

RRA Space Weather Operation under COVID-19



National Radio
Research Agency

Kichang Yoon, Yungkyu Kim, JeongHoon Kim

Outlines

I KSWC Overview

II KSWC Operation under COVID – 19

III Lessons Learned

KSWC Overview



National Radio
Research Agency

Official source to deliver space weather products
& services in Korea



KOREAN SPACE
WEATHER CENTER
(KSWC)

Operation Center
Forecast & Alert, R&D, Observation



KMA

Korea Meteorological Administration

- Space weather effect on (terrestrial) climate, weather, meteorological satellite



- Research on optical & radio astronomy, space science



Korea Polar Research Institute

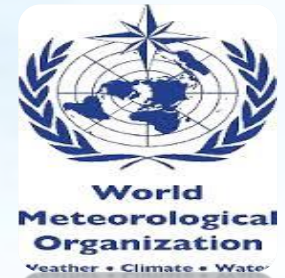
- Research on ionosphere, mesosphere in polar region

KSWC Overview



2011

Regional Warning Center



2012

Member of IPT-SwieSS



2014

Delegate for Space Weather



1980S~

Leading Agency of ROK

Recently joined ICAO MET/H

KSWC Overview

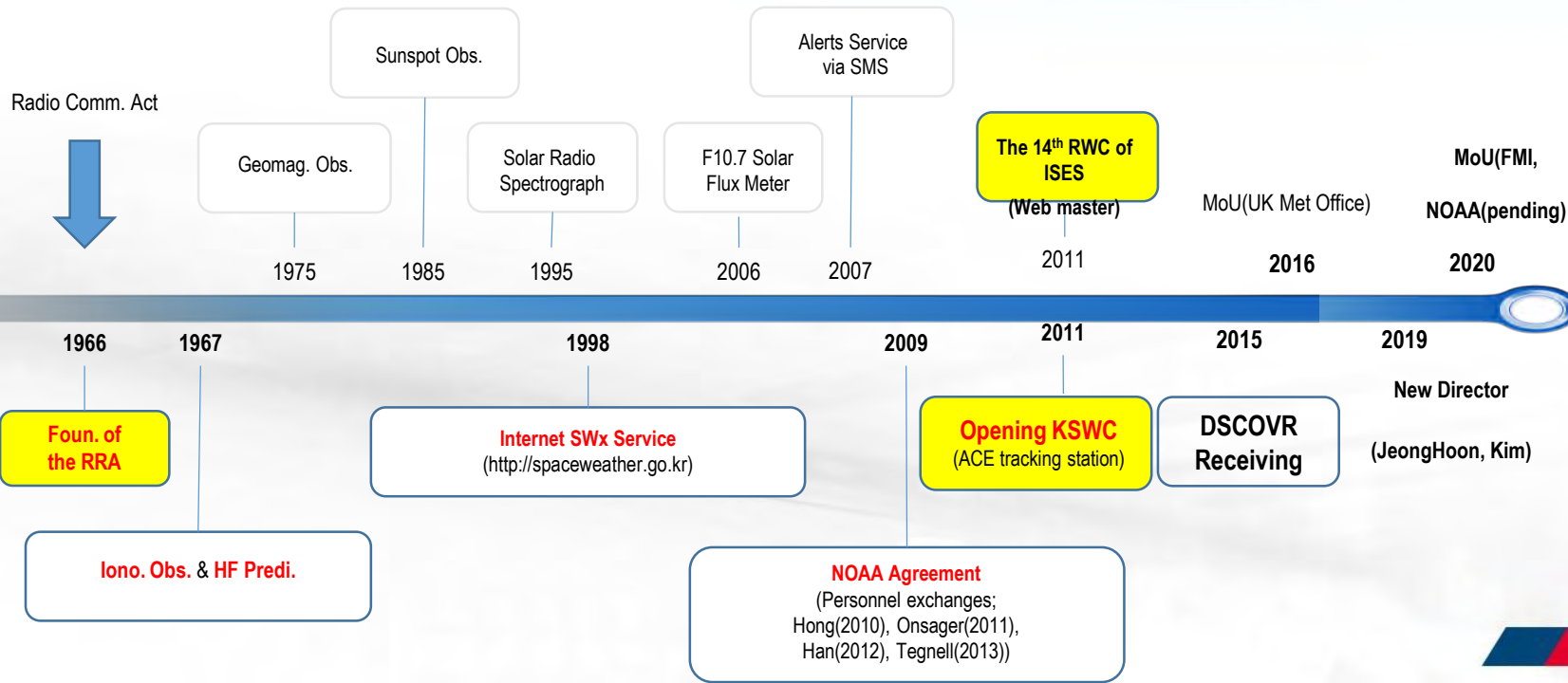
- KSWC is the government institute for SWx operation & research & the primary action agency of emergency measure to severe SWx.

MSIT MINISTRY OF SCIENCE and ICT

RRA NATIONAL RADIO
RESEARCH AGENCY

KSWC KOREAN SPACE
WEATHER CENTER

Since August 2011



KSWC operation – New Director's Inauguration



- 1th June 2019 : Director Kim has started his official work
(The world was very Peaceful & Calm, we were very happy !)

KSWC operation - Training simulation



June 30, 2020

- A Strict Directive from KCDC

“Wearing a mask can prevent infectious diseases”



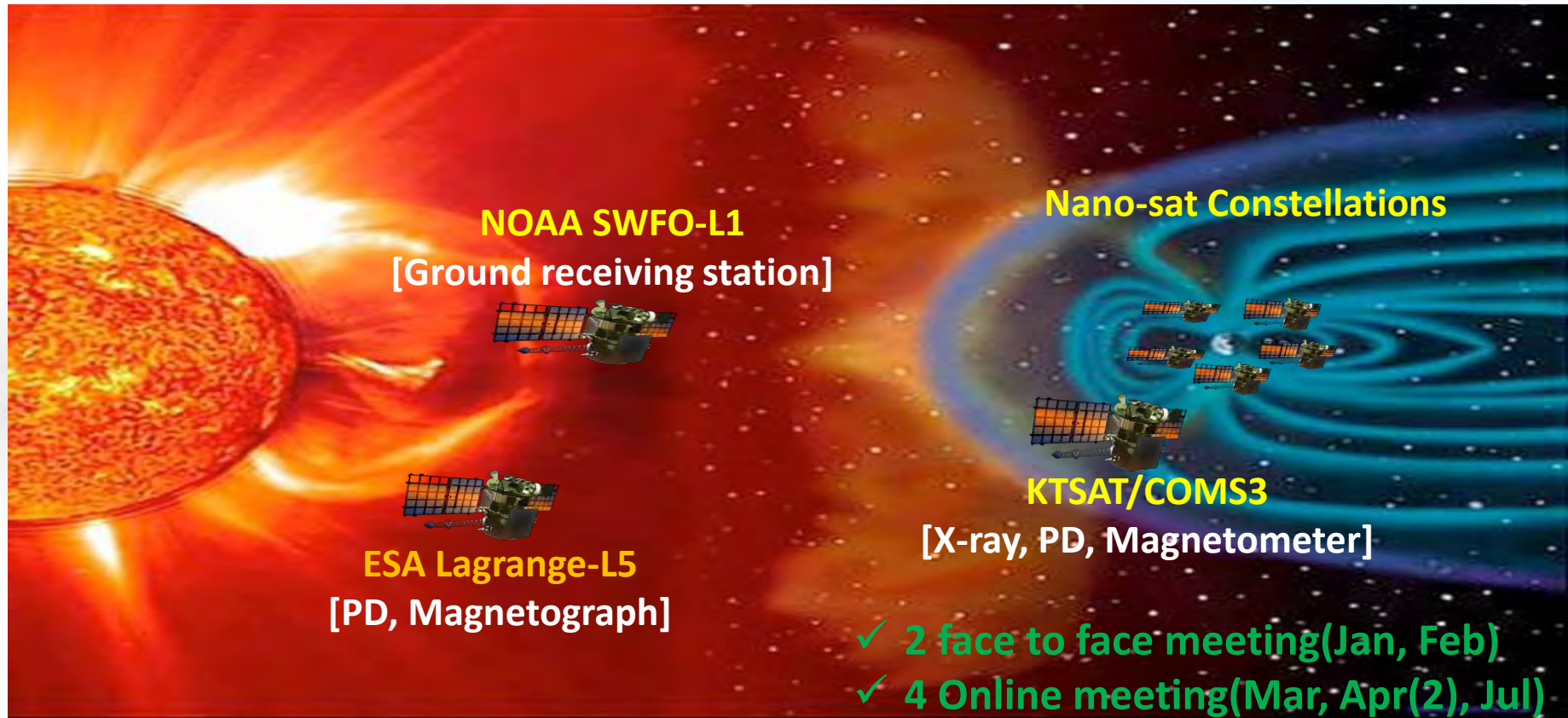
KSWC operation - Planning for the next Solar Maximum

