

하늘과 우주를 향한 대한민국의 꿈을 실현하는



# Status of GEO Satellites operated by KARI

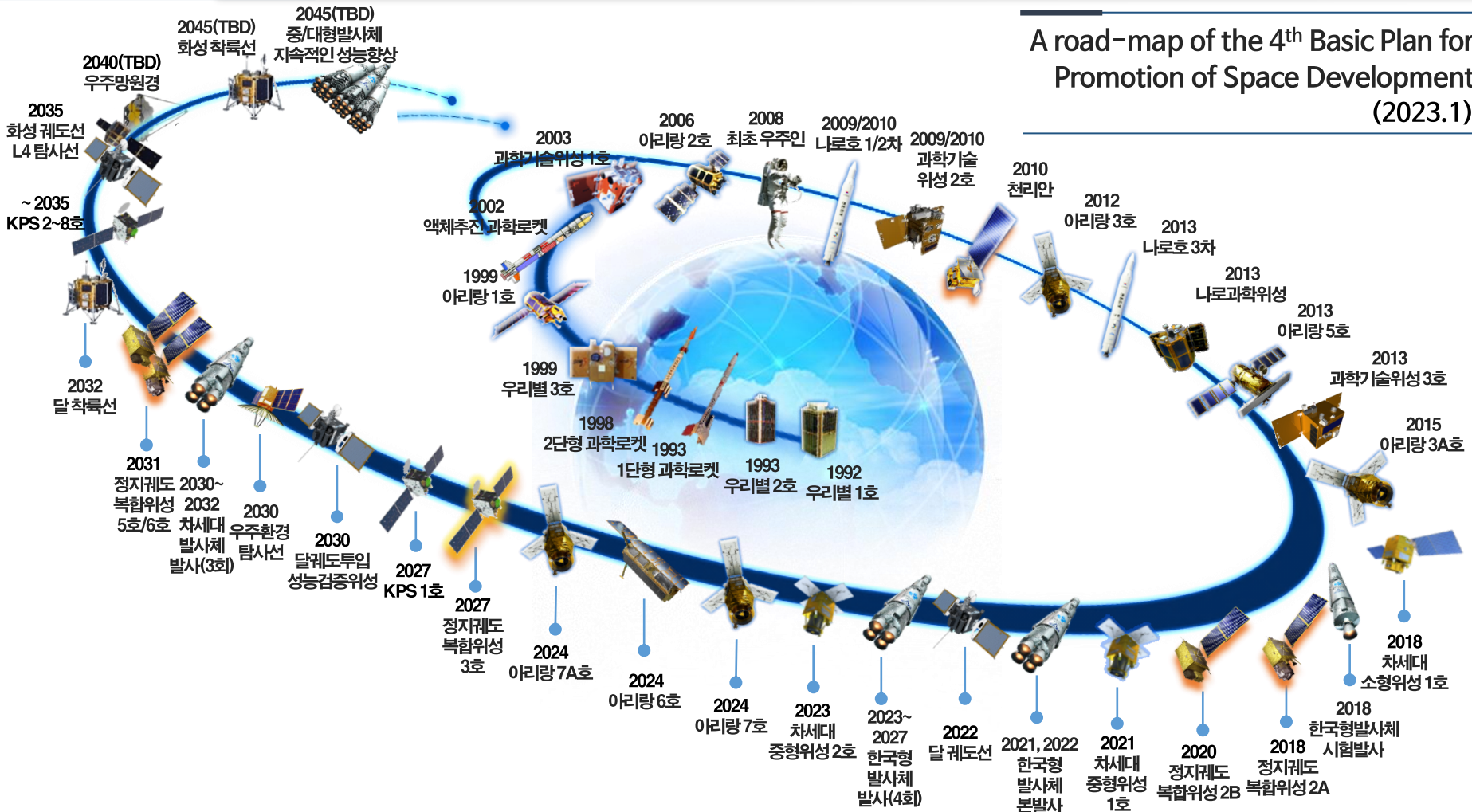
Eun-Bin Park

Mission operation and Infrastructure Service Division  
National Satellite Operation & Application Center  
KARI



## A change of the National Space Program

- Mid-to-Long Term Space Development Plan : Establishment (1996), 1<sup>st</sup> Rev.(1998), 2<sup>nd</sup> Rev. (2000), 3<sup>rd</sup> Rev.(2005)
- Space Development Promotion Act (2005)
- Basic Plan for Promotion of Space Development: Establishment (2007), 2<sup>nd</sup> (2011), Mid-to-Long Plan (2013), 3<sup>rd</sup> (2018)
- 4<sup>th</sup> Basic Plan for Promotion of Space Development (2023)





## 1 KARI HQ

Site area (m<sup>2</sup>) : 317,942

Facility area (m<sup>2</sup>) : 111,603

- Satellite Test Center
- Ground Combustion Test Center
- Satellite Ground station
- Full-Scale Airframe Static Test Facility
- Rotary Wing Aircraft Test Center
- Wind Tunnel Test Center



## 2 NARO Space center

Site area (m<sup>2</sup>) : 5,374,686

Facility area (m<sup>2</sup>) : 83,232

- KSLV Launch Site
- Mission Operation Center
- Tracking Radar



## 3 National Aviation Test Center

Site area (m<sup>2</sup>) : 1,025,445

Facility area (m<sup>2</sup>) : 8,021

- Aircraft Test Center
- Helicopter Whirl Tower Test Facility

## 4 Korea Deep Space Antenna

35 M Antenna / 750 ton

- S-Band up/downlink, X-Band downlink

## 5 Jeju National Satellite Operation Center

Site area(m<sup>2</sup>) : 61,166

Facility area(m<sup>2</sup>) : 4,408

- Operation of LEO satellites

## 6 Jeju Tracking Station

Site area(m<sup>2</sup>) : 114,811

Facility area(m<sup>2</sup>) : 2,031





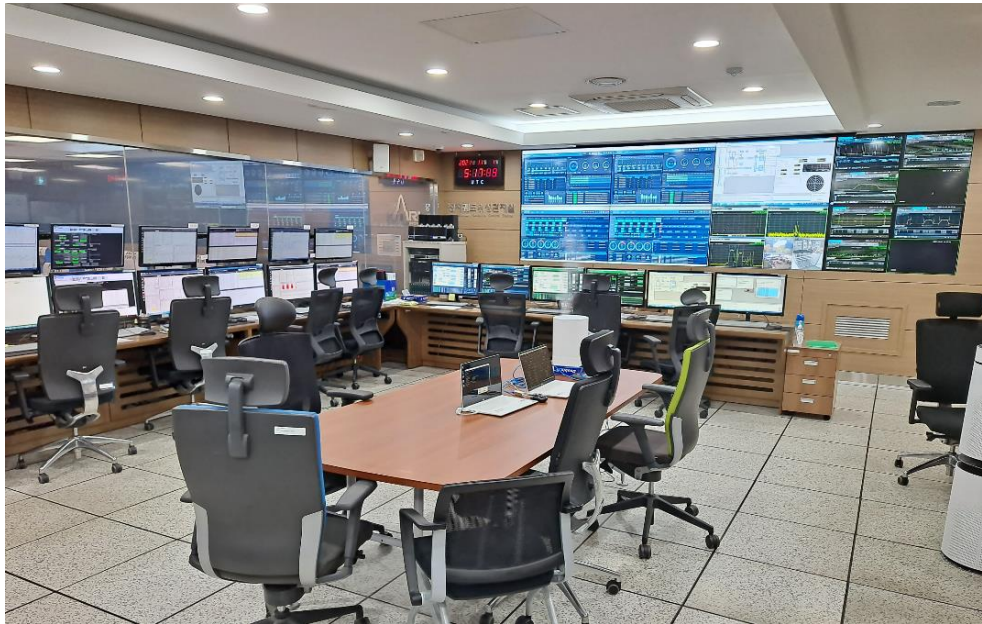
## Antenna site (Daejeon)



Satellite Operation Center (SOC)

## Satellite Control Room

- The main control room(left) and emergency recovery room(right)
- Use the emergency room in special situations (ex. satellite launch, anomaly occurrence)
- The emergency room is currently in use as Danuri control room





## KOMPSAT-1

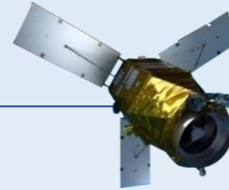
[Mission finished (2008. 7.)]

