

National Space Weather Strategy

New journey as national space agency, KASA

JUNE. 14. 2024

Kichang Yoon

* ICAO METP, ISES Web secretary



Korea AeroSpace Administration
Korea Space Weather Center

Recent Accomplishment of KSWC

1. Forecast & Warning
2. Observation Network & Research
3. International Collaboration
4. Organizational Structure of KASA



Hot Korean Movie of Moon Exploration



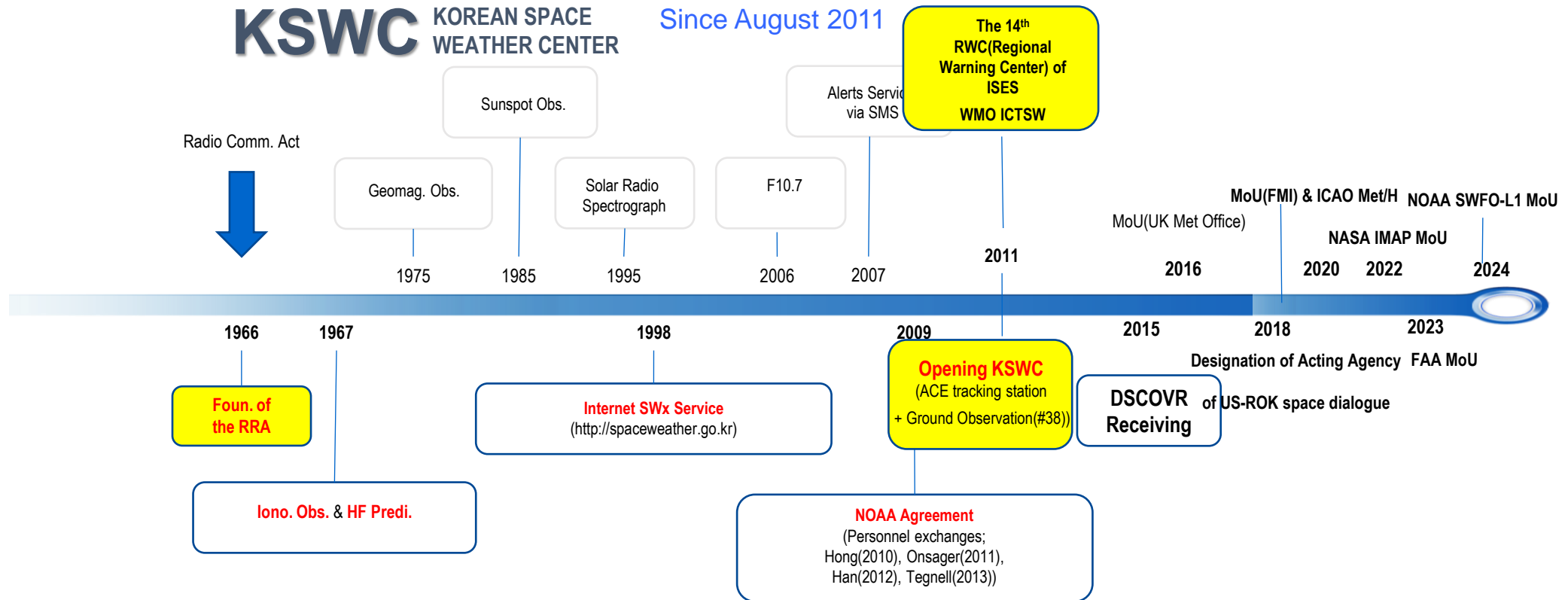
600,000 people Watch & Lunar Orbiter has serious malfunction due to CME

KSWC Supporting Spacecraft Launch



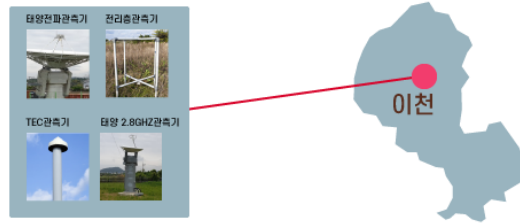
New Launch of KSLV(Korea Space Launch Vehicle) – May 23, 2023

Timeline of KSWC(Since 2011~)

