

TISTR International Conference on Air Pollution, Perspective,  
Prediction Prevention and Control

# Space-Based PM2.5 Monitoring Technology for Supporting Data to Relevant Organization on Prediction, Prevention and Control

31 August 2023

Queen Sirikit National Convention Center



# Contents



## | Satellites

- Types of Satellites.
- Utilization of Satellite .

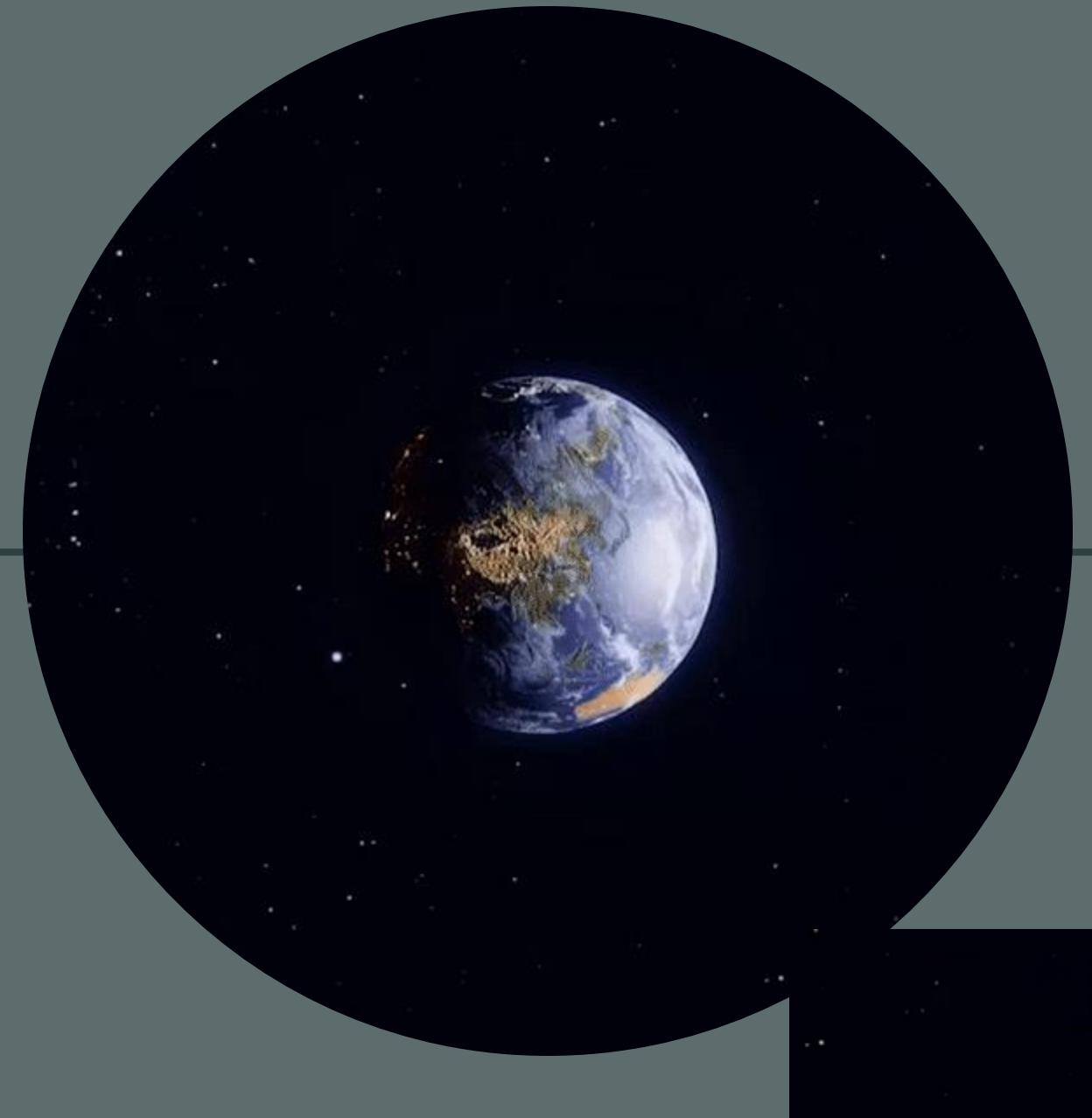
## | Air Quality

- Satellites and Air Quality Monitoring.
- Satellites and PM2.5 Monitoring.

## | Air Pollution Prediction Prevention and

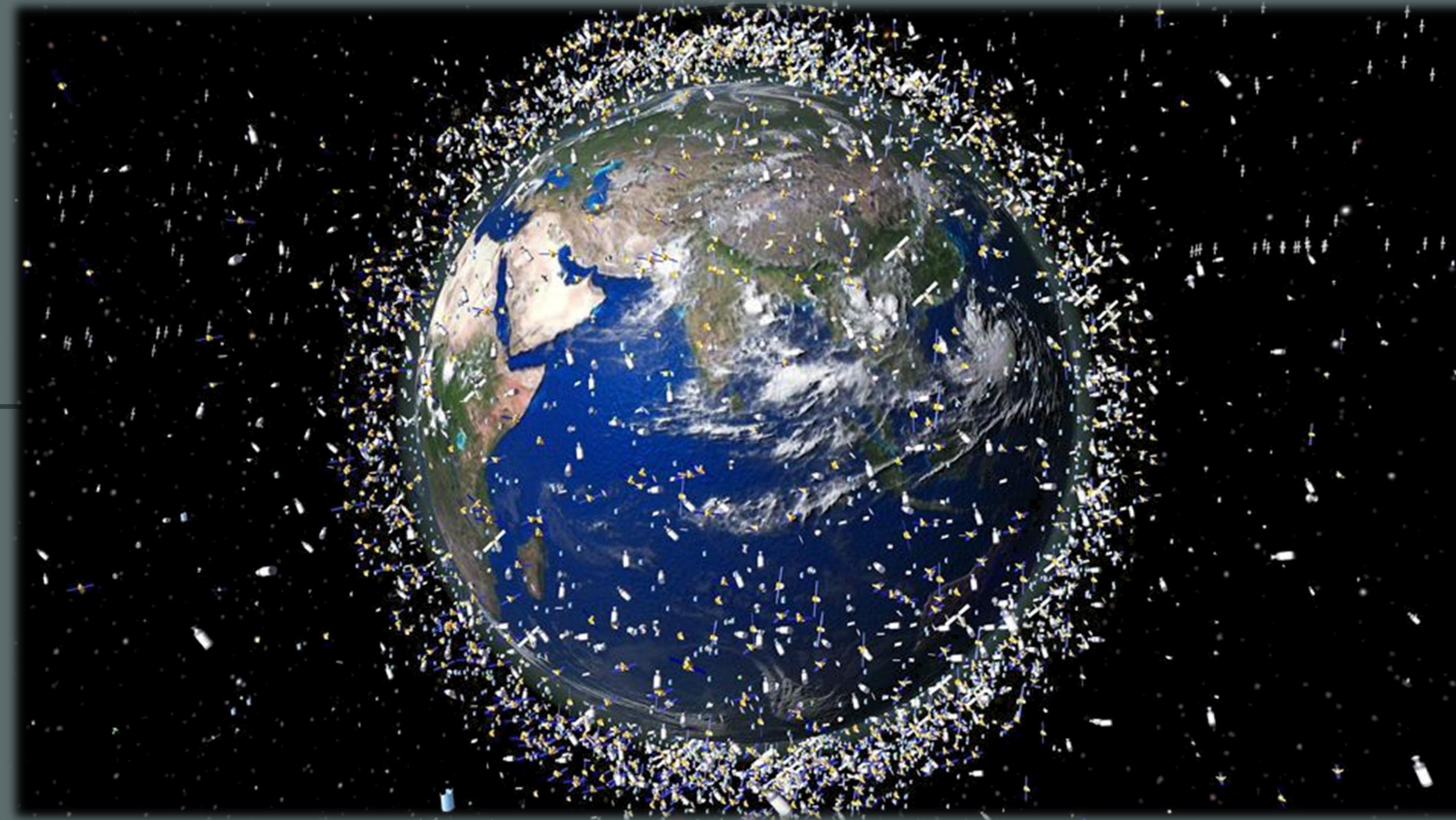
- Satellite and PM2.5 Monitoring/Controlling/Resolving support.