Advancement of Work condition, observation, R&D

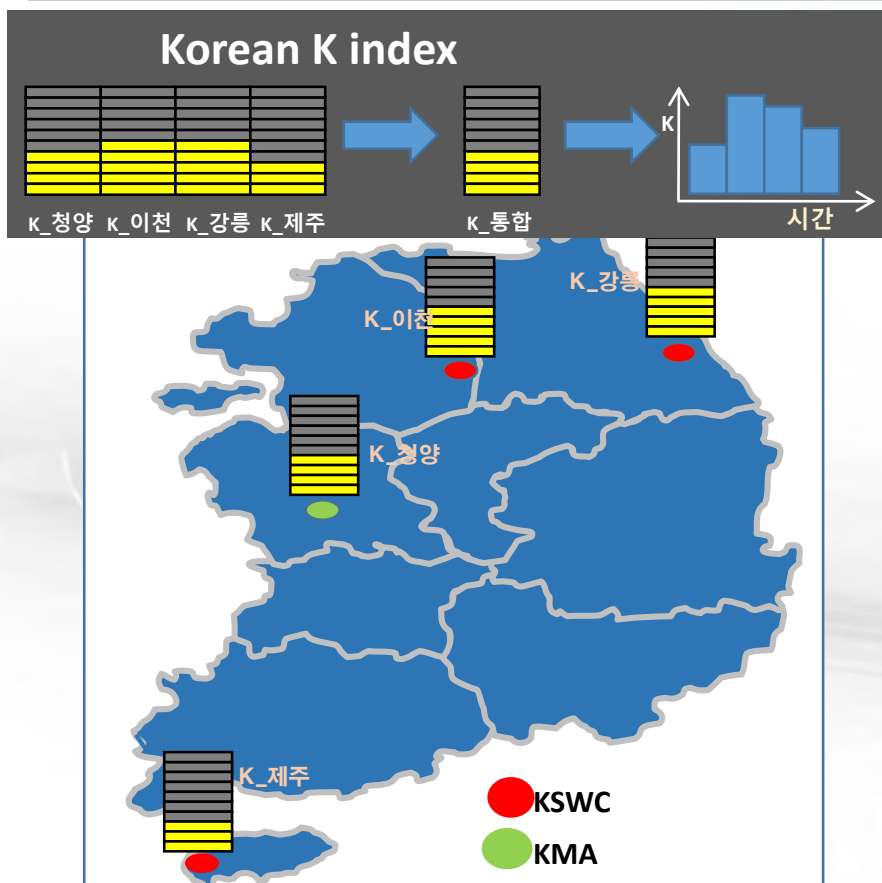


KSWC operation – Long Term Strategy for SWx satellite mission

- | | |
|----------|---|
| Chance 1 | Nano-satellite constellations(LP/PD/Magnetometer, 40 units) |
| Chance 2 | KTSAT-6B(2024), COMS3 at GEO |
| Chance 3 | ESA-L5, NOAA-SWFO L1 at deep space(Sensors) |



KSWC operation - R&D for Geomagnetic disturbance Model



Korean K model(with AI)



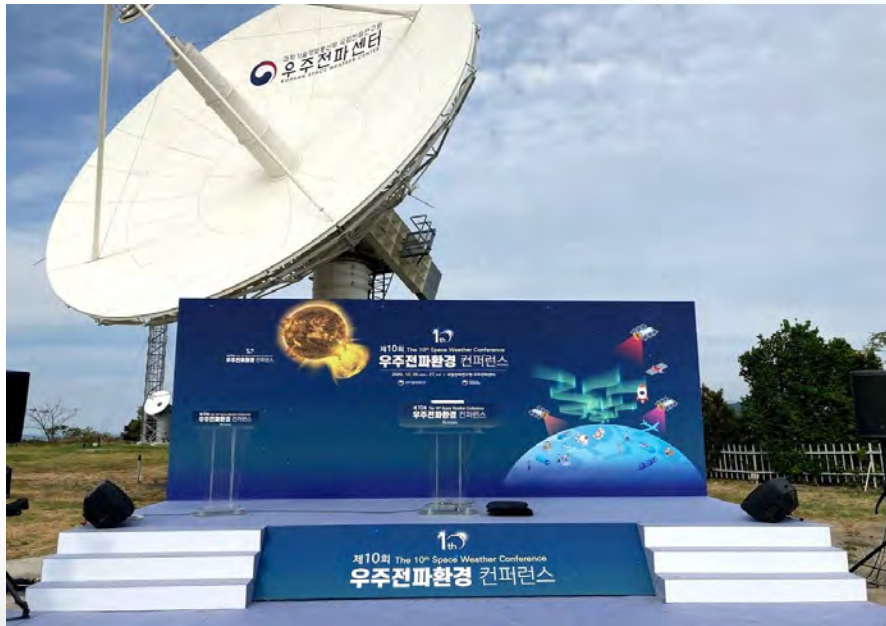
3-day forecast(Example)

날짜	Kp			K		
	Kp=4	G1-G2	G3-G5	K=4	G1-G2	G3-G5
1 d	30	10	1	20	1	1
2 d	50	20	10	40	10	1
3 d	60	40	20	50	20	1

- ✓ 3 face to face meeting(Jan, Feb, Apr)
- ✓ 7 Online meeting(Apr-Nov)

KSWC operation - 10th Space Weather Conference(Virtual)

Planned-the most biggest event in the national SWx Community



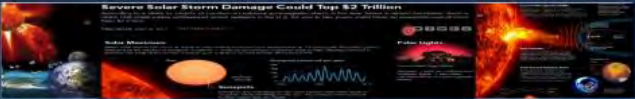
Due to Physical Distancing LV2

- ✓ **Crowdless+Online Conference**
 - Only Speakers at the event
(Including Invited Speakers)
- ✓ **Temperature Checks**
- ✓ **2 Preparation meetings via Webinar**
 - **1 face to face meeting(Feb)**

- ✓ **Participants : around 5 ths via Youtube, NAVERTV**
(Will be more increased)
- ✓ **Speakers(total of 38)**
 - For domestic : 30
 - for Foreign : 8
 - Welcome remark
(UN COPUOS, NOAA, KSSS, KASI)


KSWC operation - 10th Space Weather Conference(Virtual)

제10회 The 10th Space Weather Conference
우주전파환경 컨퍼런스



Regional and global efforts on SWx preparedness:
Lessons from a pandemic

Dong-Hun Lee
Kyung Hee University



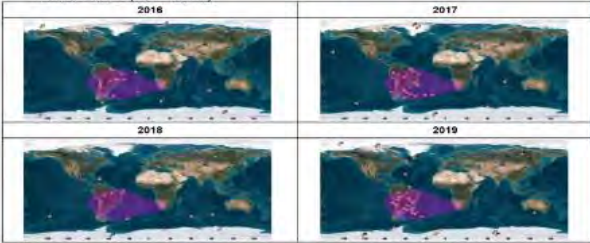
2020. 10. 27
기조연설
Keynot
우주전파
대응 노력
발표자
이 동훈

우주전파환경 컨퍼런스
우주전파센터

제10회 The 10th Space Weather Conference

Position of Single Event (2/3)

• Satellite's location at the occurrence of single event error
- KOMPSAT-5 (2016-2019)



Int'l Space Radio Environment Conference
[Jeju, 2020-10-27]

KARI Proprietary

Ministry of Science and ICT
National Space Science Agency
Korean Space Weather Center

우주전파환경 컨퍼런스
2023. 10. 26(목) ~ 27(금) | 서울특별시 관악구 우주과학센터

S4-2_P3
Space Weather Risk Management 2

Space Environment and its Effect on LEO Satellite Operations

Presenter
Ok Chul JUNG
Korea Astronomy and Space Science Institute

제10회 The 10th Space Weather Conference
우주전파환경 컨퍼런스



제10회 The 10th Space Weather Conference
우주전파환경 컨퍼런스



Terry Onsager



NWS & NESDIS
동료 여러분
스와 국립 기상 서비스를

우주전파환경 컨퍼런스

우주전파환경 컨퍼런스

Space Weather Conference

Ministry of Science and ICT
National Space Science Agency
Korean Space Weather Center

