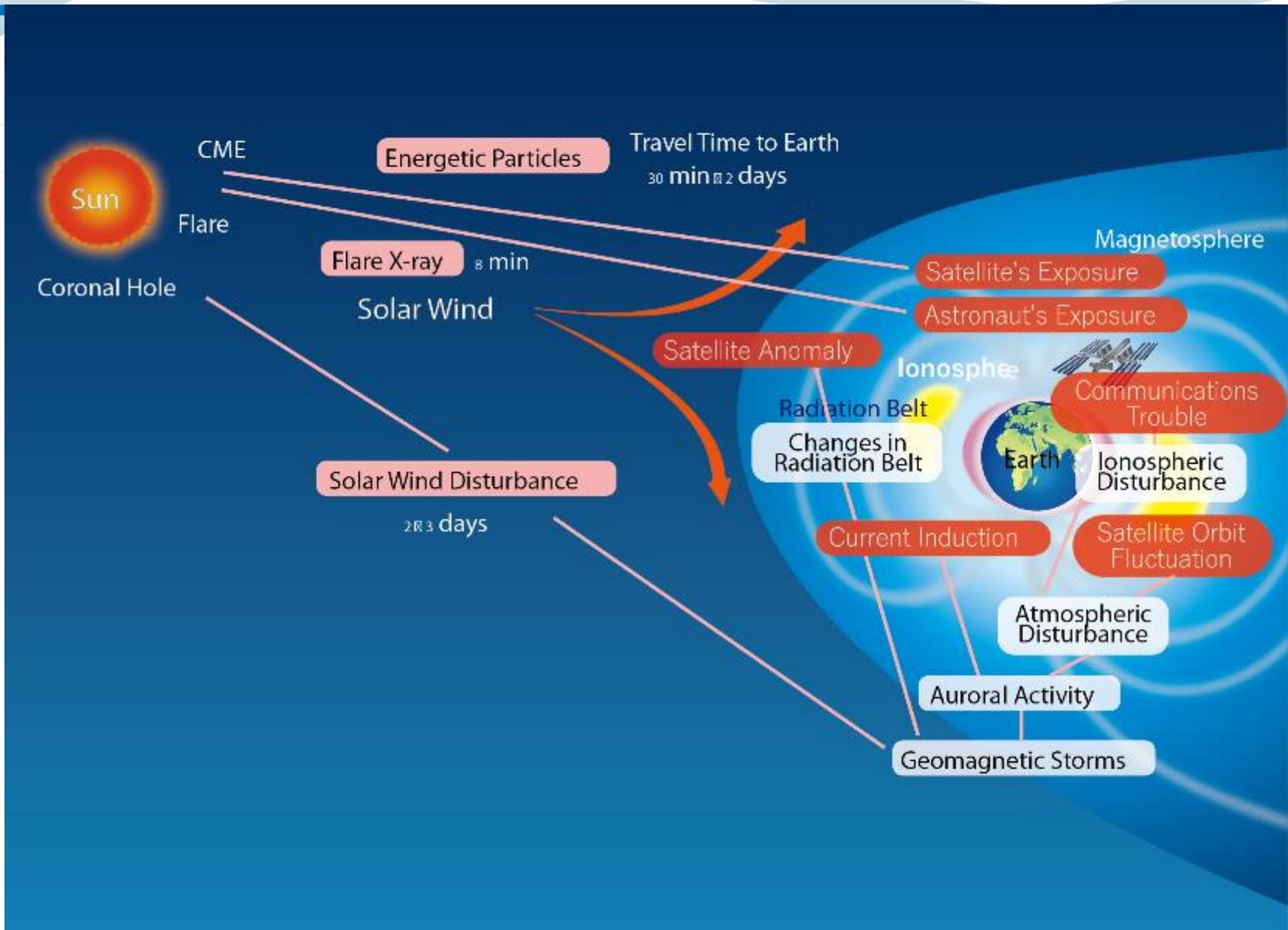
National Institute of Information and Communications Technology

# NICT Space Weather Research and Operation

Mamoru Ishii

Director, Space Environment Laboratory

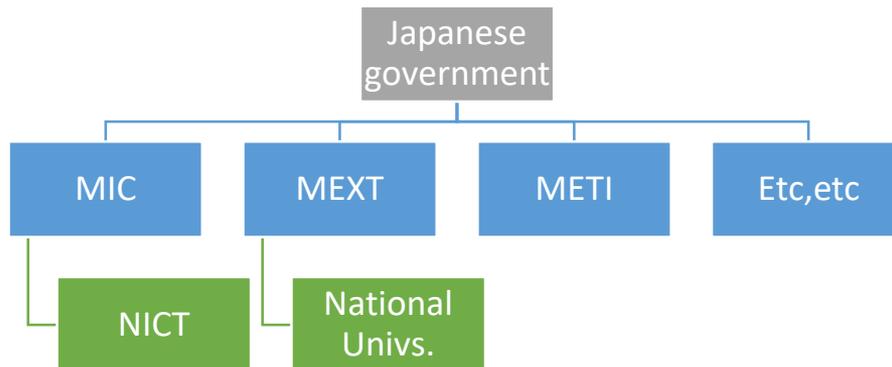
National Institute of Information and  
Communications Technology, Japan