# Satellites



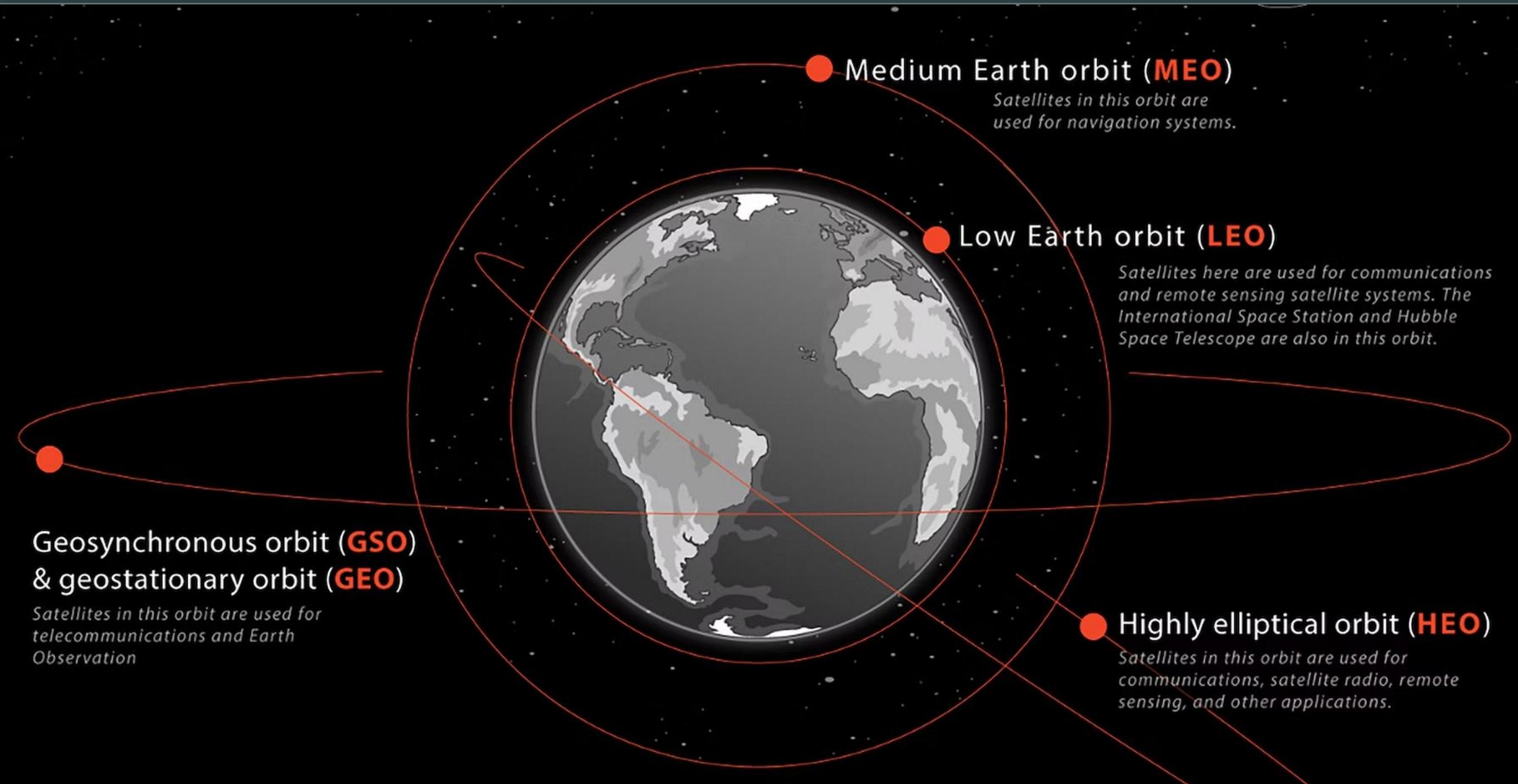
There were 11,330 individual satellites orbiting the Earth at the end of June 2023.  
~65% are active satellite.

# Satellites



20,000 and 100,000 satellites in 5 – 10 years from now.

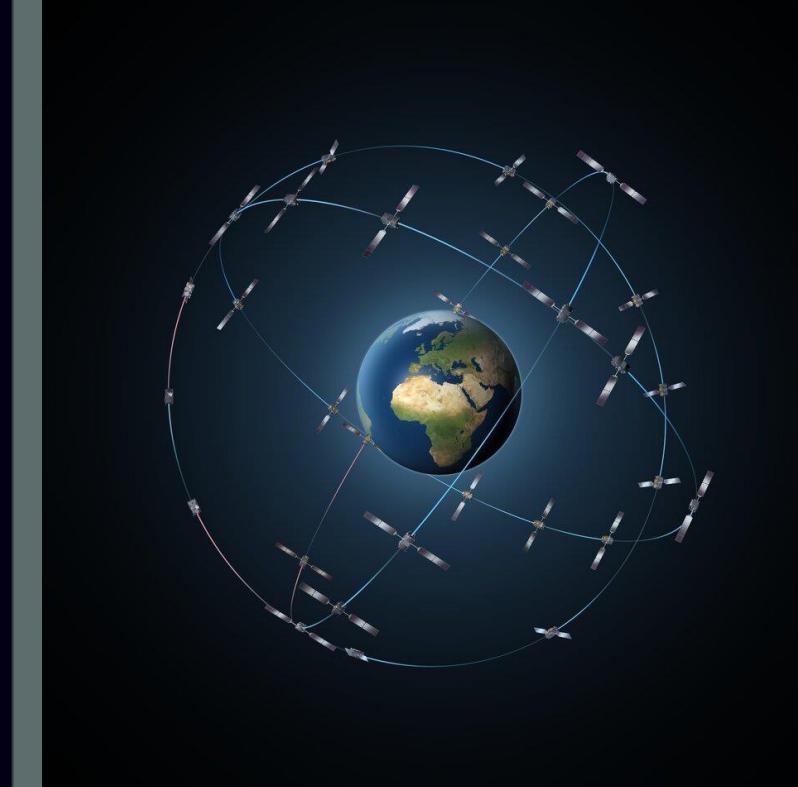
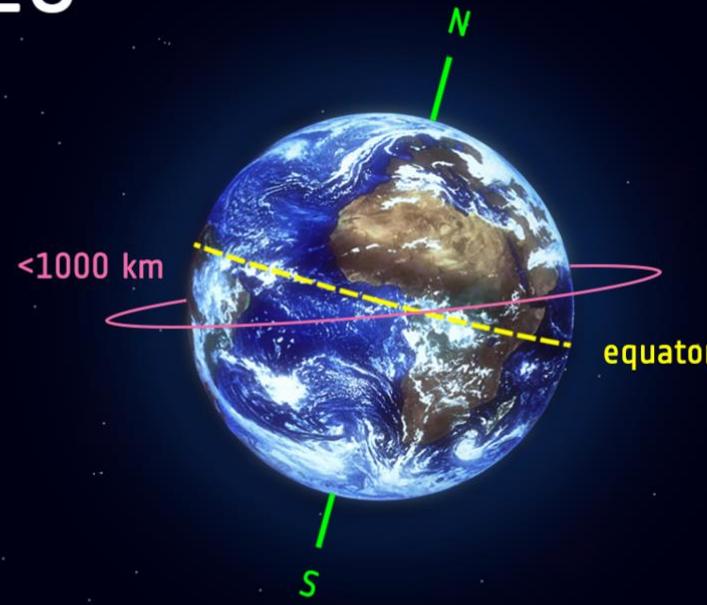
# Types of satellites