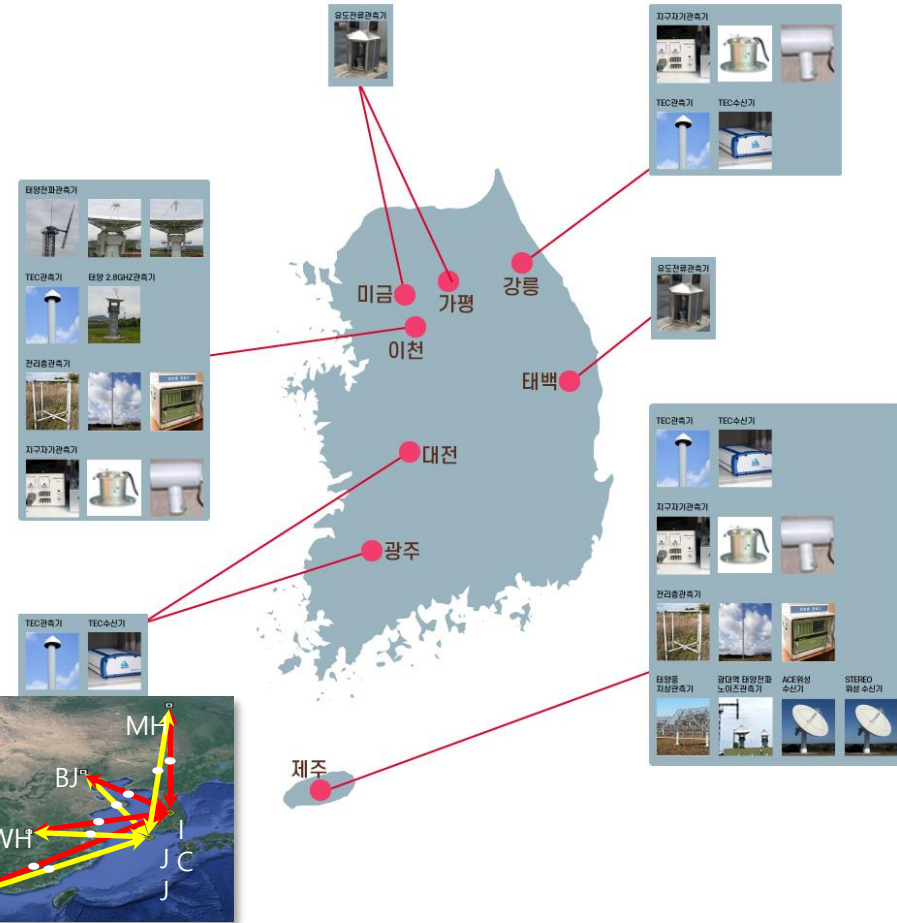


Observation Network

Before 2011



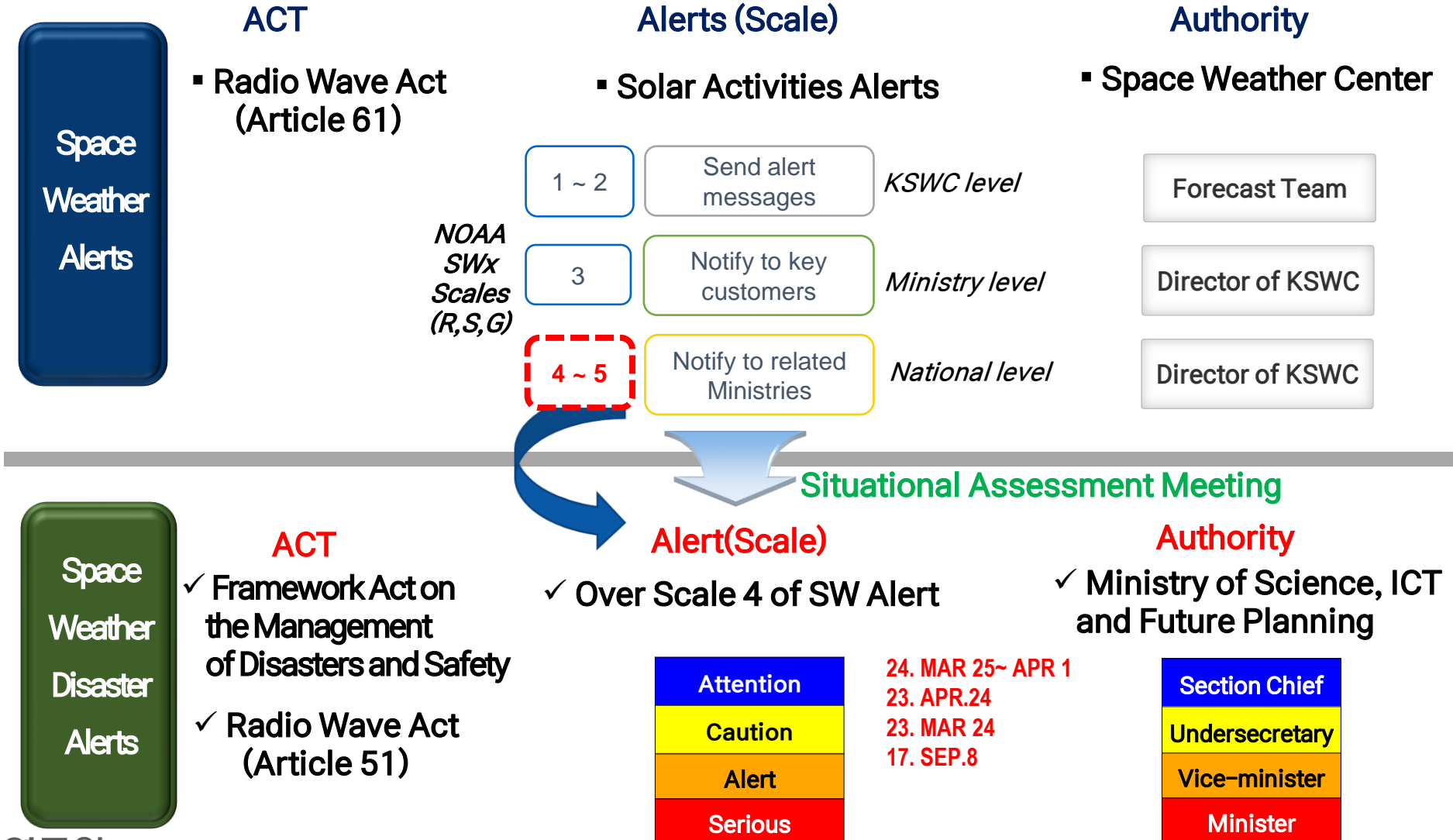
Since 2011



Newly established Geo-magnetometer(with 1-min cadence) at Jeju Site



Forecast & Warning



Publishment of 3rd national space weather strategy(2023-2027)

Radio
Wave
ACT

Article 51 (Establishment & Implementation of basic plan for the management of Space Weather Risks)

The Minister of Science, ICT and Future Planning shall establish and implement a **basic plan for the management of space weather risks** including following in order to prepare, control and recover against disasters due to variation of space weather conditions in every 5 years.

1. Matters concerning **observation** and **surveillance** of variation of **space weather conditions**;
2. Matters concerning **forecasts and alerts** of space weather risks;
3. Matters concerning **R&D** (Research and Development) and **international cooperation** for the prevention of and preparing against space weather risks.
4. Other matters necessary to provide against space weather risks.

3rd Master Plan for Space
Weather Disaster
Management
(2023~2027)



과학기술정보통신부

2023. 2.

[f1wLWKd](#)

OR



국립전파연구원
National Radio Research Agency

New Research Program(23-27) for Tailored service

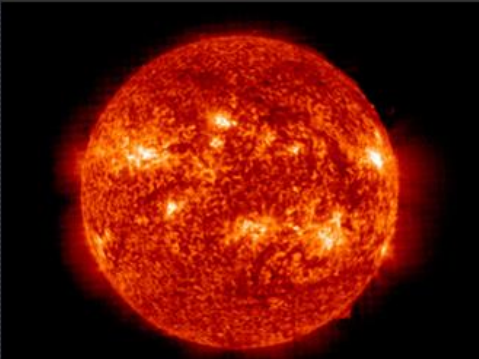
- Space Weather Environment for LEO/GEO Satellites
- > 10 MeV Solar Proton Events with Automatic CME detection
- Solar Synoptic Magnetograms Using Deep Learning
- Prediction Model for Sporadic E-Layer Occurrence
- Advancement of space weather radio observation data processing

R & D - ASSA

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

ASSA Automatic Solar Synoptic Analyzer

AboutASSA ProgramLatest ResultsFeedback



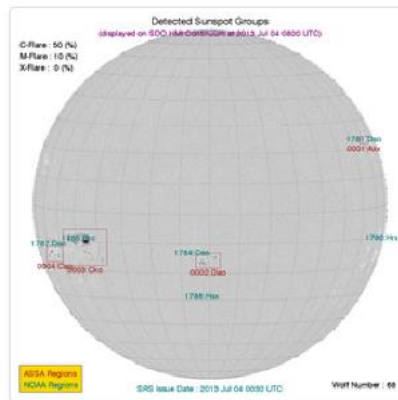
ASSA Categories

ASSA consists of the following three categories

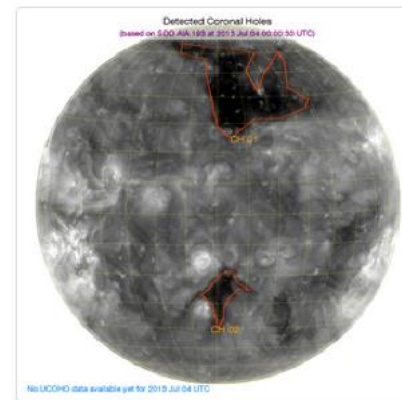
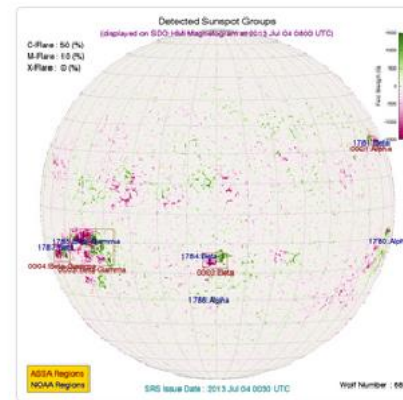
- * sunspot group identification and classification
- * coronal hole detection
- * filament detection

For each category, ASSA receives necessary solar raw images and processes them in a designated procedure to yield resultant output files.