Congratulatory Remarks

Elsayed Talaat
NOAA NWS & NESDIS

Recorded video

<https://youtu.be/9zKZ8aOGKBY>

KSWC operation – MoU with FMI for Aviation Collaboration

Memorandum of Understanding

between the

**Finnish Meteorological Institute,
under the Ministry of Transport and Communications
Finland**

and the

**National Radio Research Agency,
under the Ministry of Science and ICT
Republic of Korea**

for

**on consolidating the collaboration for maintenance of
Space Weather Services for Civil Aviation**

PREAMBLE

stitute (FMI) and the Korean National Radio Research Agency (NRRA) establish collaboration in order to develop and maintain services for civil aviation. The Parties are research institutes that observe and conduct continuous systematic measurements with the aim of

Services addressed in this Memorandum of Understanding include near-real-time information on space weather conditions. The International Civil Aviation Organization (ICAO) has set for itself the goal of space weather impact on HF-communication, GNSS, and satellite navigation.

consortium that consists of research institutes from the Republic of Korea and Finland. The consortium is designated as one of its global space weather centers. The ICAO services have global coverage.

SCOPE OF COLLABORATION

will conduct preparatory work for RRA's potential joining the consortium in coming years. In more detail the work will include at least

information on their current and forthcoming space weather activities. The Parties together can offer optimal support for the PECASUS inventory.

in establishing its 24/7 operations and quality management system. The Parties will also coordinate their arrangements in PECASUS.

ties in their plans on space weather satellite missions including the development of new space weather satellite missions.

lot phase Consortium Agreement's procedures to join the consortium in coming years.

Non Disclosure Agreement covering all information exchanged between the Parties.

of assets is limited for the purpose of ICAO space weather services. The Parties agree that any other space weather services will be negotiated separately on case-by-case basis.

case basis. Both Parties foresee to continue and expand their collaboration in research for improvements in their future space weather services.

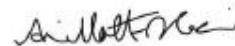
7. This MoU will come into force after both Parties have signed it. If either of the Parties wants to resign from this agreement, it should inform the other Party about it by a written notice three months before the resigning date.

8. In order to facilitate communication and coordination of efforts under this MOU, the Parties designate the following points of contact:

FMI:	Dr. Kirsti Kauristie Head of Space Weather research group Finnish Meteorological Institute E-mail: kirsti.kauristie@fmi.fi
RRA:	Dr. Yung-Kyu Kim Leader of Planning and collaboration team RRA/Korean Space Weather Center E-mail: ygheem@korea.kr

Signatures

On Behalf of FMI
under Ministry of Transport and Communications



Prof. Ari-Matti Harri
Director of Space Research and Observation Technologies
PECASUS Consortium Coordinator

Date : 11 November, 2020

On Behalf of RRA
under Ministry of Science and ICT



Mr. Jeong Hoon Kim
Director of Korean Space Weather Center

Date : 2020. 11. 11.

**Signing a formal document i.e. MoU is also Virtual !
(Used PDF Professional tool)**

Lessons Learned

1. Convenient but more complexity

- ✓ Convenient : focused on the topic
- ✓ Complexity : more preparation is required

2. Online is more expensive than Off-line

- ✓ Many of devices are required for the meeting
- ✓ Some of them is highly expensive(for broadcasting)
- ✓ Some error is inevitable(Disconnecting, low quality of service due to limited bandwidth, channels are occupied)

3. Online is not the final solution for the people

- ✓ Mis-interpretation+Time Limit
- ✓ Schedule setting is also a burden of task(irritating)

→ I'd like to be linked and have some beer with you !

How We Fought COVID – 19

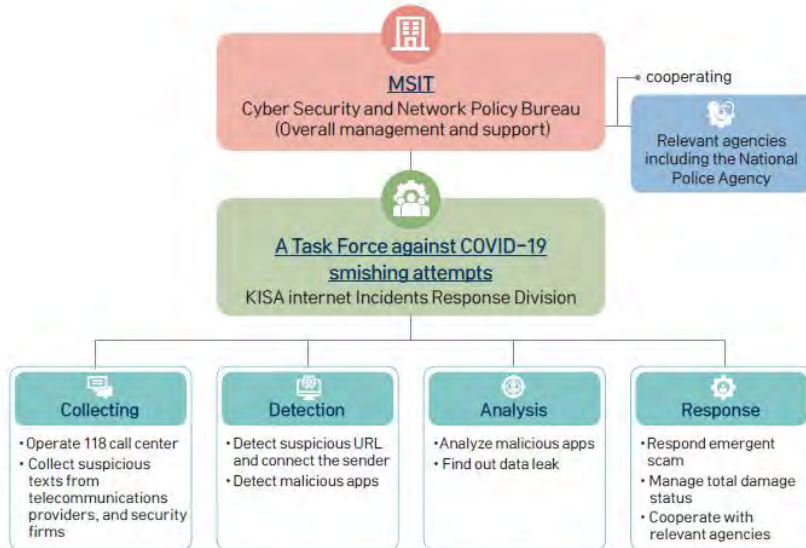


Figure 5-5-1. Task Force against COVID-19 Smishing Attempts.

6-2. Cooperation with International Organizations

- Korea actively shares its experiences with using science and ICT to tackle COVID-19 with international organizations and multilateral consultative bodies, including the G20 and OECD.
- The G20 has adopted the Ministerial Statement on COVID-19 Response, which recognizes the potential of digital technologies, such as AI, for developing diagnostics, treatments and vaccines.

1. Introduction

With the recent worldwide spread of COVID-19, major international organizations and multilateral consultative bodies have started holding discussions on how to respond to this global crisis. Korea has actively shared its experiences with using science and ICT to tackle the virus.

2. Background & Purpose

Korea has received much recognition for deploying science and ICT to prevent the spread of COVID-19. One notable example is the rapid development of COVID-19 test kits using AI. At the request of many countries around the world, Korea has shared its experiences with responding to COVID-19 using science and ICT and promoted tackling the pandemic through international cooperation.

3. Implementation

The government published *How We Fought COVID-19: A Perspective from Science & ICT* through government-wide collaboration and has shared it with the international community.

4. Key Features

The Vice Minister of the MSIT attended the Virtual Ministerial Dialogue on COVID-19 and Open Science hosted by UNESCO on March 30. He presented Korea's COVID-19 response measures, including transparent and rapid information sharing and the development of test kits, and shared the results of drug repositioning research involving drugs that demonstrated efficacy against COVID-19, such as ciclesonide.

We can learn from COVID-19 that International Cooperation is highly essential !

Q & A

Safe From COVID-19 !
Hope to see you Soon !



과학기술정보통신부 국립전파연구원

우주전파센터



Asia-Oceania Space Weather Alliance (AOSWA) online conference 2020

KSEM Operations during COVID-19”

