

KMA updates since CGMS-53 and report on the medium to long-term future plans on Earth observation

Presented to CGMS-54 plenary session, agenda item 3

CURRENT GEO SATELLITES

- **COMS** Meteorological mission (MI) was ended on 1st April 2020 and after one year Ocean Monitoring mission (GOCI) was also ended (1st April 2021). It is currently operating only communication mission, which are scheduled to continue until around 2027.
- **GK2A** for the meteorological mission using AMI and for the space weather mission using KSEM is operational since 25th July 2019.
- **GK2B** for the ocean observation mission using GOCI-II and for the environmental mission using GEMS is also operational and derived products have released since the 2nd half of 2021.

	2025	2026	2027	2028	2029	2030	2031	2032
COMS (GK1) (MI, GOCI)	Mission completed for MI & GOCI							
GK2A (AMI, KSEM)	In-operation (weather & space weather)							
GK2B (GOCI-II, GEMS)	In-operation (ocean & environment)							

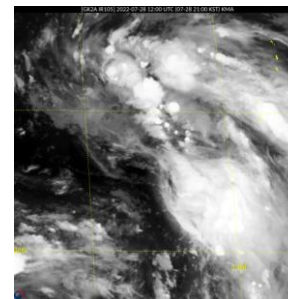
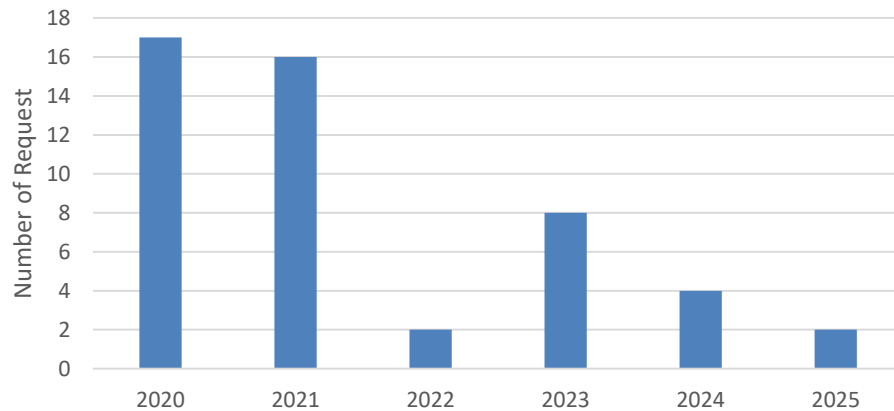
MI: Meteorological Imager; GOCI: Geostationary Ocean Color Imager
 AMI: Advanced Meteorological Imager; KSEM: Korean Space wEather Monitor
 GOCI-II: Geostationary Ocean Color Imager-II; GEMS: Geo. Environmental Monitoring Spectrometer

CURRENT GEO SATELLITES – New Observation and Data Service

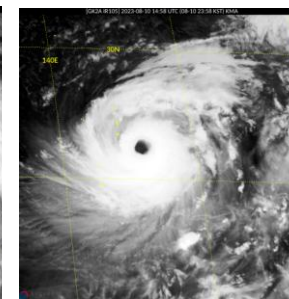
➤ GK2A Request-based Rapid Scan Observation since Feb. 2021

- Global users in GK2A coverage can request **Target Area Observation** for their own purpose via <https://nmsc.kma.go.kr/enhome/html/special/specialIntro.do?lang=en>
 - Target Area Observation: 1,000 x 1,000 km² every 2 minutes
- Portal on the RA II WIGOS Project website of the request-based high frequency regional observation launched by CMA, JMA and KMA is also available
 - (https://www.jma.go.jp/jma/jma-eng/satellite/ra2wigosproject/ra2wigosproject-intro_en_jma.html#request)

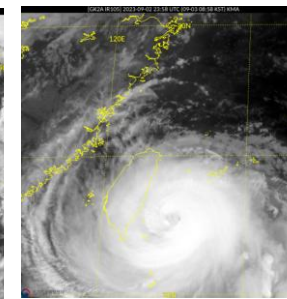
GK2A Rapid Scan Request



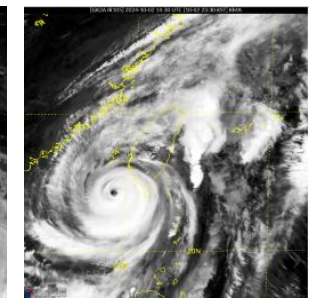
Tropical Cyclone (DOKSURI)
(2023.07.28 12:00UTC)



Typhoon (LAN)
(2023.08.10. 14:58UTC)



Typhoon (HAIKUI)
(2023.09.02. 23:58UTC)