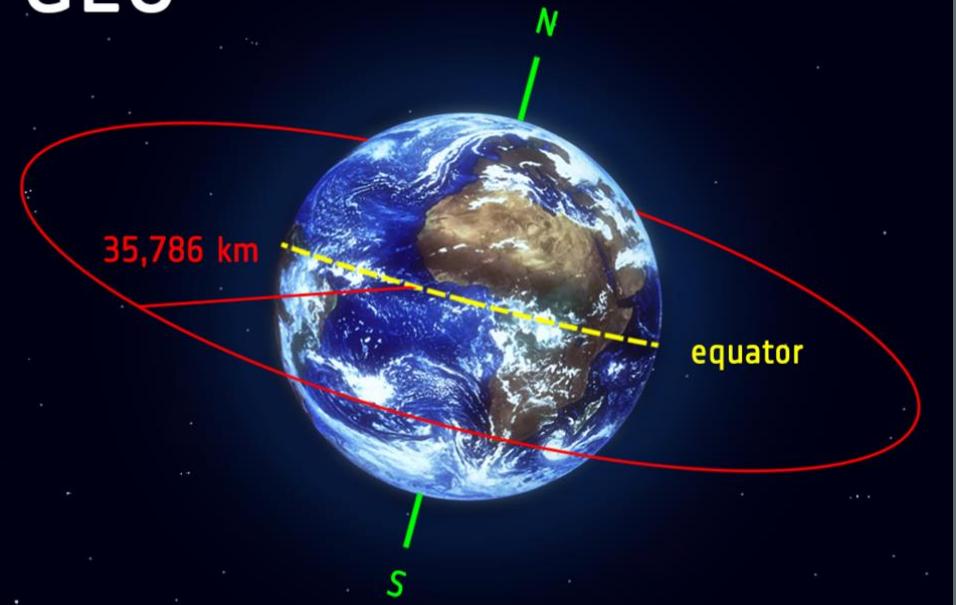
There are various orbits in which satellites are placed, depending on their intended purpose and mission requirements.

# Types of satellites

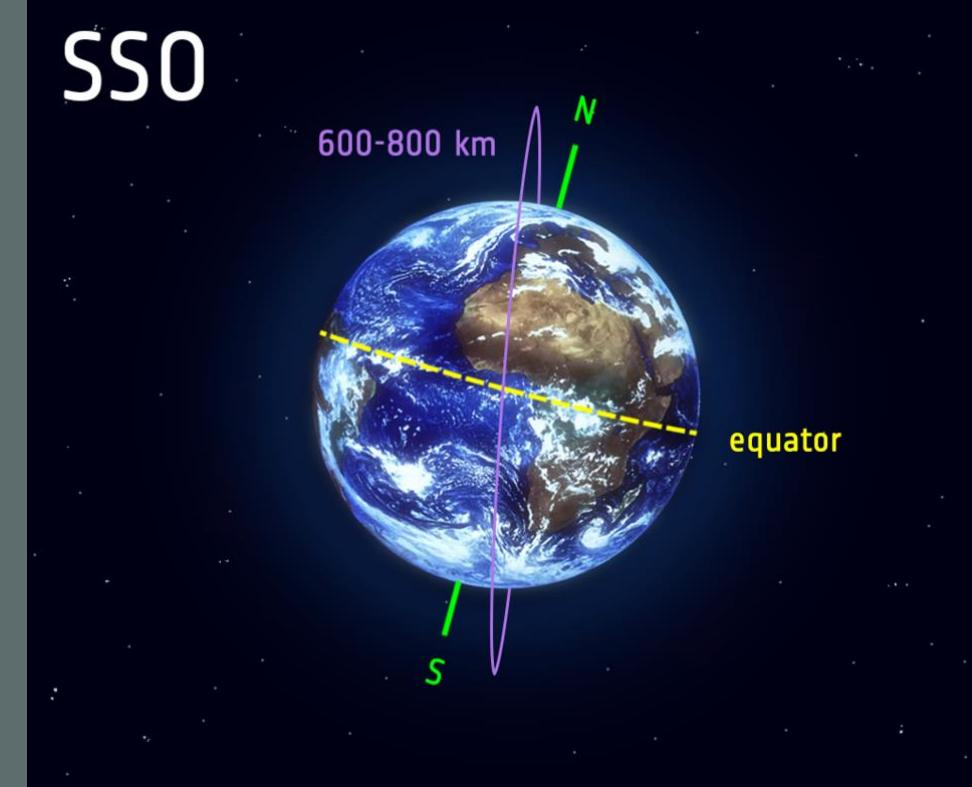
LEO



GEO



SSO



LEO

Low Earth Orbit Satellites  
Altitude : 160–1,500 km.  
All types of remote sensing,  
High-resolution earth observation,  
Rapid revisit times,  
Scientific research,  
Landsat, Sentinel, and Aqua etc.

MEO

Medium Earth Orbit Satellites  
Altitude : 5,000 - 20,000 km.  
Navigation and communication,  
Medium-resolution imagery,  
Between low Earth and  
geostationary orbits,  
GPS, GLONASS, Galileo etc.

