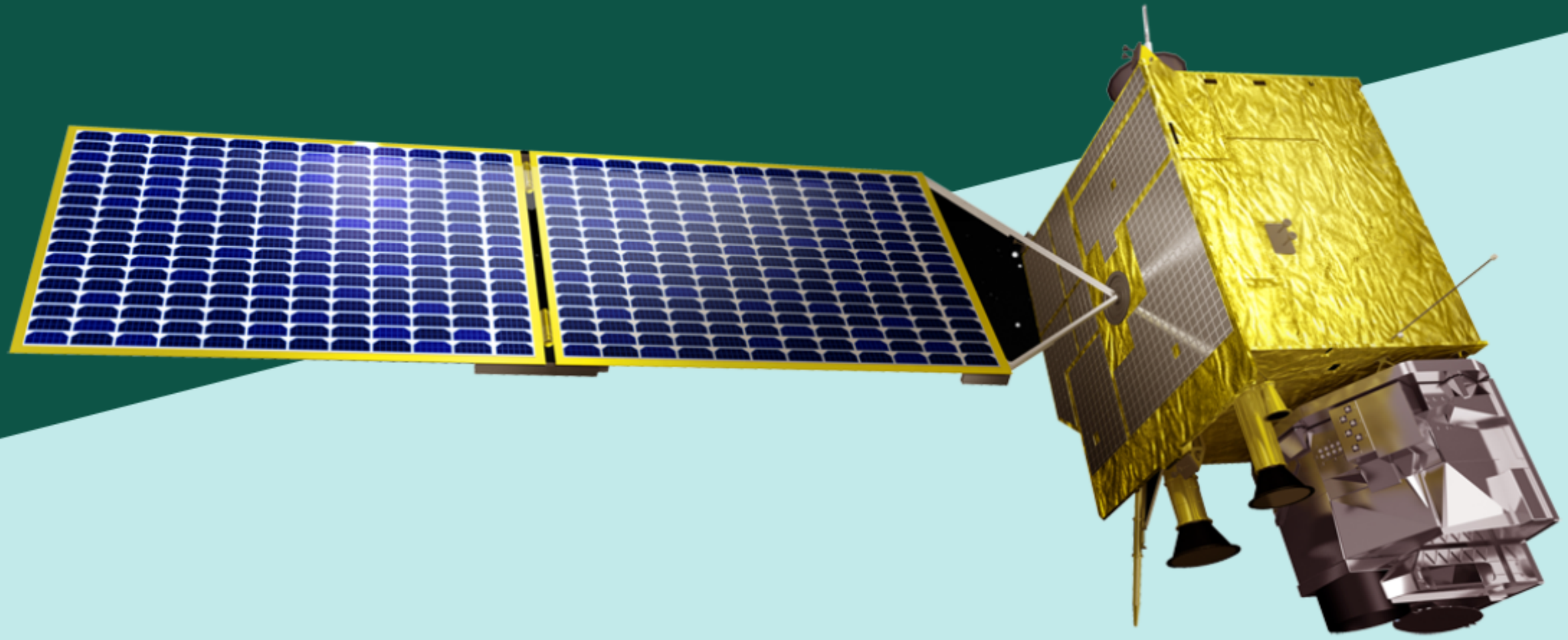
GK2A

since 2018

(G E O - K O M P S A T - 2 A)

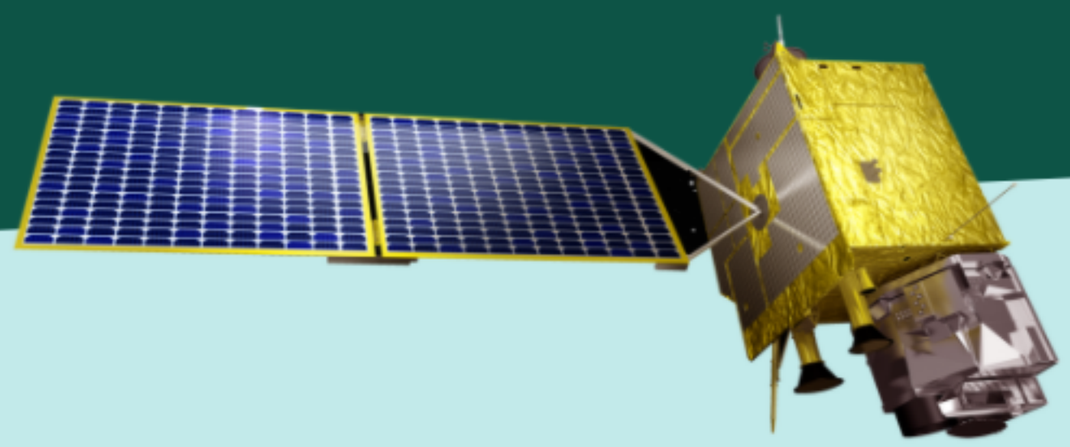
The GK2A is the second meteorological satellite
in Korea to take over the mission of COMS and
performs meteorological and space
weather observation missions.



What is the GK2A Satellite?

GK2A is a geostationary satellite operated by KMA on 128.2ºE
which carries a 16 channels imager and a space weather monotor.

Contents



Geo-KOMPSAT-2A Overview

Introduction of the Geo-KOMPSAT-2A (GK2A)

The Geo-KOMPSAT-2A (GK2A) is the new generation geostationary meteorological satellite (located in 128.2°E) of the Korea Meteorological Administration (KMA). The main mission of the GK2A is to observe the atmospheric phenomena over the Asia-Pacific region. The Advance Meteorological Imager (AMI) on GK2A scan the Earth full disk every 10 minutes and the Korean Peninsula area every 2 minutes with a high spatial resolution of 4 visible channels and 12 infrared channels. In addition, the AMI has an ability of flexible target area scanning useful for monitoring severe weather events such as typhoon and volcanic eruption and so on. And for space weather mission, the Korea Space wEather Monitor (KSEM) on the GK2A observes the space environment with the particle detector, magnetometer and charging monitor.

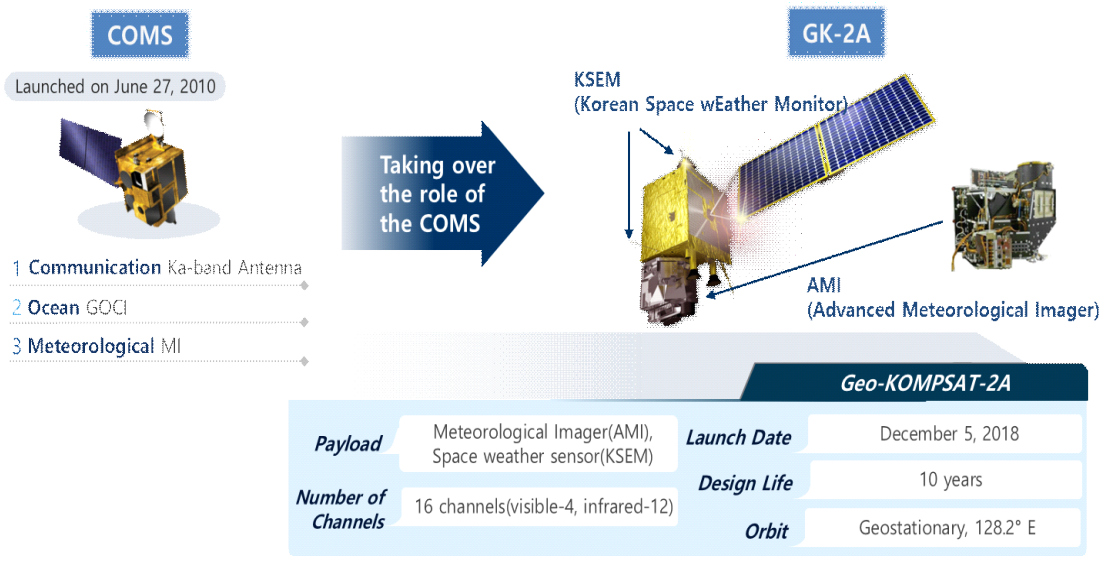


Figure 1-1 Characteristics of GK2A

The GK2A was launched on December 5, 2018 in the Guiana Space Center in South America. The design life of the GK2A is 10 years. During the 8 months in-orbit test period, the capability with multi-band and high temporal and spatial resolution was verified. After the successful IOT, KMA started GK2A's official data service on July 25, 2019. The near real-time and full resolution GK2A AMI data are now available via broadcast by the GK2A as well as on landline Real-time FTP Service (RFS).