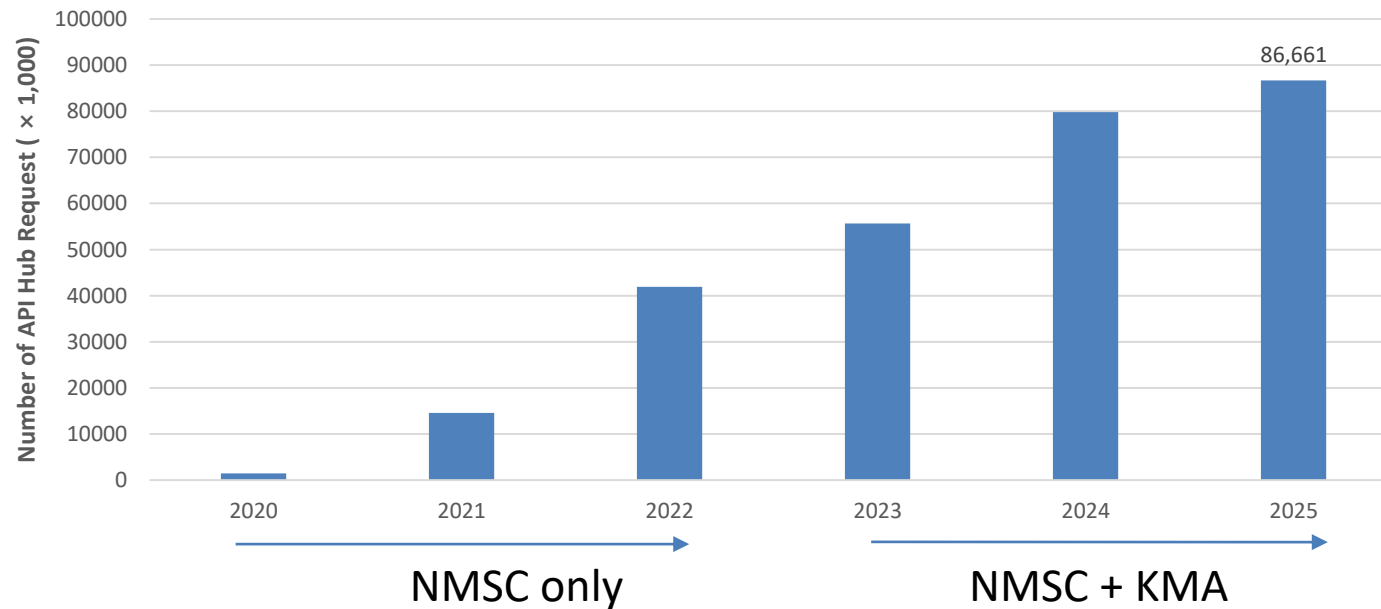
Typhoon (KRATHON)
2024.10.02. 14:30UTC)

CURRENT GEO SATELLITES – New Observation and Data Service

➤ GK2A Open API data service since Nov. 2020

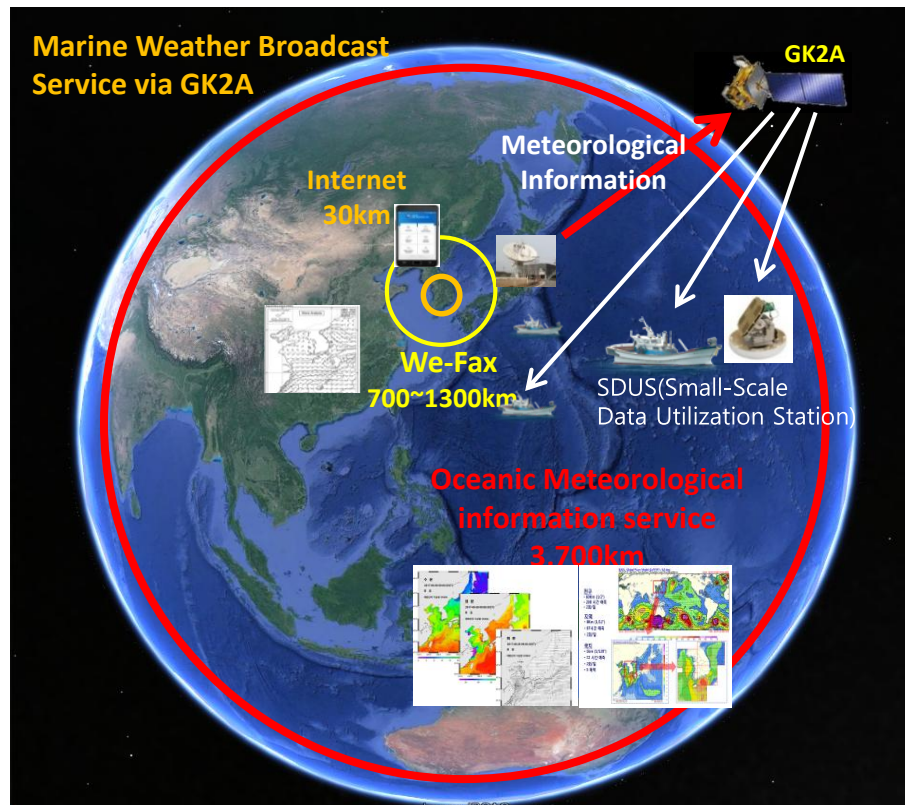
- **Open API data service** is available to agency, company, academia and individual that want to use the GK2A data.
- Integration of open API services : **nmsc API(End date: 2025.12.23.)** >> **KMA API Hub**
 - KMA API hub website (<https://apihub.kma.go.kr>)