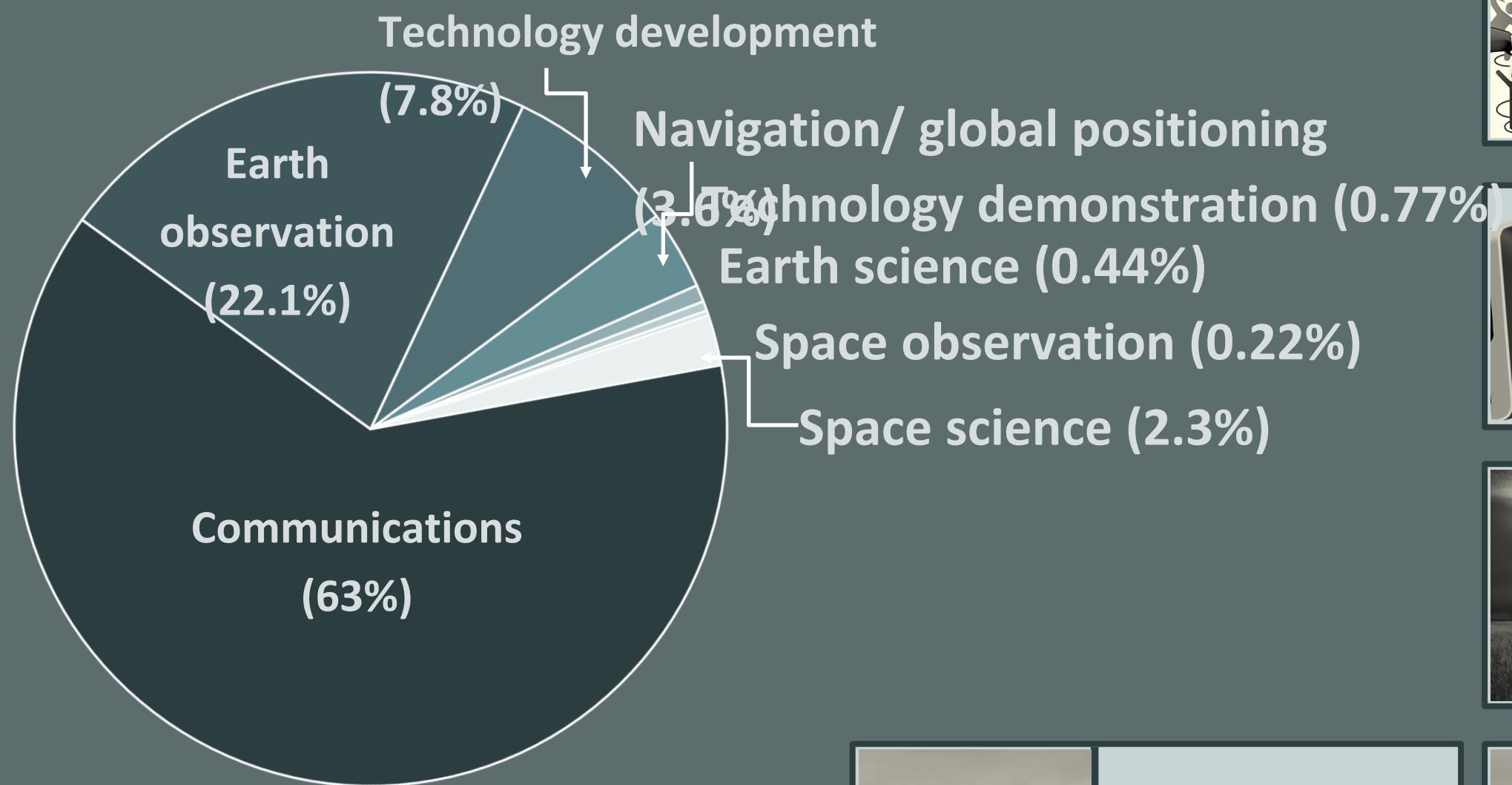
GEO

Geostationary Orbit Satellites  
Altitude : 35,786 km. Precisely over the  
equator  
Low-resolution imagery  
Communication: TV and phones  
Meteorology,  
METEOSAT, HIMAWARI etc.

SSO

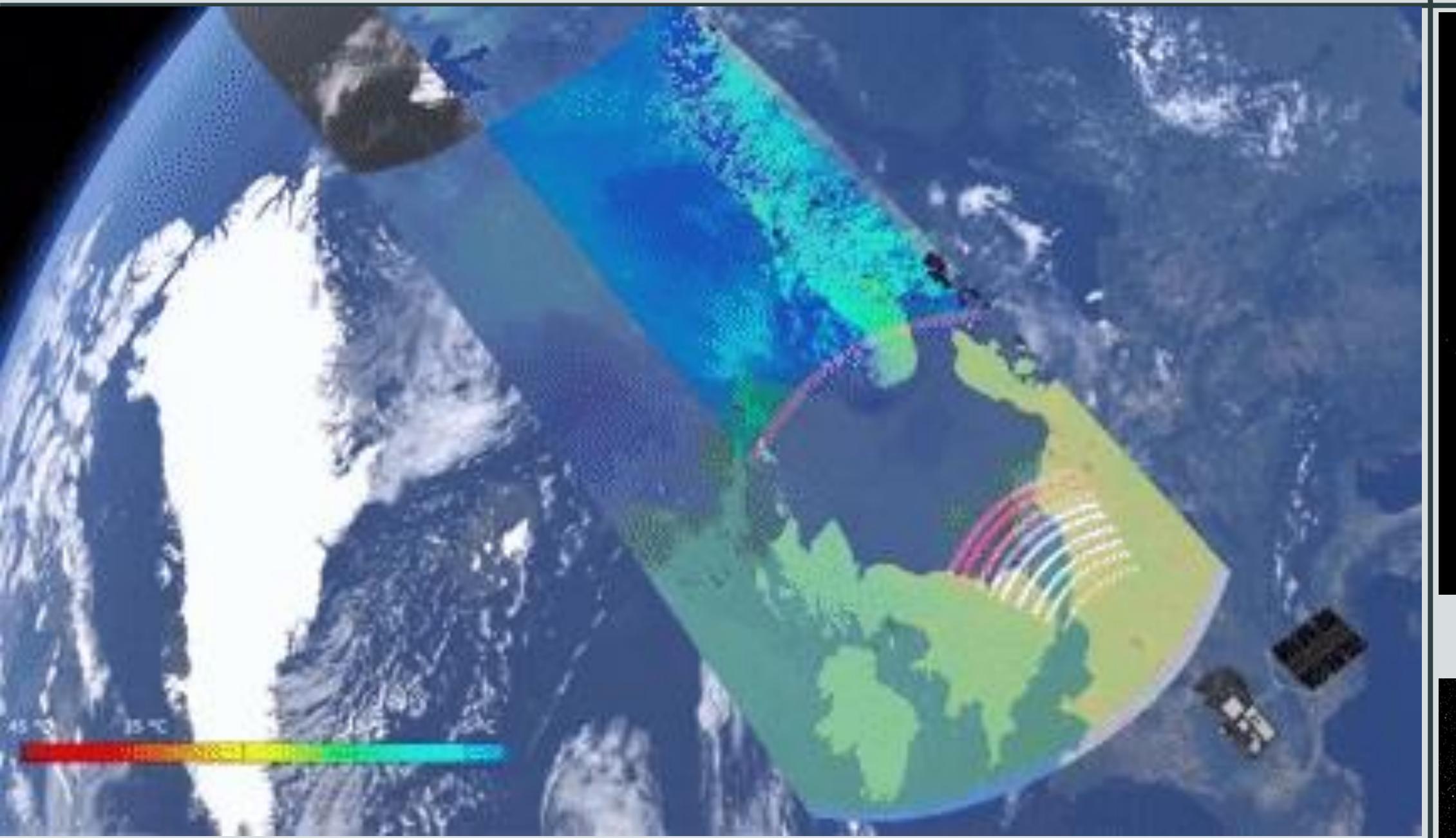
Sun-Synchronous Orbit Satellites  
Altitude : 600 - 800 km. Satellites goes  
from north to south across the polar,  
High-resolution imagery  
Earth observation and environmental  
monitoring,  
Monitoring polar regions,  
MODIS, ASTER, and Landsat etc.