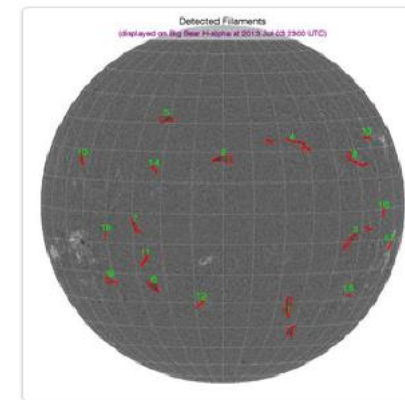
Latest Results



TEXT INFO

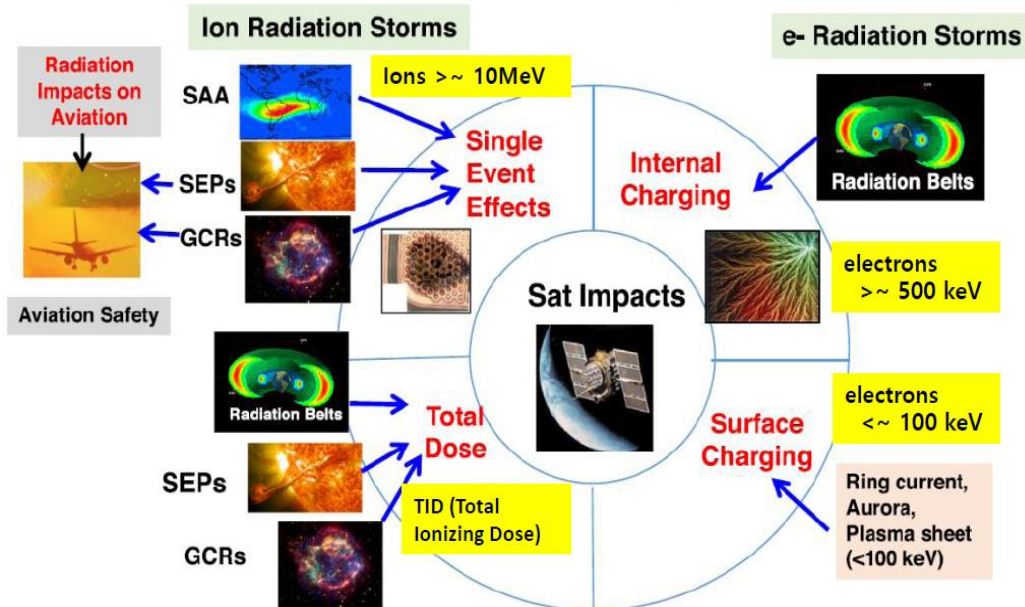


TEXT INFO



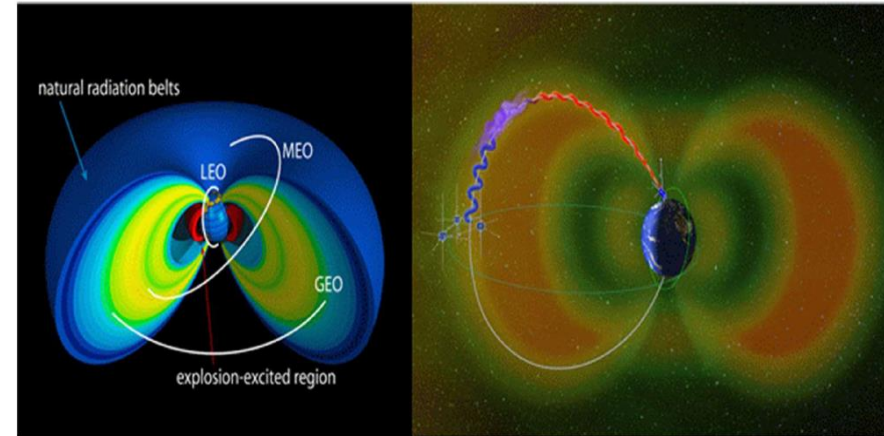
1) Space Weather Environment for LEO/GEO Satellites

❖ Radiation & Charging Effects



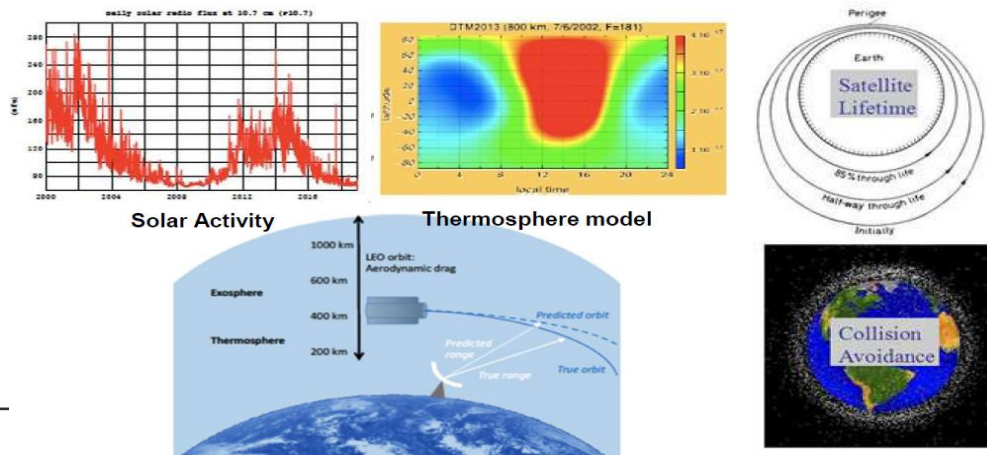
[Zheng et al., Space Weather, 2019]

❖ High Energy Particles & Van Allan Radiation Belt



[Reeves et al, 2020, AMOS Conf; Zhang et al. 2022, Nat Comm]