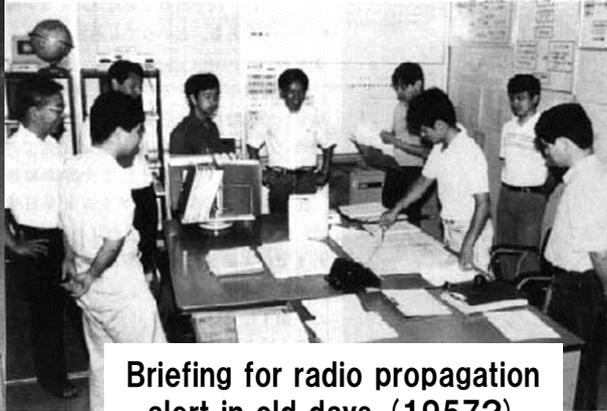
# NICT

(National Institute of Information and Communications Technology)

- The “ONLY National Institute” of Information and Communications technology in Japan
- Staff: permanent scientists: 300, temporal scientists: 400, administrative: 200 (approximately).
- Headquarter: Koganei, Tokyo
- Main Branches: Keihanna, Kobe, Kashima, Okinawa
- Observatories: Wakkanai, Hiraiso, Yamagawa, Okinawa

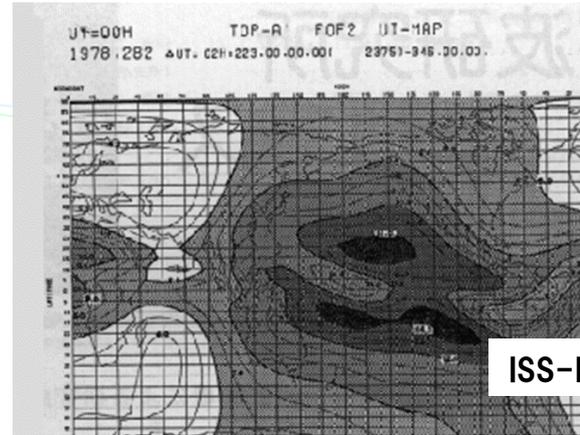


# NICT Space Weather Services

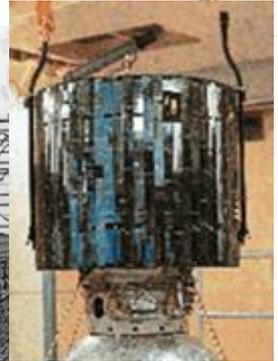


Briefing for radio propagation alert in old days (1957?)

Solar radio spectrum antenna (70-500MHz)



foF2 global map during Aug-Sep. 1978

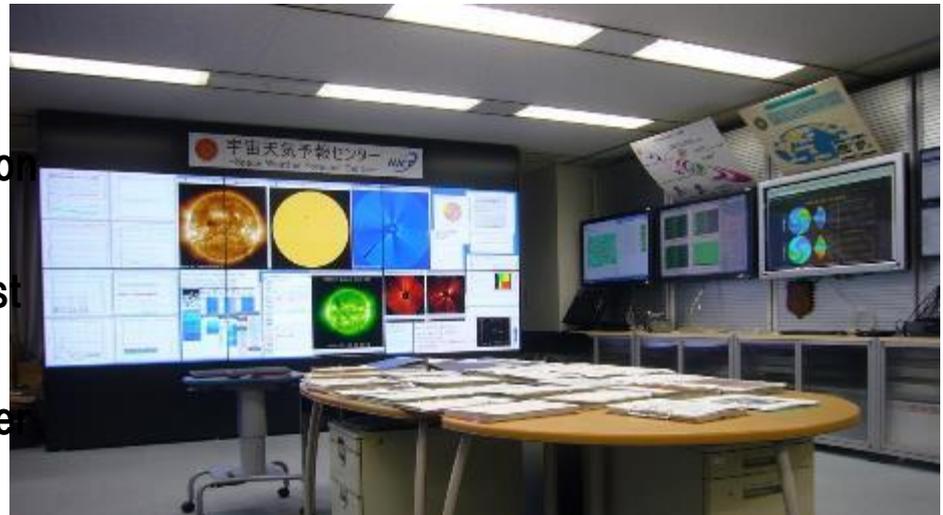


ISS-b "Ume-2" satellite

Since 1952, NICT have operationally measured solar radio spectrum, and started operational alert service for radio propagation since 1957.

