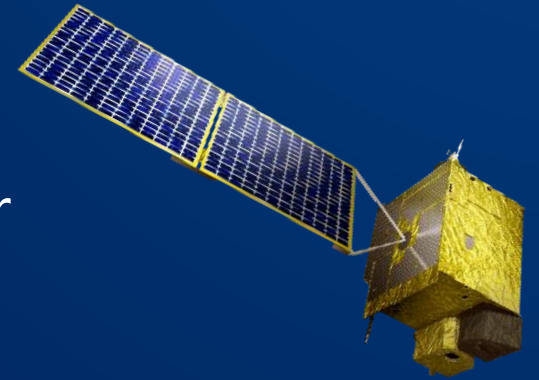


GEMS-2 Mission Preparation: From GEMS to the Next Generation

Geostationary Environmental Monitoring Spectrometer

Wonjin Lee, NIER
2 June, 2026



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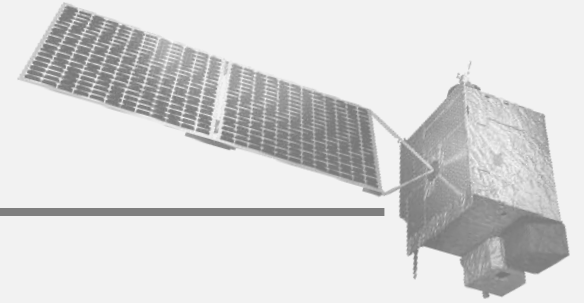
1. Motivation for GEMS-2