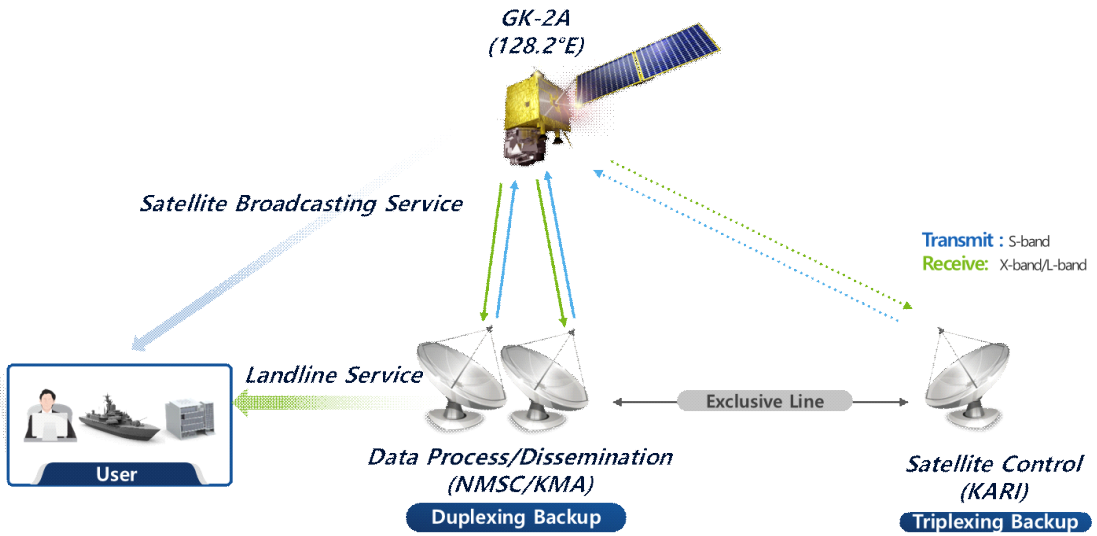


Figure 1-2 GK2A Concepts of Operation

The weather monitoring capability of GK2A is more than four times greater than that of COMS, while the observation interval and number of channels are improved by more than threefold. The satellite is expected to greatly improve the accuracy of precision weather monitoring and weather forecasting, as well as the capability of monitoring and forecasting extreme weather over the Korean Peninsula and the Asia-Pacific region.

The biggest change is that AMI provides RGB color images through channel synthesis, such as true color RGB, air mass RGB, dust RGB, water vapor RGB, and so on. This has strengthened the real-time monitoring function through satellite imagery in the mesoscale meteorological phenomena.

Furthermore, the AMI observations make the 52 derived products generation possible for the monitoring of severe weather phenomena such as typhoon, heavy rain, fog, and Asian dust. The KSEM observes high energy particle flux, magnetic field along three axis, and charge inside the satellite and it also provides 5 types of space weather prediction index, such as the magnetospheric particle flux (MPF), geostationary electron flux prediction (GEP), satellite charging (SC) index, Kp index prediction (KIP), and Dst index prediction (DIP). The GK2A products have been expected to bring effects in various fields, such as improving weather forecast accuracy, safety management, and climate change response systems.

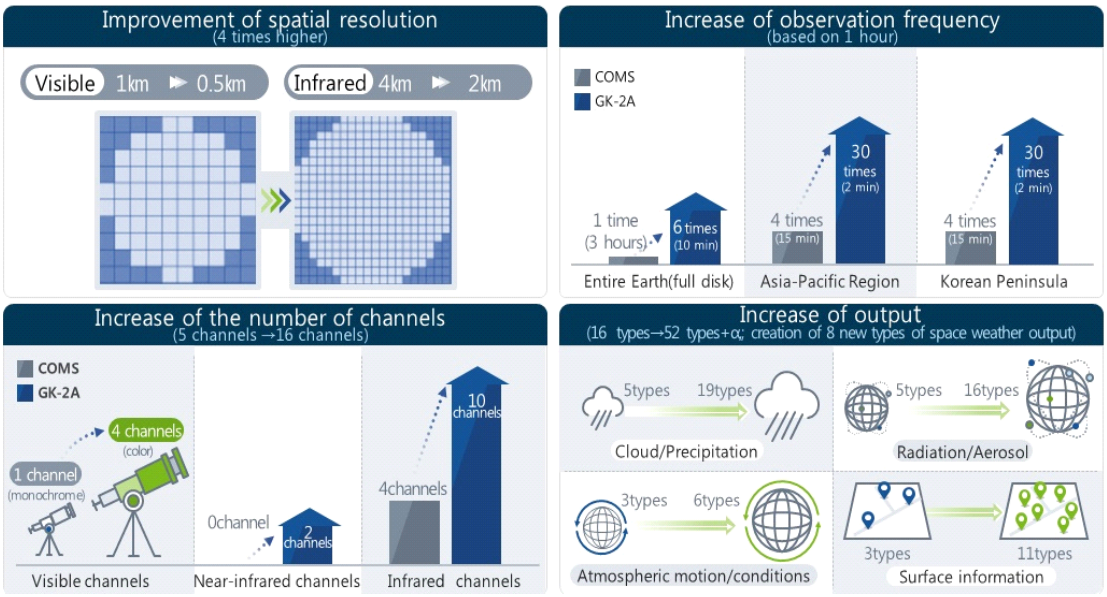


Figure 1-3 Enhancement of the observation function of GK2A compared to COMS

Ground System Overview of the GK2A

Introduction of GK2A Ground System

Ground System overview of the GK2A

A satellite ground system plays key role of data reception, processing, analysis, archiving and distribution. NMSC (National Meteorological Satellite Center) / KMA (Korea Meteorological Administration) has established the GK2A (Geo-Kompsat-2A) ground system for meteorological and space weather mission in KMA site at Jincheon-gun. And the GK2A satellite operation center has been established in KARI (Korea Aerospace Research Institute) at Daejeon city(approximately 80km away from the KMA site). Both of the ground segments started its official operation on 25 July, 2019.