In 1978, NICT provided foF2 global map first in the world using satellite observation.

Now, NICT has been providing Space Weather forecast information including weekend, and plan to operate 24/7 since 2019.

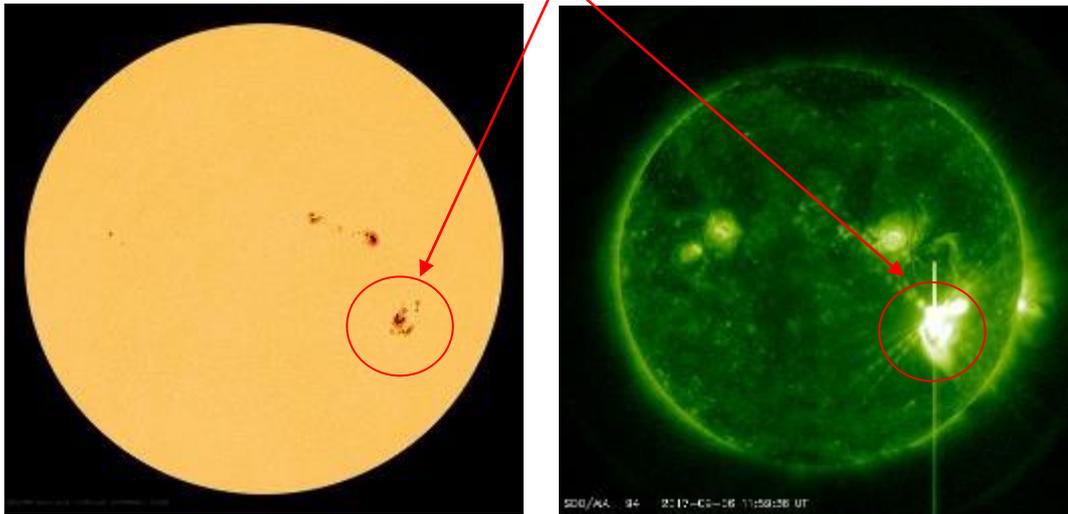


The present NICT Space Weather Center

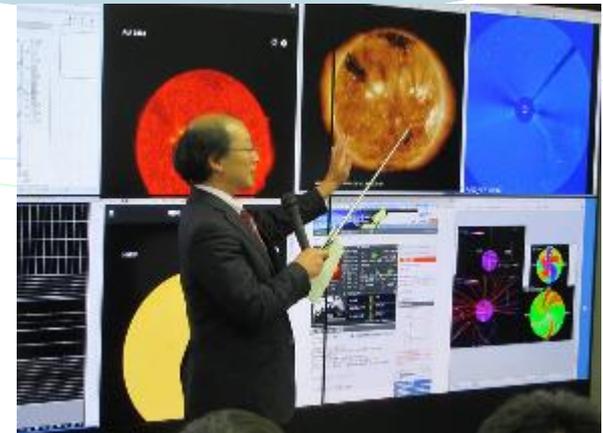
## Detail of the event

- ◆ A large scale solar flare (X9.3) was observed on 20:53JST Sep. 6, 2017, which has been 11 years since similar size event occurred.
- ◆ Coronal gas ejected simultaneously with the flare and would be forecasted to arrive to the Earth.
- ◆ The impact on GNSS, HF-communication and power grid from geomagnetic and ionospheric storm were observed.

Sun spot No. 2673



Solar images observed by SDO satellite(Left:visible, Right:UV)



Media	Number
TV	60
Newspaper	271
Web news	779

# After the Event on Sep. 6, 2017



NICT Future ICT Center (Kobe)

- Cabinet Office starts the discussion on space weather as a part of SSA in Aerospace Basic Strategy plan
- NICT prepared a robust system of Space Weather services. NICT headquarter locates in Koganei, Tokyo. It has been preparing a back up Center for space weather services at Future ICT Center, Kobe city.
- **The Japanese Radio Law was amended for including space weather as categories of Spectrum User Fee Budget.**
- **NICT started 24/7 human operation for Space Weather services since Dec. 2019.**