NMSC & KMA's API Satellite Data Service



CURRENT GEO SATELLITES – Marine Weather Broadcast Service

➤ GK2A Marine Weather Broadcast Service using SDUS since 23 July 2020



❖ Advantages of broadcasting using GK2A

- Wide service area including Western Pacific, Oceania, and Indian Ocean
- Various display media available such as PC monitor, tablet, mobile, etc.
- Large capacity and variety of information over 590/day with image, text, etc.
- Sending urgent information by alarming and pop-up message

❖ Expand the service to Asia-Pacific region from domestic users as a pilot project (RA-II-17-I-PP-1) of WMO ET-SOA

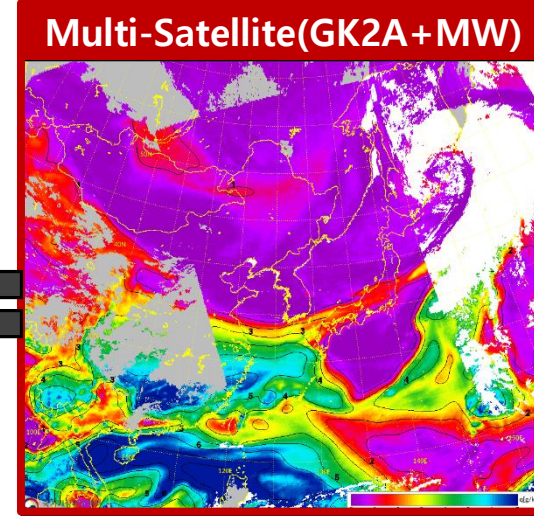
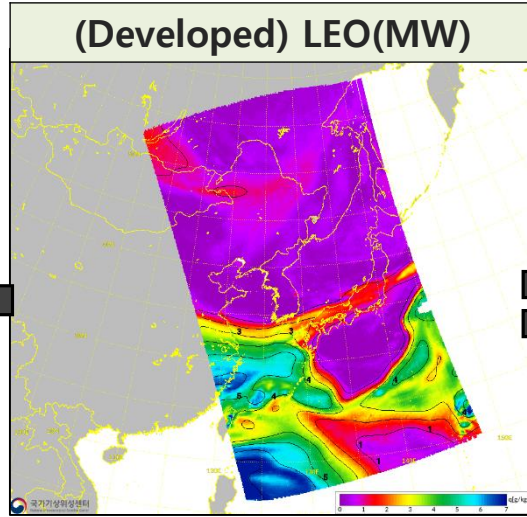
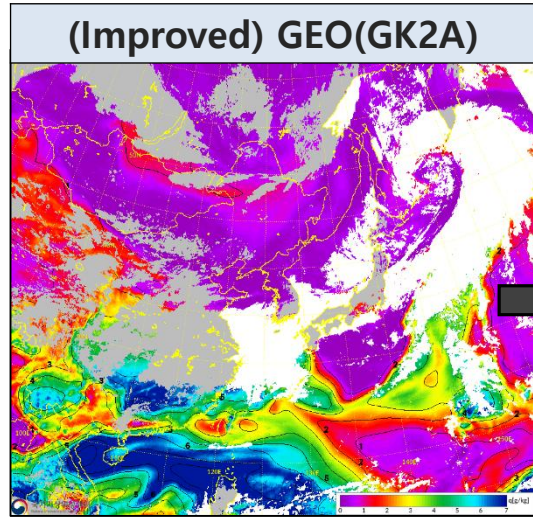
- In 2021, Submitted project proposal in RA II-17
- In 2022, Development of web page for the Emergency message request service (Korean/English)
- In 2023, Start the international broadcast service for Emergency message of urgent weather
- **KMA will continue to expand efforts to support the construction of a reception system (SDUS) in near ocean region**

❖ Service website opened in 2022

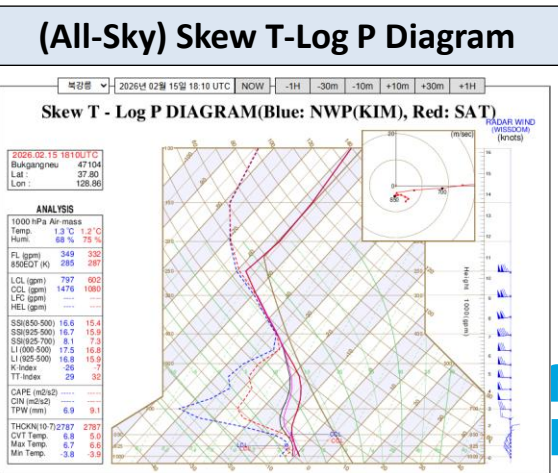
<https://nmsc.kma.go.kr/enhome/html/base/cmm/selectPage.do?page=static.utilization.reqStation>