2. Current Status and Development Plan for GEMS-2



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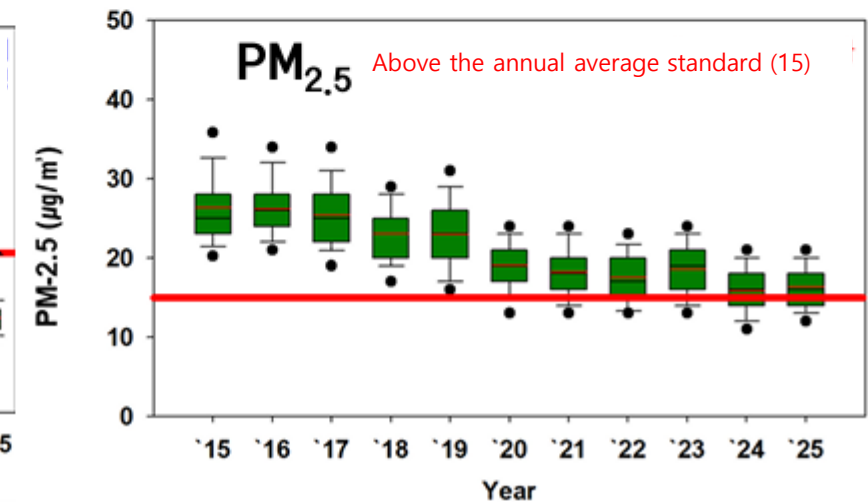
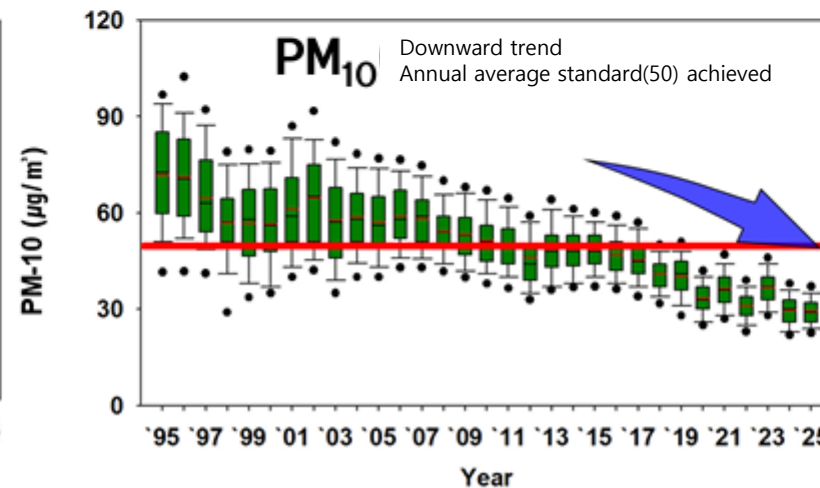
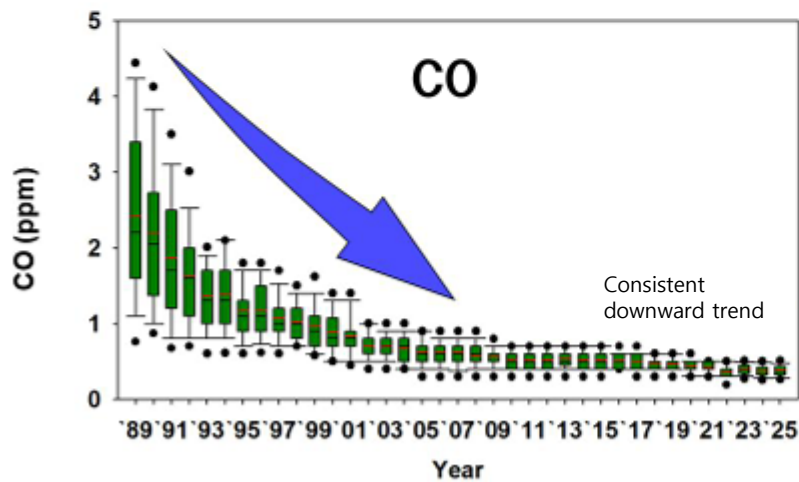
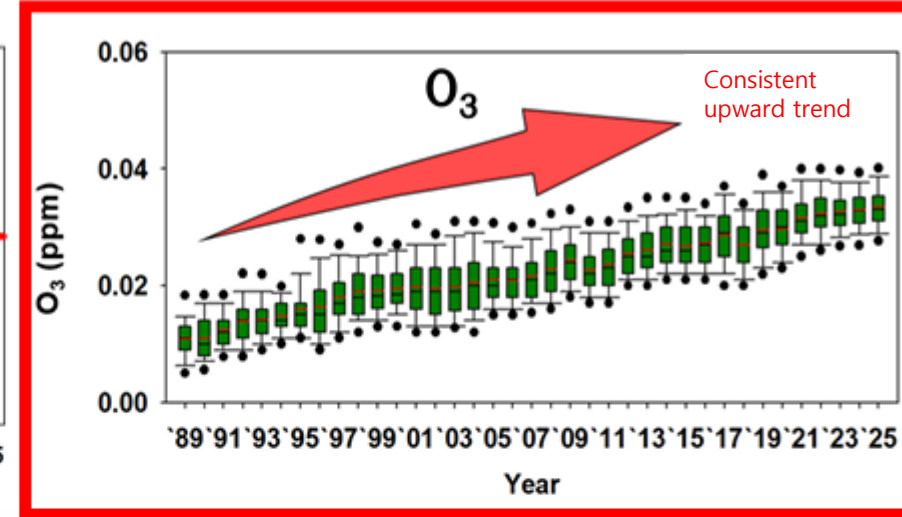
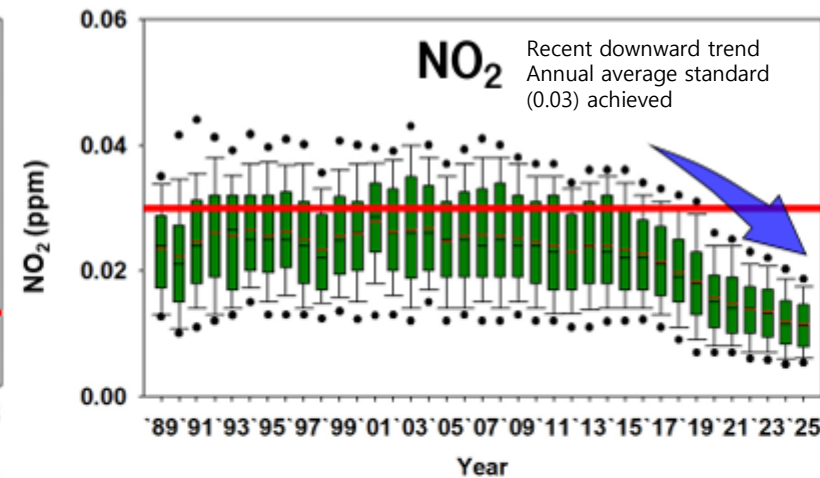
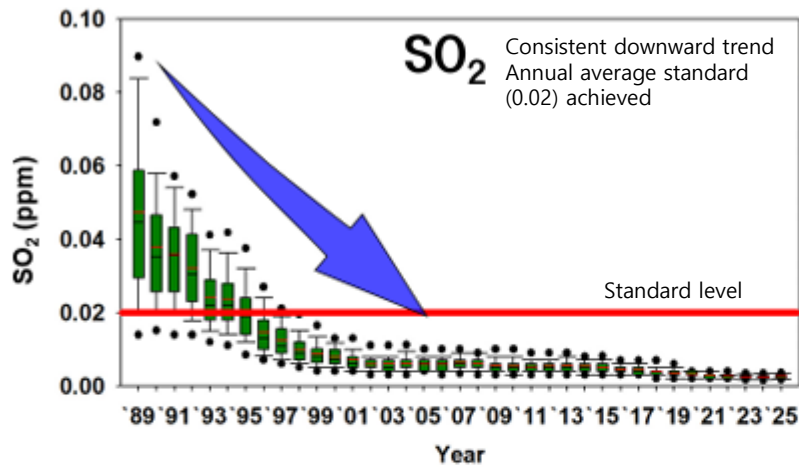
1. Motivation for GEMS-2