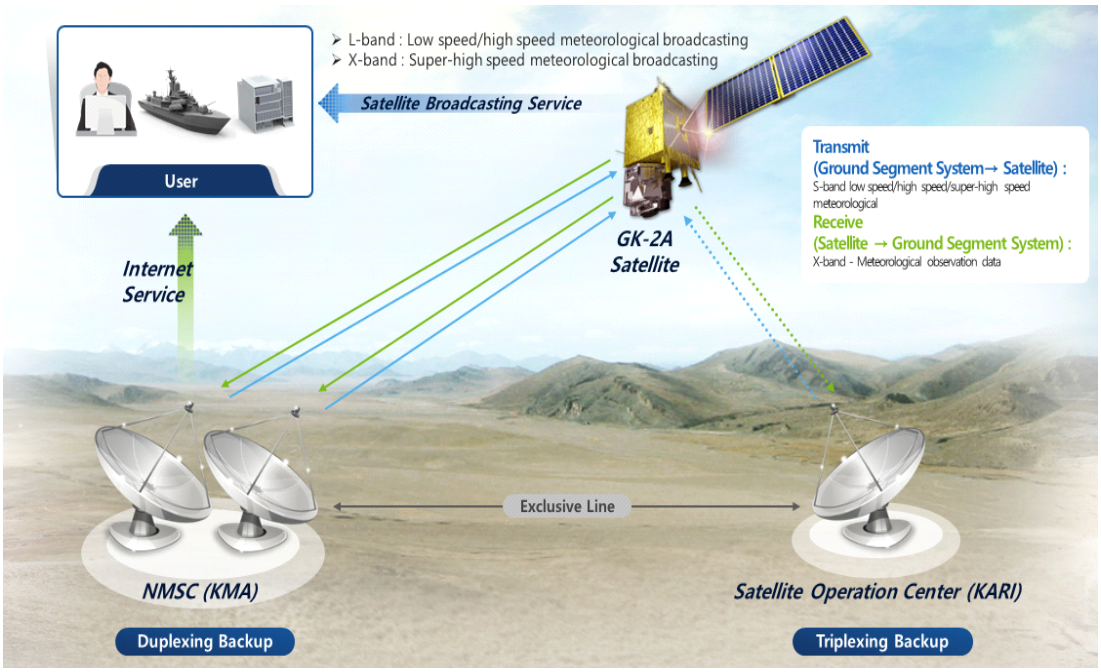


Figure 2-1 Simplified GK2A Ground System Architecture

The two ground segments can back-up each other for stable GK2A operation. The primary/backup roles of two ground segments are summarized in Table 2-1.

Table 2-1. The roles of KMA and KARI ground segments for the GK2A

Ground Segment	Satellite Control	Data processing/Service	Data Broadcast by the GK2A
KMA	Backup	Primary	Primary
KARI	Primary	Backup	Backup

By the way, all components of the NMSC ground system are configured as a multiplexing system including antennas, image processing and data management systems for non-stop operations.

With stable operation of the GK2A ground system, it is expected that KMA is able to improve the weather forecast accuracy, sharpen the competitive edge in the global meteorological information sector, establish the safety control, enhance the climate change monitoring and cultivate the professional in the meteorological sector.

▶ Ground System Structure and Functions

The GK2A ground system consists of various kinds of components as shown in Figure 2-2 and the main components and their functions are summarized.

☑ Satellite Ground Control (SGC)

The functions of the SGC system are as follows:

- ✓ generates the satellite mission planning and observation scheduling.
- ✓ generates the orbit maintenance data and determines precise locations of the satellite required for the GK2A operation.
- ✓ generates commands to control the GK2A, monitor the GK2A condition and process telemetry data.

☑ Reception and Processing (RAP)

RAP system consists of four subsystems necessary data reception, image processing and distribution.

- **CDAS (Communication and Data Acquisition Subsystem)** receives the observation data from satellite and transmits the UHRIT/HRIT/LRIT data to satellite for dissemination by the GK2A. CDAS also controls the commands of satellite for both uplink and downlink.
- **AMI-DPS (AMI Data Pre-processing Subsystem)** generates two types of products: Level 1B complete data with radiometric and geometric correction and UHRIT/HRIT/LRIT data to be used for data broadcasting service.
- **MDPS (Meteorological Data processing Subsystem)** generates automatically the 52 derived products (Level 2) and application products (Level 3/4)
- **KDPS (KSEM Data processing Subsystem)** generates space weather products and analyzes the data quality of KSEM (Korea Space wEather Monitor) observation.

☑ Data Management and Sevice (DMS)

DMS system consists of two subsystems necessary data management and service.

- **DMS (Data Management Subsystem)** collects internal/external meteorological data that is required by other data processing subsystems in real-time/non real-time and distributes the data to user systems.
- **DSS (Data Service Subsystem)** provides various types of satellite meteorological data through landline-based service such as intranet, Open API for internal users and DCPC(Data Collection and Production Center), FTP(File Transfer Protocol) and internet for external users.

☑ Management and Control (MAC)

MAC system consists of two subsystems necessary for managing

data quality and controlling all subsystems of the GK2A ground segment.

- **QMS (Quality Management Subsystem)** generates not only the quality information of all the GK2A products generated by DPS, MDPS and KDPS but also has a role of monitoring and analyzing the data quality.
- **GCS (Ground Control System)** monitors the status of all hardware and software of the GK2A ground segment and provides functions of controlling them.

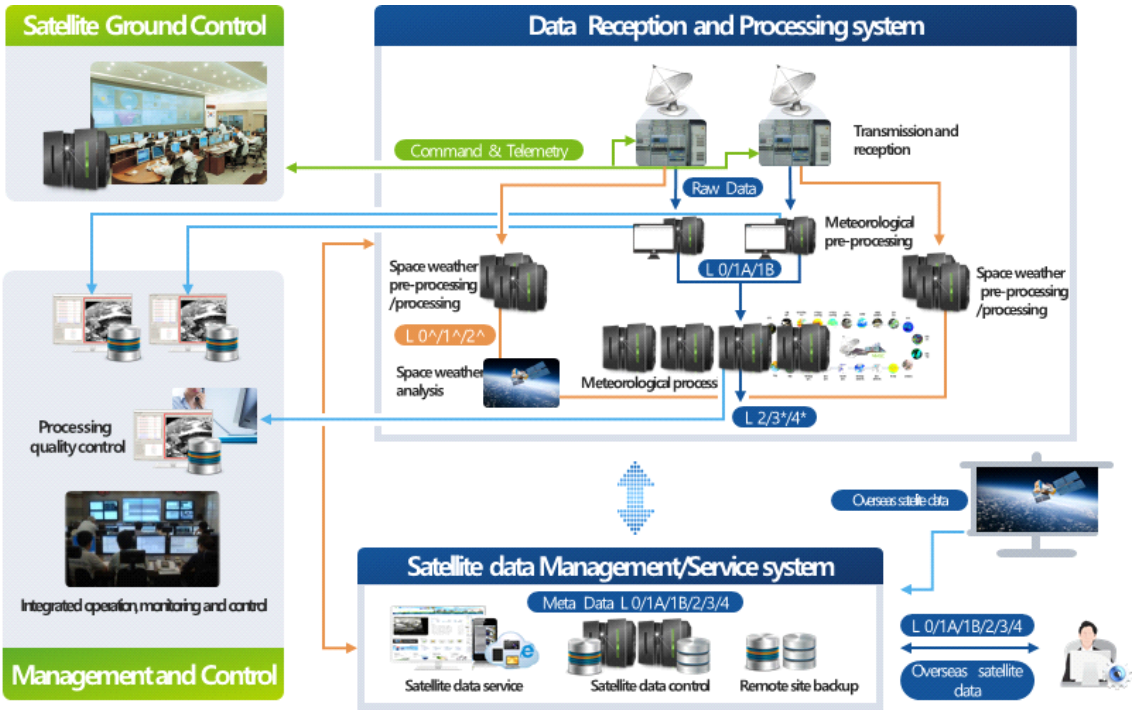


Figure 2-2 The GK2A ground system consists of various kinds of components

GK2A Advanced Meteorological Imager (AMI)

Introduction of GK2A Advanced Meteorological Imager (AMI)

GK2A Advanced Meteorological Imager (AMI)

The new-generation geostationary (GEO) meteorological satellite from the Korea Meteorological Agency (KMA), Geo-KOMPSAT-2A (GK2A), was successfully launched on December 5, 2018. The satellite started operation at 128.2°E on July 25, 2019, after the completion of overall-system checking and initial performance analysis. The GK2A features the new Advanced Meteorological Imager (AMI) with significantly higher spatial and temporal resolution than those of the previous Meteorological Imager (MI) the Communication Ocean, and Meteorological Satellite (COMS).

Figure 3-1. Illustration of Geo-Kompsat-2A (GK2A)

The GK2A AMI has a spatial resolution of 0.5 or 1 km for visible channels and 2 km for near-infrared and infrared channels. The AMI has multi-channel visibility through a thermal infrared imaging radiometer that provides observations in 16 spectral channels, which significantly exceeds the five channels of the meteorological imager(MI) on the COMS. The AMI channels configuration and comparison with other instruments is shown in Table 3-1. In terms of scan speed, the AMI can take full disk image within 10 minutes, whereas 30 minutes for COMS. In summary, compared to the COMS imager, AMI captures the Earth's hemisphere in approximately three times more spectral channels, at four times more spatial resolution, and five times faster image update rates.