**National Meteorological Satellite Center
Korea Meteorological Administration**

Daehyeon Oh

24 November 2020

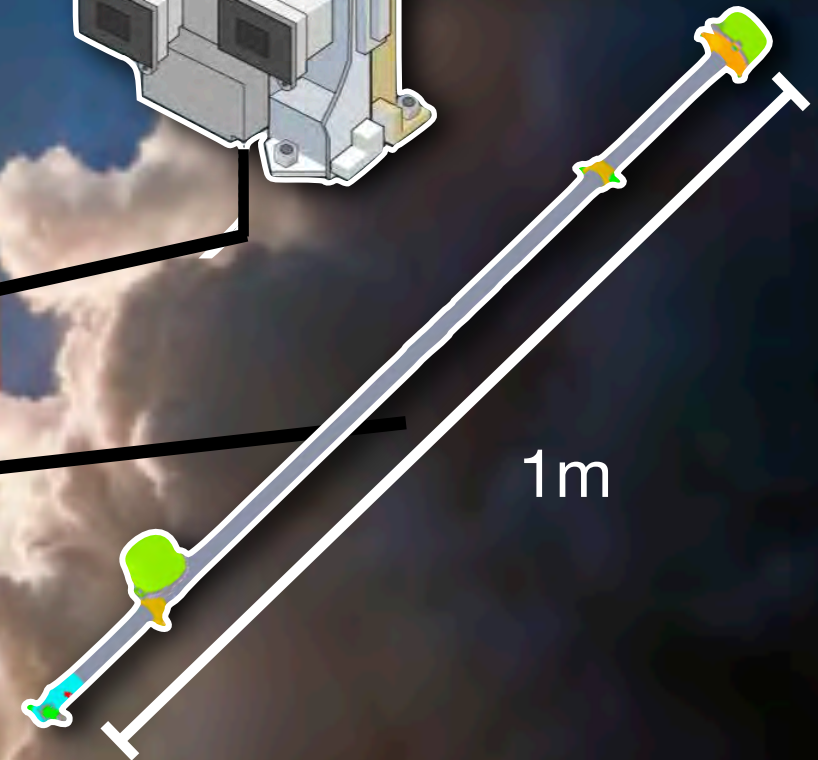
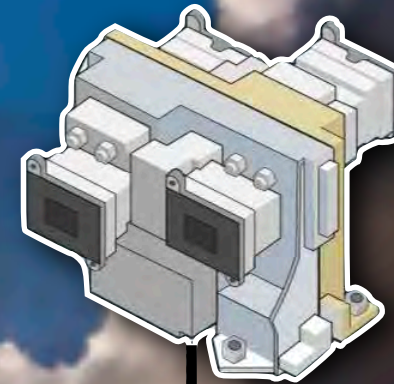
GK-2A