❖ Satellite Drag Effects



❖ Space Debris

Large Constellations and Safety of Flight - Spacecast 35

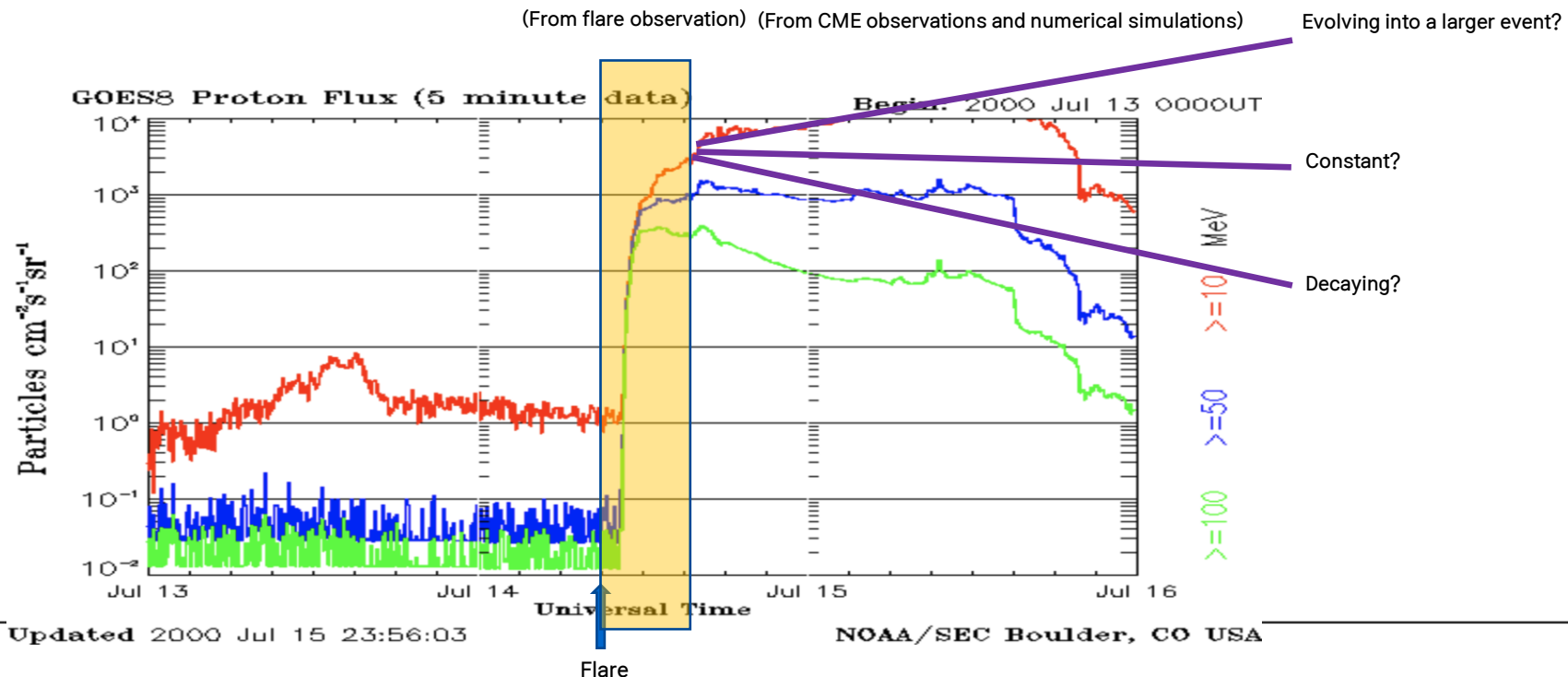
Encounters in 10 years of non-intervention ops (circa 2020, p. 3)

#	Operator	# S/C	Alt (km)	Current RSO catalog average number			~200,000 RSO catalog average number		
				Collisions in 10 years	3km warnings in 10 years	1km maneuvers in 10 years	Collisions in 10 years	3km warnings in 10 years	1km maneuvers in 10 years
39	OneWeb	2,560	1,200	0.32	754,868	83,874	2.49	10,832,864	1,203,652
40	OneWeb_next	720	1,200	0.17	286,598	31,844	1.69	4,726,261	525,140
41	OrbComm	16	750	0.00	40,930	4,548	0.00	303,482	33,720
42	Orora.Tech	100	650	0.02	198,308	22,034	0.05	1,799,993	199,999
43	Planet	200	500	0.02	167,124	18,569	0.03	1,607,487	178,610
44	PlanetIQ	18	775	0.00	54,882	6,098	0.00	449,177	49,909
45	Reaktor	36	495	0.00	26,014	2,890	0.01	264,686	29,410
46	Satellogic	300	477	0.02	236,040	26,227	0.02	2,254,977	250,553
47	Sky/Space Gbl	200	507	0.02	180,456	20,051	0.05	1,712,964	190,329
48	SkySat	6	500	0.02	6,009	668	0.12	48,980	5,442
49	Space_Norway	2	25,799	0.00	0.29	0.03	0.00	0.63	0.07
50	SpaceX	4,425	1,200	6.43	2,050,452	227,828	77.73	30,310,084	3,367,787
51	SpaceX_VLEO	7,488	350	0.99	315,000	35,000	23.90	9,318,590	1,035,399
52	SpaceX_next	60	580	0.23	73,743	8,194	1.95	758,544	84,283
53	Space_X_M-T	20,940	500	43.13	13,753,896	1,528,211	404.53	157,747,388	17,527,488
54	Space_X_U-W	9,000	330	0.93	347,030	38,559	21.85	10,053,221	1,117,025
55	Swarm	150	443	0.08	52,323	5,925	0.98	823,160	91,462

[Large Constellations & Safety of Flight, Spacecast 35]

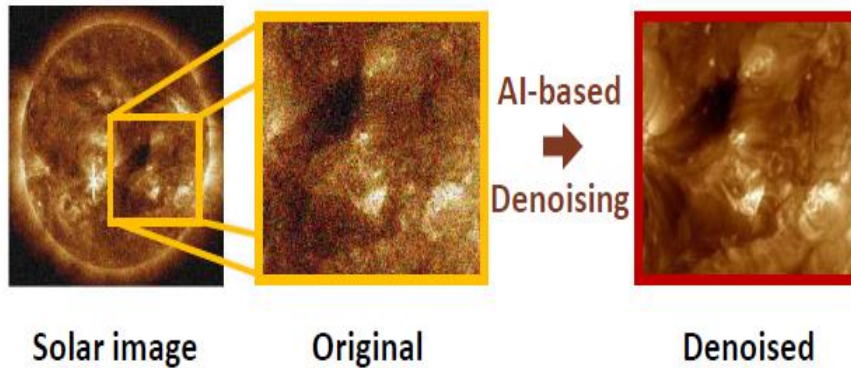
2) Modeling > 10 MeV Solar Proton Events with Automatic CME detection

- ❖ Modeling Near-Earth > 10 MeV Solar Proton Event Prediction by Probing into Solar Wind Condition with Automatic CME detection
- ❖ Making the prediction of the timing and scale of Solar Radiation Storms:
 - After obtaining the flare magnitude from GOES X-ray flux data, predict within 10 minutes the peak intensity of the prompt component of the GOES >10 MeV proton
 - After obtaining CME observations of the event, predict the 12 hours long time-intensity profile of the GOES >10 MeV proton