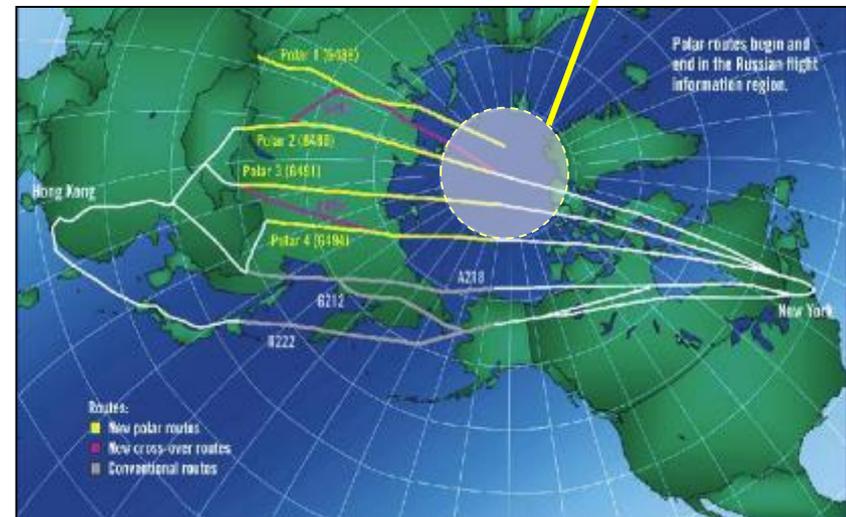
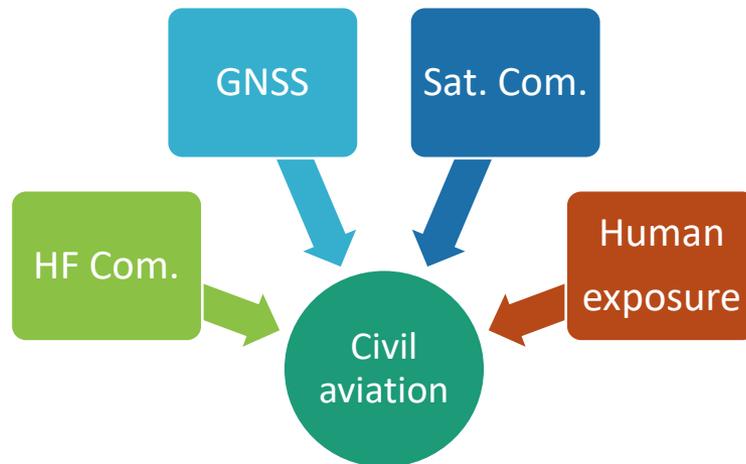
NICT Koganei Campus



# Space Weather information for ICAO

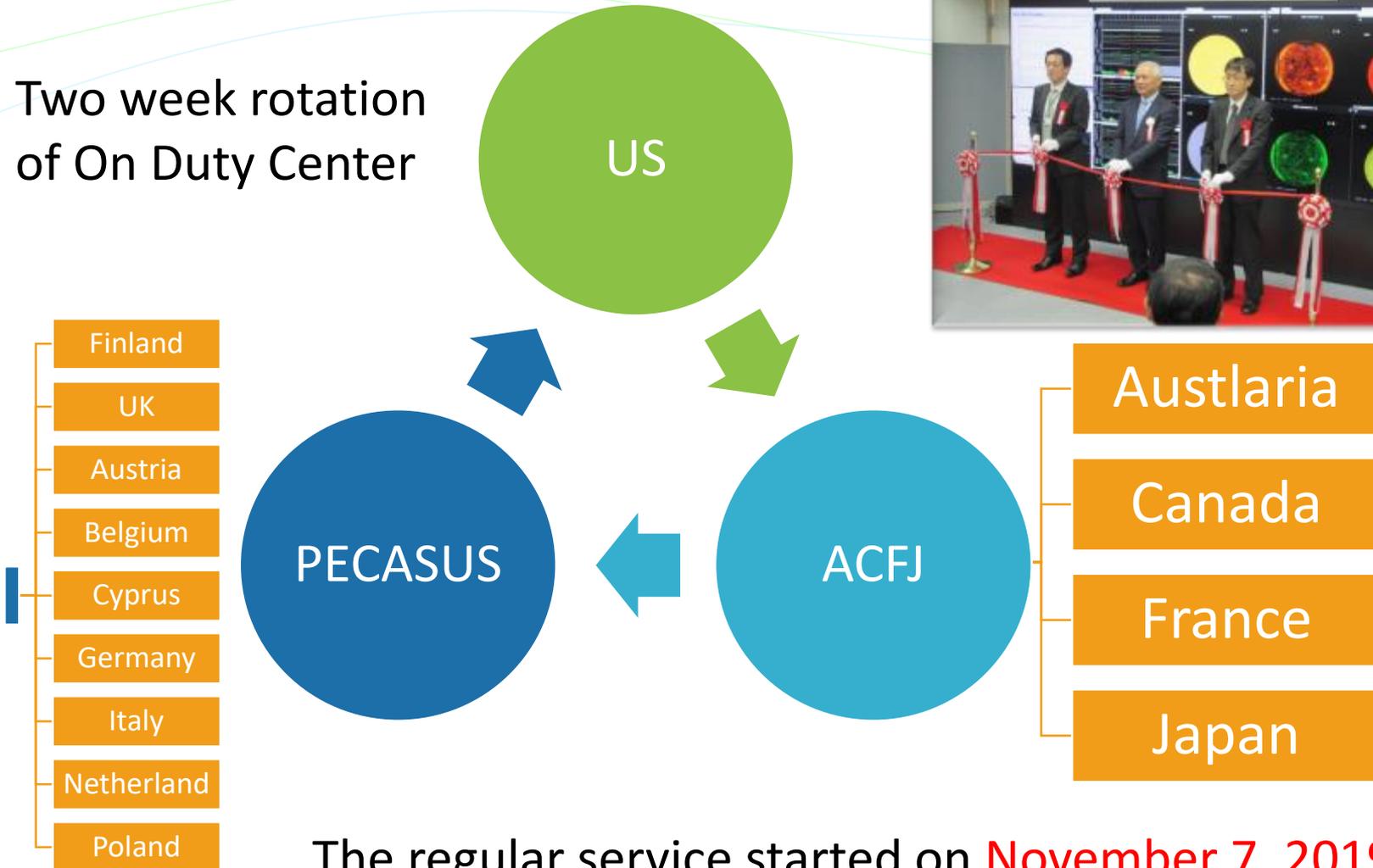
- IATA send a letter to ICAO for asking the discussion on the space weather impact on aviation on Nov. 2011.
- ICAO has discusses to add space weather information in Annex 3 which determines meteorological information for aviation. .
- In addition, ICAO had a process to assign ICAO space weather centers for providing the information on June 2017. Twenty two countries were entried, and finally three groups are assigned as ICAO global centers.