5 Dec 2018

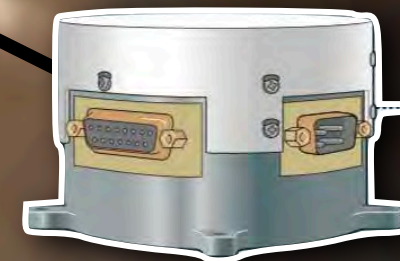


Korean Space
wEather Monitor
KSEM

Particle Detector



Magnetometer



Charging Monitor

Monitoring Space Weather

KSEM Data Analysis System



KSEM Monitoring

KSEM Forecast

KSEM Intercomparison

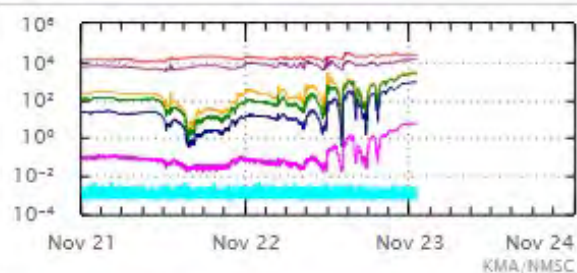
Report

Date/Time

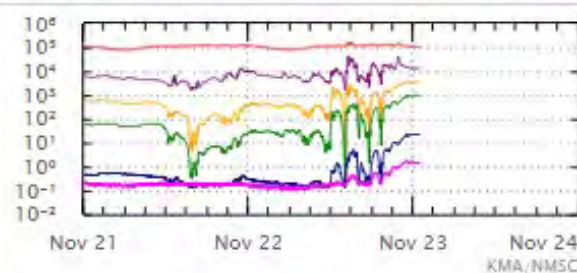


✓ KSEM Monitoring

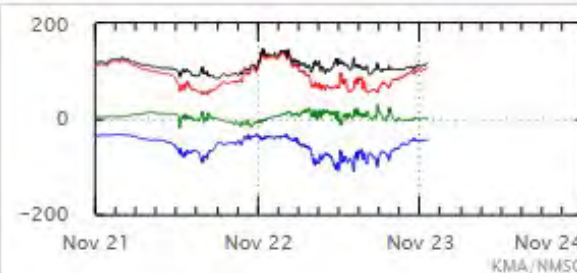
01



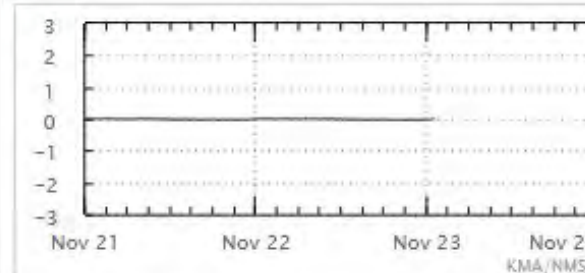
GK2A Proton Flux



GK2A Electron Flux



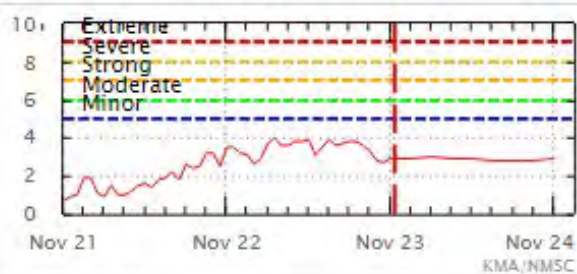
GK2A Magnetic Field



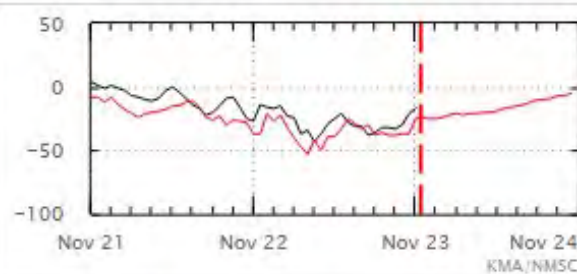
GK2A Charging Monitor

✓ KSEM Forecast

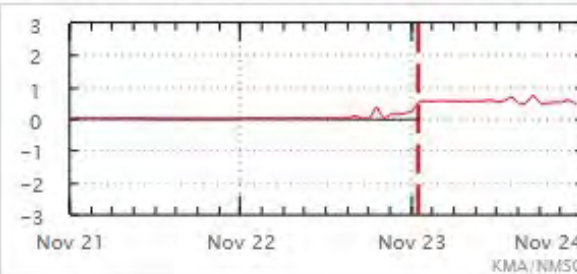
01 02 > >>



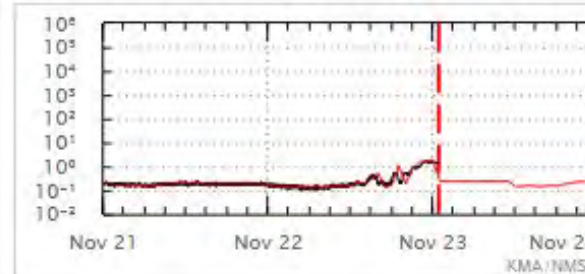
Kp Prediction



Dst Prediction



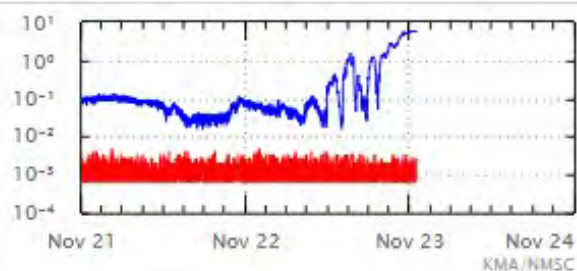
Satellite Charging



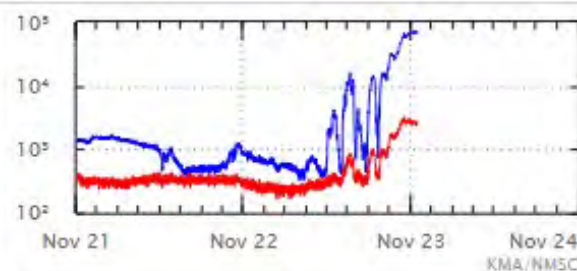
Geo. Electron Prediction

✓ KSEM Intercomparison

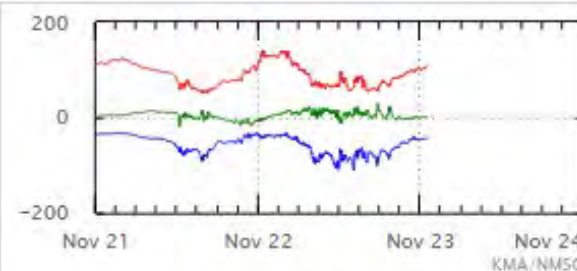
01



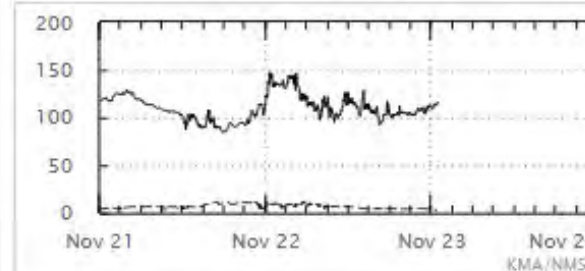
GK2A-GOES Proton Flux



GK2A-GOES Electron Flux



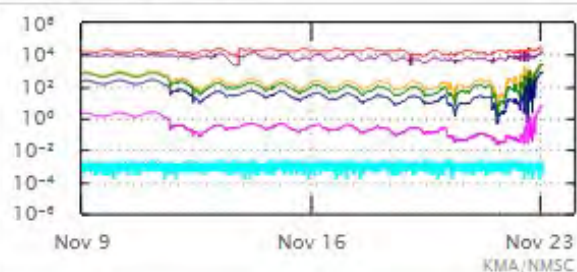
GK2A-GOES Magnetic Field



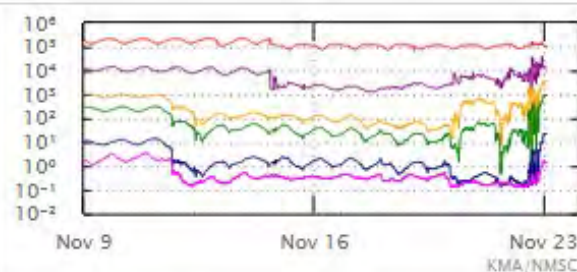
GK2A-DSCOVR Magnetic Field

✓ Event Analysis

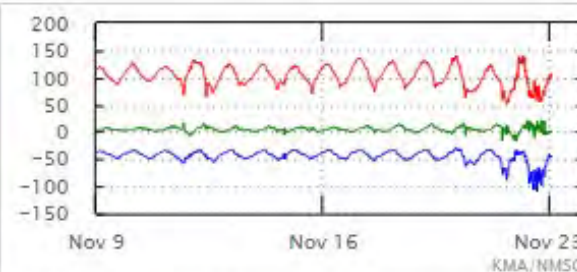
01



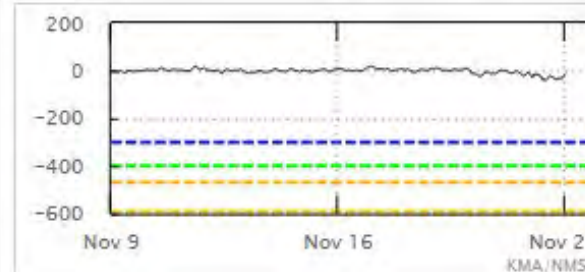
LV1 Proton Flux



LV1 Electron Flux



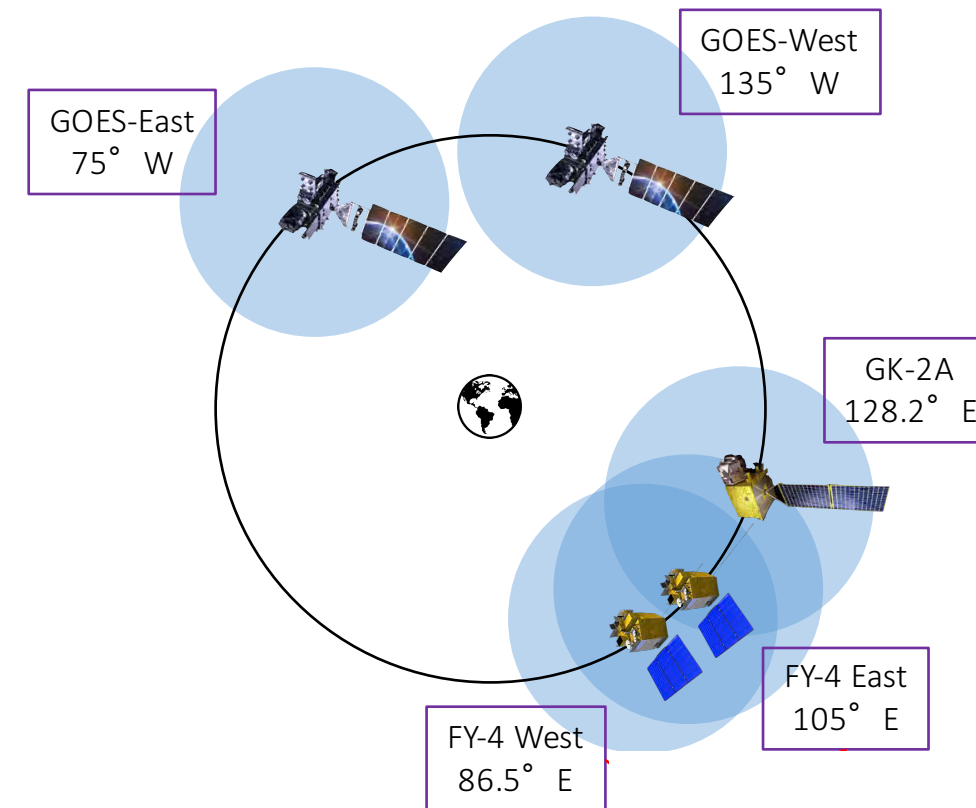
LV1 Magnetic Field Strength



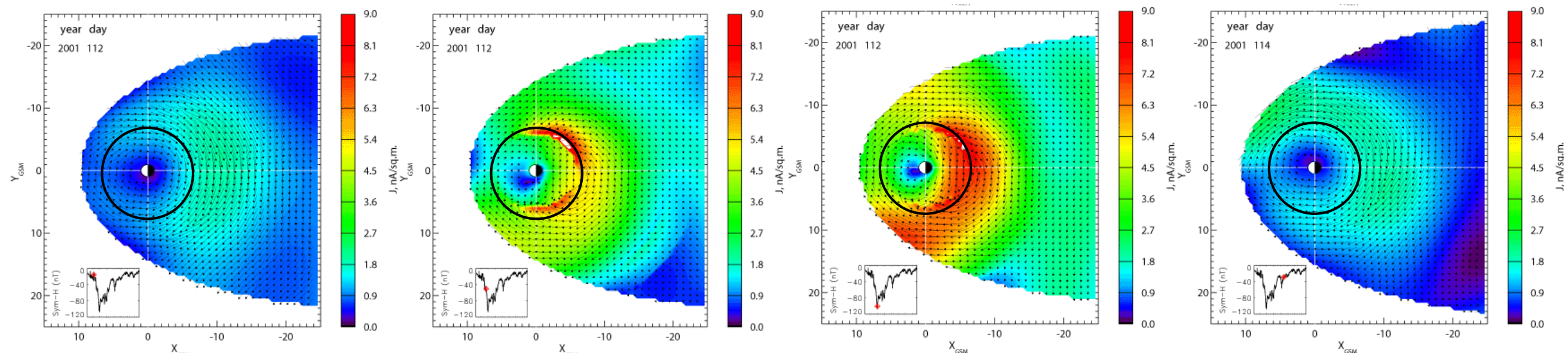
Dst Index

Monitoring Geo-orbit space weather at multipoint.

- Monitoring space weather above the eastern hemisphere is a basic and fundamental task of KSEM, but its potential uses can be expanded in scientific field.
- Combining the real-time data from GK-2A, GOES satellites, and FY-4 satellites, we can monitor a day (or night) side of magnetosphere for almost 16 hours continuously.
- Longer duration of observation provides more chance to detect short-time events such as sudden magnetopause crossing on day side, substorms on

