Current Status and Future Plan on KMA Space Program

2020. 9. 29.
Dohyeong Kim
NMSC/KMA
# COMS & Geo-KOMSAT-2A/B

<table>
<thead>
<tr>
<th>Year</th>
<th>COMS (MI, GOCI)</th>
<th>GK2A (AMI, KSEM)</th>
<th>GK2B (GOCI-II, GEMS)</th>
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- **COMS MI Mission is ended ('20.3.19.), GOCI is still operation until 2021**
- **GOCI-II: Geo. Ocean Color Imager-II**
- **GEMS: Geo. Environmental Monitoring Spectrometer**

## Diagram:
- **COMS**
  - Launched on June 27, 2010
  - 1 Communication Ka-band Antenna
  - 2 Ocean GOCI
  - 3 Meteorological MI
    - Extended operation: 2 years

- **GK-2A**
  - Launched on December 4, 2019
  - KSEM (Korean Space wEather Monitor)
  - AMI (Advanced Meteorological Imager)

- **Taking over the role of the COMS**

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GK2A Timeline and Rapid Scan

KMA operates 10-min timeline with 3 different observation areas

- **1 FD (Full Disk)** + **5 ELA (Extended Local Area)** + **5 LA (Local Area)**

- Flexibility for the local area selection and scheduling (Target Area which can observe any area by user request)
- Data format: NetCDF4 for each channels with GSICS information
GK2A/AMI Products

Primary Products

- Fire Detection
- Vegetation Index
- Vegetation Green Fraction
- Surface Emissivity
- Surface Albedo
- Snow Depth
- Ocean Current
- Cloud Type
- Cloud Amount
- Cloud Optical Depth
- Cloud Effective Radius
- Cloud Liquid Water Path
- Cloud Ice Water Path
- Cloud Layer/Height
- Probability of Rainfall
- Rainfall Potential
- Aerosol Particle Size
- Visibility
- Absorbed SW Radiation (SFC)
- Downward SW Radiation (SFC)
- Upward SW Radiation (SFC)
- Aircraft Icing

Secondary Products

- Overshooting Top Detection
- SO2 Detection
- Total Precipitable Water
- Clear Sky Turbulence
GK2A Target Observation (Australia Wildfire)

2019.11.7.~11.9.
(True Color RGB, every 10 min., 1km spatial resolution)

2019.11.7.~11.9.
(Fire Detection, every 10 min., 2km spatial resolution)
GK2A Application to Nowcasting

Increase in application area

Convective cloud monitoring and analysis (K-RDT)

RDT
(Rapid Development Thunderstorm)
- Based on NWC-SAF
- To analysis the lifecycle of thunderstorm (generation, development, maturity, decaying, and movement pattern)

K-RDT
(Koreanized RDT)
- To adjust the parameters considering the characteristics of Korea weather pattern using GK2A
  - Utilization of Neural Network Technique

Predicted satellite image (Nowcasting ➔ short-range forecast)

Predicted satellite images compositing satellite images with NWP motion vector

- WV (upper)
- IR (Window)
- Asian Dust RGB
- AOD
- Cloud amount
- Cloud type
GK2A Application to Forecast

Typhoon

Fog

Land (2019. 11. 6.)

Sea (2020. 5. 11.)

Dust

Wildfire

Australia (2020. 1. 4.)

Andong (2020. 4. 24.)
Expanding application by fusion of GK2A and GK2B

Inter-comparisons for fusion

- **GEMS vs. GOCI-II**
  - Solar calibration
  - SRF characteristics of GOCI-II
  - Absolute radiometric calibration of GEMS

- **GOCI-II vs. AMI**
  - Solar reference spectrum
  - Visible channel inter-comparison

- **AMI vs. GEMS**
  - Absolute solar irradiance
  - SRF characteristics of AMI
  - Cloud screening/detection for GEMS

* Technical issue: # of channel, bandwidth, spatial/time resolution, observation area
Area of fusion between GK2A and GK2B

**AMI, GOCI-II and GEMS**

- **NMSC**: National Meteorological Satellite Center, KMA
- **KOSC**: Korea Ocean Satellite Center
- **ESC**: Environmental Satellite Center

**Strengthening aerosol monitoring**

- Monitoring of L1B using the overlapping data
- Verification of AMI/GOCI-II SRF using Hyper-spectral GEMS data

**Monitoring over bright surfaces**

- (GEMS UV AI, AOD)

**Dust monitoring**

- (AMI+GOCI-2 Vis + NIR)

**High resolution aerosol**

- (GOCI-2)
GK2A Data Access

Real-time FTP Service (RFS)

Meteorological observation data 

Processing

By FTP protocol (method of put)

Allotted a directory

By FTP protocol (method of get)

Users

Vietnam
Bangladesh
Hong Kong
Taiwan
Germany
Indonesia
Russia
USA

Australia
Japan
Malaysia
Nepal
India
Singapore
Netherlands

✓ 15 Agencies (2020. 6. 30.)
KARI

Development of Receiving and Analysis System (ODA)

Bangladesh (~ '21)
Cambodia (~ '23)

7 LDUS Stations (UHRIT)

11

Non-stop weather broadcasting service

GK-2A (128.2E)

NMSC/KMA (duplexing)

LDUS (Large-scale Data Utilization Station for weather forecast data)

MDUS (Medium-scale Data Utilization Station for weather forecast data)

KARI

1. Large-scale Data Utilization Station (LDUS)
   - UHRIT broadcasting (high resolution Level 1B) reception
   - Utilization of commercial DVB-S2 receiver
   - Weighted/synthetic image display

2. Medium-scale Data Utilization Station (MDUS)
   - HRIT broadcasting reception
   - Application of SDR (SW demodulation/decoding) technology
   - Backward compatibility with COMS broadcasting receivers

3. Small-scale Data Utilization Station (SDUS)
   - LRIT broadcasting reception
   - Application of SDR (SW demodulation/decoding) technology
   - Building the low-cost system (application of omnidirectional antenna)
The official request of target area observations by global users over the Asian Pacific region (RA II and RA V) will be available.