HF com. Is only way for telecommunication



# ICAO Space Weather Services structure

Two week rotation  
of On Duty Center



The regular service started on November 7, 2019.

# Asia-Oceania Space Weather Alliance (AOSWA)

- The Asia-Oceania Space Weather Alliance (AOSWA) established on 2010 for information exchange among Space Weather organizations in Asia and Oceania.
- Members: 27 organizations from 13 countries
- AOSWA workshop is held every one and a half years. The last one was hosted by LAPAN in Bandung, Indonesia in September, 2018.
- **Next meeting is scheduled on Aug. 10-13 2020 in Malaysia hosted by UKM.**
- Electric newspaper “AOSWA link” is circulated

Issue5, March 2015

We hope the AOSWA members will enjoy our activities for improving space weather activities.  
<http://www.nict.go.jp/>

**AOSWA**  
Link

*In this Issue...*

► **KASI's contributions to Space Weather**

*Hyungsuk Cho,  
Group Leader Solar and Space Weather Group,  
Korea Astronomy and Space Science Institute, Korea*

► **An Introduction to ANGKASA, UKM**

*Nurul Hajjah Hair & Marina Abdullah  
Space Science Centre (ANGKASA), Institute of Climate Change  
Universiti Kebangsaan Malaysia, Malaysia*

► **Internship Trainee Program at NICT**

*Suhaka M. Buhari  
Universiti Kebangsaan Malaysia, Malaysia*

► **United Nations / Japan Workshop on Space Weather**

*Akimasa Yoshioka, Lecturer  
International Center for Space Weather Science and Education, ICWSE  
Department of Earth and Planetary Sciences, Kyushu University*

► **Domestic Collaborative Symposia**

*supported by the Solar-Terrestrial Environment Laboratory,  
Nagoya University, Japan*