CURRENT GEO SATELLITES – GK2A Products and its application

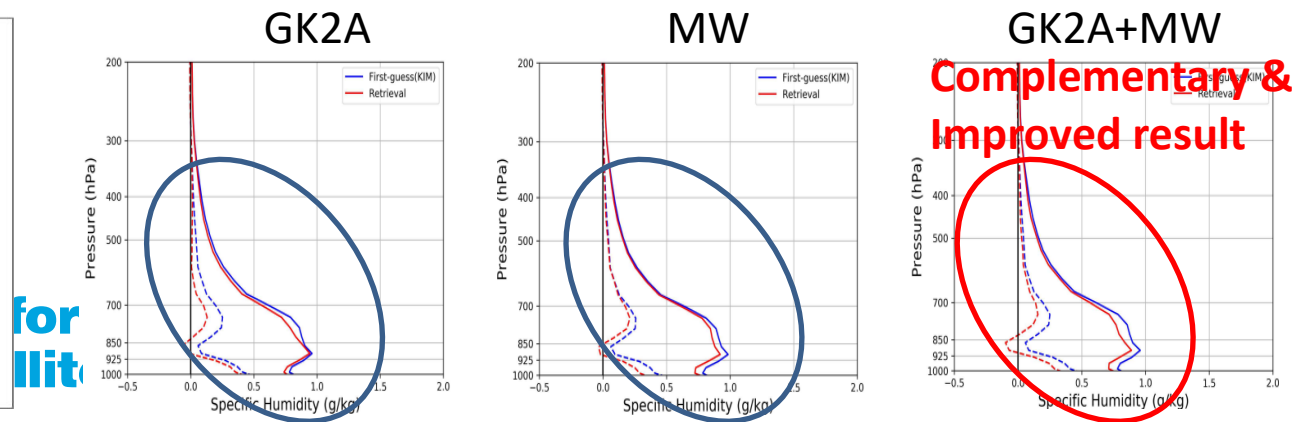
➤ Monitoring and Warning of Extreme Weather : Multi-Satellite (GEO-LEO) Atmospheric Vertical Profile



- GK2A atmospheric profiles are improved through enhancements to the 1D-Var retrieval algorithm
- LEO microwave (MW) data-based atmospheric profile retrieval algorithm is developed to obtain cloudy-sky information



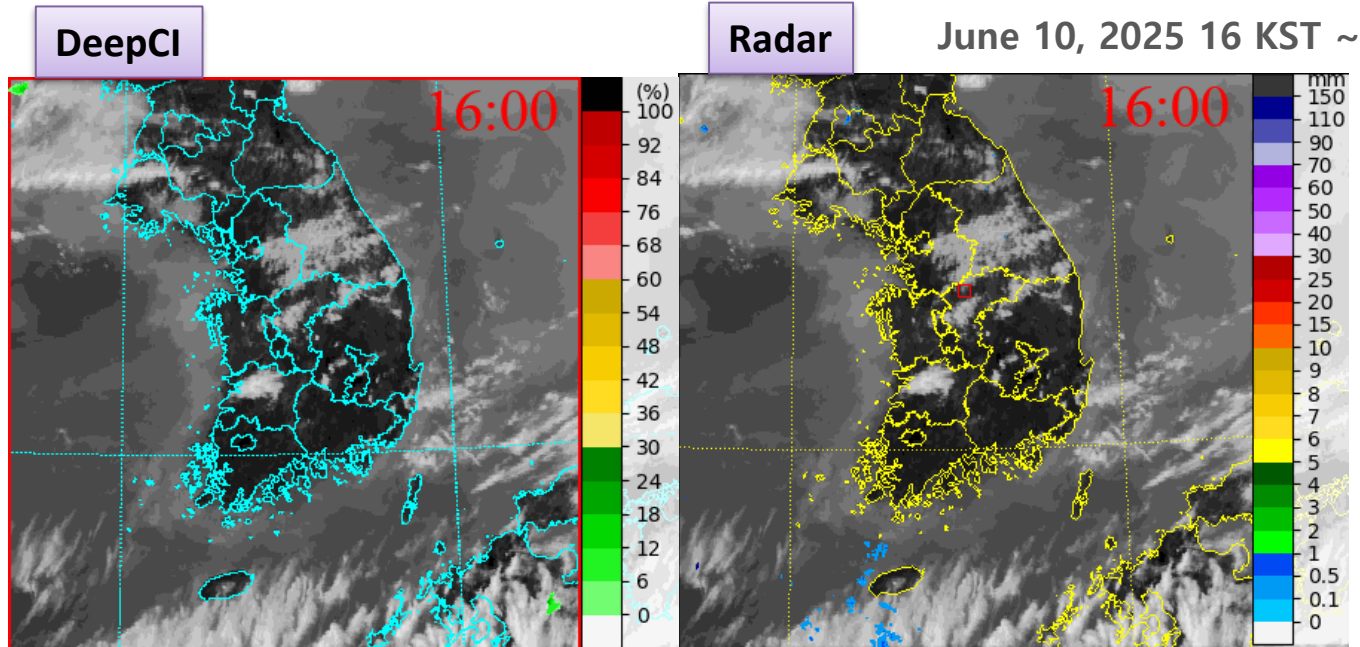
Q profile Validation Results (Truth/Period/Area: ERA-5/'26.1./EA)