- Launch date : 1999. 12. 21.
- Orbit : Sun-synchronous (Altitude: 685km)
- Payload : EO (PAN : 6.6m)



## KOMPSAT-3

- Launch date : 2012. 5. 18.
- Orbit : Sun-synchronous (Altitude: 685km)
- Payload : EO (PAN/MS : 0.7m/2.8m)



## GK-2A (Geo-KOMPSAT-2A)

- Launch date : 2018. 12. 5.
- Orbit : Geo-synchronous (Altitude : 36,000km)
- Payload : AMI(1km), KSEM

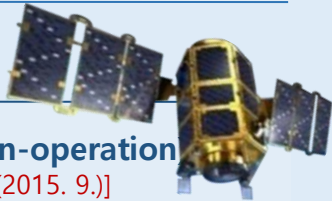


## KOMPSAT-2 (In-operation)

[Mission finished (2015. 9.)]

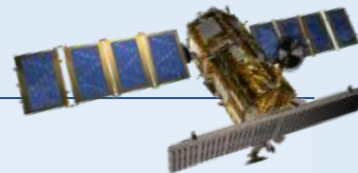
※ Additional missions are still being carried out after the official mission ends

- Launch date : 2006. 6. 28.
- Orbit : Sun-synchronous (Altitude: 685km)
- Payload : EO (PAN/MS : 1m/4m)



## KOMPSAT-5

- Launch date : 2013. 8. 22.
- Orbit : Sun-synchronous (Altitude: 550km)
- Payload : SAR (High 1m/Standard 3m/ Wide 20m)



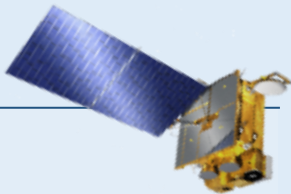
## GK-2B (Geo-KOMPSAT-2B)

- Launch date : 2020. 2. 19.
- Orbit : Geo-synchronous (Altitude : 36,000km)
- Payload : GOCI-II(250m)/GEMS(7.5km)



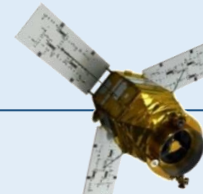
## COMS

- Launch date : 2010. 6. 27.
- Orbit : Geo-synchronous (Altitude: 36,000km)
- Payload : KA-band/GOCI(500m)/MI(1~4km)



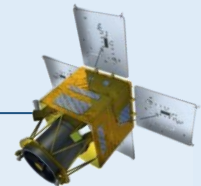
## KOMPSAT-3A

- Launch date : 2015. 3. 26.
- Orbit : Sun-synchronous (Altitude: 528km)
- Payload : EO (PAN/MS/IR : 0.55m/2.2m/5.5m)



## CAS500-1

- Launch date : 2021. 3. 22.
- Orbit : Sun-synchronous (Altitude : 36,000km)
- Payload : EO (PAN/MS : 0.5m/2m)



KOMPSAT: Korea Multi Purpose SATellite (Korean name: Arirang)

COMS: Communication Ocean and Meteorological Satellite (Korean name: Cheollian)

CAS500: Compact Advanced Satellite 500

## Termination

## In Operations (8 satellites)

## Under Development (7 satellites)

## Future (78 satellites, 2030)

LEO

GEO

Explorer



KOMPSAT-1

1999  
Optic 6.6m



KOMPSAT-2

2006  
Optic 1m



KOMPSAT-3

2012  
Optic 0.7m



KOMPSAT-3A

2015  
Optic 0.55m  
IR 5.5m



KOMPSAT-7,7A

2024  
Optic < 0.5m



CAS500-2,3,4

2024, ...



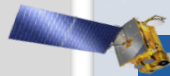
KOMPSAT-5

2013  
SAR 1m



CAS500-1

2021  
Optic 0.5m



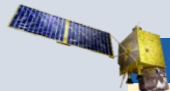
COMS

2010  
MI 1km(5ch)  
GOCI 500m(8ch)



GK-2A

2018  
AMI  
0.5,1km(16ch)



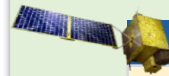
GK-2B

2020  
GEMS 7.5km  
GOCI2 250m (12ch)



KOMPSAT-6

2024  
SAR 0.5m



GK-2B

2027



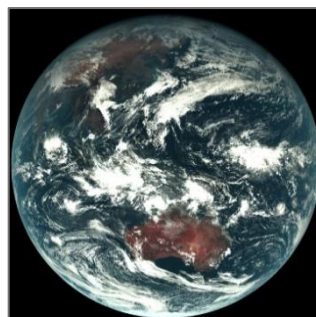
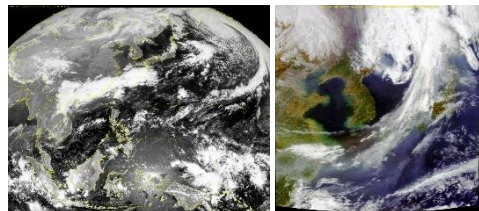
KPLO

2027

- More than 78 satellites will be developed by separate organizations of Korea (including Microsatellite constellation)

- Most of 78 satellites will be operated by KARI

# History of the KARI's GEO satellites



COMS  
Mission start

GK-2A  
Mission Start

COMS MI  
End of Mission

COMS GOCI  
End of Mission

2010  
06.27

2011  
04.01

2018  
12.05

2019  
07.25

2020  
02.19

2020  
03.31

2020  
10.01

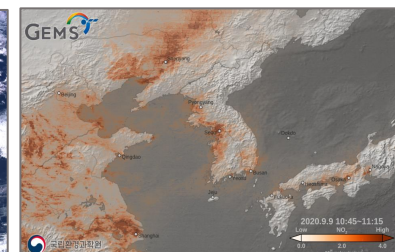
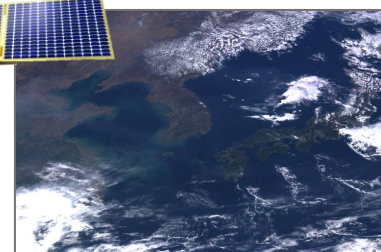
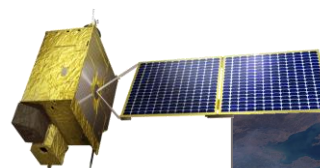
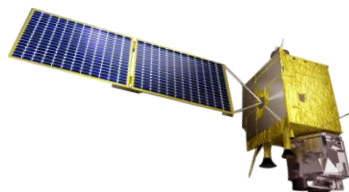
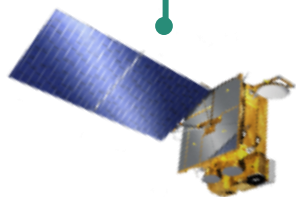
2021  
03.31