# Utilization of Satellite

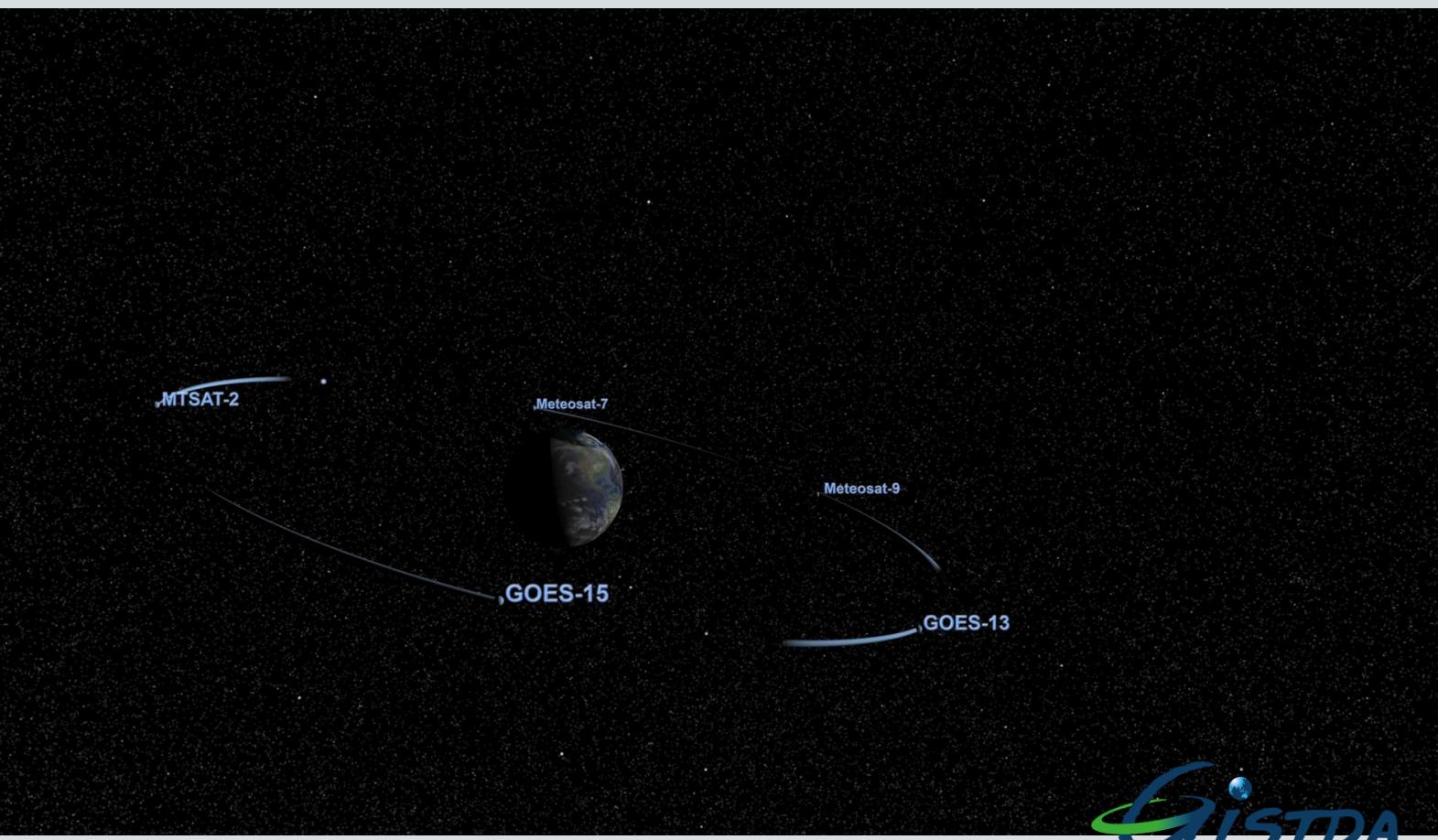
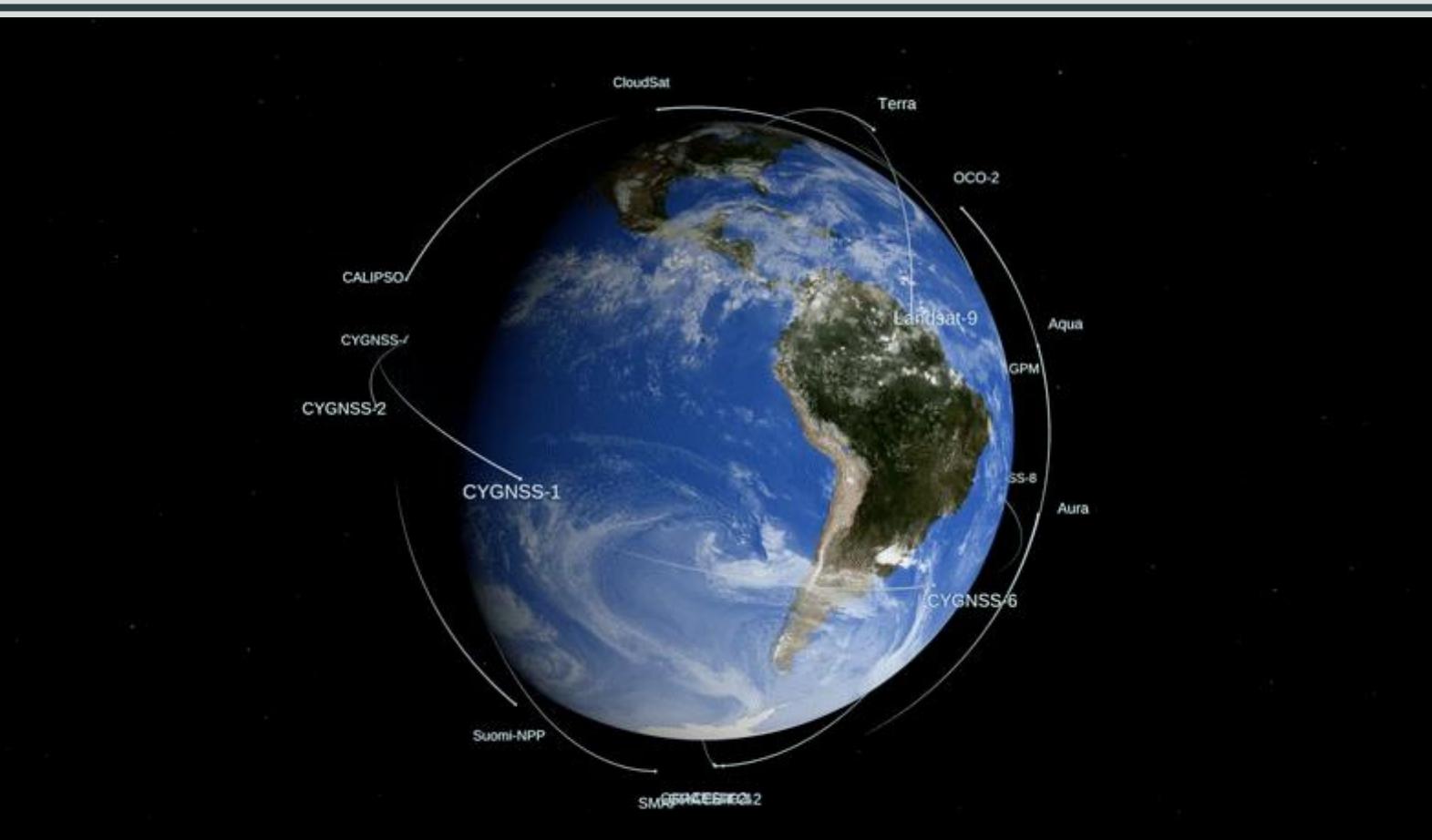