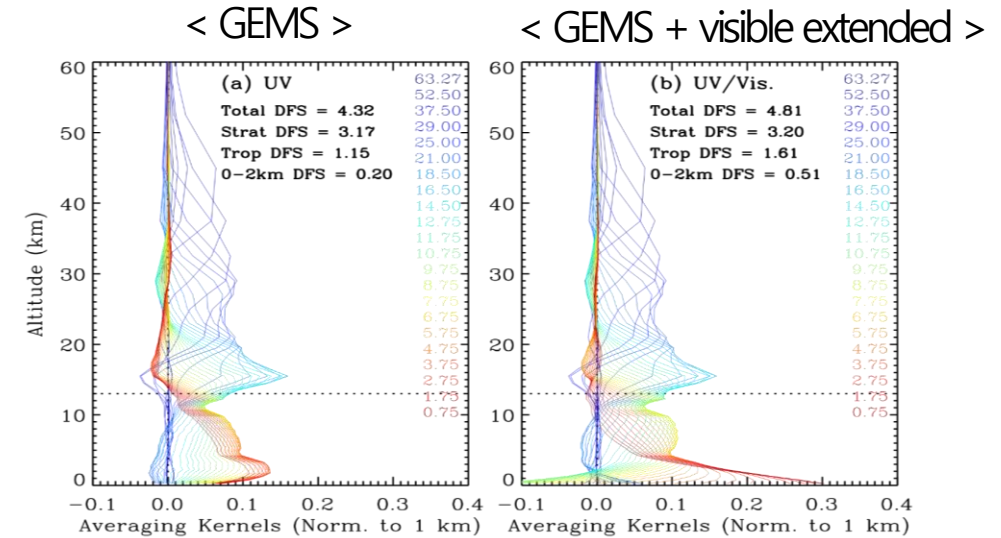
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Air quality policies have been effective → Advanced observation capability is still required



- ✓ GEMS observes mainly in the UV-Vis range from 300-500 nm wavelength.
- ✓ If we expand spectral, we expected improvement in Ozone profile retrievals with expanded visible spectral coverage
(2~2.5 times improvement in surface Ozone sensitivity)
- ✓ Expected improvement in **Aerosol retrieval accuracy, Layer height, and Type classification** with expanded visible spectral coverage