GK-2A Launch

GK-2B Launch

GK-2B  
Mission Start

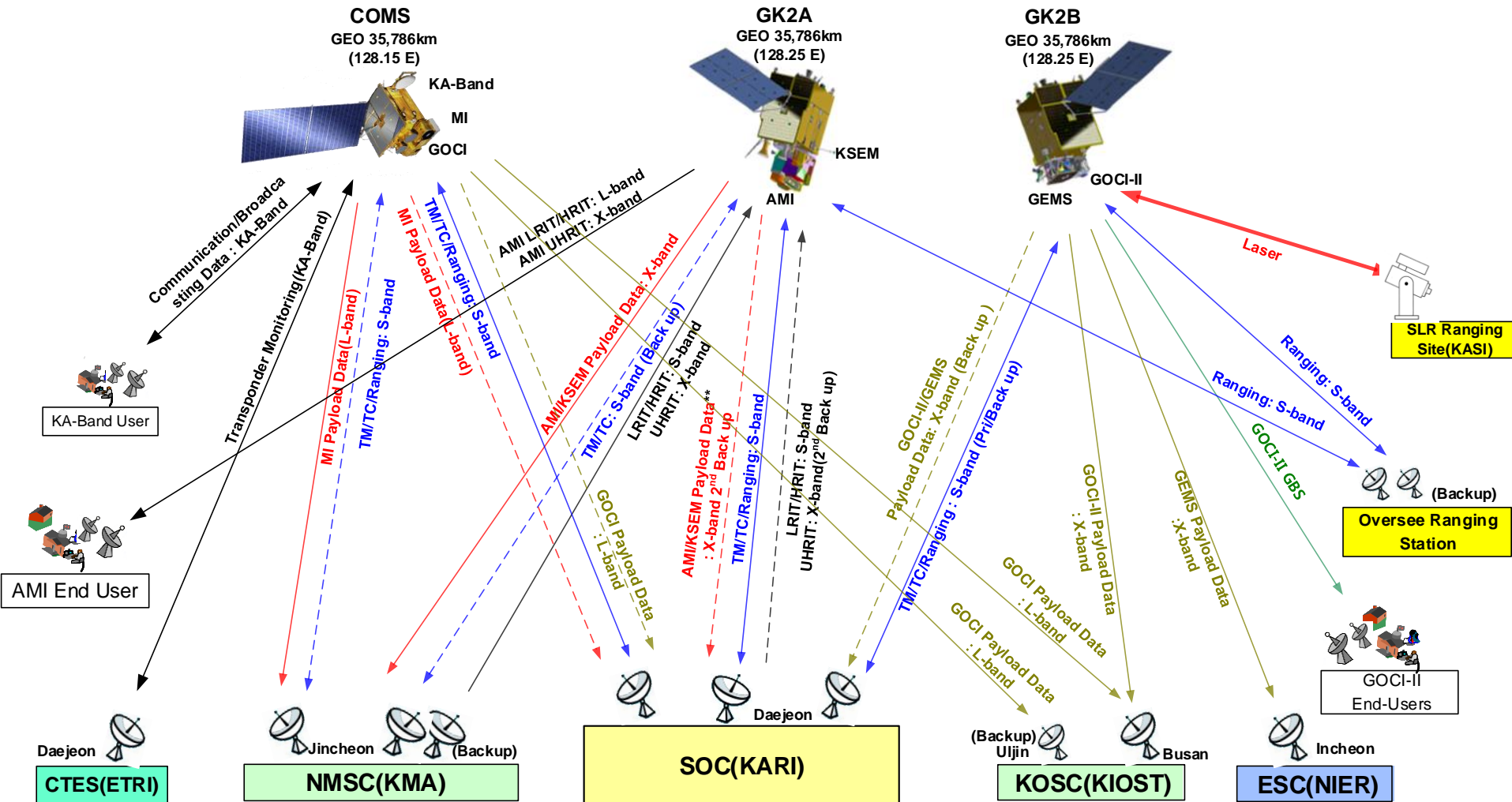
COMS Launch



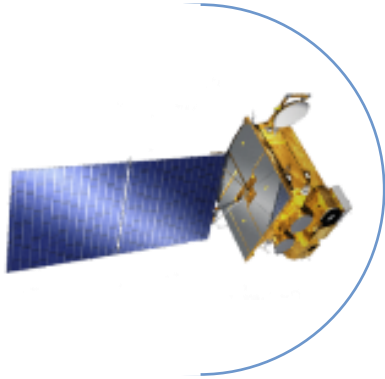
MI: Meteorological Imager  
GOCI: Geostationary Ocean Color Imager



## Ground segment architecture



## Purpose



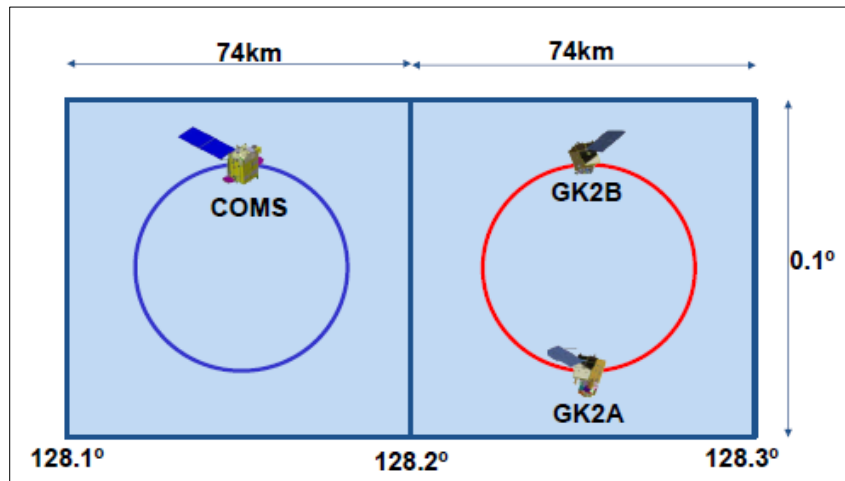
- Weather and ocean observation
- Space certification and utilization of communications payload (KA-band)
- Independence and industrialization of geostationary satellite technology
- Overseas Joint Development of Geostationary Satellite