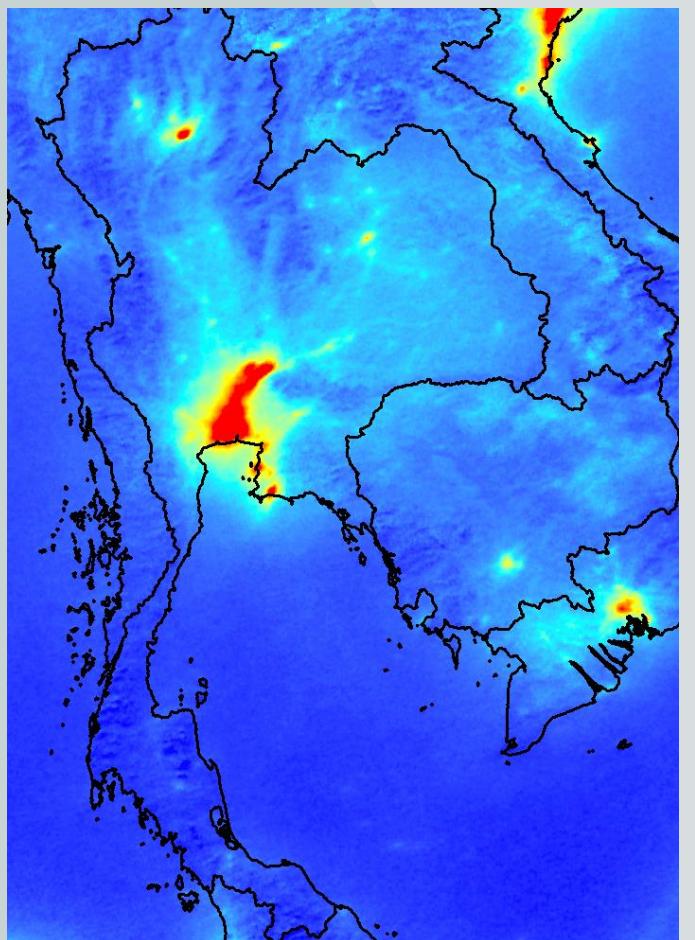
# Air Quality



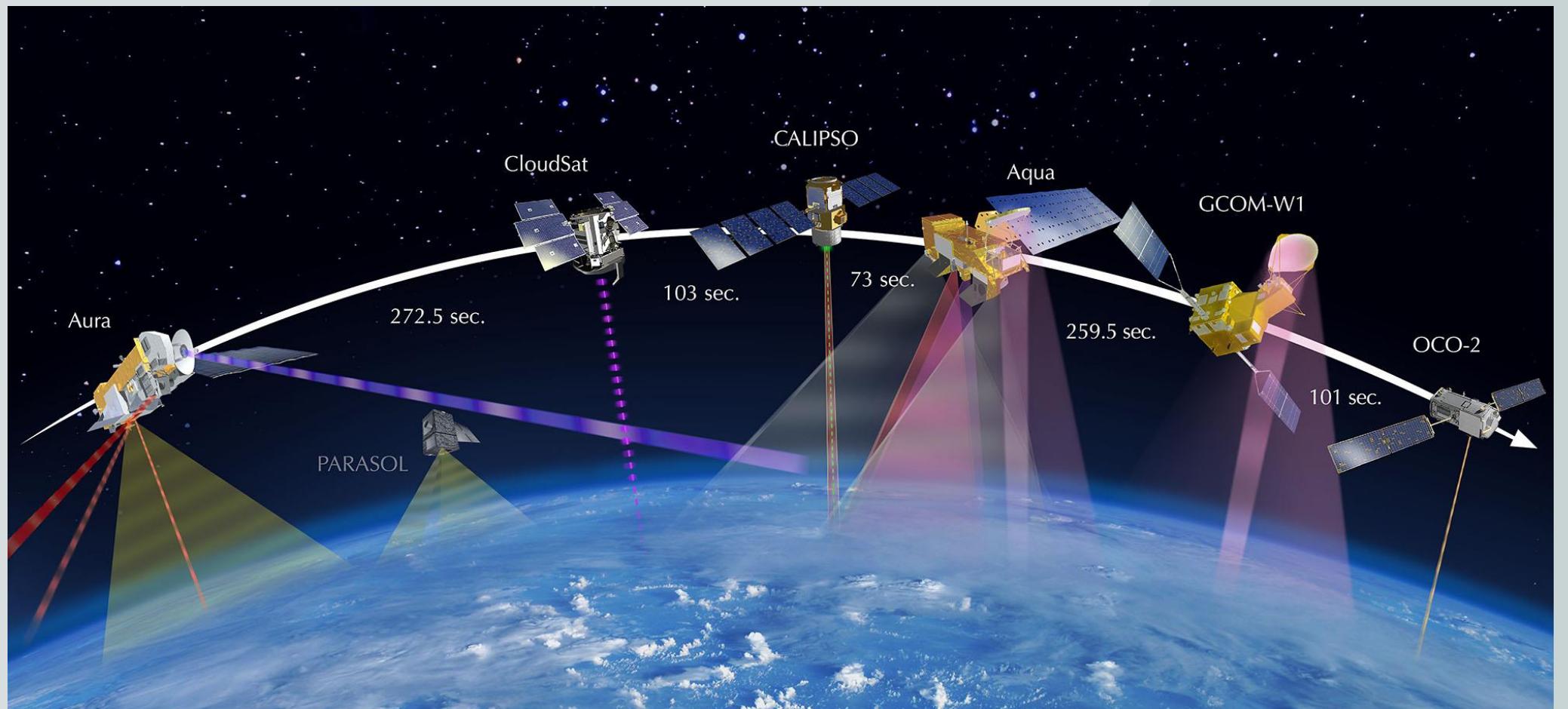
# Satellites and Air Quality Monitoring



# Satellites and Air Quality Monitoring



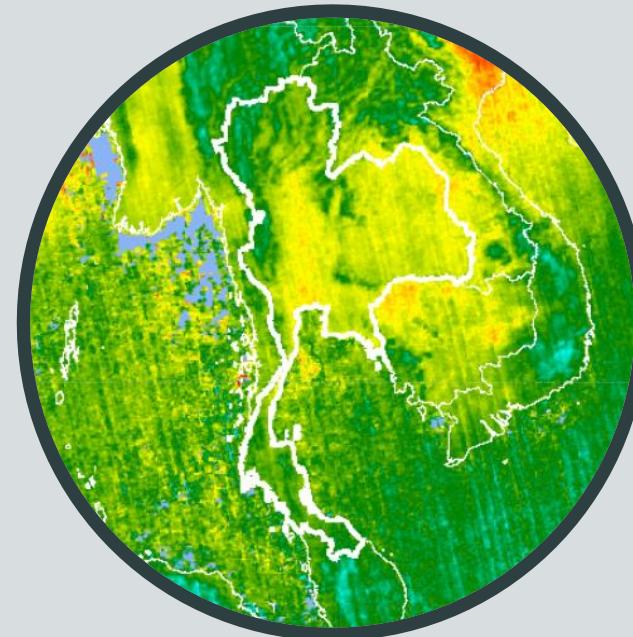
NO<sub>2</sub> - 2022



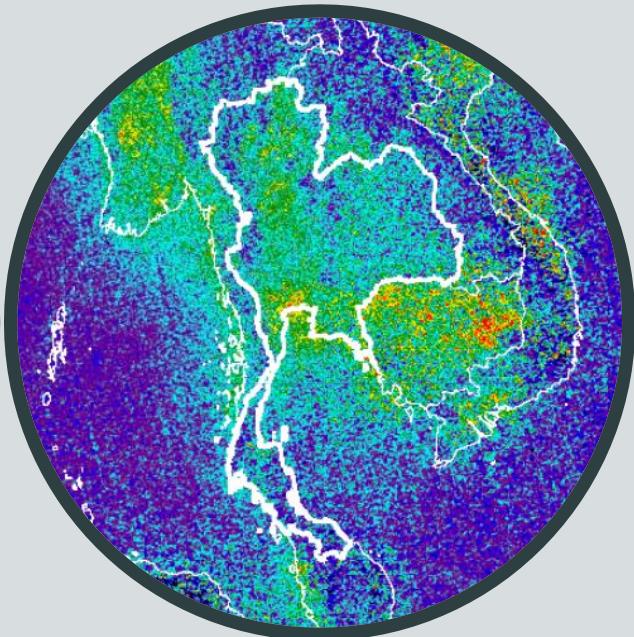
The A-Train satellite constellation

# Satellites and Air Quality Monitoring

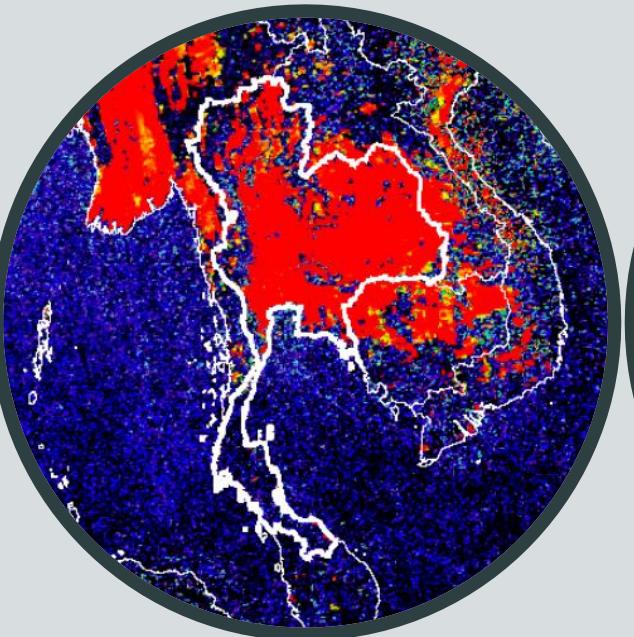
Sentinel-5P January 1-23, 2023



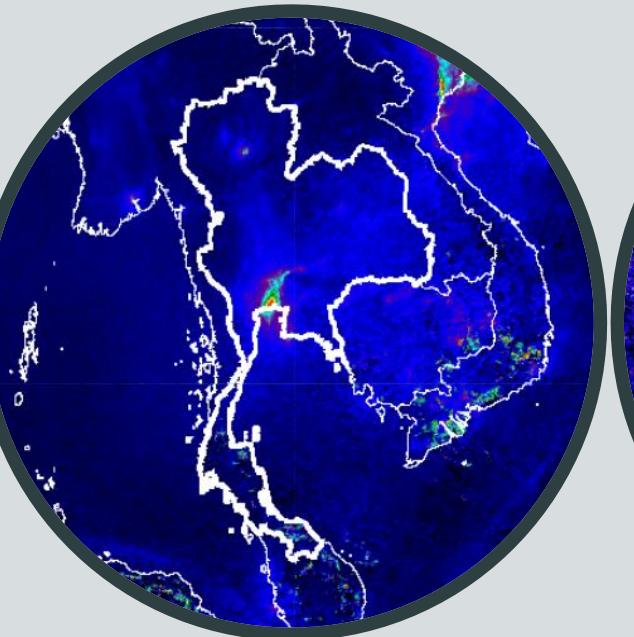
Carbon Monoxide



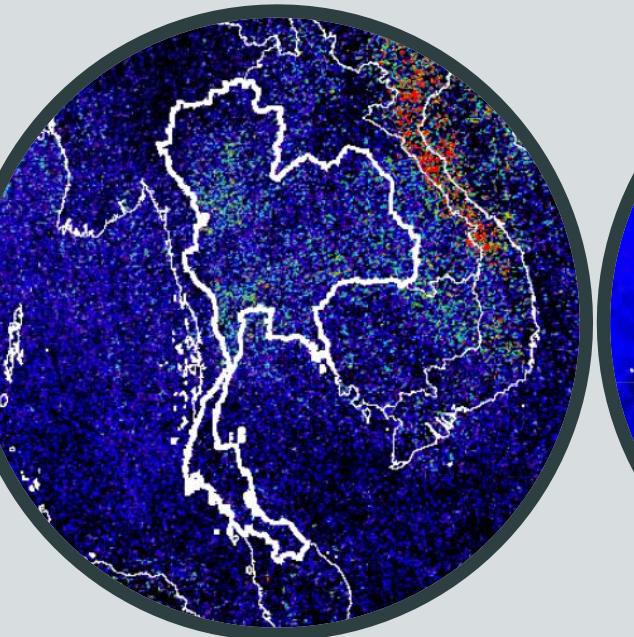