**Your contribution is always welcome!**

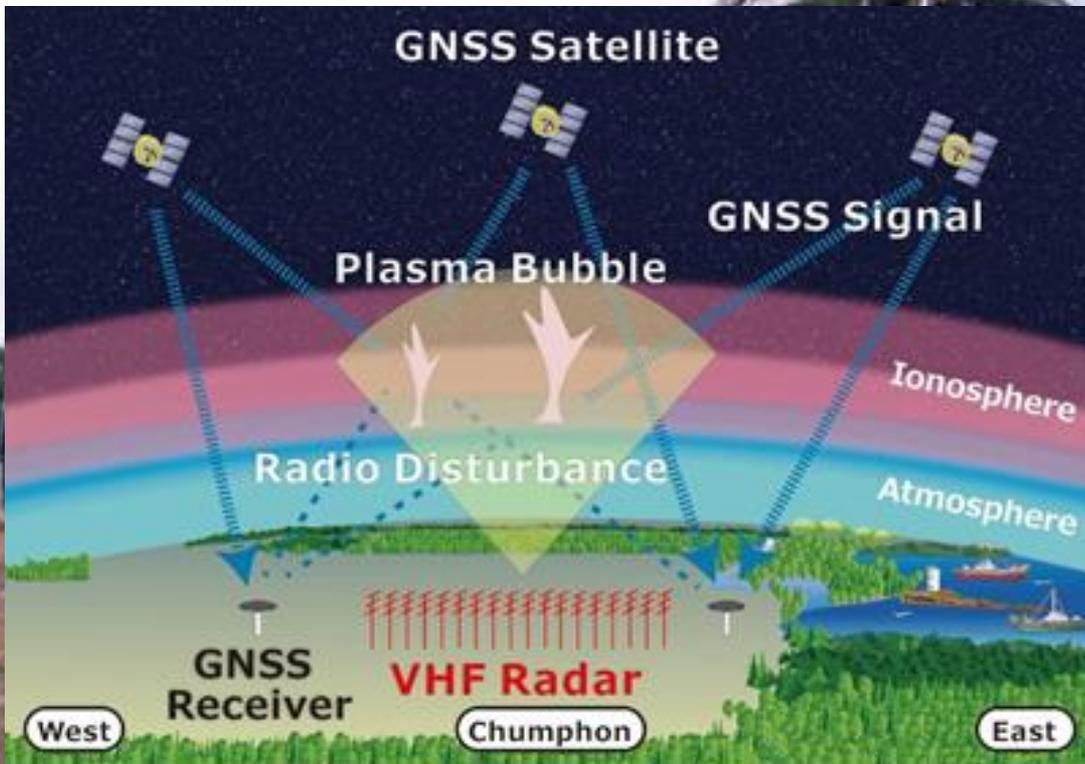
If you should wish to submit an article, you are greatly appreciated. The articles should be approximately 500 words and contain either figures or pictures. Also it is available for use as a means of spreading information, such as upcoming conference and so on. Your feedback is always welcome.

Contact : [sw-project-office@nict.go.jp](mailto:sw-project-office@nict.go.jp)