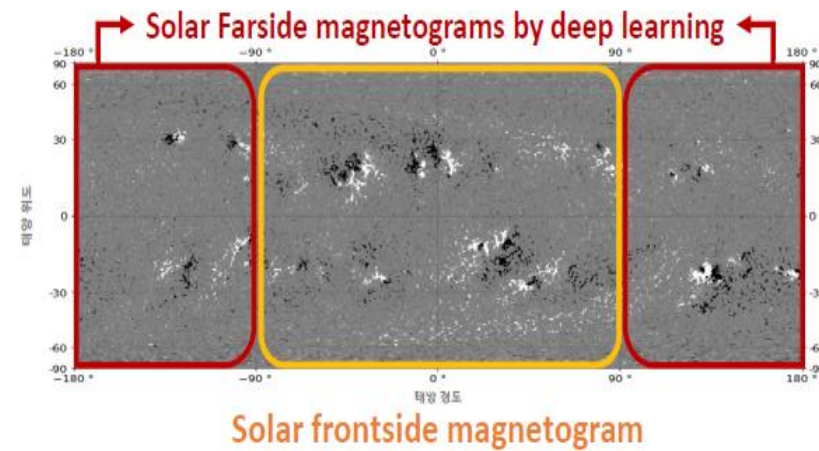


3) Development of Solar Synoptic Magnetograms Using Deep Learning

1 Improvement of Solar Data by Deep Learning



2 Generation of Solar Farside Magnetograms by Deep Learning



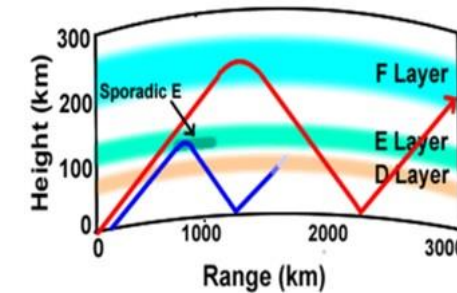
4) Development of the Prediction Model for Sporadic E-Layer Occurrence

■ Sporadic E(Es) Layer

- ✓ Es layer has significant influence on radio communications and broadcasting, and predicting the occurrence of sporadic E layer is one of the most important issues in space weather forecast
- ✓ Because of the highly complex behavior of sporadic E layer, the prediction of Es layer occurrence has been one of the most difficult issues in space weather forecast
- ✓ To explore the possibility of predicting Es layer occurrence, we performed statistical analysis of Es layer occurrence over Korea and employed the machine learning based method

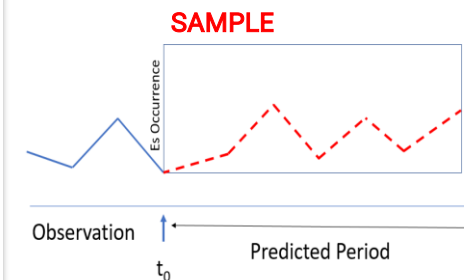
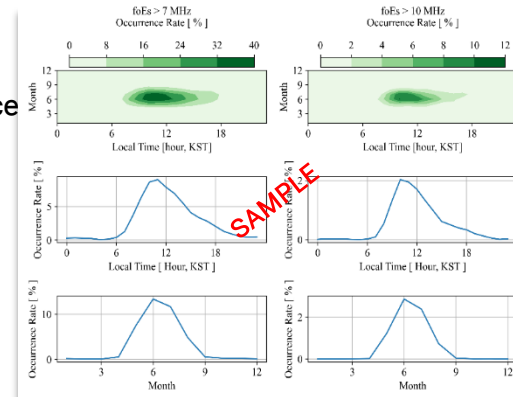
■ Research Objectives

- ✓ Statistical analysis and modelling of Es layer occurrence over mid-latitude stations
 1. Diurnal, seasonal and solar cycle variations in Es layer occurrence
 2. Correlation analysis of Es layer occurrence
 3. Development of prediction models for Es occurrence using machine learning(ML) based method