- By combining GK2A and MW data, all-sky atmospheric profiles are retrieved, and the humidity profiles become more accurate than those derived from either GK2A or MW data alone

CURRENT GEO SATELLITES – GK2A Products and its application

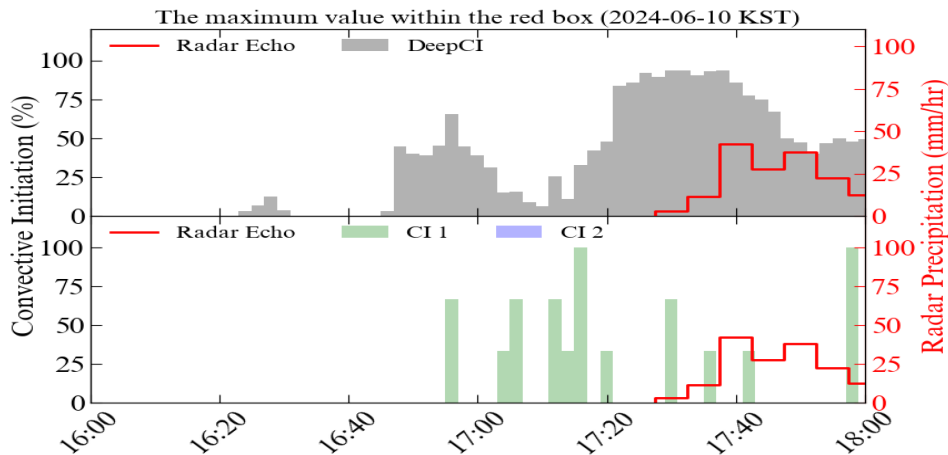
➤ Monitoring and Warning of Extreme Weather : Deep learning(ConvLSTM) based on CI (DeepCI)



- Development of convective clouds over the central region driven by cumulus row formation under atmospheric instability
- Radar Reflectivity of 35dBZ around 17:40 at red box (right panel)
- Early detection around 16:30 with a 15% probability, Early detection around 16:50 with a 50% probability

Validation : June 1, 2024 ~ Aug. 31 / every 10 minute

CI Method	POD	FAR	CSI
CI1 (Threshold)	9.62%	86.64%	5.93%
CI2 (Logistic Regression)	17.54%	80.70%	16.48%
CI(Deep Learning)	45.59%	12.36%	42.84%



CURRENT GEO SATELLITES – GK2A Products and its application

➤ Generating forecast imagery for 16 GK2A AMI channels up to 6 hours

MODEL

- Diffusion Transformer (EDM diffusion)
- Localized spatial attention
- 16ch (full AMI spectrum)
- Conditioned on ERA5 atmospheric fields

DOMAIN

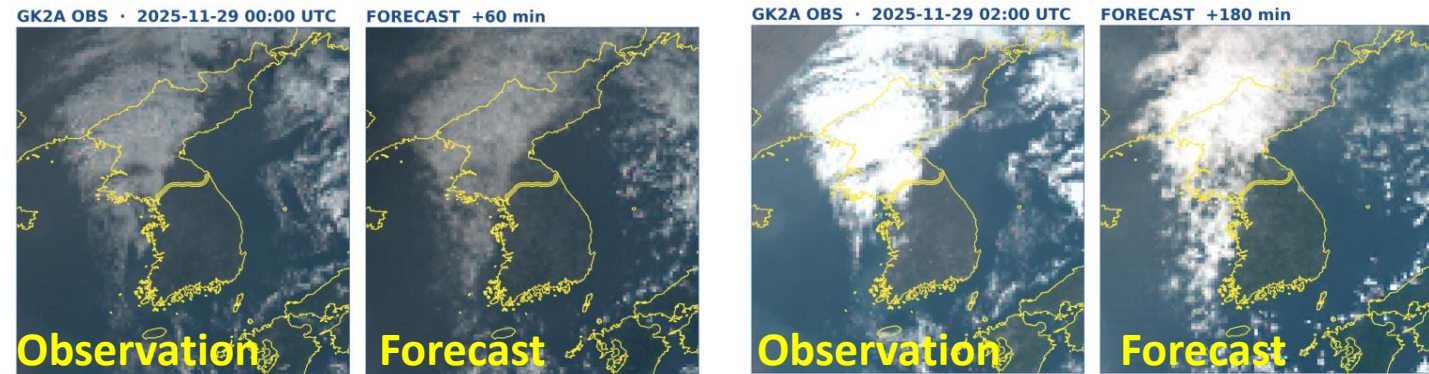
- East Asia, ~6 km nominal
- Center: 36.6°N, 126.0°E
- 10-minute time step, autoregressive

TRAINING

- GK2A AMI 2024–2025 (2-year archive)
- + ERA5 reanalysis as large-scale prior
- Diffusion denoising (100 EDM sigma steps)