AOSWA-5 @ Bandung in Sep. 19-21, 2018 hosted by LAPAN, Indonesia

# Establishment of VHF radar in Chumphon, Thailand on Jan. 2020



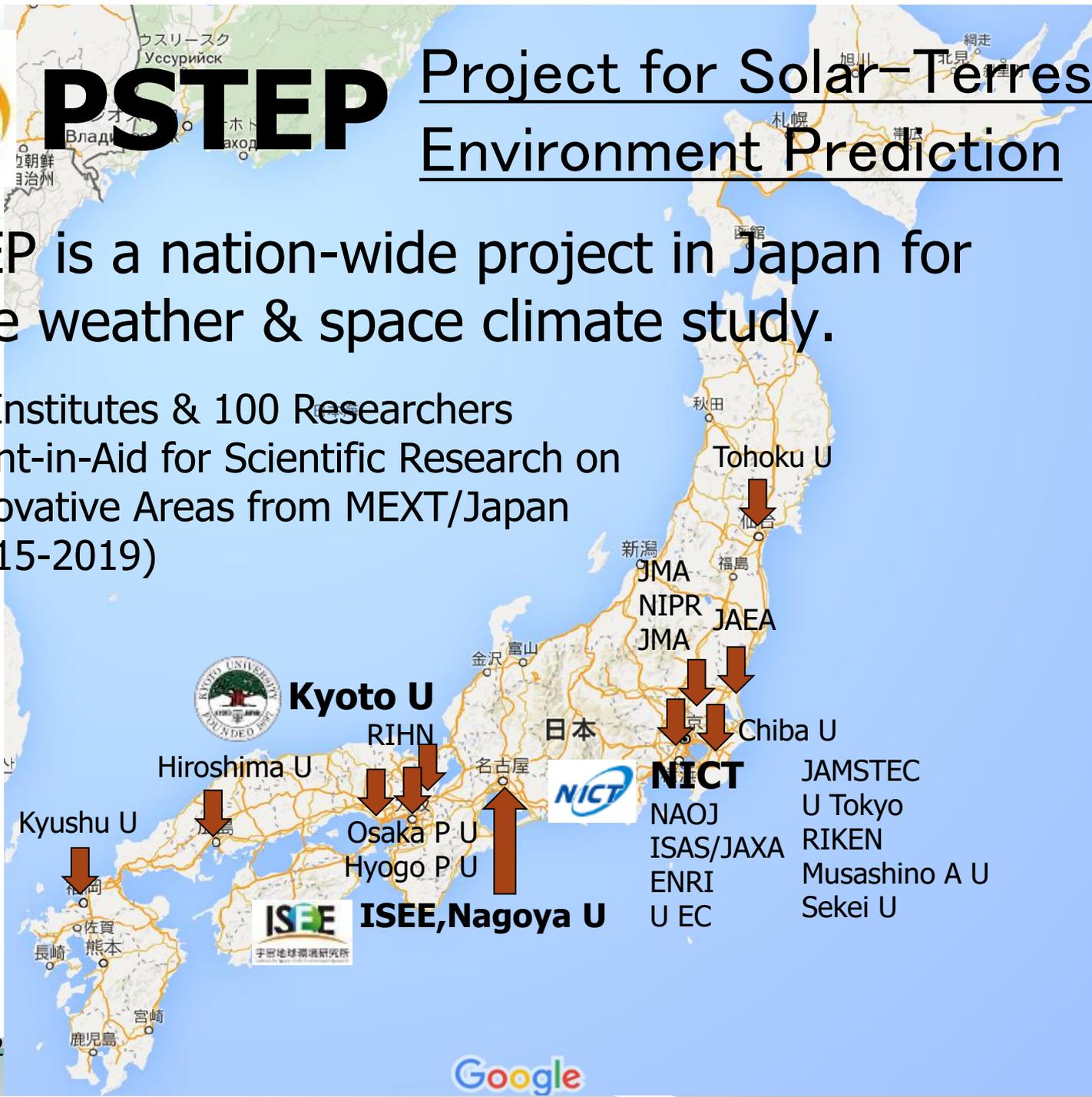


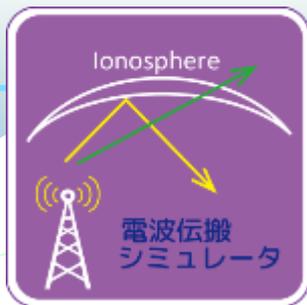
# PSTEP

## Project for Solar-Terrestrial Environment Prediction

PSTEP is a nation-wide project in Japan for space weather & space climate study.

- 20 Institutes & 100 Researchers
- Grant-in-Aid for Scientific Research on Innovative Areas from MEXT/Japan (2015-2019)

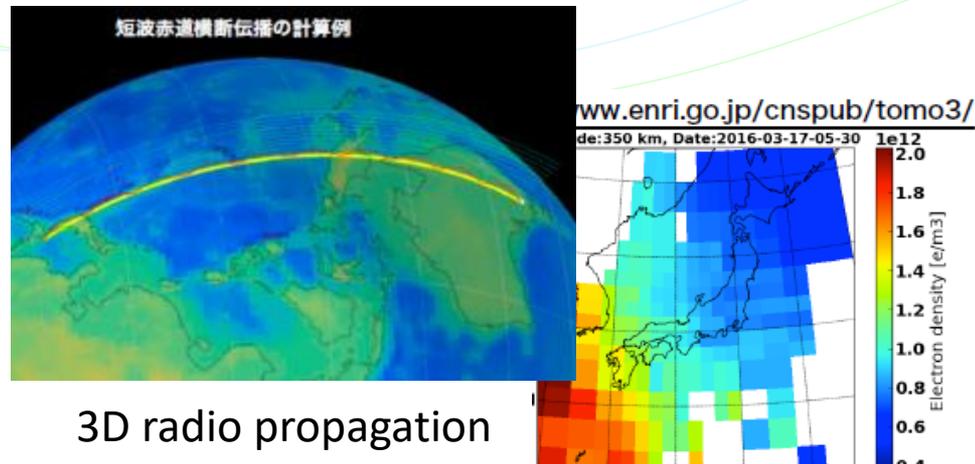




# Developing Radio Propagation model

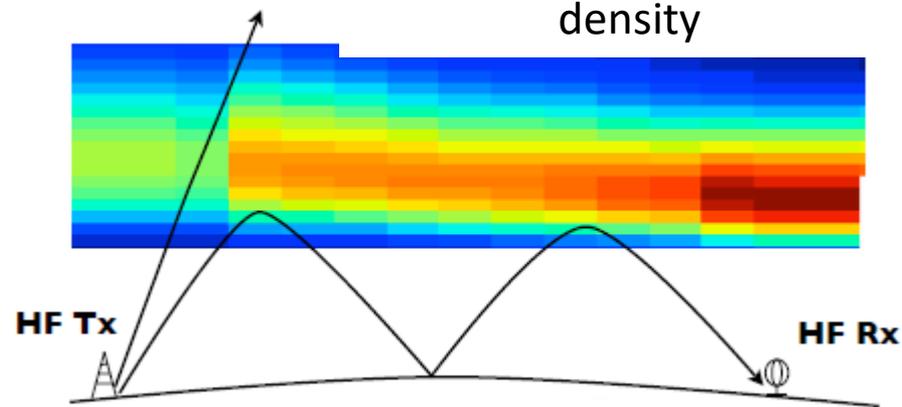
Radio propagation model is necessary to notice the usability of HF, VHF and GNSS at a particular point. We develop a new 3D radio propagation model “HF-START”