## Operational history

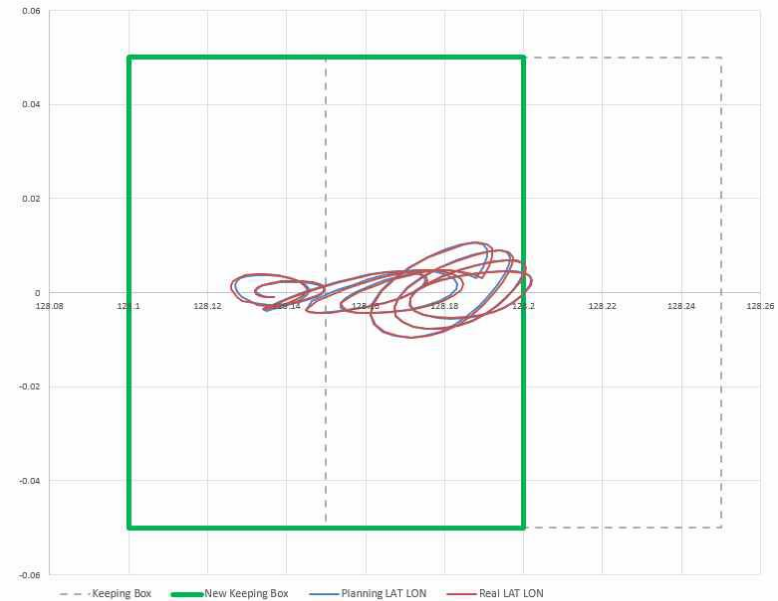
- 01** Launch: 2010.06.27
- 02** Normal mission period: 2011.04.01~2018.03.31 (7 years)
- 03** 1<sup>st</sup> Mission extension: 2018.04.01~2020.03.31 (2 years) → MI mission finished
- 04** 2<sup>nd</sup> Mission extension: 2020.04.01~2021.03.31 (1 year) → GOCl mission finished
- 05** 3<sup>rd</sup> Mission extension: 2021.04.01~2022.03.31 (1 year)
- 06** 4<sup>th</sup> Mission extension: 2022.04.01~2023.03.31 (1 year)
- 07** 5<sup>th</sup> Mission extension: 2023.04.01~2024.03.31 (1 year)

## Major operational change

- Orbit Adjustment for Central longitude Movement ('18.8)
- Orbit movement for simultaneous operation with GK-2A/B
  - Central longitude :  $128.2^{\circ} \rightarrow \underline{128.15^{\circ}}$
  - GK-2A/B:  $\underline{128.25^{\circ}}$



Conceptual diagram of simultaneous operation of the Geostationary satellites

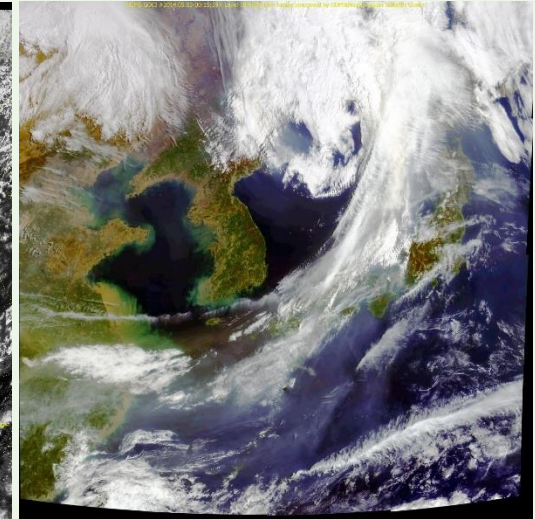
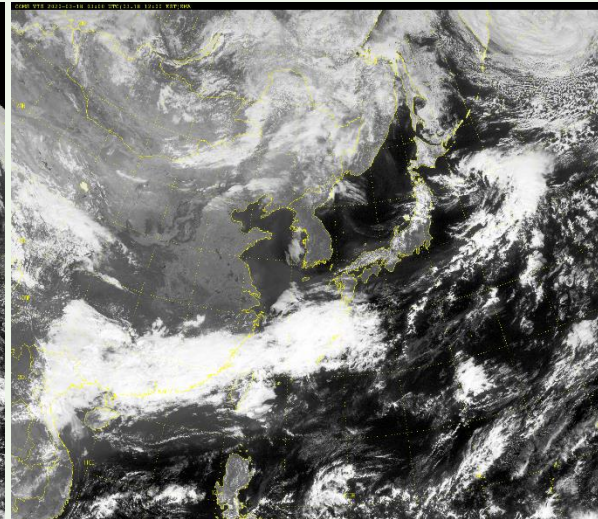
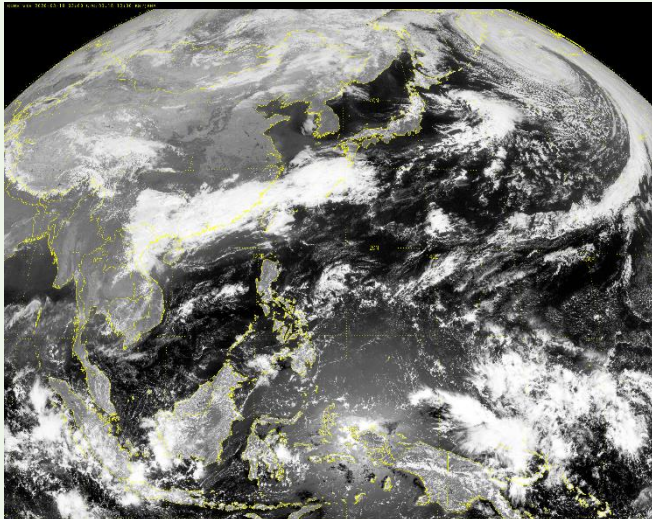


Change in LAT/LON according to orbital movement



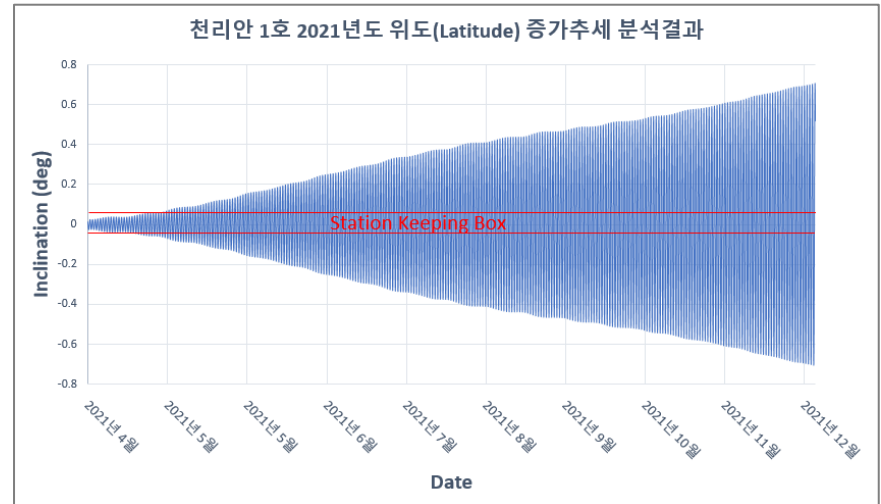
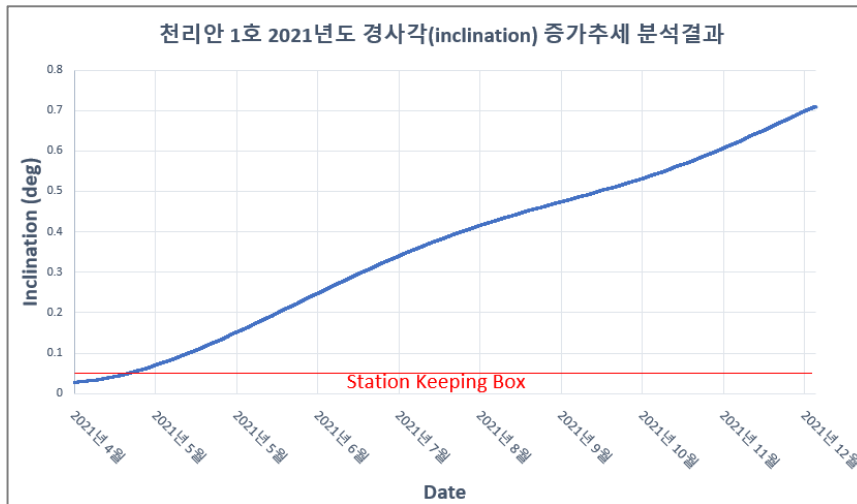
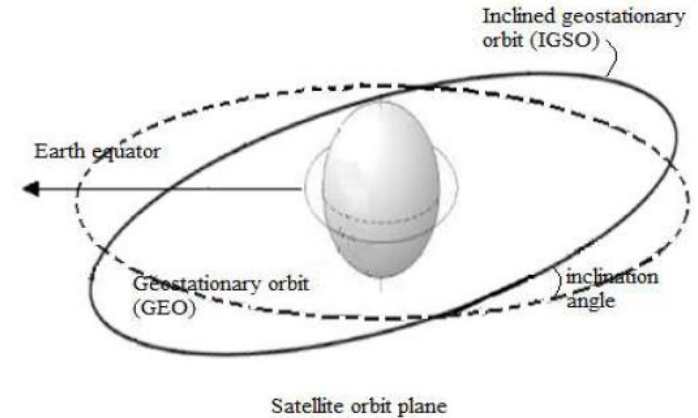
## End of Mission (MI/GOCI)