AMI (Resolution)		ABI	AHI
1 blue	0.47 (1km)	0.47	0.46
2 green	0.511 (1km)		0.51
3 red	0.64 (0.5km)	0.64	0.64
4	0.856 (1km)	0.865	0.86
5	1.38 (2km)	1.378	
6	1.61 (2km)	1.61	1.6
		2.25	2.3
7	3.830 (2km)	3.90	3.9
8	6.241 (2km)	6.185	6.2
9	6.952 (2km)	6.95	7.0
10	7.344 (2km)	7.34	7.3
11	8.592 (2km)	8.50	8.6
12	9.625 (2km)	9.61	9.6
13	10.403 (2lkm)	10.35	10.4
14	11.212 (2km)	11.2	11.2
15	12.364 (2km)	12.3	12.3
16	13.31 (2km)	13.3	13.3

Table 3-1. GK2A AMI channel configruation and comaprision with other instruments on GOES-16(ABI) and Himawari-8(AHI)

With this improved observation capacities of the AMI, we can generate more kinds of meteorological products and also can enhance the abilities of nowcasting, NWP(Numerical Weather Prediction) application and environment monitoring.

- GK2A AMI SRF(Spectral Response Function):
http://nmsc.kma.go.kr/enhome/html/base/cmm/selectPage.do?page=satellite.gk2a.intro

▶ Observation Areas and Timeline

For the GK2A AMI, in operational 10 minute timeline (scanning scenarios), the entire full disk of the Earth is imaged in all 16 channels at a 10-min interval while also imaging 0.1064 (EW) × 0.067 (NS) radian (3800 km × 2400 km at nadir) regional extended local area (ELA) area every 2 min and a separate 0.028 × 0.028 radian (equivalent to 1000 km × 1000 km at nadir) mesoscale area or local area (LA) every 2 min, where each mesoscale can be located anywhere in whole image frame or in space (e.g., Moon observation).

Within operation timeline, the observations for radiometric and geometric calibration, such as internal blackbody targets, space looking, or star sensing are included. All observation data are seamlessly transmitted to ground station, where the raw data are processed as following sequences:

Ⅰ. Data are uncompressed to detector sample values.
Ⅱ. Radiometric calibration is applied.
Ⅲ. Calibrated detector values are navigated to Earth location.
Ⅳ. Calibrated and navigated values are re-sampled to fixed grid angular coordinate projection.
Ⅴ. Images are generated.

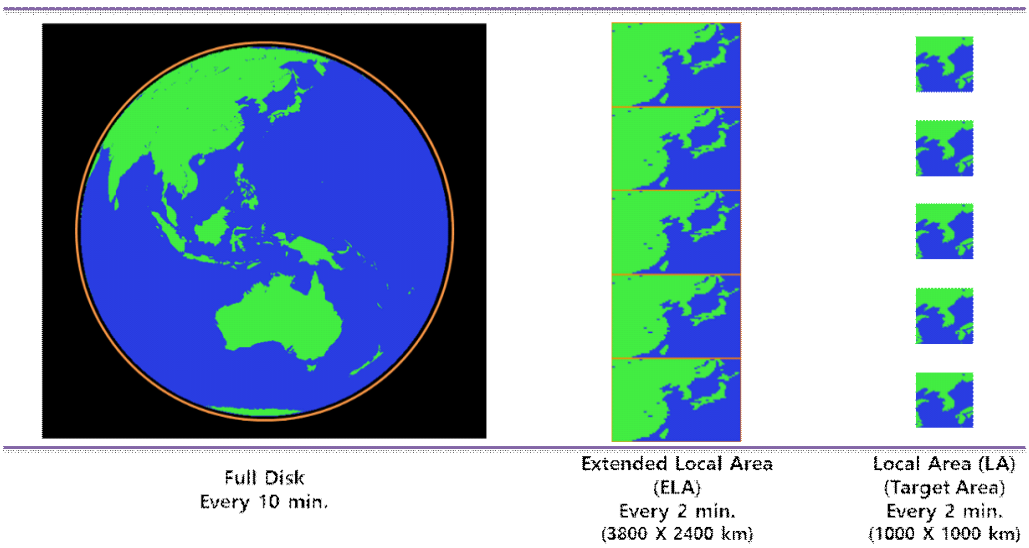


Figure 3-2. GK2A AMI observation areas and frequencies in one 10-minute timeline.

▶ Benefits from the GK2A AMI observation

The AMI monitors various kinds of meteorological phenomena such as cloud formation, atmospheric motion, convective development, land and sea surface temperatures, ocean dynamics, flow of water, fire, smoke, volcanic ash, aerosols and air quality, and vegetative health. Data from the AMI helps meteorologists to pinpoint and track the areas of developing storms in much greater detail.

- ✓ Improved Typhoon track and intensity forecasts
- ✓ Increased warning lead time for severe storms
- ✓ Improved fog/low cloud detection
- ✓ Increased fire detection ability and intensity estimation
- ✓ Improved detection of heavy rainfall and flash flood
- ✓ Improved smoke and dust monitoring

Korea Space wEather Monitor (KSEM) on GK2A

Introduction of Korea Space wEather Monitor(KSEM) on GK2A

Korea Space wEather Monitor (KSEM)

The Korea Space wEather Monitor (KSEM) is a suite of space weather monitoring instruments on GK2A. The KSEM is to provide real-time monitoring of space weather at geostationary orbit in 128.2 E. The KSEM consists of a particle detector (PD), magnetometer (MG) and charging monitor (CM) (Figure. 4-1).

The PD has 128 channels for measuring energy of electrons and protons; it measures their fluxes in an energy range of 100 keV to 2M eV.

The MG measures a magnetic field of ±64,000 nT along three axis. The KSEM service oriented spacecraft magnetometer (SOSMAG) system uses a 1 -m long deployable boom to reduce disturbance by the satellite body. It is a remarkably short compared to other satellite-based MG booms with similar level measurement performance.

The CM is for direct monitoring of the satellite's internal charging, and its products are used for cross-verification with PD data. Table 4-1 lists the specifications of each sensor.

The data from those sensors are used to produce the advanced and various level 2 data.

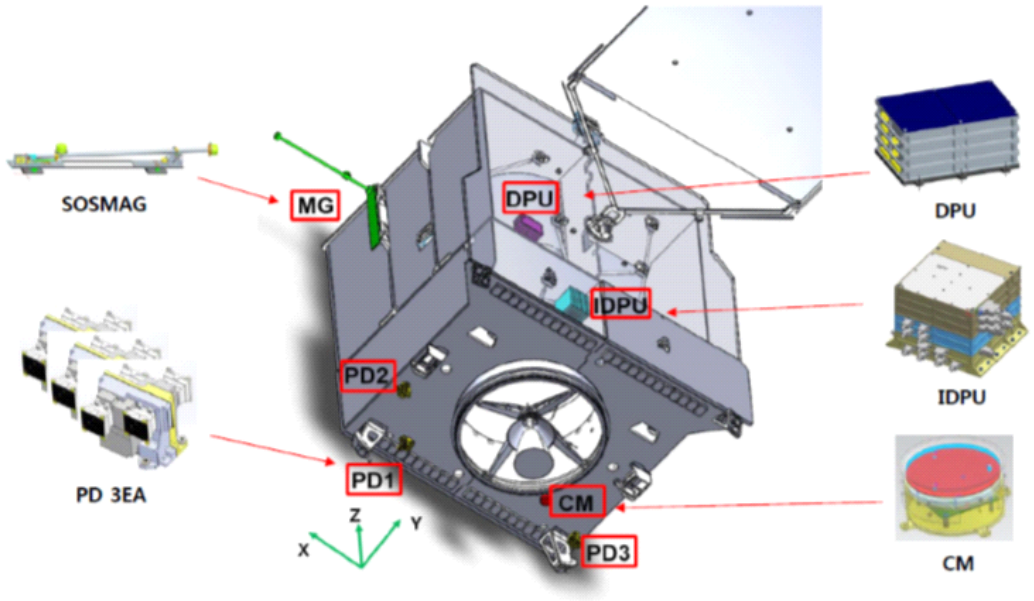


Figure 4-1. The GK2A and KSEM instruments.