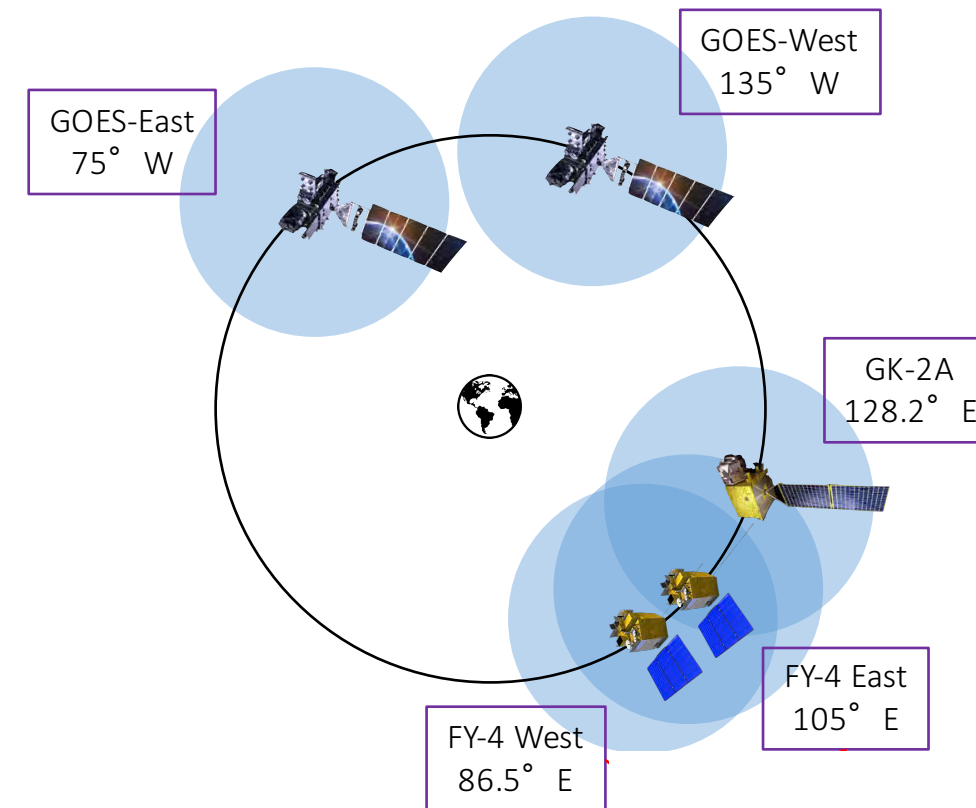


Asymmetric equatorial current density change in April 2001 storm (Sitnov et al., 2008)
Black Circle: Geo-orbit

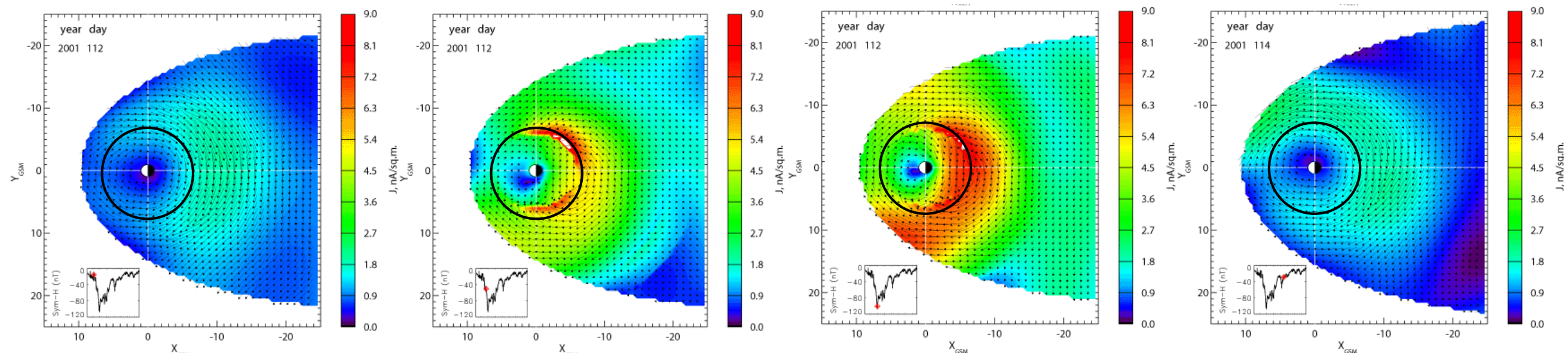


Monitoring Geo-orbit space weather at multipoint.

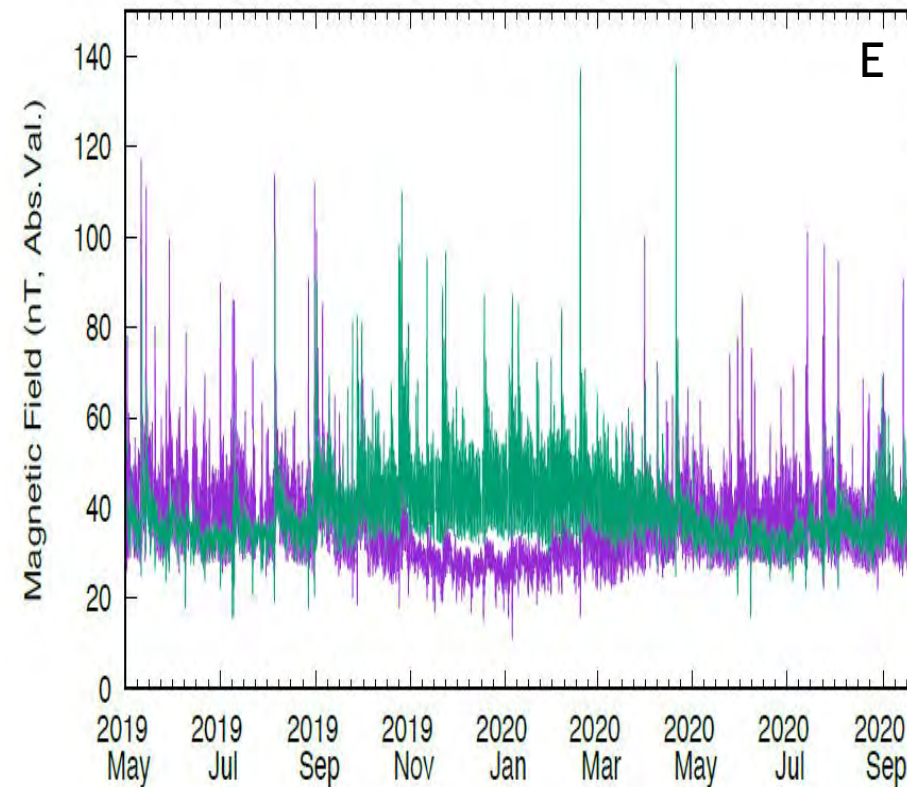
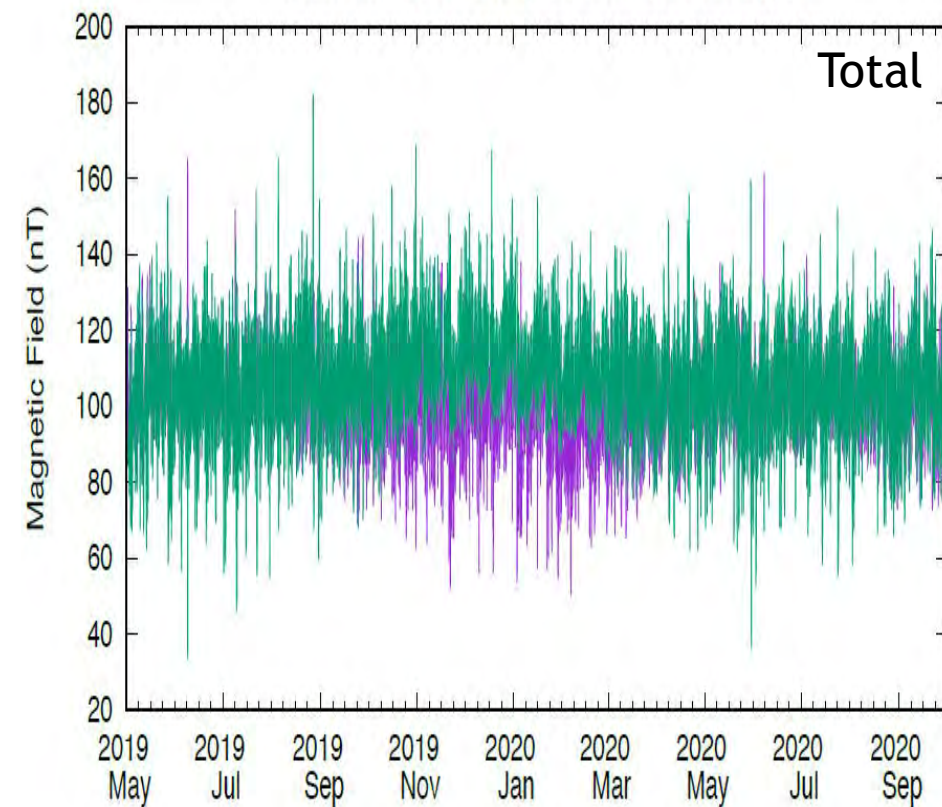
- This also makes possible to do more precise studies on asymmetric phenomena which may have some physical relationship occurs on different hemispheres.
- Such potential studies can be used for better assessing the level of geomagnetic activities, and in more advanced case, it could be used for developing new space weather indices based on geostationary magnetic field data.