< Courtesy by Baek >

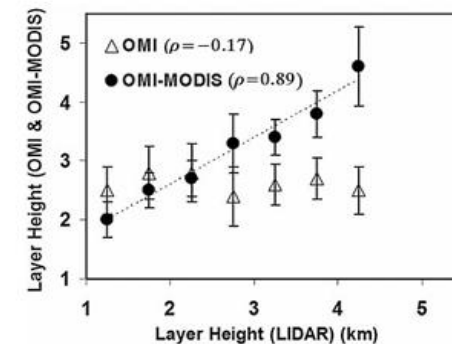
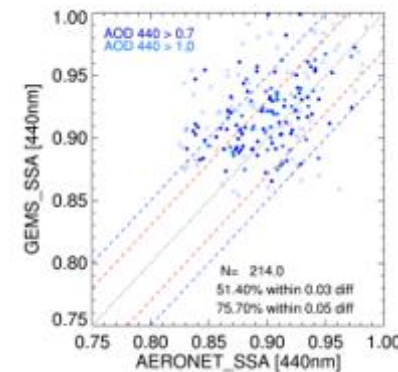
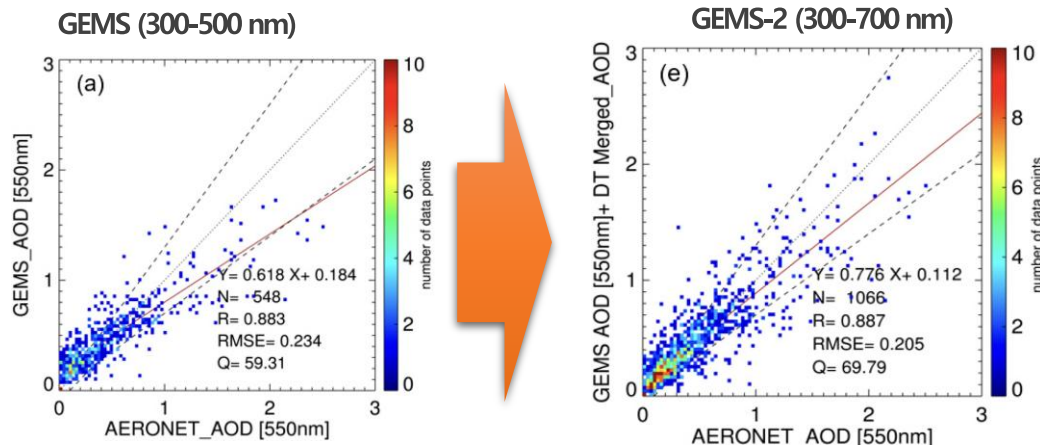
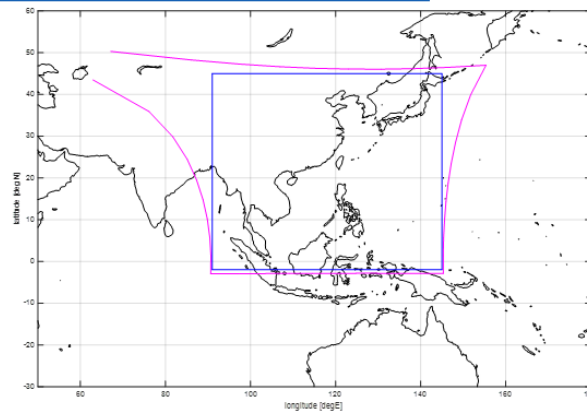
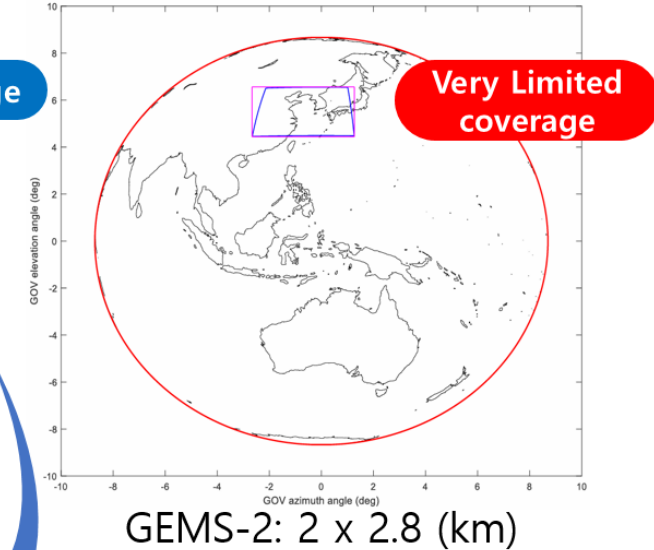
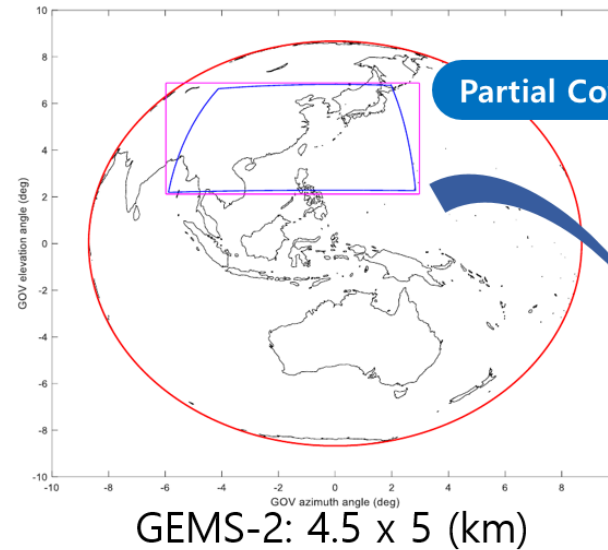
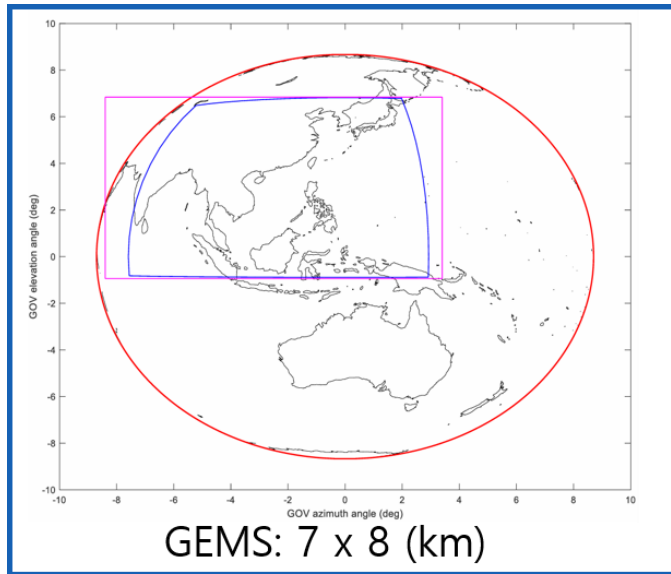
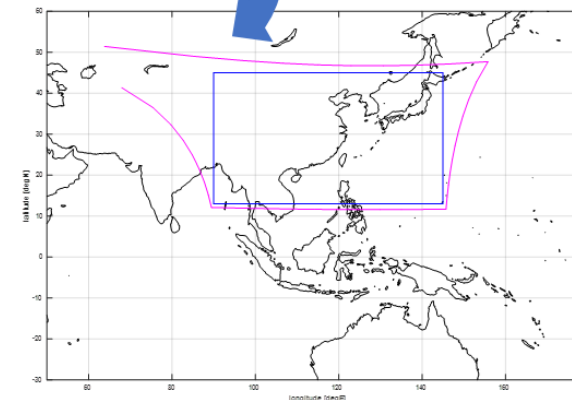