- MI ('11.4~'20.3, 9 years)
- Earth observation taken 564,264 times
- Mission success rate 99.81%
  - Full disk(FD): 27,209 times
  - Extended North Hemisphere(ENH): 250,249 times
  - Local Area(LA): 286,806 times
- GOCI ('11.4~'21.3, 10 years)
- Earth observation taken 31,112 times
- Mission success rate 99.66%



## Inclined-orbit operations ('21.04~)

- Non-performance of NS station keeping
- Reduces fuel consumption
- Get longer operational periods



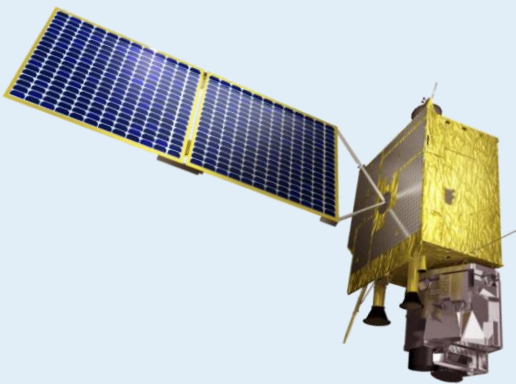
## Purpose

- Weather, space weather, environment, and ocean observation at all times
- Improve weather forecast reliability, Climate Change Response
- Fine dust observation, marine environment observation
- Securing self-supply capacity for domestic geostationary satellite demand

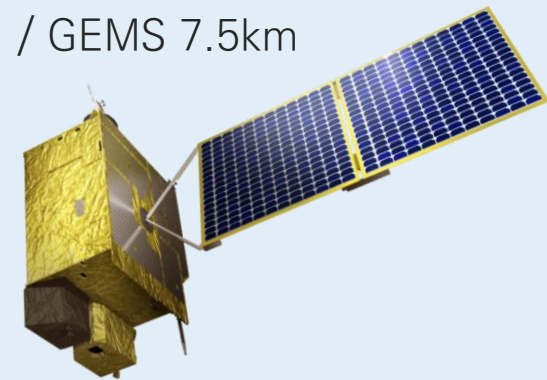
### GK-2A

### GK-2B

AMI 1km	Resolution	GOCI-II 250m / GEMS 7.5km
3.5ton	Kg	3.4ton
2.6kw	Power	2.6kw
10 years	Mission Life	10 years



GK-2A  
〈Launch: 2018.12.05〉



GK-2B  
〈Launch: 2020.02.19〉

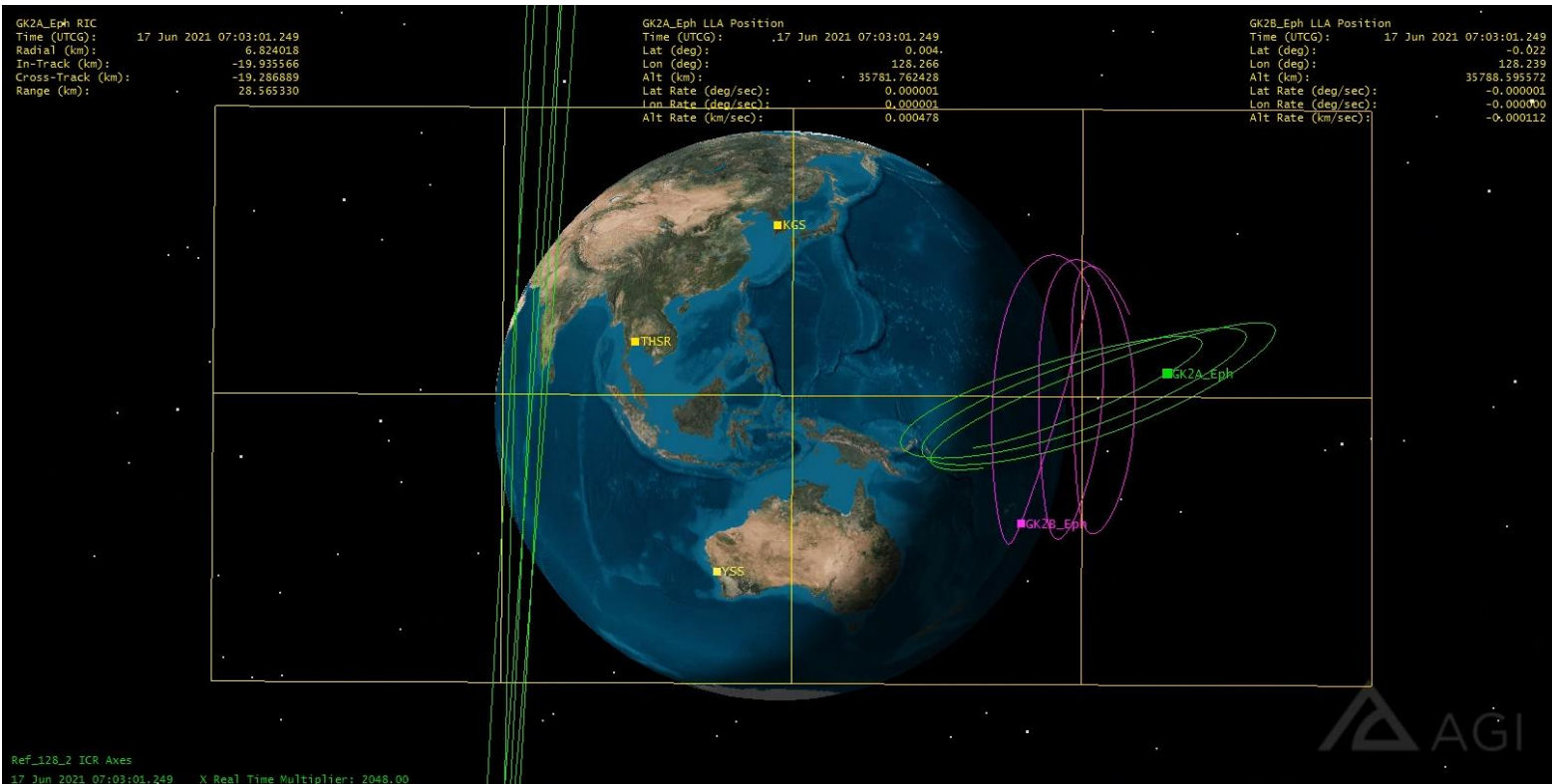
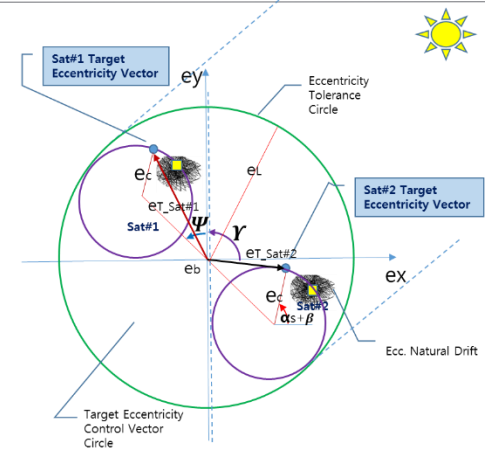
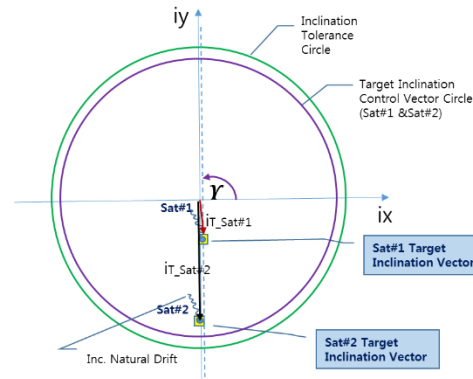