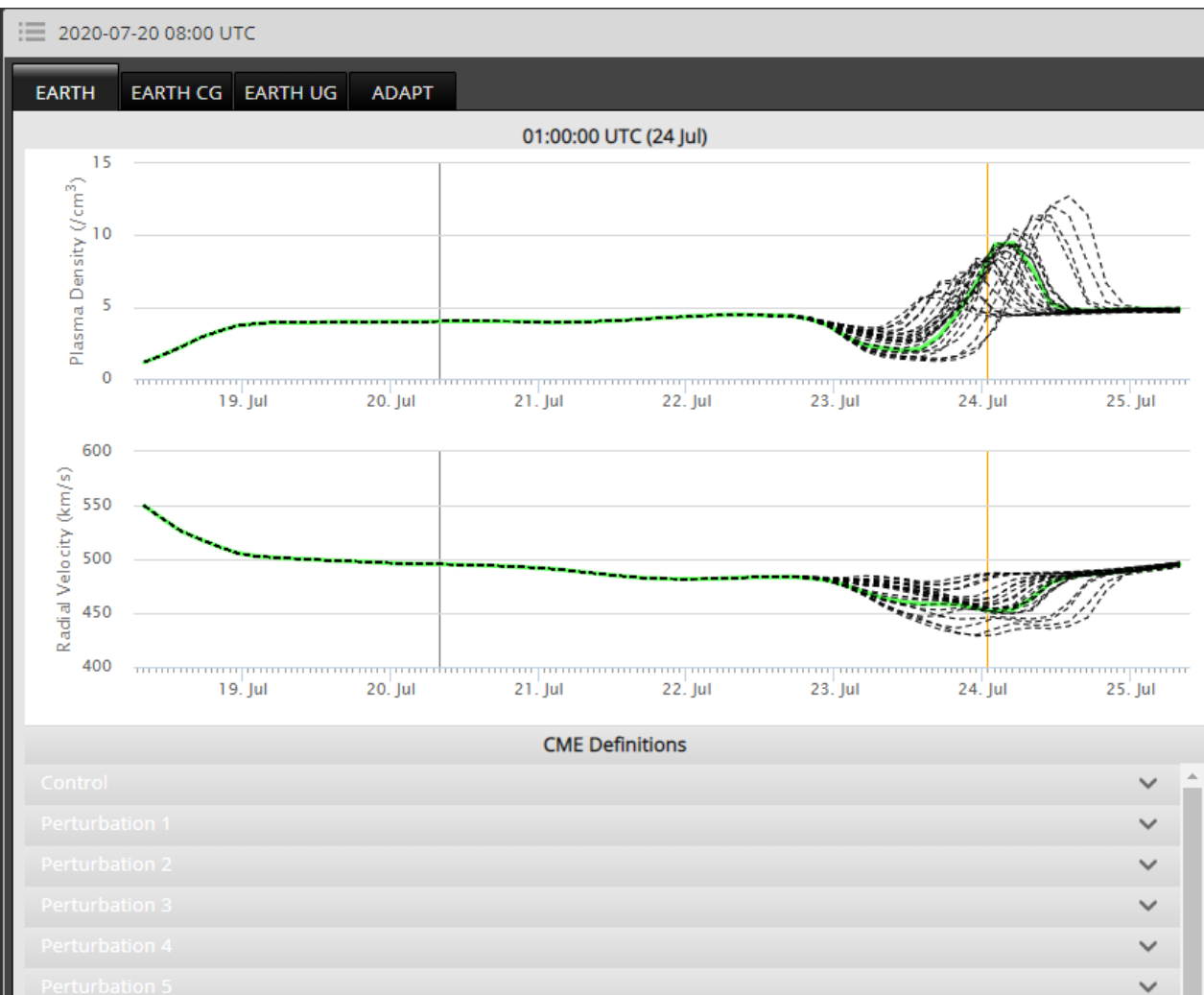
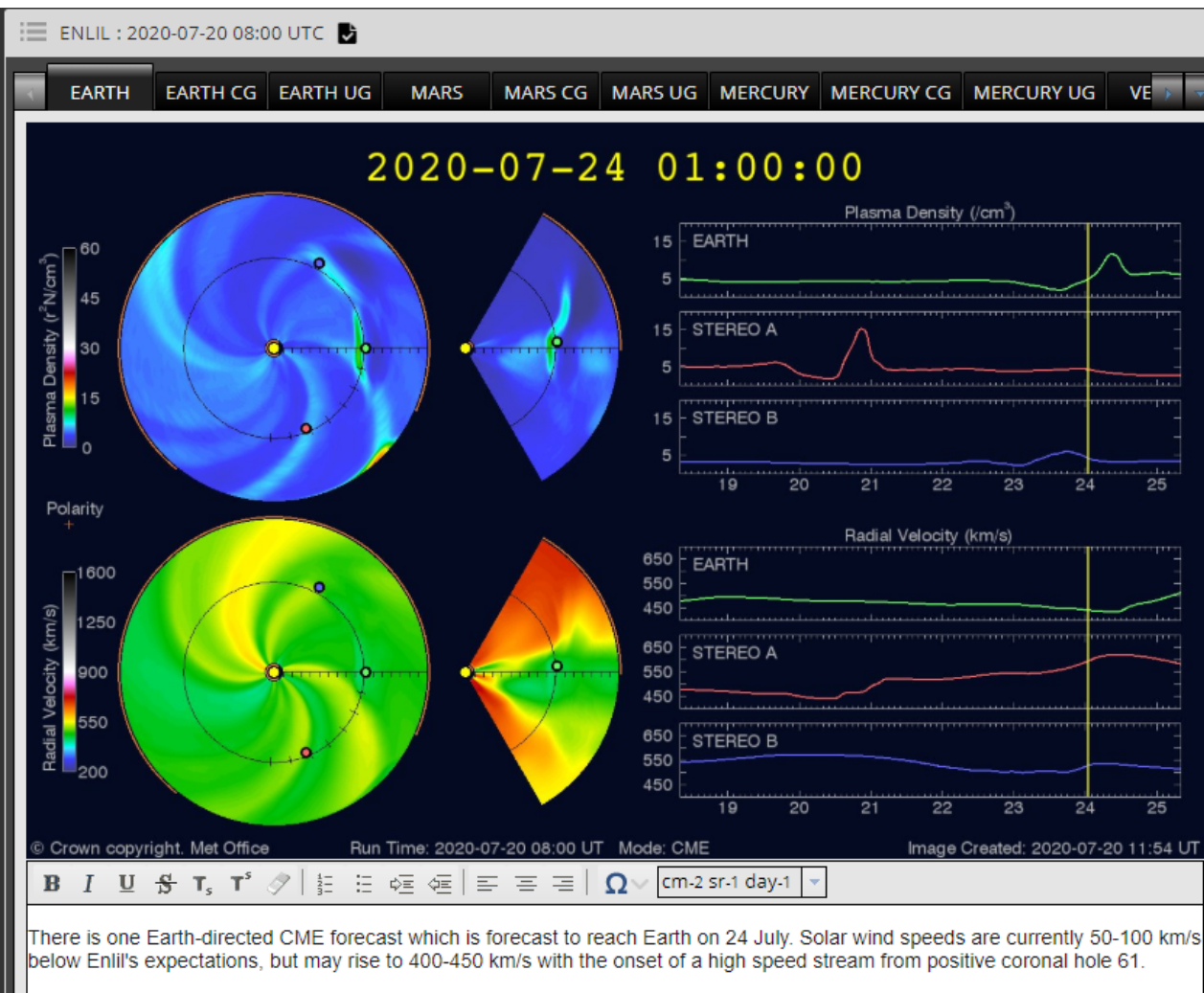


■ Expected Results

1. Local time, seasonal distribution of Es layer occurrence over mid-latitude stations
2. Solar cycle variation of Es layer occurrence
3. Basic quantity for ML based model
4. Real-time Es occurrence forecast system



Ensemble Enlil Operation



Support to Int'l Satellite Project(SWFO, IMAP)



ACE/STEREO/DSCOVR receiving station at KSWC



NASA IMAP & SWFO-L1 will be constructed in 2025

COSPAR(Panel on Space Weather) – July 13–21

▪ Session 7(International Collaboration) : July 17~18

➤ SOC



MSO : Kichang
(KSWC)



DO: Mamoru Ishii
(NICT)



Suzy Bingham
(UK METOFFICE),



✓ Terry Onsager(NOAA)



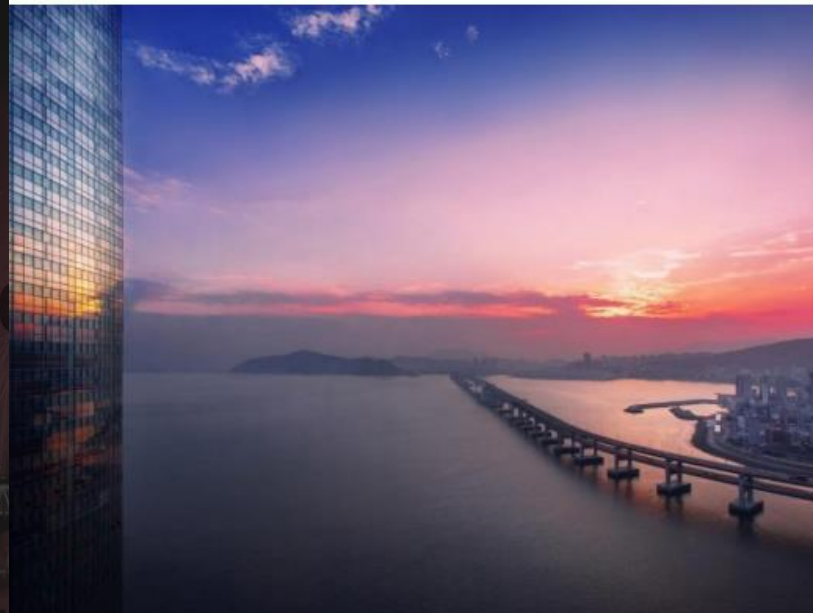
Joaquim(INPE)



