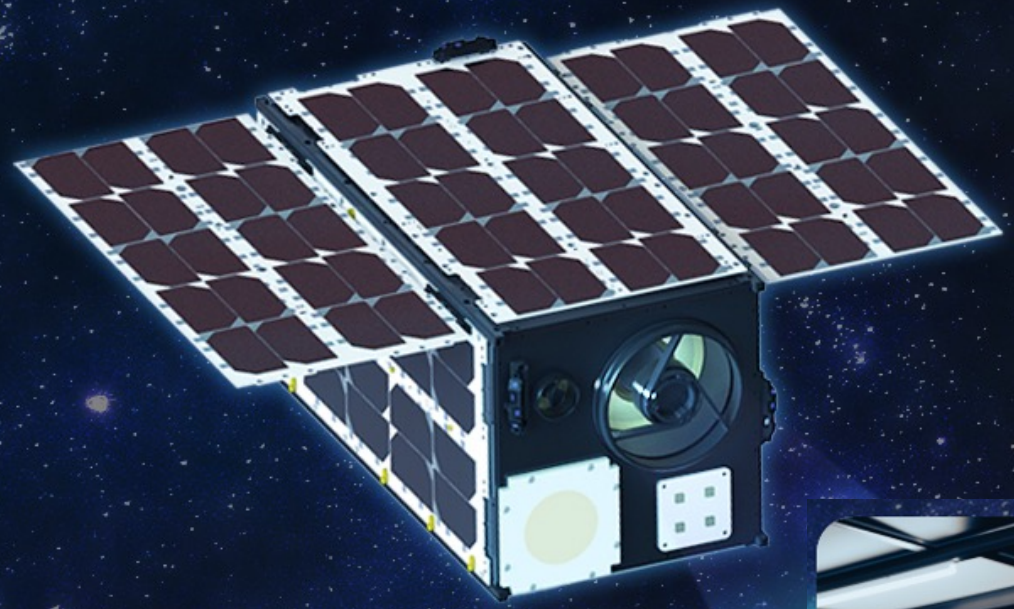
Mission Design and Introduction to the First Korean Spaceborne Methane Monitoring Project: Narsha

[1]**Hayoung Park***, [2]Jinyoung Shin, [2]Geuk-Nam Kim, [2]Jae-Pil Park, [1]Jaemin Hong, [2]Kwangwon Lee, [2]Seongwhan Lee, [2]Jungkyu Lee, [1]Dong Yeong Chang, [1]Yu-Ri Lee, [3]Young-Jun Choi, [1]Sujong Jeong,

[1]Climate Lab, Graduate School of Environmental Studies, Seoul National University, South Korea
[2] Nara Space Technology Inc., South Korea
[3]Korea Astronomy and Space Science Institute, South Korea

NARA SPACE | CLIMATE LAB | 서울대학교 SEOUL NATIONAL UNIVERSITY | KASI 한국천문연구원 Korea Astronomy & Space Science Institute