Formaldehyde



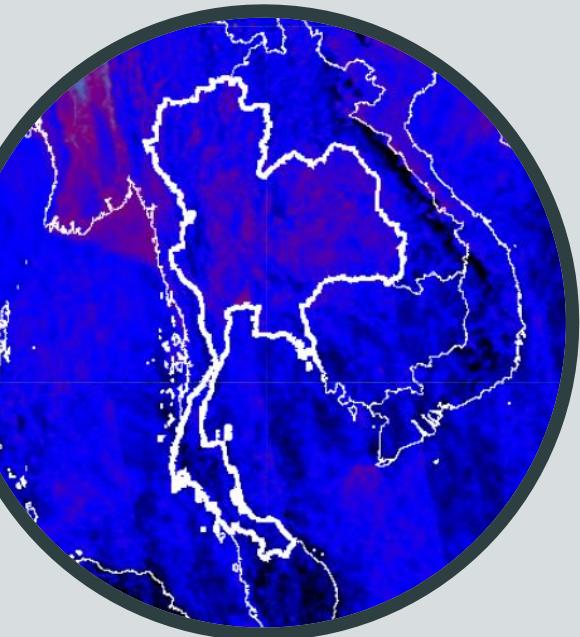
Methane



Nitrogen Dioxide



Sulfur Dioxide



UV Aerosol

# Satellites and PM2.5 Monitoring

## Satellite and GI - based Estimation of PM2.5 concentrations

**Space-Based PM2.5 Monitoring System**

Color Description:

- Very Good: 0 - 25
- Good: 25 - 37
- Moderate: 37 - 50
- Sensitive Groups: 50 - 90
- Unhealthy: + 90

PM2.5 Statistics:

Data Fusion: Himawari, PM2.5, Wind Speed, Pressure, Relative Humidity, NDVI, and DEM

Display:

- Satellite Image
- Thematic Map
- Stations