The IDPU (Instrument Data Processing Unit) for all KSEM instruments and DPU (Digital Processing Unit) for SOSMAG are located in the satellite body. The Z-axis is towards Earth. Each PD has a different position and angle of view. The DPU, IDPU, and two AMR (Anistropic Magneto-Resistance) magnetometers are located inside the satellite body. The SOSMAG is a type of deployable boom.

Table 4-1. Summary of sensors equipped on the KSEM.

Sensors	Parameter	Specification
Particle Detector (PD)	Energy Range	100 keV ≤ E ≤ 2 MeV
	Energy Resolution	ΔE/E ≤ 0.2%
	Time Resolution	≤0.33 sec
	View Direction	six directions
	Count Resolution	8 bit
Magnetometer (MG)	Range	±350 nT
	Accuracy	≤1 nT
	Time Resolution	0.1 sec
	Boom Length	1 m
Charging Monitor (CM)	Range	-3 pA/cm2 to + 3pA/cm2
	Accuracy	≤0.01 pa/cm2
	Time Resolution	≤0.1 sec

Products and Applications of AMI data on GK2A

Introduction of GK2A AMI products and applications

Products and Application of AMI on GK2A

▶ Geophysical Products

NMSC produces the 52 kinds of meteorological products using GK2A (Geo-Kompsat-2A) observation and auxiliary data for applying weather monitoring, numerical weather prediction, climate, and so on. There are 23 primary products and 29 secondary products. The primary products are more directly related to weather forecast and higher priority for data release than the secondary products*.

* Secondary products are challenging items based on meteorological imager observations, which can be applicable to various fields of researches such as oceanography, hydrology, atmospheric environment, cloud physics and aviation meteorology, etc.

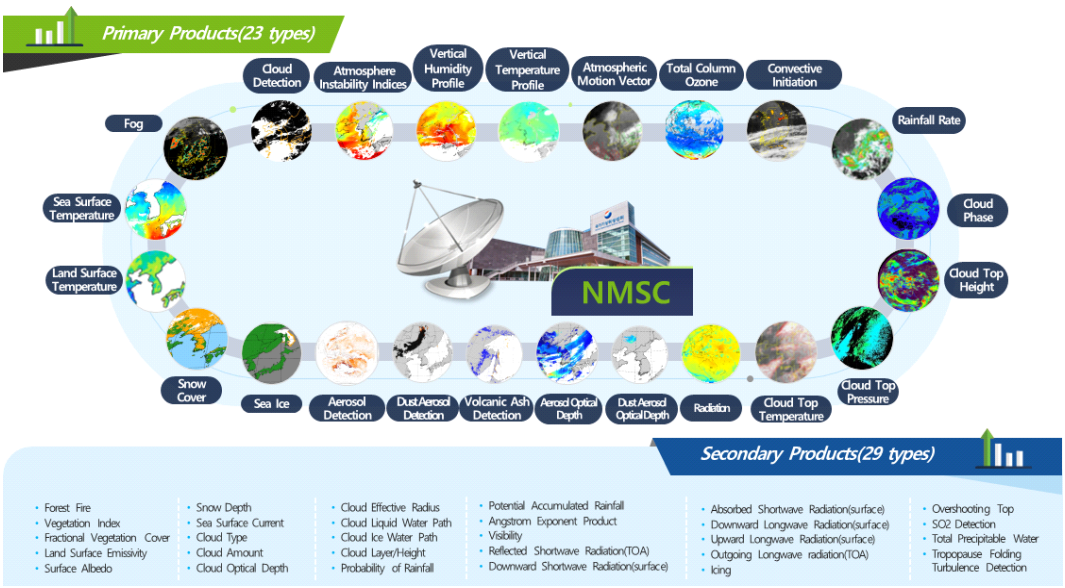


Figure 5-1 GK2A/AMI Geophysical Products

Table 5-1 GK2A/AMI Geophysical Products

	Scene & Surface Analysis	Cloud & Precipitation	Aerosol & Radiation	Atmospheric condition & Aviation
Primary Products	Cloud detection	Cloud Top Temperature	Aerosol Detection	Atmospheric Motion Vector
	Snow Cover	Cloud Top Pressure	Aerosol Optical Depth	Vertical Temperature Profile
	Sea Ice Cover	Cloud Top Height	Asian Dust Detection	Vertical Moisture Profile
	Fog	Cloud Phase	Asian Dust Optical Depth	Instability Index
	Sea Surface Temperature	Rainfall Rate	Volcanic Ash Detection, Height & Mass	Convective Initiation
	Land Surface Temperature		Radiance	Total Ozone
Secondary Products	Surface Emissivity	Cloud Type	Aerosol Particle Size	Total Precipitable Water
	Surface Albedo	Cloud Amount	Visibility	Clear Sky Turbulence
	Fire Detection	Cloud Optical Depth	Downward SW Radiation (SFC)	SO_2 Detection
	Vegetation Index	Cloud Effective Radius	Reflected SW Radiation (TOA)	Overshooting Top Detection
	Vegetation Green Fraction	Cloud Liquid Water Path	Absorbed SW Radiation (SFC)	Aircraft Icing
	Snow Depth	Cloud Ice Water Path	Upward LW Radiation (TOA)	
	Ocean Current	Cloud Layer/Height	Downward LW Radiation (SFC)	
		Rainfall Potential	Upward LW Radiation (SFC)	
		Probability of Rainfall		

▶ Application of Geophysical Products

NMSC has been developing various application technologies for nowcasting, Typhoon and ocean analysis, hydrology, land surface analysis, climate change monitoring and environmental applications. To retrieve more specific and value added information on weather phenomena from these application technologies, all available data including LEO products, ground observations, NWP forecast as well as GK-2A and 2B observation data are used.