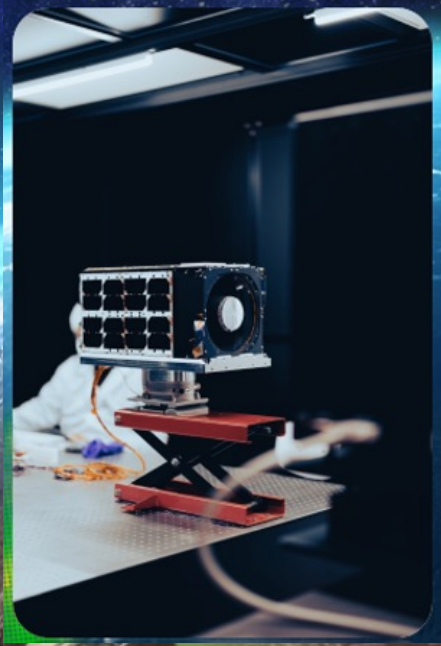
Constellation Mission: **Narsha**

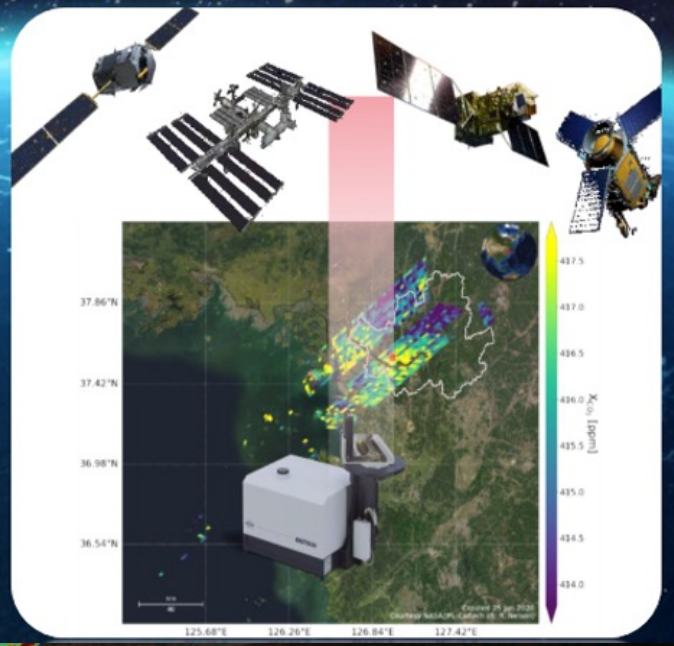
First Satellite of Narsha Project: **K3M** (Korea Methane Monitoring Microsatellite)

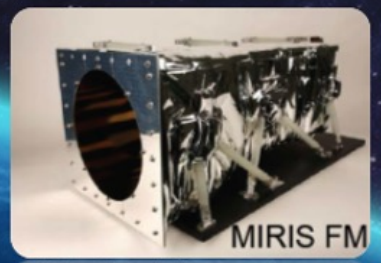
Target of First Launch: **2026 Q4**

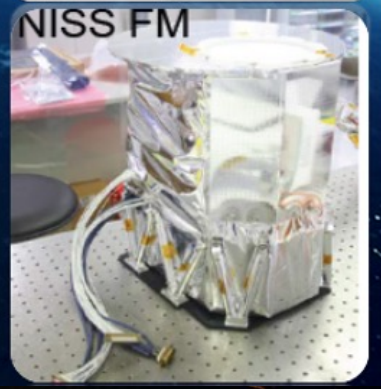
Project manager: Jaepil Park (Nara Space)

Project science team lead: Sujong Jeong (Seoul National University)