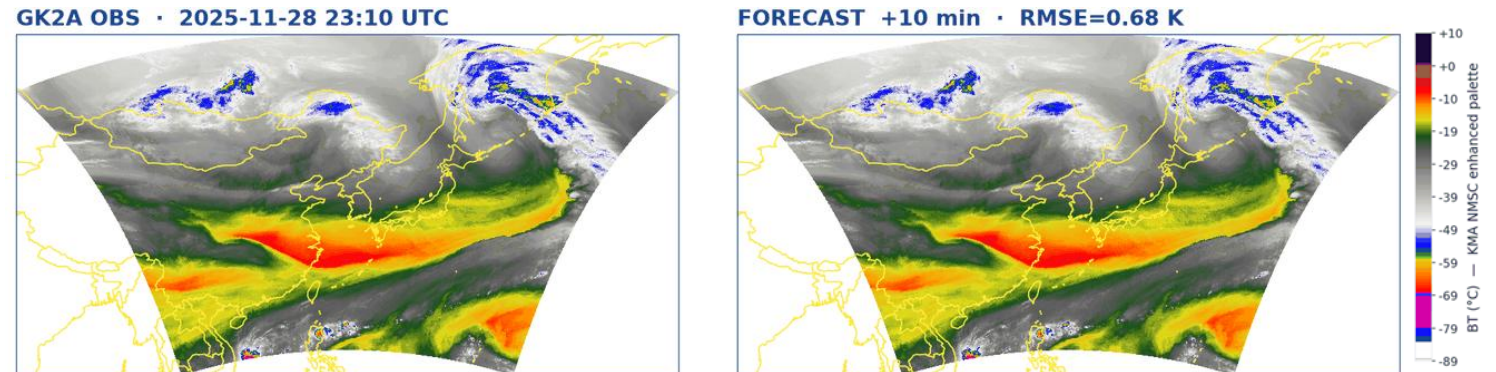
Case A — Cloud-system True Color RGB forecast

Init 2025-11-28 23 UTC(Init Time) · Korea zoom · yellow country borders · titles inside each panel



Case B — Mid-Trop water-vapor forecast (WV069, 6.9 μm)