Figure 8. Comparison of aerosol layer height obtained from OMI retrieval and OMI-MODIS combined retrievals with those obtained from airborne lidar.

- ✓ - Want improve spatial resolution for better local-scale for air quality monitoring. (Spatial $\uparrow$, coverage $\downarrow$)
- About 2 times better spatial resolution, coverage much smaller than the current GEMS mission area
- Possible solution is increase N/S pixel count from 2,000 to 3,000, GEMS-2 keep a GEMS coverage



N/S: 3096 Pixels (3K)



N/S: 2048 Pixels (2K)



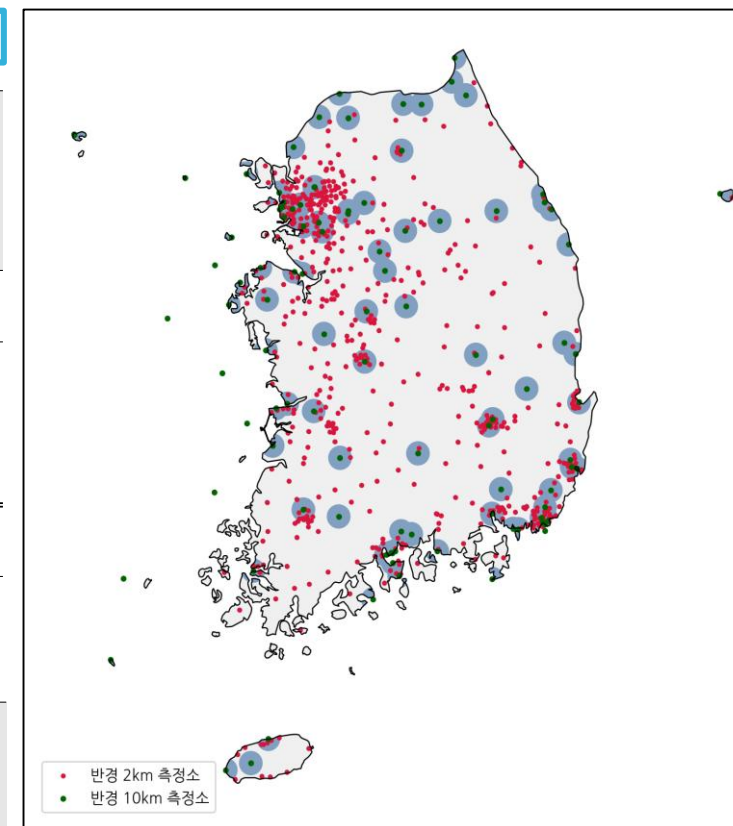
- 1) (Spatial resolution) Estimated benefit from improved spatial resolution: approximately **USD 150 million**
- 2) (Surface Ozone) Estimated health benefit from reduced short-term ozone exposure: approximately **USD 49 million**

Additional Benefits from Filling ground monitoring gaps through improved spatial resolution

Category	Gap Area (South Korea)	Coverage area per air- quality monitoring station	Spatial Correlation Factor	Benefit (USD)
GEMS	79,781km ²	12.56km ²	0.22	97 million
GEMS-2 (2.5 fold improvement in spatial resolution)			0.56	247 million
Additional benefit GEMS-2 over GEMS			150 million	

Additional Health Benefits from Improved Ozone Observation Accuracy

Mortality Attributable to Ozone Exposure (South Korea)	Reduction in Mortality using Satellite	Value of Statistical Life per Person	Satellite Operationa l Lifetime	Benefit
2,109 persons	1.25%	0.56 million	10 years	49 million



< Air quality Ground Monitoring Coverage in South Korea >



Air-quality Pollutants Trends and increase accuracy

- Particle Matter, Ozone

Continue and advance mission

Continue and advance mission for airquality monitoring, to better understanding of aerosol mechanism in Asia, etc.,.