Luca Spogli(IN)



Pornchai (KMITL)



4-year Program for R20-O2R process(2025-2028)



In May 27

>>>>>

>>>>>

New Korea AeroSpace Administration, KASA



KASA Fundamental Direction



Flexible R&D

- Term-based civil servant
- Project Team based operation



Flexible HR Management

- Salary payment 150% higher than existing civil servants
- Permission for concurrent employment



Autonomy in Budget execution

- Budget-specific
- AEROSPACE FUND



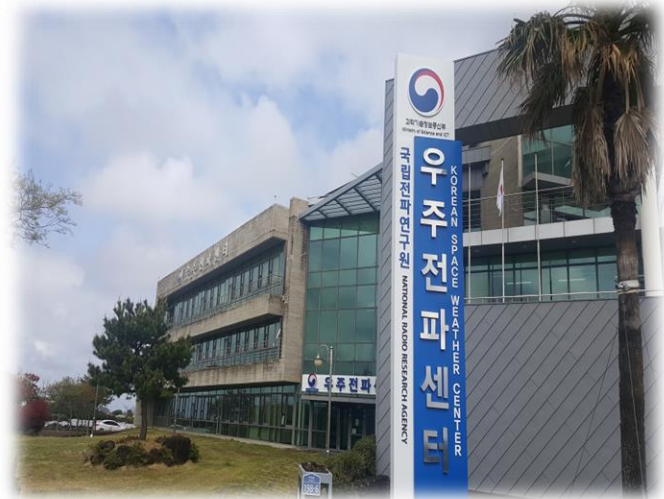
Collaboration with Research Institutes

- KARI·KASI (NST → KASA)

KASA Locations

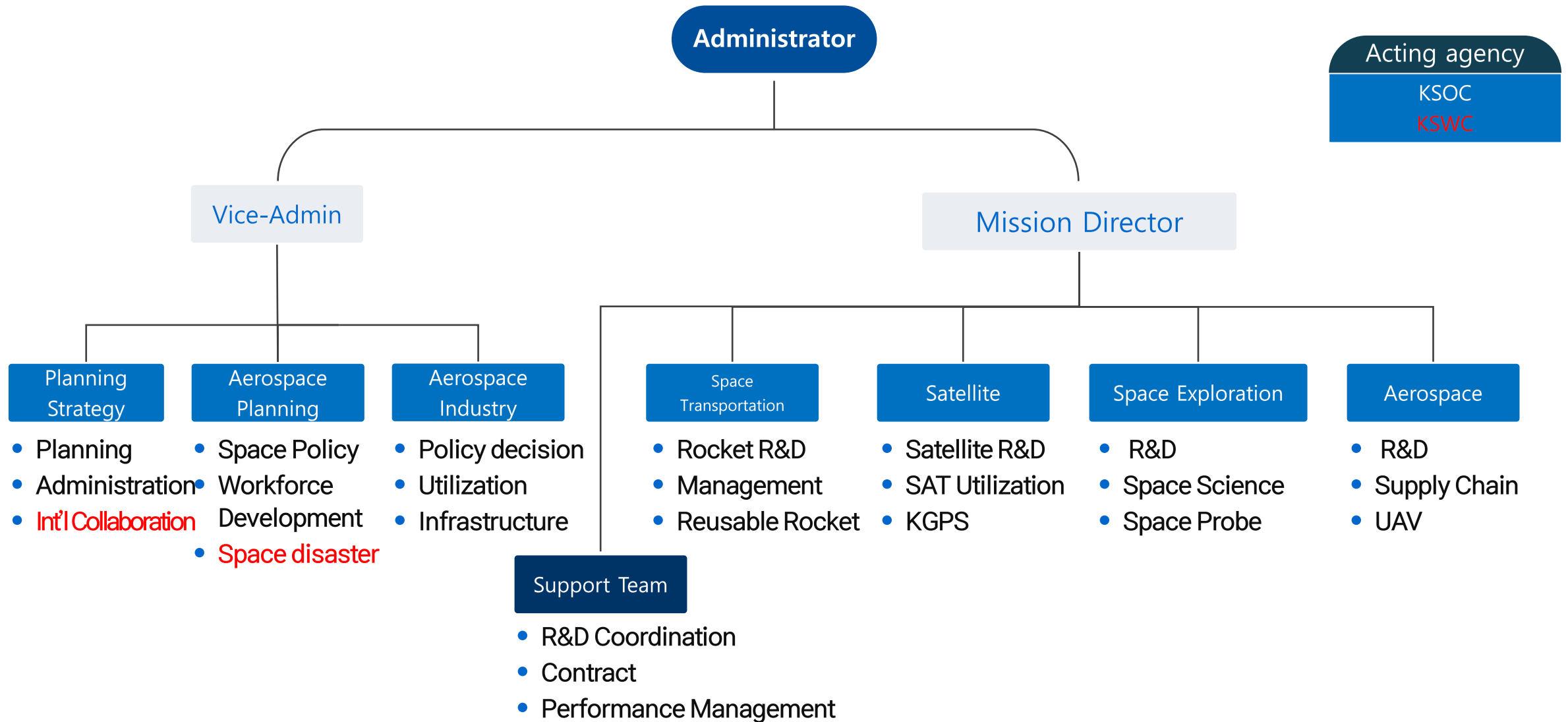


Space Weather Center



- Location: Jeju Hallim
- Main Responsibility
 - Space weather forecast & operation
 - Management of Space weather risk

Organizational Structure of KASA



New Mission of Korea Space Weather Center

- Support [Space Disaster](#)(with Space Debris) in [SSA](#)(Situational Space Awareness)
 - R&D(Solar activity, Geomagnetic field, Ionosphere) Strategy and Planning
 - Space Weather Observation & Research on Observation Technology
 - Space Weather Forecast & Warning
 - International SWx Organization
 - Management of Space weather Risk
 - Establishment of national space weather risk management & operation
 - Public awareness of Space Weather
-

NEW Challenge of Korea Space Weather Center

Thank you for your attention
portion@korea.kr



BACK UP Slides

International Collaboration

■ COSPAR PSW Session 7 : International Collaboration

PSW.7-0001-24 09:00 - 09:15

International Space Weather Initiative: The Way Forward

Gadimova, Sharafat; Gadimova, Sharafat; Amory, Christine

PSW.7-0002-24 09:15 - 09:30

Geoelectromagnetic opportunities for international, interagency, and interdisciplinary cooperation

Love, Jeffrey; Lewis, Kristen; Kelbert, Anna; Rigler, E. Joshua; Bedrosian, Paul; Ringler, Adam T.