〈Guiana Space Centre / Ariane-5 Rocket〉



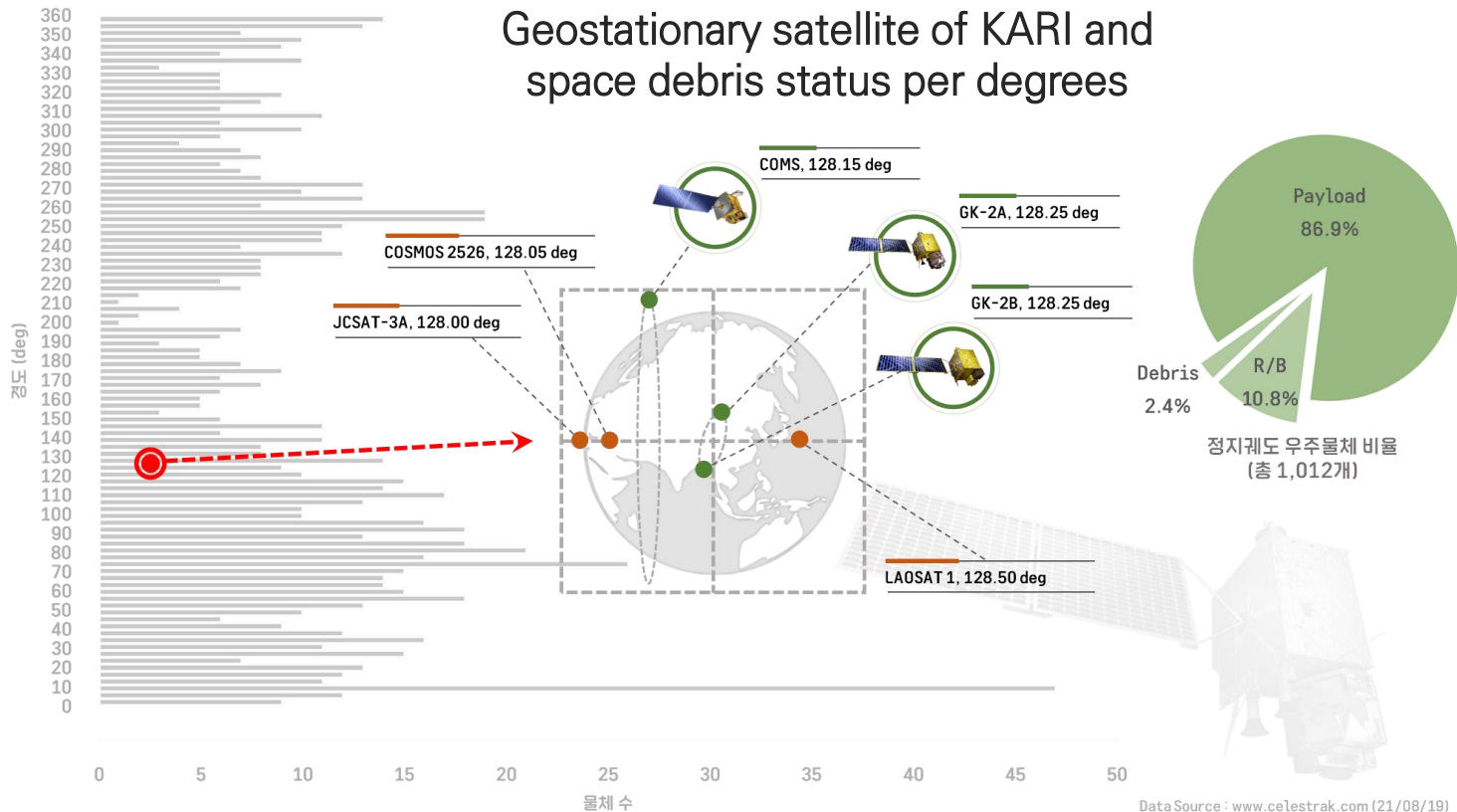
## Collocation Strategy

- Fixed inclination target
- Eccentricity vector is defined using the fixed inclination target vector
- Minimum separation is guaranteed



## Space Situational Awareness (SSA)

- Constant monitoring to prevent collisions with space debris
- Establish avoidance activation plan through detailed analysis when close objects occur
- Approximately 10 maneuvers were carried out to avoid collisions



## Annual operation

- **Battery balancing** and eclipse period operation(Feb.~May, Aug.~Oct.)
- **Sun interference** monitoring and analysis (Mar., Oct.)
- Battery charge at the Sun eclipse by the Moon
- AMI Scanner calibration

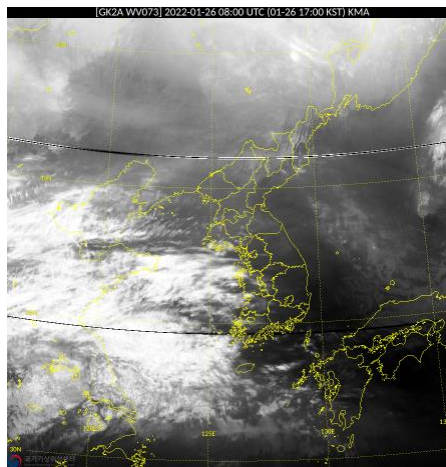
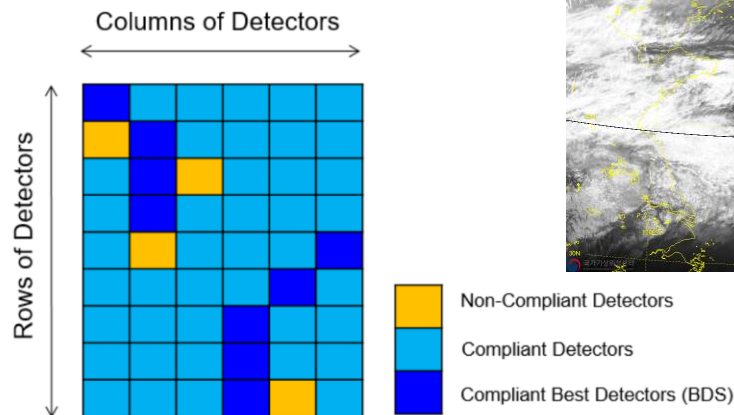
## Monthly operation