More detail monitoring for air-quality policy

Support non-ground observation area

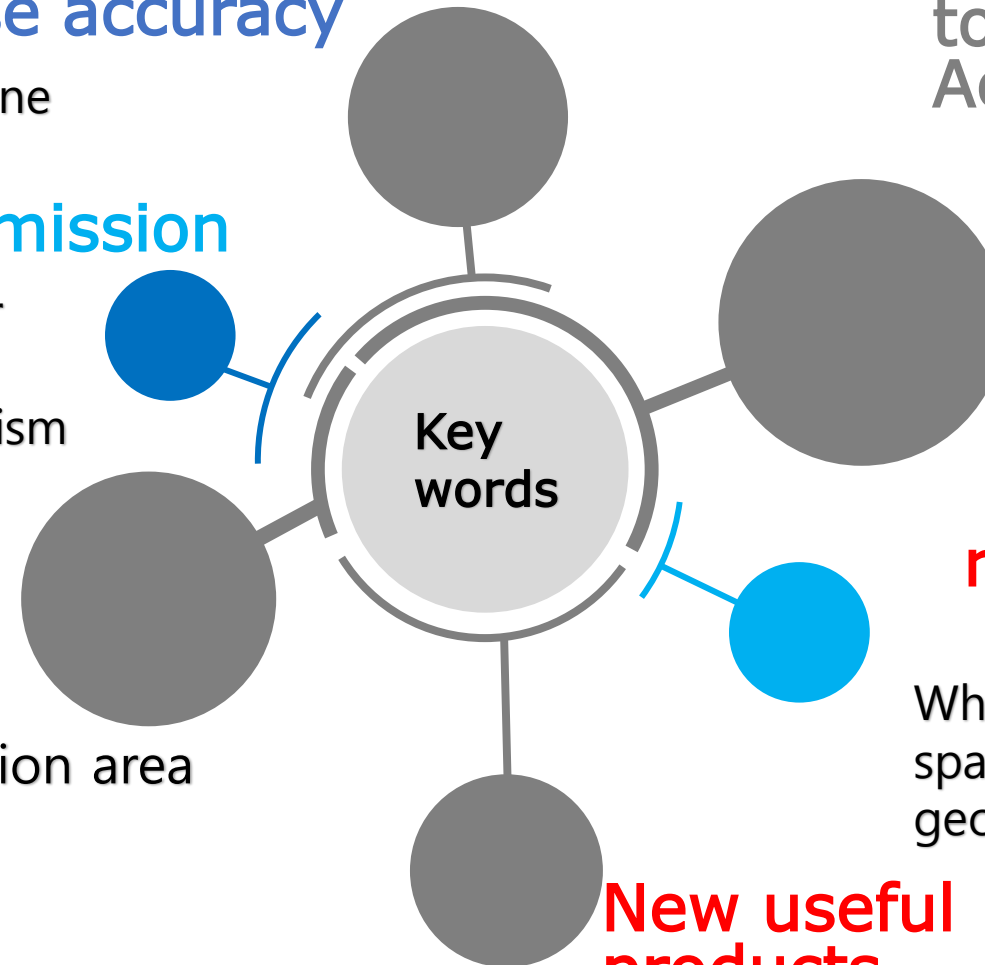
Extend wavelength to Increase Accuracy

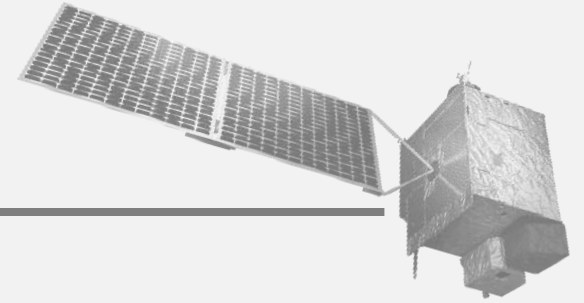
Which wavelength demand for increase ozone and aerosol accuracy