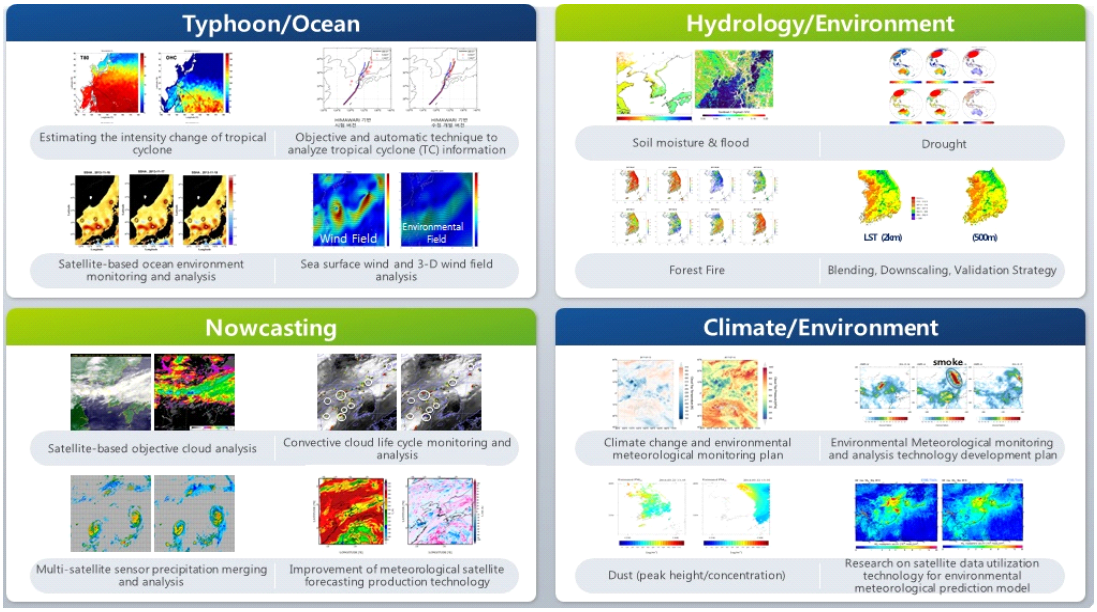


Figure 5-2 Using GK2A/AMI Geophysical Products

Table 5-2 Classification of Application Technology

Classification	Application Technology
Nowcastion (Short-range Weather)	➢ Satellite-based objective cloud analysis technology ➢ Convective cloud lifetime monitoring and analysis technology ➢ Multi-satellite-based precipitation synthesis and analysis technology ➢ Predictive image generation technology improvement and analysis
Typhoon/Ocean	➢ Objective analysis technology of typhoon location and intensity ➢ Typhoon development/weakening analysis technology ➢ Ocean monitoring and analysis technology ➢ Ocean wind and 3D horizontal wind field analysis technology
Surface/Hydrology	➢ Soil moisture, drought, and flood analysis technology ➢ Forest fire analysis technology (occurrence risk, damage area, radiant heat) ➢ High-resolution detailing and synthesis technology ➢ Satellite output standard verification analysis technology
Climate/Environment	➢ Climate change monitoring and analysis technology ➢ Environmental weather monitoring and analysis technology ➢ Satellite data utilization technology for environmental weather prediction model

Products and Applications of KSEM data on GK2A

Products and Application of KSEM on GK2A

▶ Space Weather Products

The Korea Space wEather Monitor (KSEM) level 1 data (i.e., high energy particle flux, magnetic field along three axes, and satellite internal charging) are currently used to produce five types of level 2 data: the magnetospheric particle flux (MPF), geostationary electron flux prediction (GEP), satellite charging (SC) index, Kp index prediction (KIP), and Dst index prediction (DIP) (Table 6-1 and Figure 6-1). The algorithms for the GEF and DIP utilize additional data from the GOES series to improve prediction performance. Details of the algorithms are described in additional papers currently being prepared and soon to be submitted. We describe these algorithms briefly here.

Table 6-1. Summarized KSEM Level 2 products

Product	Period	Resolution	Application
Magnetospheric Particle Flux (MPF)	1hr	0.2 Re	Monitoring of Particle flux in magnetosphere
GEO Electron Flux (GEF)	1hr	1hr	Prediction of Particle flux prediction at geostationary orbit
Satellite Charging (SC)	1hr	1hr	Estimate Internal charging index of the satellite
Kp Index Prediction (KIP)	1hr	1hr	Prediction of Kp index prediction
Dst Index Prediction (DIP)	1hr	1hr	Prediction of Dst index prediction

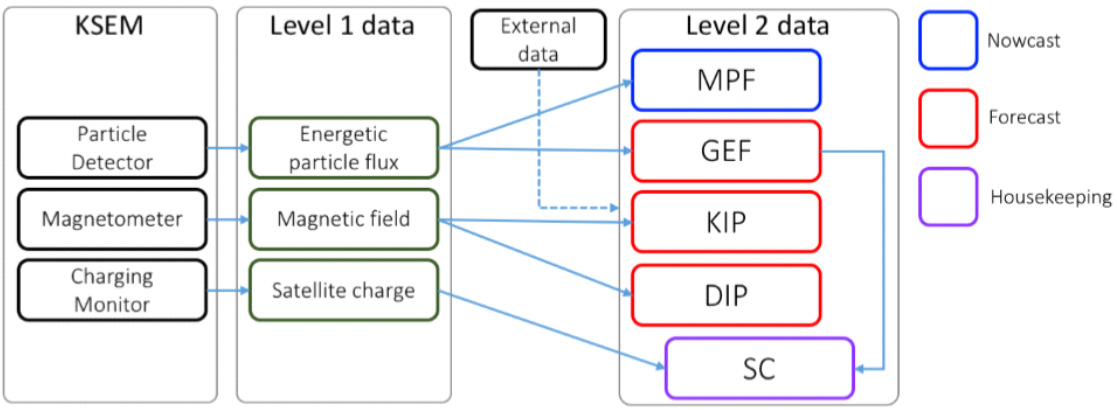


Figure 6-1. Schematic of KSEM data process.

☑ Magnetospheric Particle Flux (MPF)

The MPF is the estimated electron flux for the entire magnetosphere in five energy channels. It provides electron fluxes at L=2-7 in intervals of 0.2nT.

☑ Geostationary Electron Flux (GEF) Prediction

The GEF is the estimated electron flux at geostationary orbit in 16 energy channels. The GEF neural network algorithm predicts the electron flux over a geostationary orbit (GEO) up to 12hr in advance in 1 hr interval while maintaining sufficient accuracy.

☑ Satellite Charging (SC)

The SC is the estimated internal current caused by high-energy plasma around a spacecraft. It provides the charging index of a 0.2-2.0 mm thick aluminum shield at 0.2-mm increments and predicts the SC 1-24 hr in advance at 1 hr interval. The SC algorithm uses the GEF prediction values as input data.

☑ Kp Index Prediction (KIP)

The KIP predicts the Kp index 1-24 hr in 3hr intervals. The KIP algorithm consists of empirical formula and neural networks and uses magnetic field data of measurements on geostationary orbit.

☑ Dst Index Prediction (DIP)

The DIP is the estimated Dst index, and the algorithm consists of empirical formula and neural networks that use magnetic field data measurements on geostationary orbit. The algorithm uses magnetic field data from measurements on entire GEO orbit. With a single spot measurement, it must use the latest 24-hr data that could have different values in the present. The DIP algorithm predicts the Dst index 1-14 hr in 1 hr intervals.

☑ KSEM Contribution to Space Weather monitoring network

KSEM level 2 products are designed for space weather monitoring and forecasting.

The longitudinal location of the GK2A is 128.2°E, while those of the GOES-East/West satellites are 75°W and 135°W, respectively. A combination of these three geostationary satellites data can make it possible to monitor solar wind dynamic pressure for almost 13 hours every day (Figure 6-2).

The GK2A is located on almost the opposite side of GOES-East, so they can simultaneously observe to provide real-time information on the configuration and temporal variation of each half side the geomagnetic environment. This can facilitate further quantitative studies and provide a better understanding of the interaction and dynamics of the geomagnetic field and interplanetary magnetic field (IMF).

Empirical magnetosphere modeling is a key for studying the magnetic field response to solar wind and tracing plasma waves and energetic particles around the Earth. The reliability of empirical magnetosphere models is intrinsically dependent on obtaining as much in situ data on conditions and fluctuations as possible.

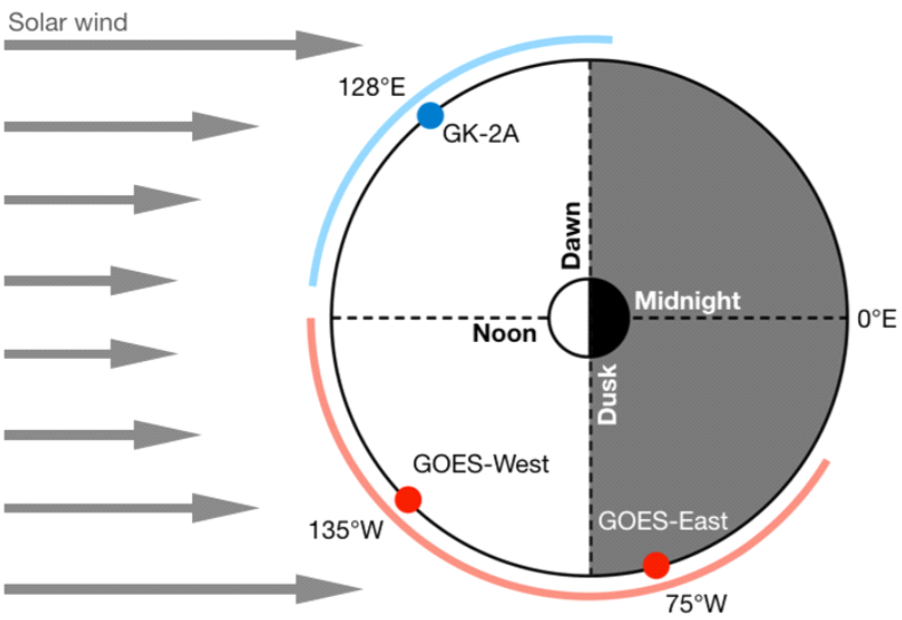


Figure 6-2. Schematic of GK-2A and GOES satellites orbital positions.
Two GOES satellites separated by approximately 4hr local time provide an indicator of solar wind dynamic pressure during ~10hr each day (red circles). With GK-2A, under the same conditions (blue circle), the total monitoring duration of dynamic pressure could be expanded by more than half a day.