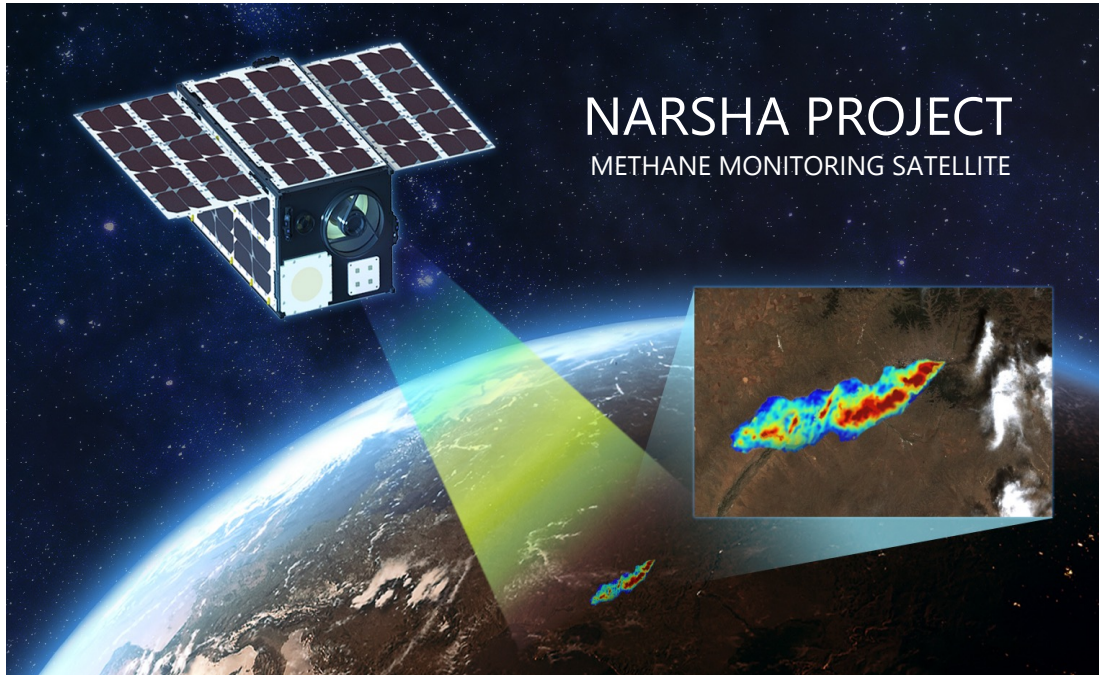






The Narsha Project

- First Korean methane monitoring microsatellite constellation mission specifically designed to measure methane emissions, led by a private enterprise in collaboration with various institutions.
- Initiative aligns with the Global Methane Pledge aimed at reducing methane emissions worldwide as well as to establish a dependable MRV system in the global effort to mitigate anthropogenic greenhouse gas emissions.
- By supporting methane abatement efforts, especially in East Asia, Narsha will play a crucial role in enhancing methane management practices both domestically and internationally



NARA SPACE | CLIMATE LAB | 서울대학교 SEOUL NATIONAL UNIVERSITY | KASI 한국천문연구원 Korea Astronomy & Space Science Institute

Mission Statement

- Develop a hyperspectral microsatellite capable of detecting methane in the atmosphere and operate it for at least three years
- Operate in a satellite constellation and establish a system to produce measurements on methane concentration and emissions in local areas (point sources) and provide data recognized as a reliable measurement method
- Monitor methane emission in local areas (point sources) and provide global data with a focus on East Asia

NARA SPACE | CLIMATE LAB | 서울대학교 SEOUL NATIONAL UNIVERSITY | KASI 한국천문연구원 Korea Astronomy & Space Science Institute

Mission Statement

- **Mission Objectives**

K3M-OBJ1 Detect and quantify local methane sources with emissions of 100 kg/h or more