Better spatial resolution for local scale monitoring

What's the best option for spatial resolution in UV-VIS geostationary satellite

New useful products





2. Current Status and Development Plan for GEMS-2



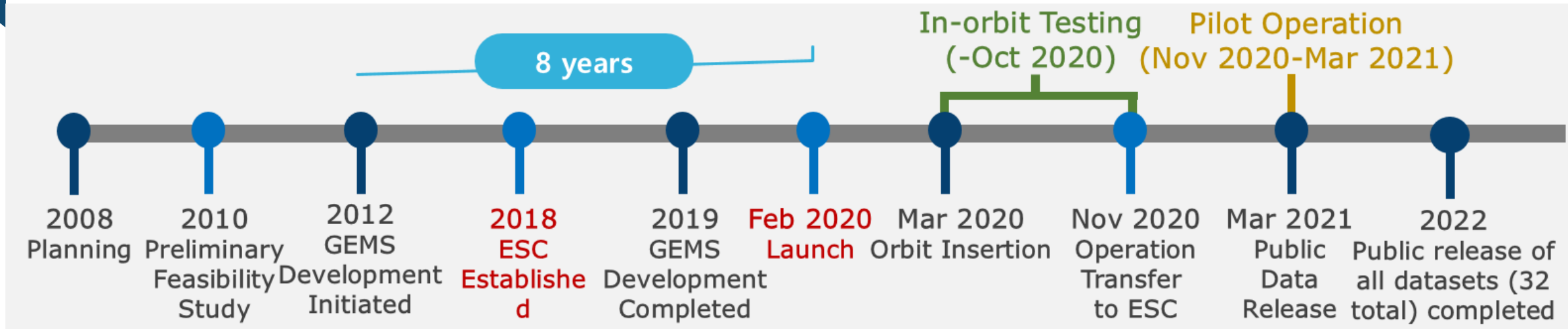
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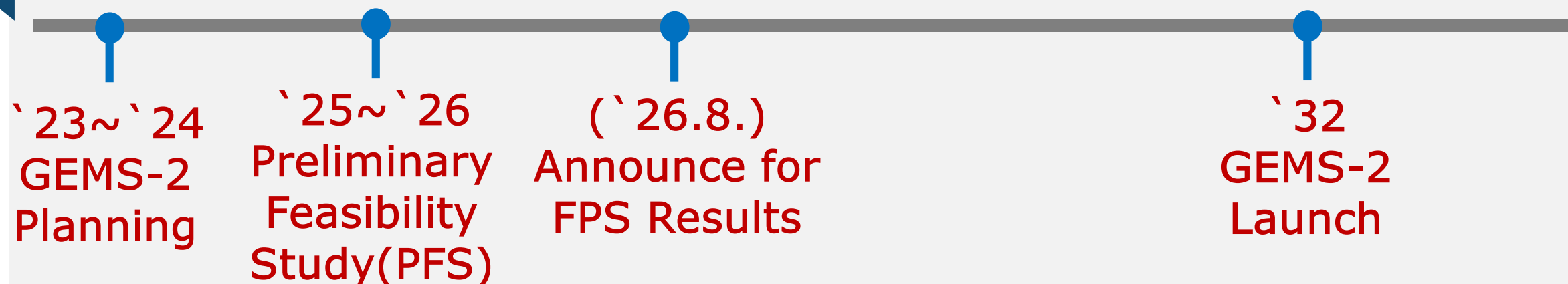


Mission	GEMS -2	GEMS	Comparison
Mission Period	10 years	10 years	- Same with GEMS
FWHM	$\leq 0.6\text{nm}$	$\leq 0.6\text{nm}$	- Same with GEMS
FOR	2K: 13N to 45N / 90E to 145E (3K: 2S to 45N/ 90E to 145E)	5S to 45N / 75E to 145E	- As the spatial resolution per pixel increases, the overall observation coverage decreases
Spatial Resolution	4.5(N/S) x 5(E/W)km	7(N/S) x 8(E/W)km	- More than twofold increase in spatial resolution per pixel
Wavelength	300 ~ 500, 540 ~ 740nm	300 ~ 500nm	- Extend for VIS
SNR	TBD	> 252 @300nm	- CCD => CMOS
Imaging time/step	TBD	2.56s	- TBD, relate to the SNR
No.per Day	10 times/day (60 min)	8 times/day (30 min)	- Include Night Time (1~2) - Acquisition time increased
Weight	< 180kg	160kg	- Slightly Increased
Volume	1.4m x 1.1m x 1.2m	1.2m x 1.1m x 0.9m	
Power	< 250W	< 200W	