- AMI Solar calibration (for GK-2A)
- **Moon imaging** (for GK-2A)
- GOCl- II Video parameter update (for GK-2B)
- Battery charge at the Sun eclipse by the Moon
- Antenna condition check
- Ground station subsystem condition check
- Special operation for storm chasing (related with Kim's poster)



## AMI BDS(Best Detector Selection) map update

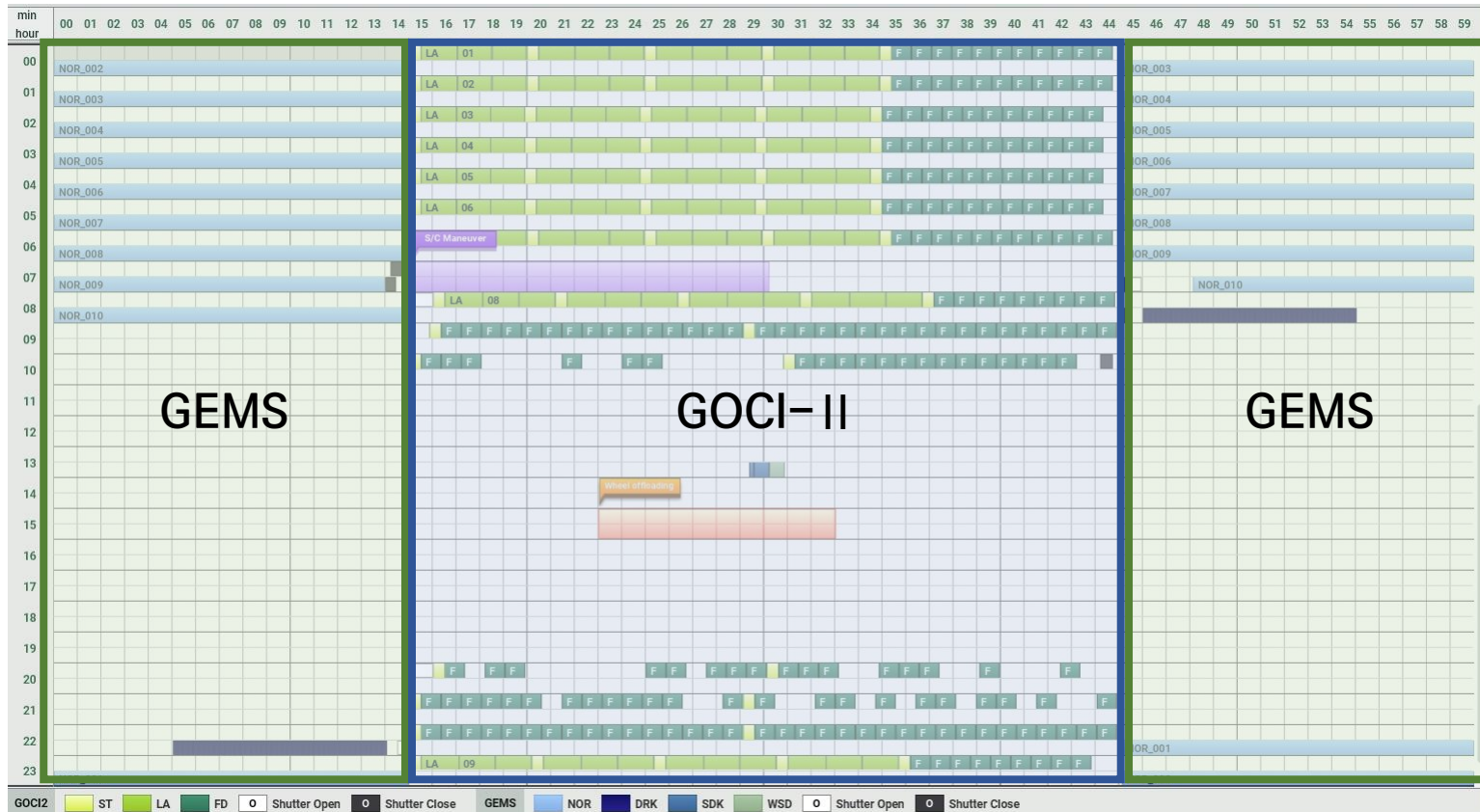
- AMI has 6 detectors per row (except VIS004~VIS008)
- Generate the Earth observation image using observation values from the best performing detector among them
- When image quality deterioration occurs, such as detector performance degradation during normal operation, the detector is changed (Jin et al., 2021)



No	Channel	Row	Detector	Date
1	WV073	46	2→6	2019.07
2	WV073	172	1→6	2019.11
3	WV073	235	4→1	
4	WV073	290	4→6	
5	WV087	35	6→2	
6	IR123	350	1→5	
7	IR123	351	3→1	
8	WV073	30	2→5	2019.12
9	IR105	163	1→2	2020.02
10	IR112	135	4→5	
11	WV073	99	3→2	2020.04
12	WV069	289	6→3	2020.06
13	WV073	155	2→3	2020.10
14	IR096	16	5→1	2020.11
15	IR087	74	3→2	2021.05
16	IR087	183	4→5	
17	IR105	173	5→4	
18	IR112	143	6→3	
19	IR123	188	2→6	
20	IR123	275	5→3	
21	IR133	58	6→2	2022.01
22	WV069	195	2→3	
23	IR096	60	6→4	
24	WV063	102	1→3	2022.02
25	WV073	155	3→6	2022.04
26	WV069	192	5→4	2023.05

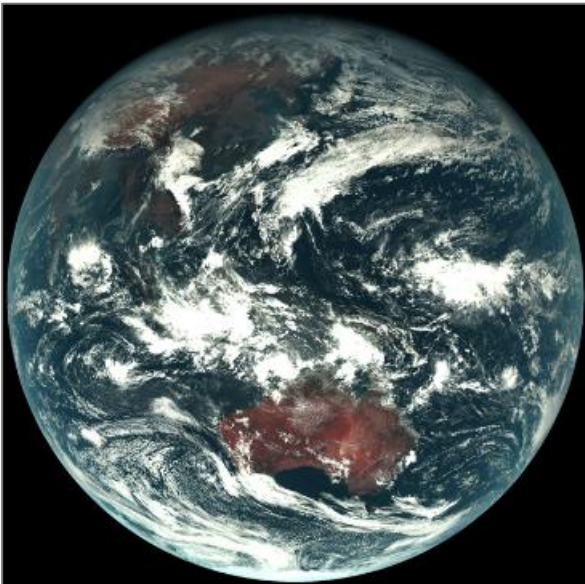
## GOCI-II & GEMS co-operation

- Both GK-2B payloads can only observe during the daytime
- Cut an hour in half, GOCI-II for 15 to 45 minutes and GEMS for 45 to 15 minutes
- Overlapping operation with SK and WOL is not possible





