Geostationary Environmental Monitoring Spectrometer (GEMS)

Overview and Current status

JEONG AH YU and Satellite Data Analysis & Application Team

Environmental Satellite Center (ESC)
NIER, Republic of KOREA
Successful GK-2B Satellite launch!
GEMS Overview

Target center: 120E, 17N

S/L: 128.2E

Field of Regard

Nominal scan area

Monitoring Items

- O₃, SO₂, NO₂, HCHO, CHOCHO, and aerosol, etc.

Mission Duration

10 Years

Spectrum/Spectral Resolution

300 – 500 nm / 0.6 nm

Spatial Resolution

7 km (3.5) × 8 km @Seoul

Observation cycle

8 times / day

Spatial Coverage

5,000 km × 5,000 km
(5 °S – 45 °N, 75 °E – 145 °E)
GEMS Overview

GEMS Mission

- To provide observations of tropospheric composition over Asia at high spatial and temporal resolution
- To contribute to the establishment and implementation of a science-based policy on air quality

Science-based Policy

<table>
<thead>
<tr>
<th>Air Quality</th>
<th>Climate Change</th>
<th>National/international Cooperation</th>
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</table>

GEMS standard products

- Aerosols (PM)
- Ozone
- SO₂
- NO₂
- HCHO

※ 20 products including information on clouds, surface, and UV.

Additional data

- Other satellites
- Ground-based measurements
- Models
- Meteorological data
- Geographic information
- Etc.
GEMS Overview

Roles of GEMS Ground Station

- **Reception**: A non-stop 24/7 operating ground station
- **Monitoring**: Archiving of all data received and produced in main storage
- **Data processing & analyzing**: Real-time data acquisition and near-real-time data distribution
- **Validation**: Construction of a back-up system for data reliability
- **Data back-up & archiving**: Operating for 10 years, which is the designed duration of GK2B
- **Distribution**: Achieving 99% or higher operational availability for high-speed processing and customized services
- **Public service** (http://nesc.nier.go.kr)

Universities
Institutes
Air Quality Forecasting Center
IOT schedule and work list

- DPS and INR parameter tuning
- Level 2 retrieval algorithm tuning, improvement, and validation
- Continuous test operation of ground station system
  - Testing 1\textsuperscript{st} stage and 2\textsuperscript{nd} stage L2 production
  - Concluding operation concept for L2 processing
- Definition of GEMS quality indicator
- Cross-calibration/validation
GEMS L2 Algorithm test

< GEMS Baseline Products >

<table>
<thead>
<tr>
<th>Product</th>
<th>Window (nm)</th>
<th>Spat. Resol. (km²)@Seoul</th>
<th>Algorithm</th>
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GEMS L2 Algorithm test plan during IOT


2020 2021

KARI: Korea aerospace research institute
ESC: Environmental satellite center
IAC: Initial activation and check out
DPS: Data pre-processing sub-system
INR: Image navigation and registration

GEMS Power on and DPS test

Bus IAC

Test plan & Preparing

L2 1st test

L2 Algorithm update

L2 2nd test

INR Test

GEMS Announcement Opportunity

GMAP campaign for GEMS validation

Long-term validation

KARI: Korea aerospace research institute
ESC: Environmental satellite center
IAC: Initial activation and check out
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INR: Image navigation and registration

L2 1st test: L1B SRF(spectral response function)
NO₂, Ozone, AOD, surface reflectance
L2 2nd test: SO₂, HCHO, ozone profile, UVI, cloud
This AO call is to harness professional knowledge and expertise of experienced scientists to perform validation and accuracy assessment of data and products of GEMS through independent data analysis.

1. Evaluation of Level 2 retrieval algorithms
2. Assessment of regional errors and their sources
3. Comparison with other space-borne instruments
4. Comparison with ground-based and/or airborne measurements
5. Comparison of diurnal variations of each atmospheric species between GEMS measurements and modeling results
6. Assessment of the impact of auxiliary data used in product retrieval
7. Analysis of major error sources and error budget
8. Assessment of heterogeneous geographic effects

<table>
<thead>
<tr>
<th>Product</th>
<th>Importance</th>
<th>Window (nm)</th>
<th>Spatial resolution (km x km) at Seoul</th>
<th>Algorithm</th>
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Current Status

GEMS cal/val activities timeline

Table 2 illustrates an overview of the timelines of GEMS cal/val activities.

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GEMS AO information can be obtained from [https://nesc.nier.go.kr](https://nesc.nier.go.kr)
Help desk: Dr. Changsuk Lee, leecs00@korea.kr
Current Status

Activities for GEMS validation

GMAP & SIJAQ

* SIJAQ: Satellite Integrated Joint monitoring of Air Quality
* GMAP: GEMS Map of Air Pollution

PAN

* Pandora Asia Network

Pre-GMAP

Apr. – May 2020
(delayed due to COVID-19)

1st GMAP

19 Oct. – 27 Nov. 2020
(depending on COVID-19)

2nd GMAP

Oct. – Dec. 2021

SIJAQ


Main campaign
Current Status

GEMS data application plan

- Estimation of ground-level PM concentrations
- Monitoring of long-range transported air pollutants
- Data fusion of satellites
- Estimation of top-down emissions
- Trend and ozone sensitivity analysis
- Relationship between air pollution and climate change
Announcements by NIER

• The 11th GEMS workshop is scheduled to be held from 12 to 14 October 2020.

• The 1st GMAP will start on 19 October (to 27 November).

(Depending on COVID 19)
Thank you for your attention!

http://nesc.nier.go.kr