Asymmetric equatorial current density change in April 2001 storm (Sitnov et al., 2008)
Black Circle: Geo-orbit



From May 1, 2019 to September 30, 2020 – GK2A/KSEM MG & GOES 16 MG



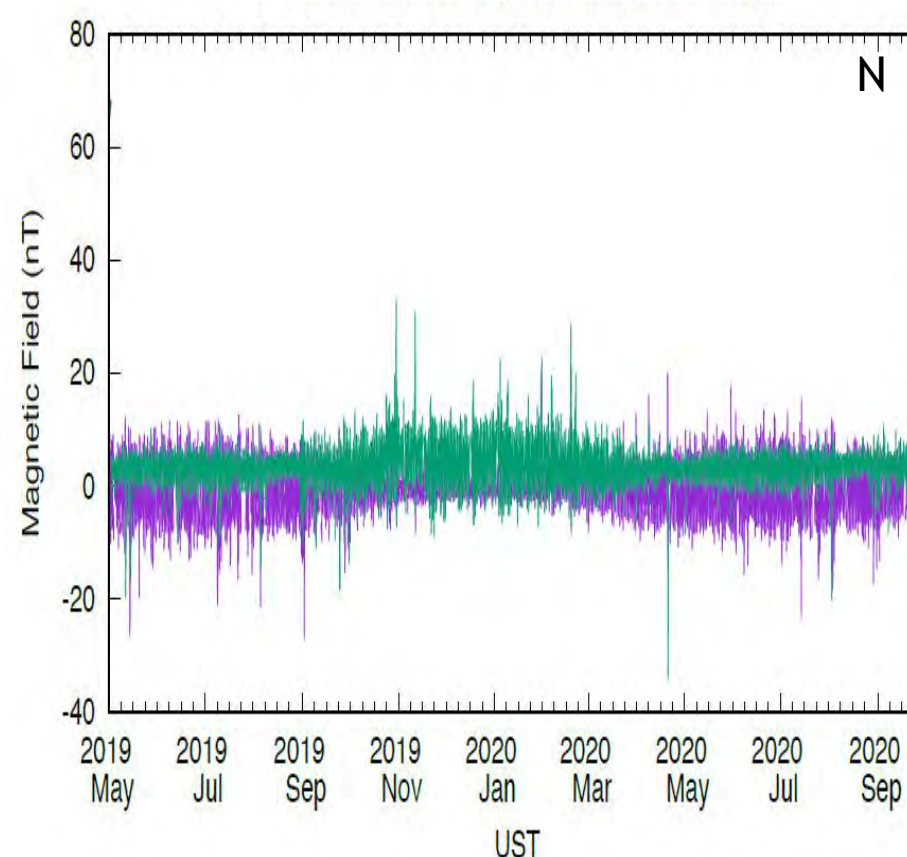
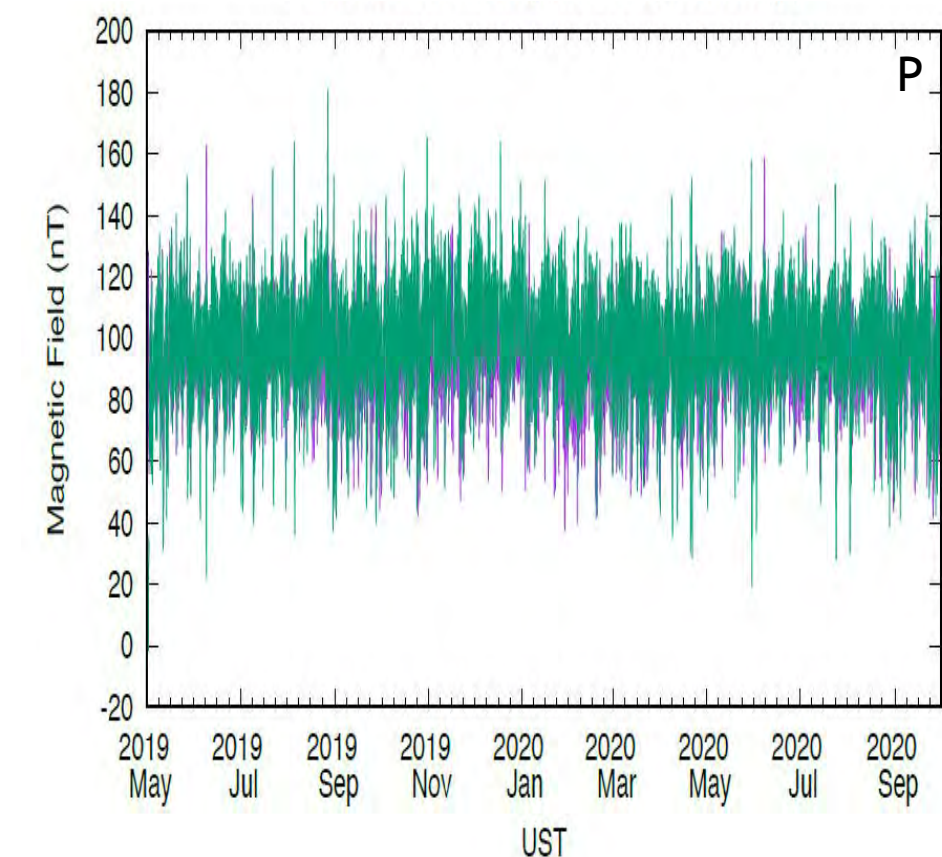
— KSEM
— GOES

- ◆ No critical issue in MG data producing
- ◆ We found a periodic seasonal change of daily amplitudes from E and N data.

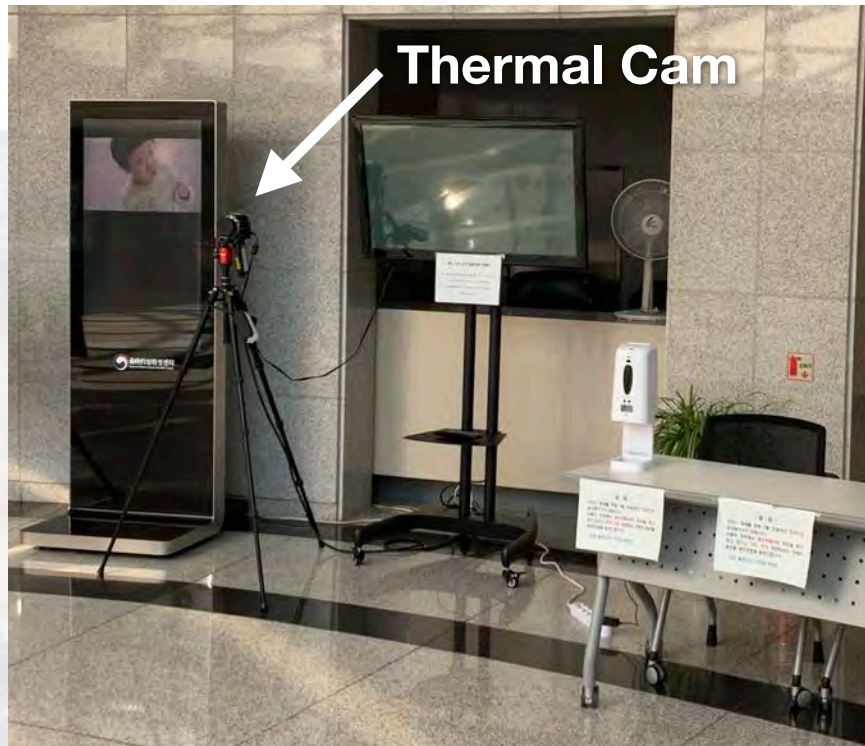
- It has opposite phase with GOES-16 MG data (purple in left figures)