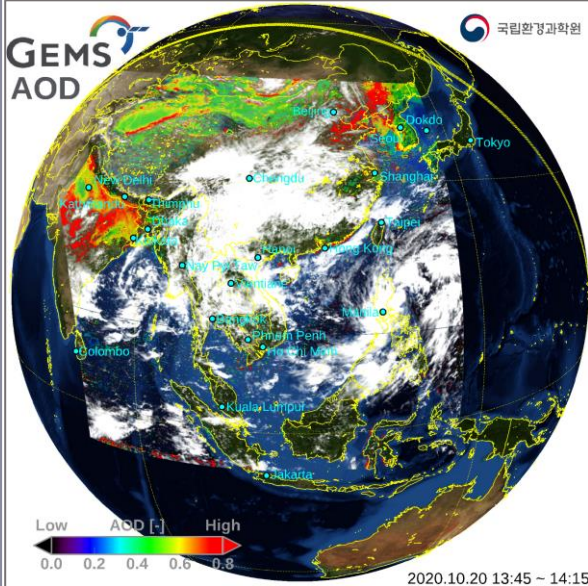
GK2A



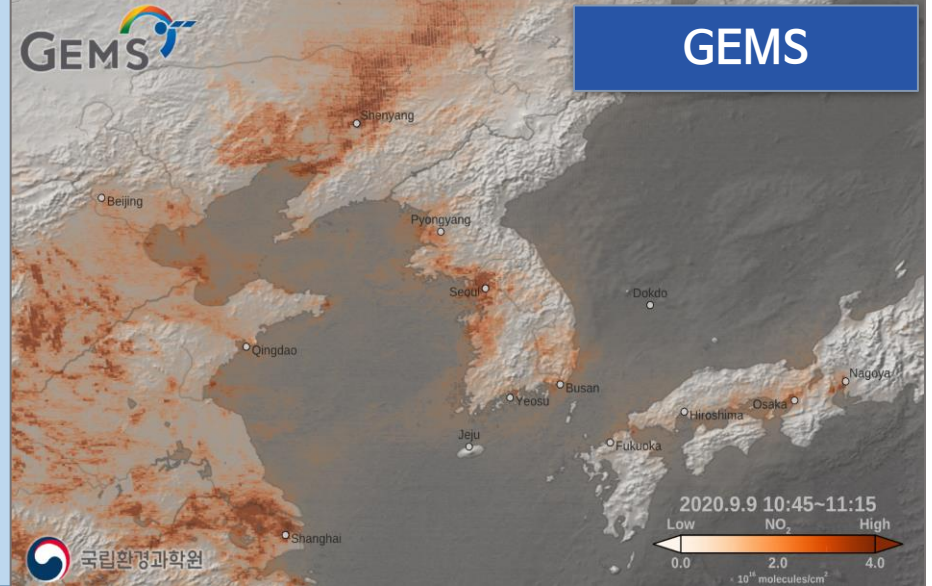
GOCI-II



GK2B



GEMS





## Geostationary Orbit Public Multipurpose Communication Satellite

### ■ Purpose

Disaster/Emergency communication and precision navigation reinforcement support to prepare for a communication paradigm shift

### ■ Development period

2021.04~2027.12

### ■ Launch date

Scheduled for the second half of 2027

### ■ Specification

Operating orbit: 36,000km, Geostationary orbit

Size: 3.2m x 2.5m x 3.5m (3.5 ton), Power : 5.3kw

Mission Life : 15 years

### ■ Payload type

- Flexible broadband communication system(FBCS)
- Data Collection System(DCS)
- Satellite-Based Augmentation System(SBAS)



The image features a central logo for KARI (Korea Aerospace Research Institute) set against a dramatic space background. The logo consists of a stylized white 'A' shape above the text 'KARI' in a bold, sans-serif font, with 'KOREA AEROSPACE' to the left and 'RESEARCH INSTITUTE' to the right. The background shows the Earth's horizon with a blue and white atmosphere, a bright blue rocket trail ascending from the horizon, and a large, dark, cratered celestial body (likely the Moon) in the upper center. The sky is filled with numerous stars.

KOREA AEROSPACE **KARI** RESEARCH INSTITUTE

# [Appendix-1] Specification of the KARI's GEO satellites

	COMS		GK-2A AMI	GK-2B	
	MI	GOCI		GOCI-II	GEMS
<b>Design/ Mission Life</b>	7.7 / 9 years ( '11.4.1.~'20.3.31.)	7.7 / 10 years ( '11.4.1.~'21.3.31.)	10 years ( '19.07.25~)	10 years ( '20.10.01~)	10 years ( '20.11.01~)
<b>Observation Area</b>	Full disk (FD), Extended Northern Hemisphere (ENH), Local Area (LA)	2,500km * 2,500km (Korea)	Full disk (FD), Extended Local Area (ELA), Local Area (LA)	2,500km * 2,500km (Korea)	5,000km * 5,000km (Korea)
<b># of Channels</b>	5	8	16	12	Hyper-spectral
<b>Wavelength</b>	0.67, 3.7, 6.7, 10.8, 12.0 $\mu\text{m}$	0.41~0.86 $\mu\text{m}$	0.4~13 $\mu\text{m}$	0.37~0.86 $\mu\text{m}$	0.3~0.5 $\mu\text{m}$ (Spectral resolution: 0.0006 $\mu\text{m}$ )
<b>Spatial Resolution</b>	VIS: 1km IR: 4km	0.5km	VIS: 0.5, 1km IR: 2km	0.25km	Gaseous: 7km*8km Aerosol: 3.5km*8km
<b>Time Resolution</b>	FD: 30 min ENH, LA: 15 min	An hour	FD: 10 min ELA, LA: 2 min	An hour	An hour
<b>Bits per pixel</b>	10 bit	13 bit	11~13 bits	12 bits	14 bits
<b>Data transfer rate</b>	6.2 Mbps	6.2 Mbps	115 Mbps	62 Mbps	40 Mbps
				Total: 115 Mbps (Margin: 13 Mbps)	
<b># of products</b>	16	13	52	26	20



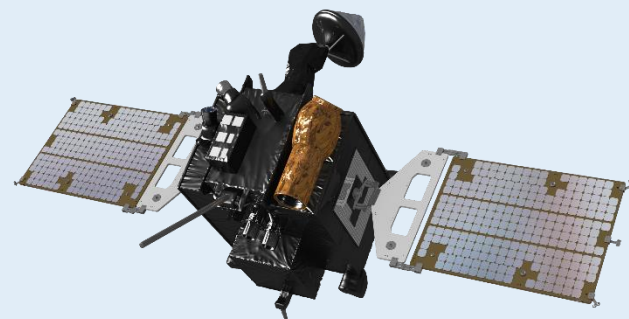
## Purpose

- Acquiring lunar exploration technology capabilities
- Development of Moon Exploration System for Moon Science Mission
- Key Technology Study in Phase 2 of Moon Exploration

**Launch date** : 2022. 8. 5.(Fri) 08:08 KST

## Course of Navigation (Earth to Moon)

- Launch (8/5 08:08)
- Enter the WSB/BLT transfer orbit (8/5 08:58)
- 1<sup>st</sup> maneuver for moving trajectory (8/7)
- 2<sup>nd</sup> maneuver for moving trajectory (9/2)
- Maximum distance reached
- 3<sup>rd</sup> maneuver for moving trajectory (11/2)
- 4<sup>th</sup> maneuver for moving trajectory (11/6)
- Enter the Moon orbit and 3 times maneuver (12/17,12/21,12/26)



Danuri image

**Mission orbit** : 2022. 12. 27.(Tue) [145 days from launch]



다누리(KPL0) 달 공전 이미지  
22. 09. 15