✧ Reference : Daehyeon Oh, Jiyoung Kim, Hyesook Lee, Kun-Il Jang, Satellite-based In-situ Monitoring of Space Weather: KSEM Mission and Data Application, Technical Paper J. Astron. Space Sci. 35(3), 175-183 (2018) https://doi.org/10.5140/JASS.2018.35.3.175

GK2A Data Service

Introduction of the GK2A Data Download, Format and Tool

This chapter on GK2A data service introduces the data access via landline, rebroadcast by GK2A, data format information and user support tool.

Data access via Internet

▶ Web-based data service

Users can search and download the GK2A L1 (level 1 image data), L2 (level 2 meteorological products) data and images through the KMA/NMSC website with functions of data search, selection and download as below:

Ⅰ. Login NMSC/KMA website.
Ⅱ. Search the data what you want on web-page.
- THE GK2A web-based service URL:
  http://datasvc.nmsc.kma.go.kr/datasvc/html/data/listData.do

Ⅲ. Add data to wish-list.
Ⅳ. Request wish-list.
Ⅴ. Check the results of data request and download.
- Details of web-based data service request step described on this web page:
  http://datasvc.nmsc.kma.go.kr/datasvc/html/base/cmm/selectPage.do?page=static.introduction

---

▶ DCPC (Data Collection and Production Center)

As a component of WIS (WMO Information System), the DCPC NMSC has been operated to provide the GK2A L1 and L2 data. Data request and delivery service requires user registration. User registration process is as below;

Ⅰ. Go to DCPC user registration menu on main page.

Ⅱ. Submit the form of data access membership request to web-master (kmasod@korea.kr). The form is available on the webpage

Ⅲ. After the membership request is approved by NMSC DCPC, then you can search and request any data on DCPC website and download the data in real time.

* Membership approval process may take a couple of working days

- NMSC DCPC URL:
  http://dcpc.nmsc.kma.go.kr/openwis-user-portal/srv/en/main.home

▶ Open-API (Application Programming Interface)

User can download the GK2A data via the Open-API service which provides data download link for requested data. The users can collect the GK2A data using variable URL download applications such as wget, curl, Python, etc. The data access procedure by the Open-API is as below:

Ⅰ. Register on NMSC webpage as a user

Ⅱ. Request issue key : download and fill a issue key application form and submit to NMSC Open-API manager via email, kmasod@korea.kr.

- Issue key application form link:
  http://datasvc.nmsc.kma.go.kr/datasvc/json/base/resources/selectAtchFile.do?attachFileUsq=40579

Ⅲ. Use the key to create a URL in user page after getting a response from the open-API manager.

Ⅳ. Execute a user own Open-API Program.

- Open-API Python code sample link:
  http://datasvc.nmsc.kma.go.kr/datasvc/json/base/resources/selectAtchFile.do?attachFileUsq=40549

Real-time FTP Service (RFS)

For national meteorological and hydrology services (NMHSs), NMSC provides the GK2A real-time ftp service (RFS). With RFS, NMSC provides the AMI (Advanced Meteorological Imager) L1 full disk (FD) and rapid scan local area (LA) data and KSEM L1, L2 data. The FD and LA data are uploaded in every 10 and 2 minutes within 10 and 3 minutes after start of each observation, respectively. User registration is required for the RFS.

- RFS registration available via e-mail, kmasod@korea.kr

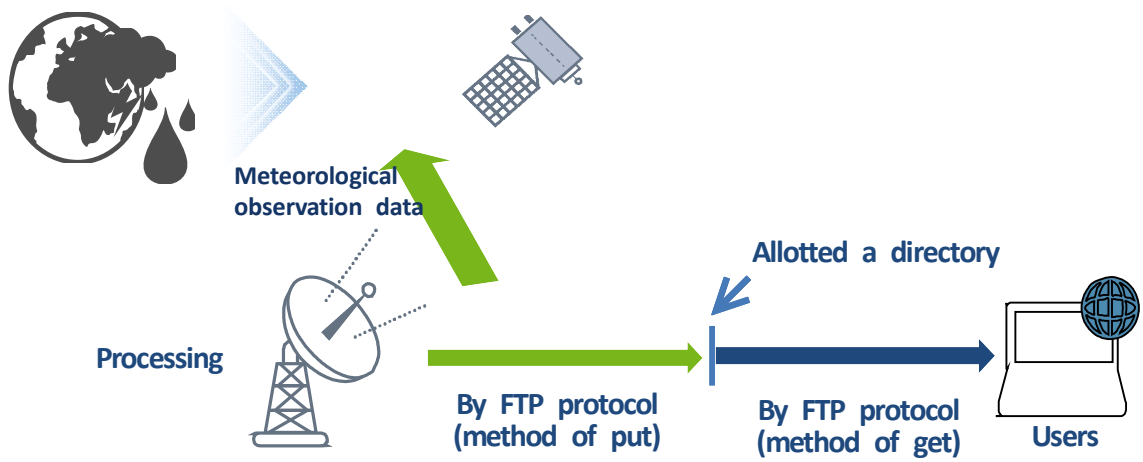


Figure 7-1 GK2A Real-time FTP Service (RFS) system

Broadcast by GK2A

KMA rebroadcasts full-resolution L1 and some L2 products in format of UHRIT (Ultra High Rate Information Transmission), HRIT (High Rate Information Transmission), LRIT (Low Rate Information Transmission) for LDUS (Large-scale Data Utilization Station), MDUS (Medium-scale Data Utilization Station), SDUS (Small-scale Data Utilization Station), respectively. xRIT(UHRIT/HRIT/LRIT) broadcast service is based on the Open Systems Interconnection (OSI). xRIT broadcast data as below table:

Table 7-1 GK2A Broadcast format and service data

Format/System	Data
UHRIT/LDUS	- 16 channels full disk L1B - cloud phase - cloud top temperature/pressure/height - rainfall rate - cloud emissivity - sea surface temperature
HRIT/MDUS	- reduced spatial resolution 5 channels FD L1B
LRIT/SDUS	- reduced spatial resolution IR105 channel full disk L1B imagery - weather forecast information