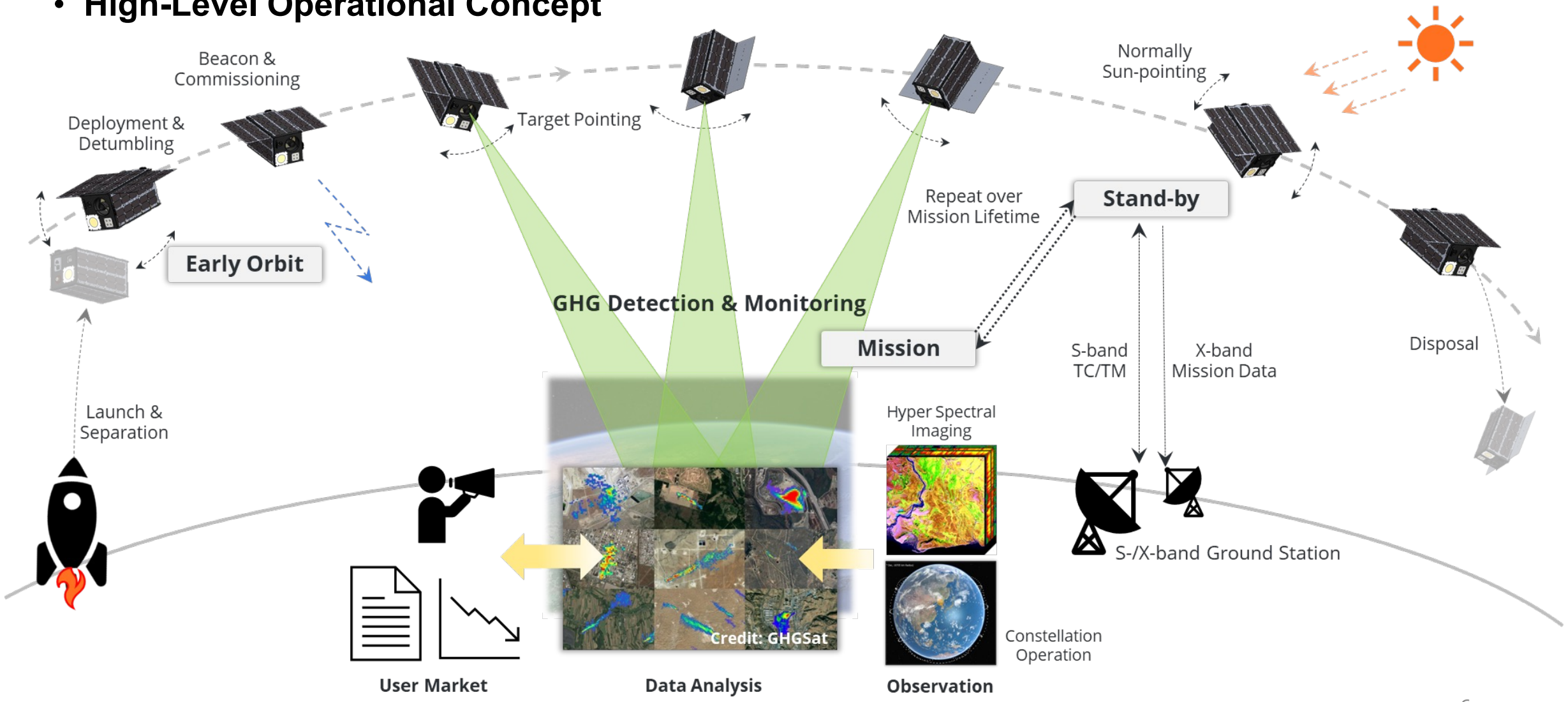
K3M-OBJ2 Operate a satellite constellation system to observe specific emission sources with a temporal resolution of one day

K3M-OBJ3 Establish a data collection, analysis, and distribution system capable of providing Level 2 to Level 4 data to customers within 4 weeks upon request

NARA SPACE | CLIMATE LAB | 서울대학교 SEOUL NATIONAL UNIVERSITY | 한국천문연구원 Korea Astronomy & Space Science Institute