• GEMS Project Timeline

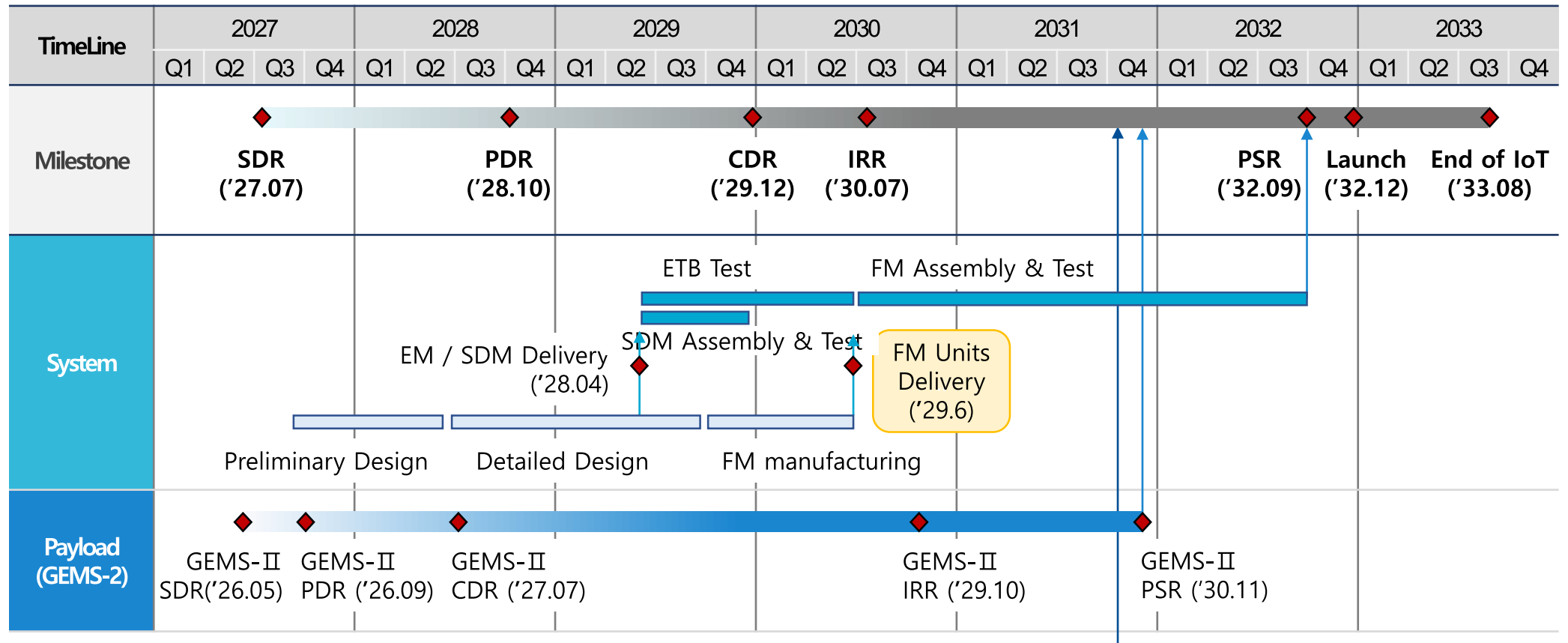


• GEMS -2

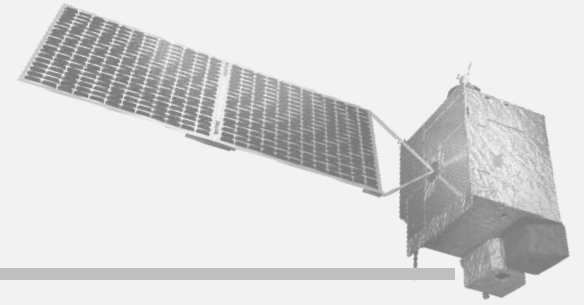


The project will begin development in **2027** and is expected to launch in **2032** after six years of development.

After
GEMS-2
Mission
Approval,
we start
GEMS-2
develop
ment



- **GEMS-2 will advance air quality monitoring in Asia by building on the achievements of GEMS.**
 - **Extended spectral coverage** will improve ozone and aerosol retrieval accuracy.
 - **Enhanced spatial resolution** will help fill gaps in ground-based observations and provide more detailed information on local-scale air pollution.
 - **Socio-economic benefits** are expected through improved public health protection and more effective air quality policy.
- **GEMS-2 is currently in the Preliminary Feasibility Study phase**, with development planned from 2027 and launch targeted for 2032.
- **GEMS-2 will provide more accurate, detailed, and policy-relevant environmental information for a cleaner and more resilient Asia.**



“

We will continue to strengthen
GEMS operations and utilization
for **better air quality and climate resilience in Asia.**”



Thank you



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