- Provide significant improvements in the real-time monitoring of Typhoon, thunderstorm and dust events
- Global users submit official request form defining specific request webpage (http://datasvc.nmsc.kma.go.kr/datasvc)

GK2A Request-based Rapid Scan Observation

- GK2A / GK2A AMI Special Observation

The GK2A AMI special observation mode takes images over flexible target area by user request. Normally it takes images over the Korean Peninsula.
Rapid Scan
Target Observation

Typhoon HAISHEN
2020. 9. 4. 06 ~ 09 UTC
(VI006, every 2 min., 0.5km)
KMA follow-on GEO program

The plan of follow-on Geo-KOMPSAT-2A (Target launch schedule: 2028)

- Based on Vision for WIGOS in 2040; Geostationary Ring
- Proposed target instruments
  - VIS/IR Imager
  - Hyperspectral IR Sounder
  - Lightning Mapper

- Impacts of Hyperspectral Sounder on KMA NWP model
  - Impacts on KMA NWP model (Korea Integrated Model) using OSSE system
  - Focusing on precipitation (area, intensity) forecast, typhoon track
Composition of OSSE system

**NR**
- KIM3.5a, res.: 12.5 km, 91 levs,
  3 month free run (2019.6.–2019.8.)

**Simulate obs.**
\[
y_o = y_t + (\varepsilon \times \alpha)
\]
- \(y_o\) (OBS): simulate observation
- \(y_t\) (TRUE): true observation from NR
- \(\varepsilon \times \alpha\) (ERROR): calculated error
  - \(\varepsilon\): obs. error of KMA NWPs
  - \(\alpha\): error inflation factor (=1)

**DA & Forecast**
- KIM3.4, res.: 25 km, 91 levs,
  stochastic physics applied,
  3DVAR,
  2019.07.22.–2019.08.31. (40 days)

**HSSGEO data and DA method**

<table>
<thead>
<tr>
<th>meta data</th>
<th>Equal to meta data of GK-2A</th>
</tr>
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<tbody>
<tr>
<td>Reference instrument</td>
<td>IASI</td>
</tr>
<tr>
<td>Coverage</td>
<td>Full disk (same as AMI of GK-2A) blank: cloud or highland area</td>
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<tr>
<td>Channels</td>
<td>temp.: 81, WV: 10</td>
</tr>
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<td>Thinning</td>
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<td>Radiative transfer coefficient</td>
<td>IASI/MetOp-B of RTTOV10.2 is used</td>
</tr>
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<td>Instrument error</td>
<td>same as observation error of IASI</td>
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**HSSGEO ch. 345 <2019.08.01.00 UTC>**
- Coverage: Full disk (same as AMI of GK-2A)
  blank: cloud or highland area
- Channels: temp.: 81, WV: 10
  spatial: 300 km, temporal: 1 h
- Radiative transfer coefficient: IASI/MetOp-B of RTTOV10.2 is used
- Instrument error: same as observation error of IASI
KMA follow-on GEO program

Impact study of HSSGEO on KMA NWPs (KIM) by OSSE system

Result of precipitation verification

On short-term forecast, precipitation area and intensity in experiments applying HSSGEO are more similar to NR.

Result of TC track verification

The forecast performance of TC track on short-term forecast is improved by applying HSSGEO.
KMA follow-on GEO program

The plan of follow-on Geo-KOMPSAT-2A (Target launch schedule: 2028)

- Proposed target instruments
  - VIS/IR Imager, Hyperspectral IR Sounder, Lightning Mapper

- Two-track strategy for GK2A follow-on development
  - Need to update the capacity for Hyperspectral IR Sounder both NWP and Satellite groups
  - Establish the joint center of satellite data assimilation in KMA
  - Propose the two-track strategy; first Imager and second is Hyperspectral sounder
Status of KMA LEO program

Current status of **KMA LEO program** in 2020

- To investigate the **updated user requirements** and application
- To investigate the **development roadmap** followed by updated payloads proposed from new user requirements
- The LEO program is slow in progress due to changes in KMA’s internal space program roadmap

Development of GNSS-RO receiver (2nd payload of CAS500)

- To develop GNSS-RO receiver (< 15kg) for NWP application
  - Compact Advanced Satellite, 500kg (total weight including payloads)
  - CAS500 program is also slow in progress due to COVID-19
- Specification: banding angle error < $10^{-6}$ radian
- GNSS-RO Design Concept(2021), and Flight Model(2023)
Thank you
GK2A Rapid Scan AMV

- **Period**: 2019.7.20.07:00 ~ 13:50 KST (TYPHOON – 5 DANAS)
- **Channels**: Visible (0.64 μm), IR (10.4 μm)
- **Spatial Resol.**: VI (12km 12km), IR (16 km 16 km)
- **Temporal Resol.**: 10 minutes