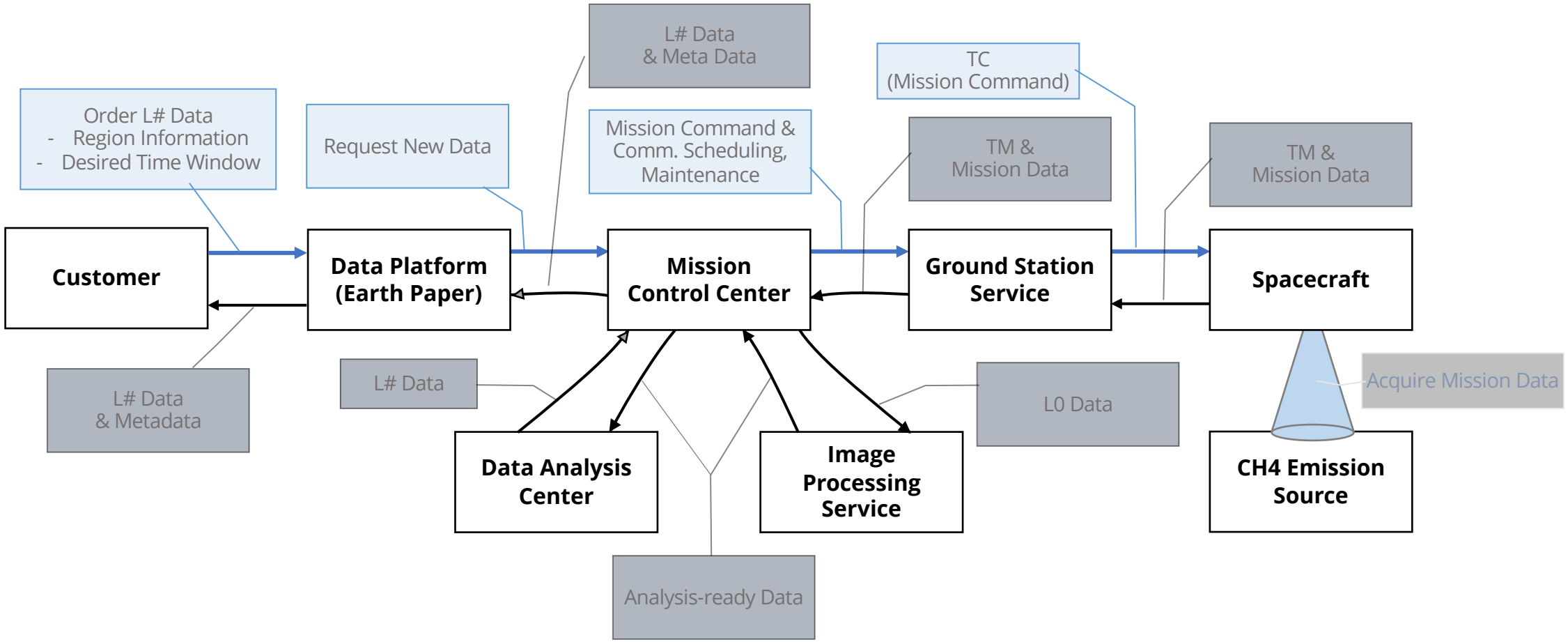
Concept of Operations

- **High-Level Operational Concept**



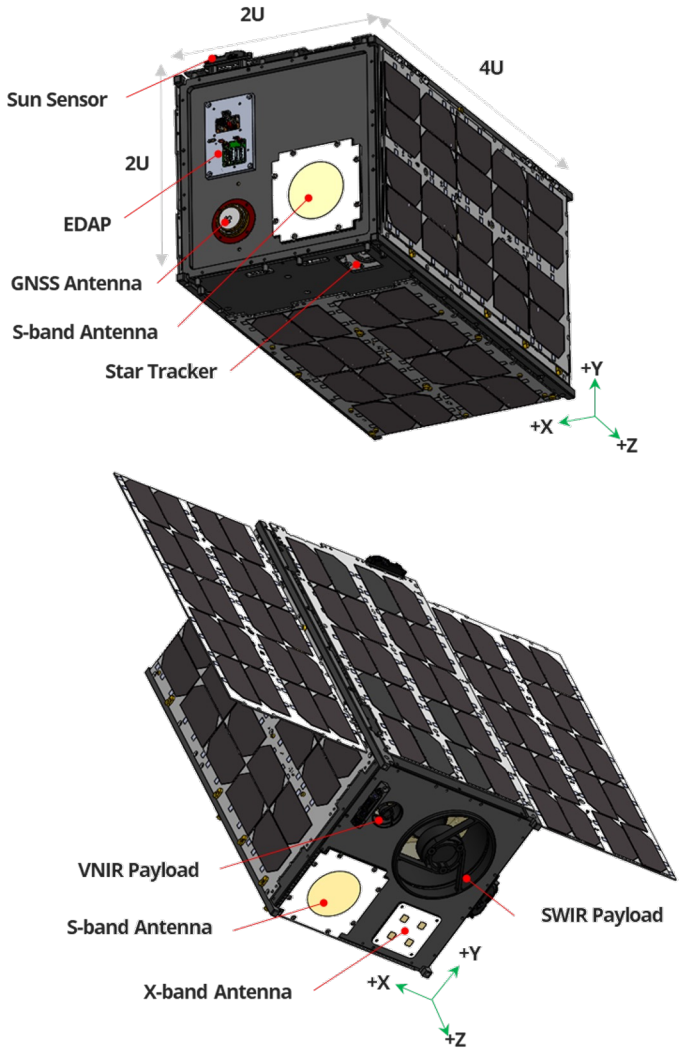
Concept of Operations

- **Operational Node Connectivity**



Microsatellite System Design

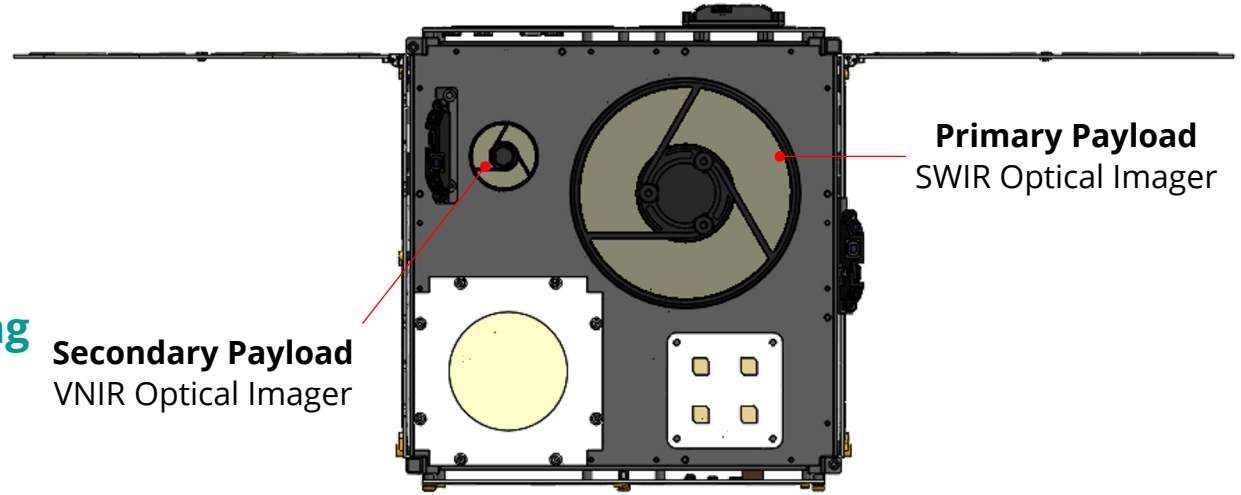
- **System Specification**



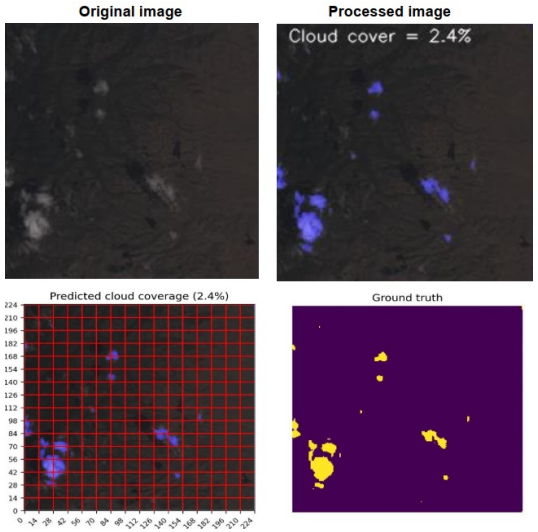
Contents		Performance (TBD)	Remark
Mission	Lifetime	>3 years	-
	Orbit	500~600 km / SSO	6+satellites for constellation
	Spectrum	**SWIR (CH_4 @1625-1670 nm)**	Weak CO_2 absorption
		VNIR (@400-1000 nm)	On-board cloud detection
	Detection Threshold	**>100 kg/h**	-
	Data Availability	**L1, L2, and L4**	-
	Data Delivery	<4 weeks/image	Request-to-delivery, L4
Bus	Pointing Accuracy	<+/-0.02 deg	-
	Off-Nadir Pointing	<+/-30 deg	-
	Data Downlink	Up to 200 Mbps	Up to 512 GB storage
Payload	Spectrum Resolution	**<0.3 nm**	SWIR FWHM
	Signal-to-Noise Ratio	**>150**	@Albedo 0.2 & SZA 60 deg
	Swath	**>10 km x 10 km**	@500 km, VNIR & SWIR
	Ground Sampling Distance	**<25 m**	@500 km, VNIR & SWIR
	Dimension & Mass	<12U / <15 kg	-