Same init · East Asia full domain · yellow country borders

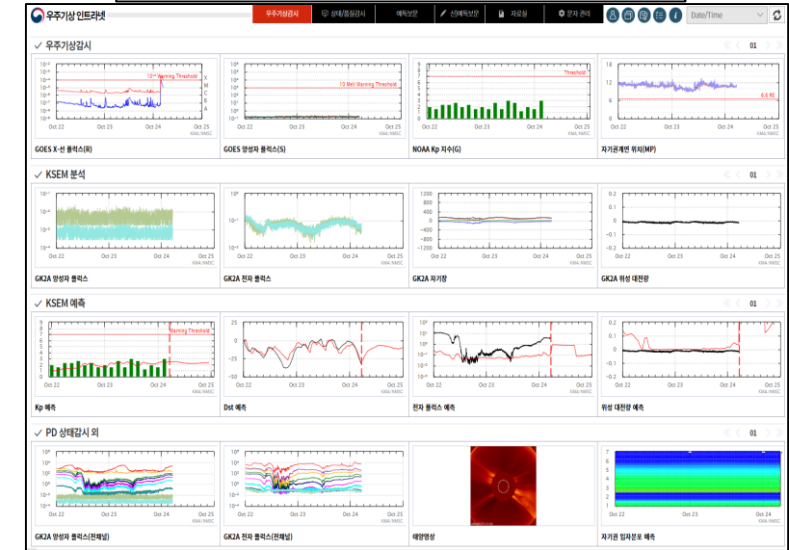


CURRENT GEO SATELLITES – Space weather monitoring using GK2A

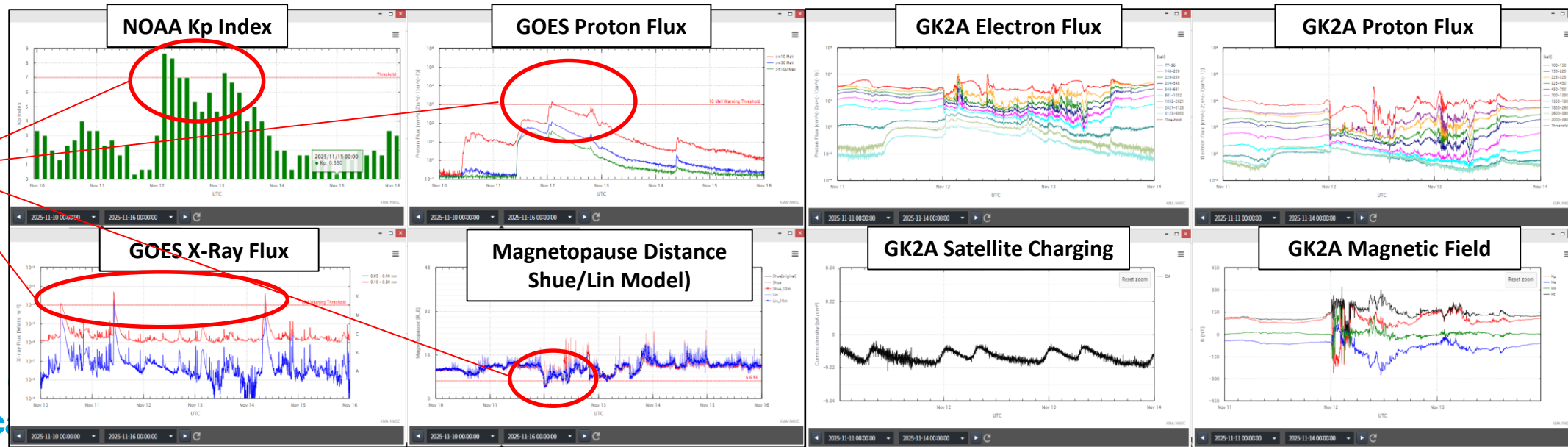
Space Weather Monitoring

- KMA/NMSC is continuously monitoring various space weather data, including GK2A, GOES, and DSCOVR, and issues warnings when hazardous situations occur.
- An monitoring and alert issuance case for space weather events that occurred between November 12, 2025, due to solar flares and arrival of CMEs.

Space Weather Monitoring System



Alert Issued



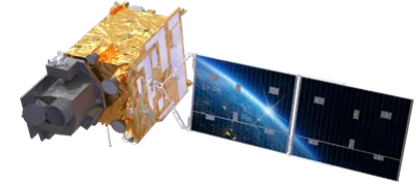
FUTURE GEO SATELLITES – The GK2A follow-on satellite, GK5

- The KMA GEO satellite program will continue based on CGMS baseline and WIGOS vision 2050.
- GK2A follow-on program (**GEO-KOMPSAT-5, GK5**) began in April 2025.
 - The KMA has, for the first time, appointed a private Korean company as the prime developer for the satellite system, advancing satellite development in collaboration with the private sector
 - Payload development project
 - (1) **Meteorological Imager**: 18 channels for meteorological mission
 - (2) **Space weather Payloads**: Proton/Electron Detector, Satellite Charging Monitor, Magnetometer (provided by ESA)

❖ GK5 Development Program Progress

- ✓ (Apr. 2025) **Program launched** via project and task agreements
(System Integration and S/C Development, Space weather Payload Development)
- ✓ (May 2025) Initiation of Public-Private Technology Transfer Council
- ✓ (Oct. 2025) Meteorological Payload Development project initiated
- ✓ (Dec. 2025) System Requirement Review & System Design Review (SRR/SDR) of GK5 program
- ✓ **(Currently Underway) Preliminary Design Phase** for the GK5 satellite system

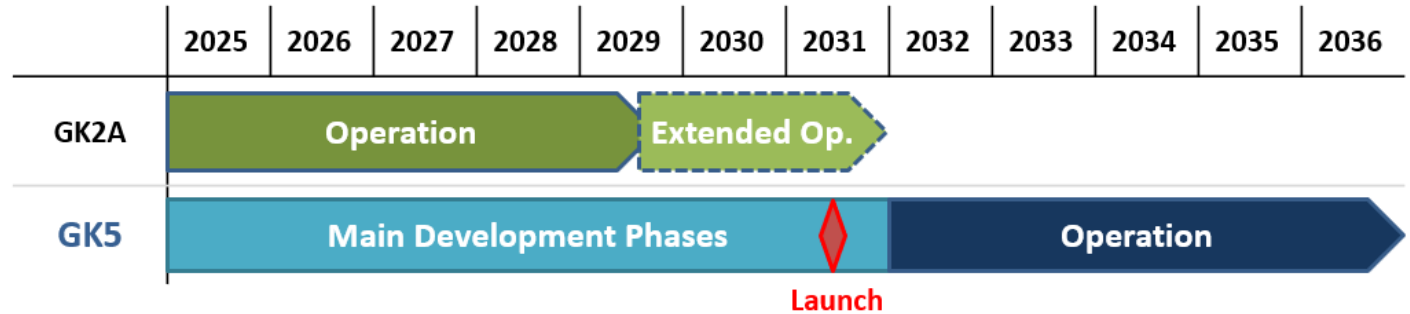
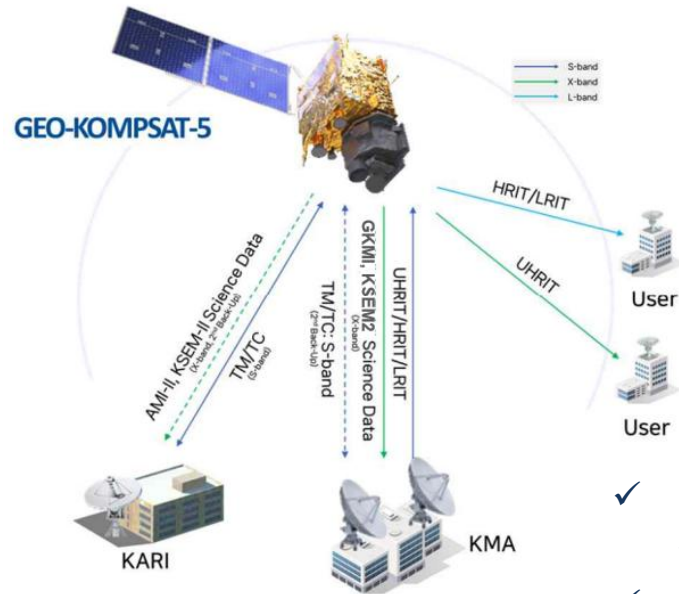
FUTURE GEO SATELLITES – The GK2A follow-on satellite, GK5