PSW.7-0003-24 09:30 - 09:45

Establishing a real-time space weather research downlink network for the NASA/IMAP mission in collaboration with international partners

Posner, Arik; Goldemen, Elizabeth; Williams, Bradley; Bussey, George; Janches, Diego

PSW.7-0004-24 09:45 - 10:00

Compact Ionospheric Probe on CubeSat Constellation for Space Weather Missions

Chao, Chi-Kuang

PSW.7-0005-24 10:00 - 10:15

Recent Space Weather Activities of Regional Warning Center China of ISES

Luo, Bingxian

PSW.7-0006-24 10:15 - 10:30

SCOSTEP's contribution to the cooperation of international space weather

Shiokawa, Kazuo

PSW.7-0007-24 11:00 - 11:15

Reinventing Space Weather with Artificial Intelligence

Camporeale, Enrico; Berger, Thomas

PSW.7-0008-24 11:15 - 11:30

Recent Activities of International Space Environment Services [U+FF08]ISES)

Ishii, Mamoru; Dasso, Sergio

PSW.7-0009-24 11:30 - 11:45

Integrative Approaches to Advance Space Weather Capability

Talaat, Elsayed

PSW.7-0011-24 12:00 - 12:15

On the Latin America effort for fostering the International Space Weather Cooperation: locally and globally

Denardini, Clezio Marcos; Gulisano, Adriana Maria; Meza, Amalia; Scipión, Danny E.; Costa, Joaquim; Valdivia, Juan Alejandro; Gonzalez-Esparza, Americo; Milla, Marco; Molina, Maria Graciela; Natali, Maria Paula; Dasso, Sergio

PSW.7-0012-24 12:15 - 12:30

International Agency Space Weather Research and Mission Coordination Forum

Spann, James

Date: Wed, Jul 17, 2024. Room: EC1-315

PSW.7-0013-24 17:00 - 17:15

Contributions of the World Meteorological Organization to International Collaboration on Space Weather

Andries, Jesse

PSW.7-0014-24 17:15 - 17:30

The Space Weather Operational Readiness Development (SWORD) Center - an international focal point for orbital space weather forecasting research

Berger, Thomas; Pulkkinen, Tuija; Gombosi, Tamas; Baker, Dan Team: The SWORD Center of Excellence Co-Is and Collaborators

PSW.7-0015-24 17:30 - 17:45

Space weather cooperation in the context of ground based (observational) data

Bhattacharya, Shreya; Lefevre, Laure Team: SIDC team

PSW.7-0016-24 17:45 - 18:00

The Need for Improved Ground-Based Coordination for Space-Weather Purposes with a Focus on Heliospheric Remote-Sensing Capabilities Using Radio Techniques

Bisi, Mario M.; Jackson, Bernard; Gibson, Sarah; Hapgood, Mike; Fallows, Richard; Iwai, Kazumasa; Tokumaru, Munetoshi; Forte, Biagio; Zucca, Pietro; Kuznetsova, Maria

PSW.7-0017-24 18:00 - 18:15

The International Meridian Circle Program: Addressing the Challenges of Space Weather and Space Climate via International Collaboration

Blanc, Michel; Wang, Chi; Liu, William; Shen, Xuhui; Wu, Jian; Zhang, Shunrong; Denardini, Clezio Marcos; Amory, Christine; Rabiou, Babatunde; Bounhir, Aziza

PSW.7-0018-24 18:15 - 18:30

Global Collaboration in Space Weather Research: Insights from Thailand's Experience

Channumsin, Sittiporn; Bumrungrkit, Acharaporn; Kaewthongrach, Rungnapa; Puttasuwa, Keerati

Date: Thu, Jul 18, 2024. Room: EC1-315

PSW.7-0020-24 09:15 - 09:30
Towards an Ideal Space Weather Service Network: Comparative Analysis and Best Practices
de Patoul, Judith Team: SIDC/STCE - Space Weather Operations Center - Royal Observatory of Belgium

PSW.7-0021-24 09:30 - 09:45
Global Cooperation in Space Weather: ISWI Perspective
Gopalswamy, Nat

PSW.7-0022-24 09:45 - 10:00
The international need for ground-based and spacecraft space weather heliospheric remote sensing cooperation
Jackson, Bernard; Bisi, Mario M.; Iwai, Kazumasa; Tokumaru, Munetoshi

PSW.7-0023-24 10:00 - 10:15
Pathways to international coordination in space weather
Kuznetsova, Maria; Andries, Jesse; Opgenoorth, Hermann; Ishii, Mamoru; Bingham, Suzy; Kauristie, Kirsti; Dasso, Sergio; Mann, Ian Team: International Space Weather Action Teams Moderators

PSW.7-0024-24 10:15 - 10:30
International cooperation in Space Weather activities by European Space Agency
Luntama, Juha-Pekka; Glover, Alexi

Date: Thu, Jul 18, 2024. Room: EC1-315

PSW.7-0025-24 11:00 - 11:15
Towards improved international coordination in space weather: What are the next steps following the work of the United Nations Expert Group on Space Weather?
Mann, Ian

PSW.7-0026-24 11:15 - 11:30
International Space Weather Cooperation Activities of the Australian Bureau of Meteorology
Marshall, Richard

PSW.7-0027-24 11:30 - 11:45
A Revision of the Space Weather Scales
Murtagh, William; Wallace, Clinton

PSW.7-0028-24 11:45 - 12:00
Operational Space Weather Activities in The Coordination Group for Meteorological Satellites
Nagatsuma, Tsutomu; Monham, Andrew; Talaat, Elsayed; Luntama, Juha-Pekka

PSW.7-0029-24 12:00 - 12:15
International cooperation on ground-based and multi-vantage point observations of the Sun
Pevtsov, Alexei; Sabrina Bechet, Sabrina

PSW.7-0030-24 12:15 - 12:30
Italy-Canada-Finland cooperation for GNSS Space Weather infrastructure in Arctic : PAGINA project
Romano, Vincenzo; Cesaroni, Claudio; Jayachandran, Thayyil; Kauristie, Kirsti; Mainella, Sara; Marcocci, Carlo; Pica, Emanuele; Spogli, Luca; Viola, Massimo

PSW.7-0031-24 15:00 - 15:15
Advancing Space Weather Research: Collaborative Research in GNSS and Space Weather through ASEAN IVO Platform and Beyond
Supnithi, Pornchai; Myint, Lin Min Min; Jamjureegulgarn, Punyawit; Budtho, Jirapoom; Nishioka, Michi; Perwitasari, Septi

PSW.7-0032-24 15:15 - 15:30
COMMERCIAL RADIATION INTERNATIONAL COLLABORATIONS
Tobiska, W Kent

PSW.7-0033-24 15:30 - 15:45 (solicited)
International Efforts in Enabling Space Weather Risk Mitigation over Africa
Tshisaphungo, Mpho; Katamzi-Joseph, Zama; Matamba, Tshimangadzo Merline; Nndanganeni, Rendani Rejoyce