- The fundamental structure of radio propagation parameter for HF has completed. Validations of the model comparing with observational results are to be executed.
- The model for GNSS is planned to be build cooperated with CNES, France.
- Real time radio propagation model is to be possible by connecting the 3D tomography technique build by Kyoto Univ.



3D radio propagation simulator

3D distribution of ionospheric electron density

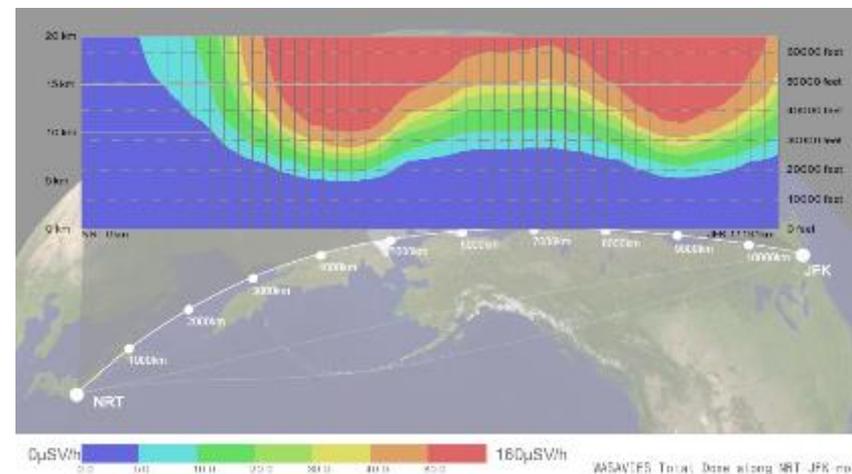
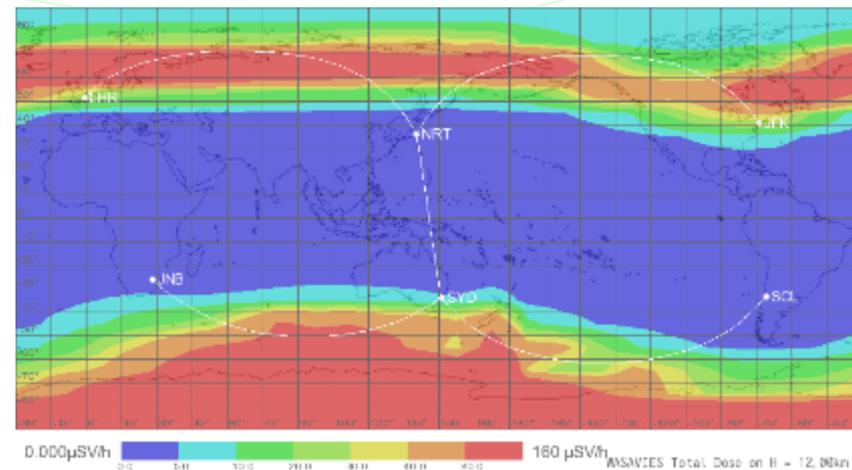


Example of real time radio propagation model



# Purpose of Estimation system of human exposure

- Initial purpose
  - Is to establish the system for providing the present radiation level in the airplane when the large proton event is occurred to happen to the GLE events.
- Final goal
  - Is to develop the system to provide the forecast of temporal variation of human radiation in the airplane with several hours from the event occurred.
  - And to develop the system to estimate the nowcast and forecast of human radiation in ISS



# Conclusions

- NICT is only organization to provide space weather forecast information operationally in Japan.
- After X9.3 solar flare on September 6, 2017, Japan has constructed robust system for monitoring and forecasting space weather including the set of back up center and 24/7 operation.
- Japan contributes to ICAO as a part of space weather global centers. The service started on Nov. 7, 2019.
- NICT has national and international collaboration for improving space weather observation and forecast framework.

Acknowledgement: Some parts of this activities are consigned from the Ministry of Internal Affairs and Communications. PSTEP is supported by the Grant-in-Aid for Scientific Research on Innovative Areas (2015-2019), MEXT, Japan