❖ GK5 Development Milestone

Development Schedule	2025				2026				2027				2028				2029				2030				2031			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
GK5 Milestone	KO ▲		SRR/SDR 1 ▲		▲SDR 2		PDR ▲		CDR ▲				IRR ▲								PSR ▲				▲L/C			

- ✓ (End of 2027) Critical Design Review (CDR) will completed
- ✓ (End of 2031) Official service of GK5 observation data





❖ GK5 Data Distribution to Users

- ✓ GK5 observation data will be distributed to users through **satellite broadcasting** and **terrestrial network**
- ✓ For assistance, the Cloud, OpenAPI, Real-time FTP, Receiving Station
→ <https://nmsc.kma.go.kr/enhome/html/main/main.do>

FUTURE GEO SATELLITES – The GK2A follow-on satellite, GK5

➤ Channel Comparison of Meteorological Payloads between GK2A and GK5

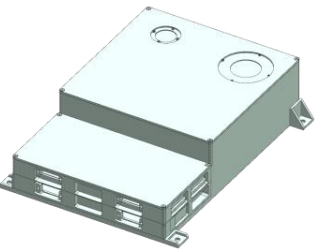
Wavelength Range	AMI (GK2A)			GKMI (GK5)		
	Channel No.	Central WL (μm)	Spatial Resolution (km)	Channel No.	Central WL (μm)	Spatial Resolution (km)
VIS/NIR	1	0.47	1	1	0.47	0.5
	2	0.51	1			
	3	0.64	0.5	2	0.64	0.25
	4	0.86	1	3	0.86	0.5
				4	0.91	1
	5	1.38	2	5	1.38	2
	6	1.61	2	6	1.61	1
MWIR				7	2.25	1
				8	3.9	1
				9	5.1	1
	8	6.24	2	10	6.2	2
	9	6.95	2	11	6.9	1
	10	7.34	2	12	7.3	2
LWIR	11	8.59	2	13	8.6	2
	12	9.63	2	14	9.6	2
	13	10.40	2	15	10.4	1
	14	11.21	2	16	11.2	2
	15	12.36	2	17	12.4	2
	16	13.31	2	18	13.3	2

 Channels improved in spatial resolution
 Newly added channels

※ 0.51 μm channel will be generated as a simulated product.

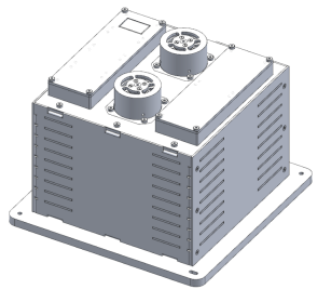
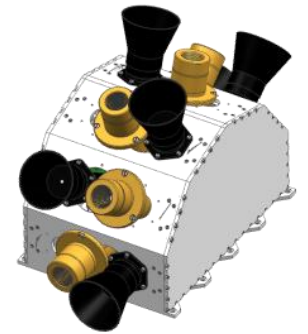
FUTURE GEO SATELLITES – The GK2A follow-on satellite, GK5

Planned Space Weather Payloads (KSEM2) onboard GK5



High Energy Proton Monitoring Suite	
Components	Key Parameters
HEPT-1 (High Energy Proton Telescope)	Energy Range: 1 ~ 30 MeV Channels: 5 in log-scale GF: 0.15 cm ² ·sr
HEPT-2 (High Energy Proton Telescope)	Energy Range: 30 ~ >500 MeV Channels: 6 in log-scale GF: 2.0 cm ² ·sr

High Energy Electron Monitoring Suite	
Components	Key Parameters
SED (Semiconductor Electron Detector)	Energy Range: 0.1 ~ 2 MeV Channels: 6 in log-scale GF: 0.032 cm ² ·sr
CED (Cherenkov Electron Detector)	Energy Range: 0.6 ~ 10 MeV Channels: 40 in log-scale GF: 0.032 cm ² ·sr



Spacecraft Charging and Radiation Monitoring Suite	
Components	Key Parameters
CM (Charge Monitor)	Range: -3 ~ 3 pA/cm ² Resolution: < 10 fA/cm ²
RM (Radiation Monitor)	Range: 1 ~ 100 krad(Si) Resolution: < 10 rad(Si)
SESA (Segmented Electro-Static Analyzer)	Range: 0.01 ~ 20 keV $\Delta E/E$: ~0.115

Service Oriented Space Magnetometer	
Components	Key Parameters
SOSMAG-II (Service Oriented Space Magnetometer)	Range: $\pm 1,000$ nT ✳ <i>Planned to be developed through collaboration with ESA</i>



Thank You!