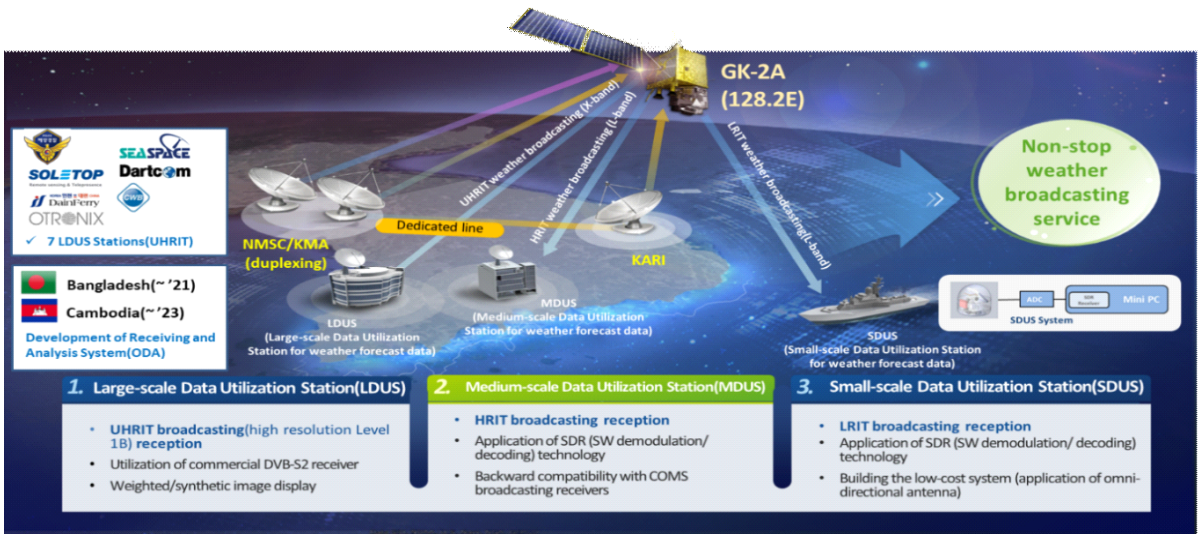


Figure 7-2 GK2A broadcast system

Data Characteristics of the GK2A L1

▶ File naming rule

The GK2A file naming rule helps users to capture the data characteristics (sensor, product name, observation area, resolution, map projection, etc.) easily. The basic rules and format of the GK2A file name as blow:

Table 7-2 GK2A file naming rule format

Classification	Type	Example
Satellite	Char	gk2a
Sensor	Char	ami
Level	Char	le2
Data name	Char	amv
Area	Char(3)	fd
Resolution	Integer(3)	020
Map projection	Char(2)	ge
Time	Integer(12)	202112312350
format	Char	png

Ⅰ. Use only English small characters and "_, +, ., -, ( )" for Arabic numbers.
Ⅱ. Classify the revised version with "_".
Ⅲ. Use either "+" or "-" for the complex attributes in revised versions.
Ⅳ. Use "." before the file name extension.
Ⅴ. Use "zzz" in no case of attribute data of corresponding revision, however, na is used for map projection.
Ⅵ. Use 3-digit integers for resolution and its unit is 100m.

Ex) In case of 2km resolution: 020

Link of description of area and map projection code of file name: http://datasvc.nmsc.kma.go.kr/datasvc/html/base/cmm/selectPage.do?page=static.productDefinition2

Due to the different data attribute, KSEM file name does not perfectly follow the GK2A naming rule. The GK2A KSEM L1, L2 file name as below:

Table 7-3 GK2A KSEM File name list

level	Data	Time resolution	File name
L1	proton flux	1 min	gk2a_ksem_pd_p_1m_le1_20190101.nc gk2a_ksem_pd_p_1m_le1_20190101.txt
		5 min	gk2a_ksem_pd_p_5m_le1_20190101.nc gk2a_ksem_pd_p_5m_le1_20190101.txt
	electron flux	1 min	gk2a_ksem_pd_e_1m_le1_20190101.nc gk2a_ksem_pd_e_1m_le1_20190101.txt
		5 min	gk2a_ksem_pd_e_5m_le1_20190101.nc gk2a_ksem_pd_e_5m_le1_20190101.txt
	magnetometer	1 min	gk2a_ksem_mg_auto_1m_le1_20190101.nc gk2a_ksem_mg_auto_1m_le1_20190101.txt
		5 min	gk2a_ksem_mg_auto_5m_le1_20190101.nc gk2a_ksem_mg_auto_5m_le1_20190101.txt
	charging monitor	1 min	gk2a_ksem_cm_1m_le1_20190101.nc gk2a_ksem_cm_1m_le1_20190101.txt
		5 min	gk2a_ksem_cm_5m_le1_20190101.nc gk2a_ksem_cm_5m_le1_20190101.txt
L2	magnetospheric particle flux	1 hr	gk2a_ksem_mpf_le2_20190101.nc gk2a_ksem_mpf_le2_20190101.txt
	GEO electron flux prediction	1 hr	gk2a_ksem_gep_le2_20190101.nc gk2a_ksem_gep_le2_20190101.txt
	spacecraft charging	1 hr	gk2a_ksem_sc_le2_20190101.nc gk2a_ksem_sc_le2_20190101.txt
	Dst (Disturbance Storm-Time) index prediction	1 hr	gk2a_ksem_dip_le2_20190101.nc gk2a_ksem_dip_le2_20190101.txt
	Kp (Planetary K) index prediction	1 hr	gk2a_ksem_kip_le2_20190101.nc gk2a_ksem_kip_le2_20190101.txt

File Format

The file formats of the GK2A imagery and data are PNG (Portable Network Graphic) and compressed NetCDF4 (Network Common Data Form version 4), respectively. NetCDF4 consists of variables and global attributes. Core values (radiance, meteorological values) are stored under variables. Exceptionally, the file format of some KSEM data is ASCII. KSEM ASCII file includes the description of data information in header of each file.

- THE GK2A L1B data user manual link: http://nmsc.kma.go.kr/enhome/html/base/bbs/selectBbs.do?bbsCd=00069&bbsUsq=200021#

GK2A User-Customized Image Processing Tool

The user-customized image processing tool is designed to support users to process GK2A meteorological data easily. It is a standalone software for research and educational purposes on a PC (Window/Linux OS). The biggest advantage of this tool is to easily display and manage GK2A data without the professional skills. It means that users can generate RGB composite imagery with simple calculation functions. This tool can be downloaded in the National Meteorological Satellite Center (NMSC) website.

- https://nmsc.kma.go.kr/enhome/html/base/cmm/selectPage.do?page=satellite.gk2a.intro)

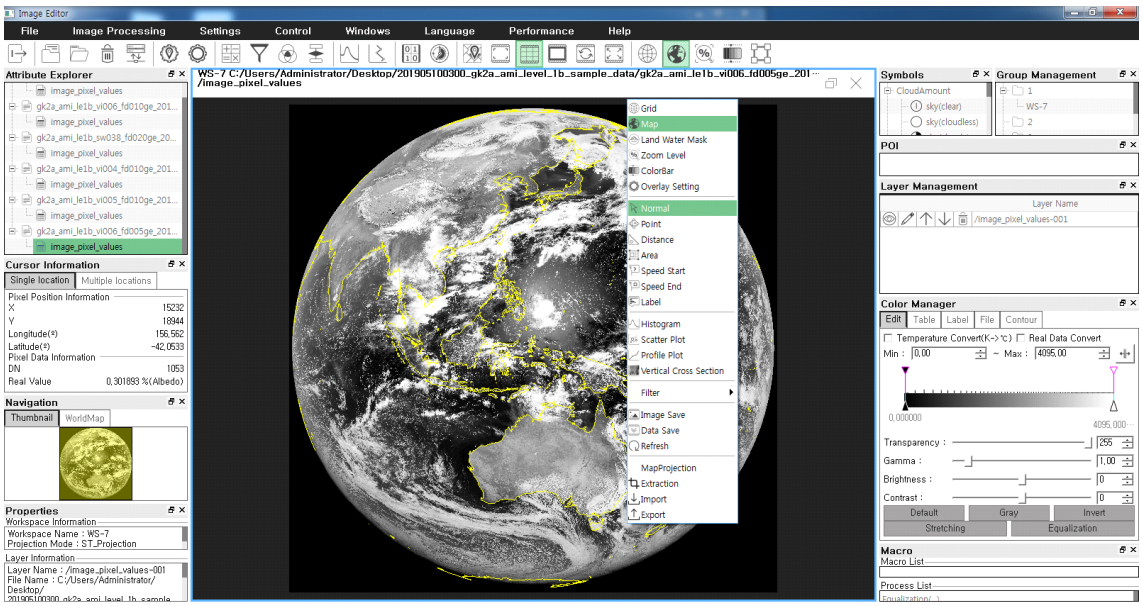


Figure 7-4 Main page of GK2A User-customized image processing tool