- GK2A/KSEM:
 - Wide in winter, narrow in summer

- GOES-16:
 - Narrow in winter, wide in summer



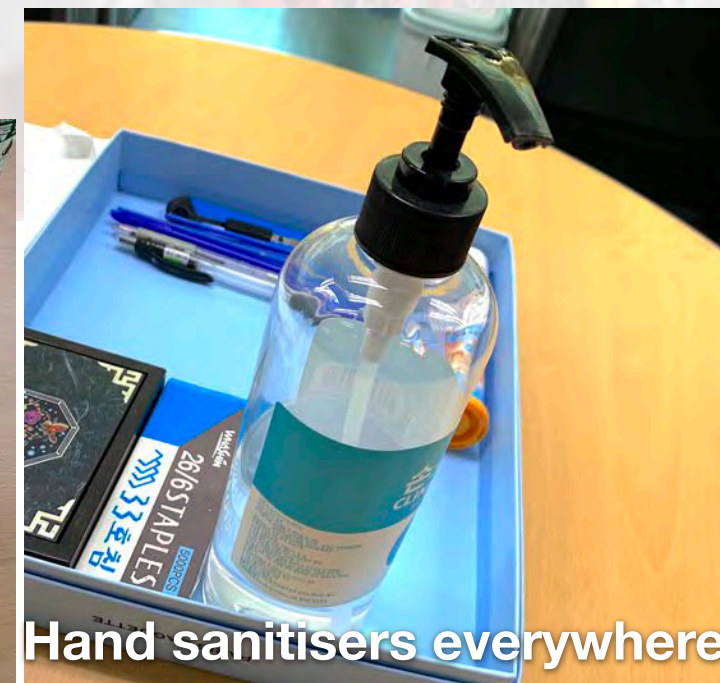
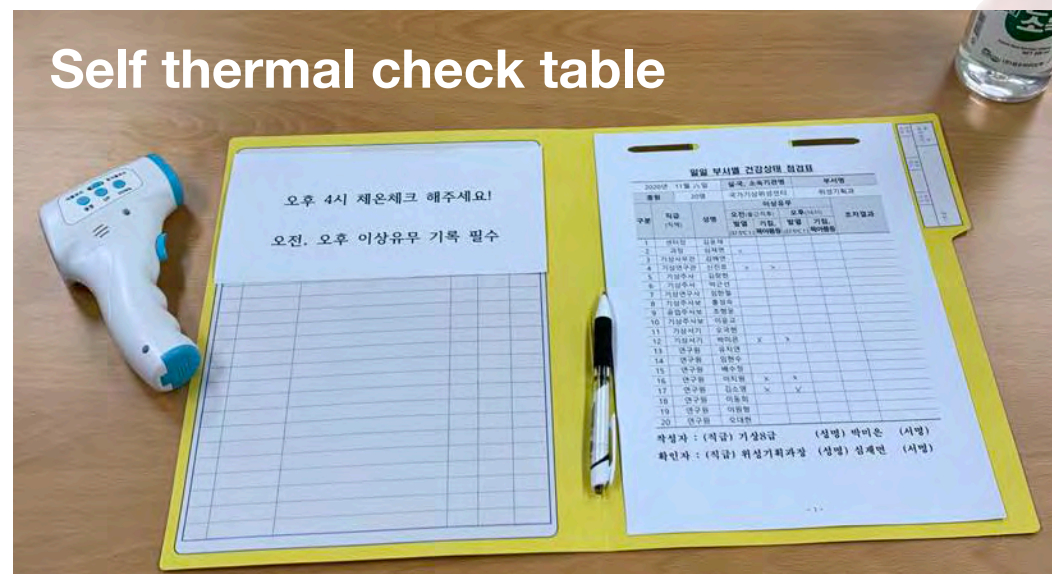
NMSC/KMA during COVID-19 pandemic



- ◆ Everyone who enters the building must pass thermal check.
- ◆ Everyone in office must wear face mask.
- ◆ Transparent acrylic walls in meeting room.
- ◆ Most of meetings and conferences use video conferencing services.
- ◆ Hand sanitisers in almost every offices and tables.
- ◆ Self thermal check twice a day.



Self thermal check table



NMSC/KMA during COVID-19 pandemic

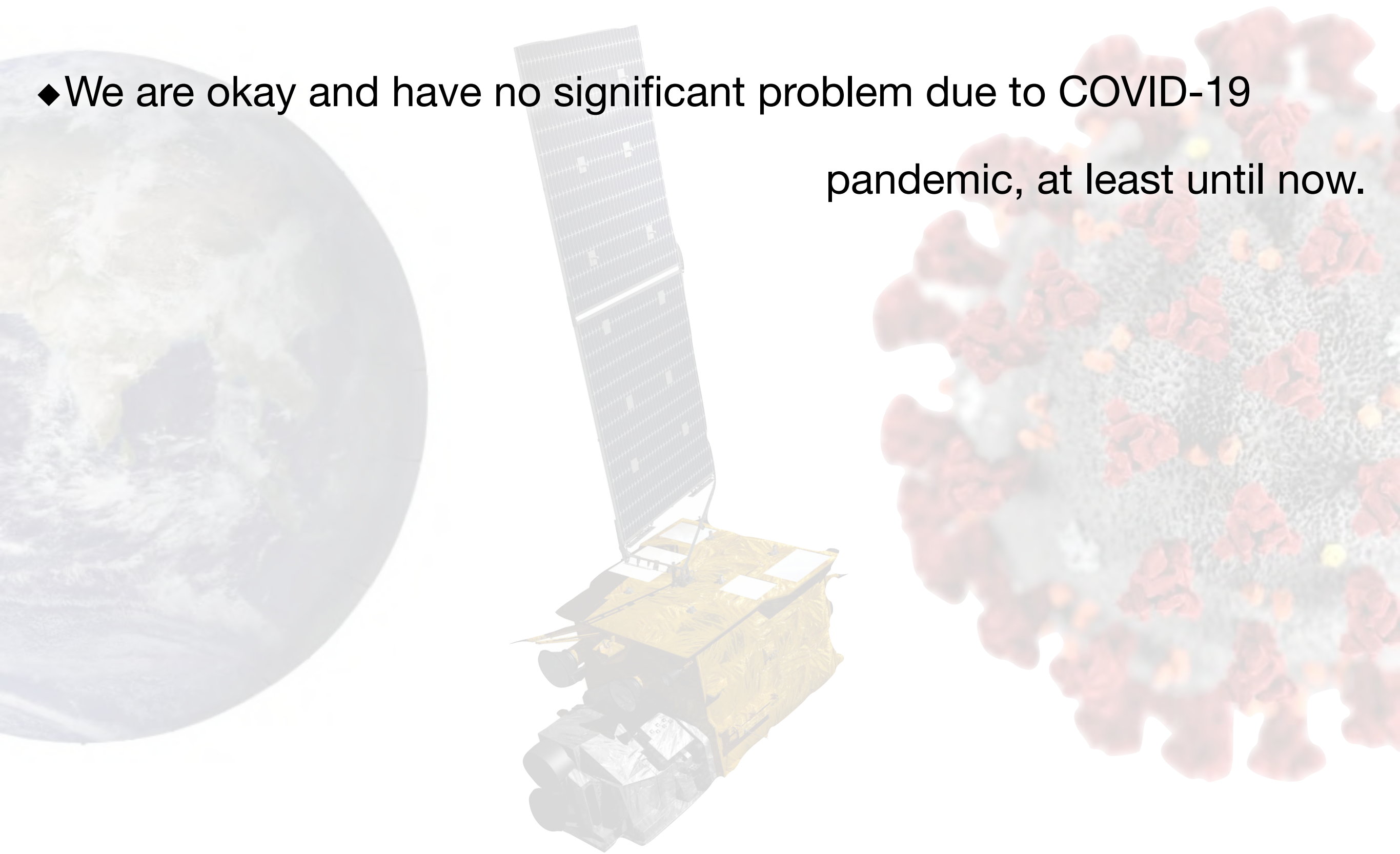
- ◆ No significant/Critical impact to date.
- ◆ One of our contractor employees was reported as Covid-19 confirmed case after visiting NMSC, but there was no inside infection from him/her.
- ◆ No Covid-19 Confirmed case in NMSC to date.
- ◆ Work from/at Home
 - Since end of June 2020: Once in three days with rotation
 - Since end of November 2020: Once in four days with rotation
 - *Maybe 'Once in three days' again soon after...*

NMSC/KMA during COVID-19 pandemic

- ◆ We are in KSEM long-term (>1 year) data review phase and, fortunately the Sun is relatively calm these months, there is no big change in regular KSEM operation.
- ◆ Work from/at Home
 - Since end of June 2020: Once in three days with rotation
 - Since end of November 2020: Once in four days with rotation
 - Maybe 'Once in three days' again soon after...

Summary

- ◆ We are okay and have no significant problem due to COVID-19 pandemic, at least until now.





**Thanks
And
Stay Safe**