Microsatellite System Design

- **Payload Concept**
  - 2 Channel Spectrometer :
    - SWIR – **GHG detection**
    - VNIR – **Target information & Cloud masking**
  - Size : <12U & 15 kg
  - Spectral resolution : **<0.3 nm @SWIR**
  - On-board processing :
    - Data compression
    - Cloud detection & masking
    - Radiometric calibration
    - Thermal control



Payload Data Handling System
AI on-board processing



Ground-Aircraft-Satellite 3D Methane Monitoring System

Data Platform – Earth Paper

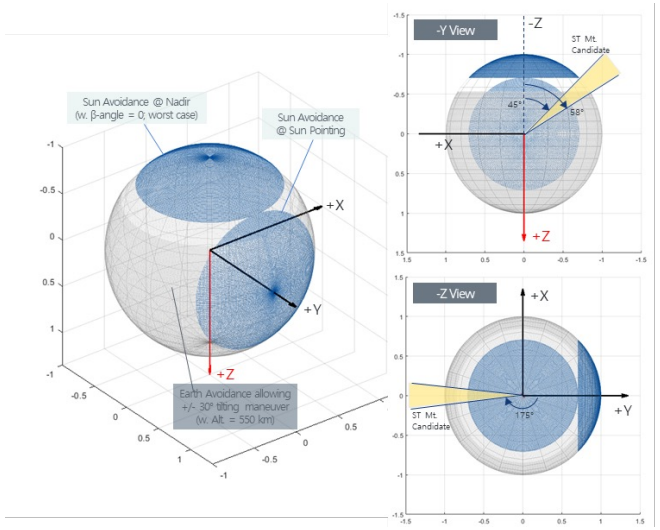
EarthPaper

Measure I Monitor I Report

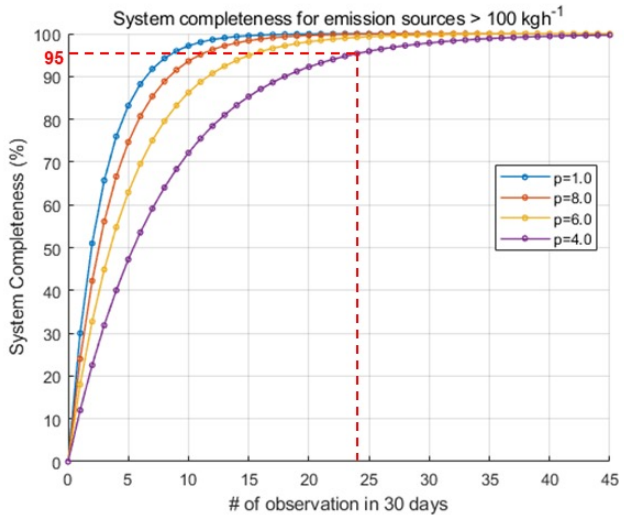
Proprietary AI cloud-based platform offering cutting-edge global methane emissions reporting

Conclusion

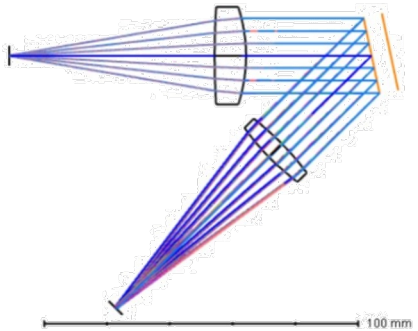
- **Near-term Activities**
  - Conduct **mission analysis** & establish **a development plan for payloads** to meet methane observation requirements & design a constellation
  - Establish **product assurance plan** for standardization of the microsatellite system to be considered for **mass production**
  - Identify risk factors of the project and their mitigation plans



Attitude Control for Imaging



Constellation Requirement Analysis



Optical Payload Design & Analysis

THANK YOU

NARSHA PROJECT

METHANE MONITORING SATELLITE

EXPAND OUR UNIVERSE