Date/Time:

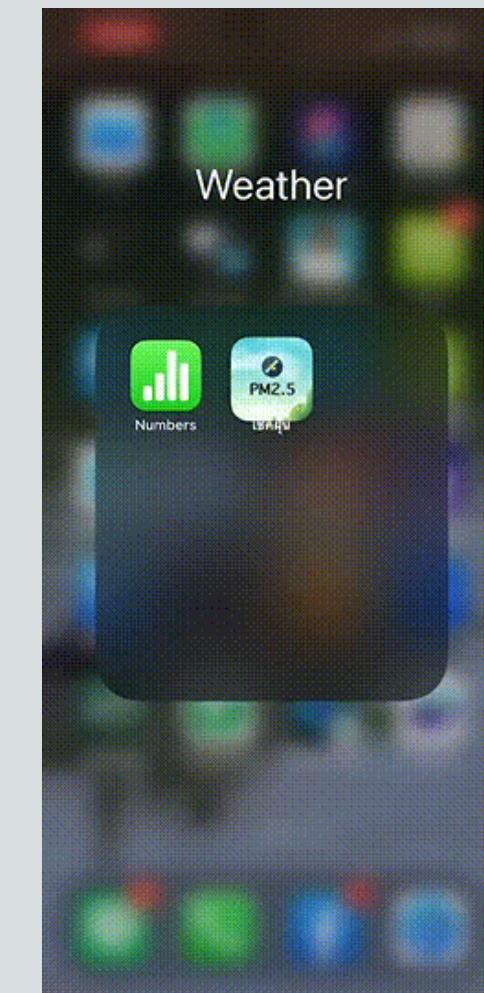
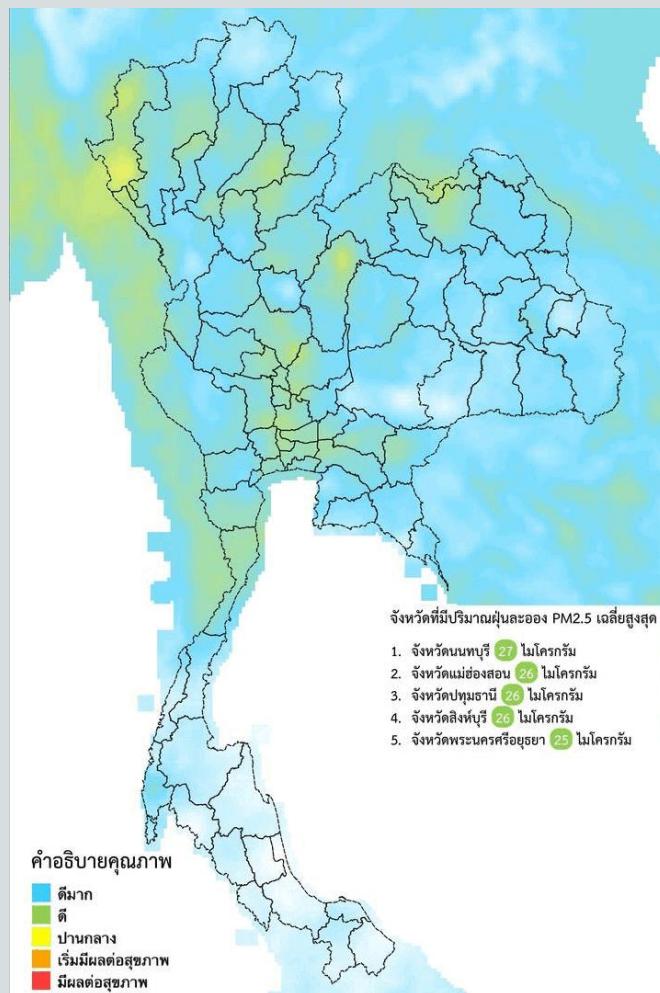
Tuesday, January 26, 2021 5:00 PM

Report: District Average PM2.5 (Ranking)

No.	District	Province	PM2.5 (avg. $\mu\text{g}$ )
1	Chiang Klang	(Nan)	59
2	Pua	Nan	58
3	Thung Chang	(Nan)	58
4	Chaloem Phra Kiat	Nan	57
5	Tha Wang Pha	(Nan)	57
6	Bo Kluea	Nan	56
7	Muang Nan	(Nan)	56
8	Phu Phiang	Nan	56
9	Santi Suk	(Nan)	56

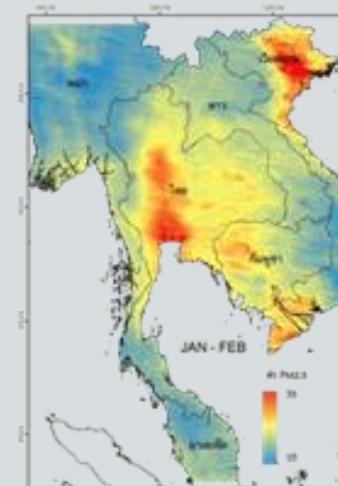
คำอธิบายคุณภาพ:

- ดีมาก
- ดี
- ปานกลาง
- เริ่มมีผลกระทบสุขภาพ
- มีผลกระทบสุขภาพ

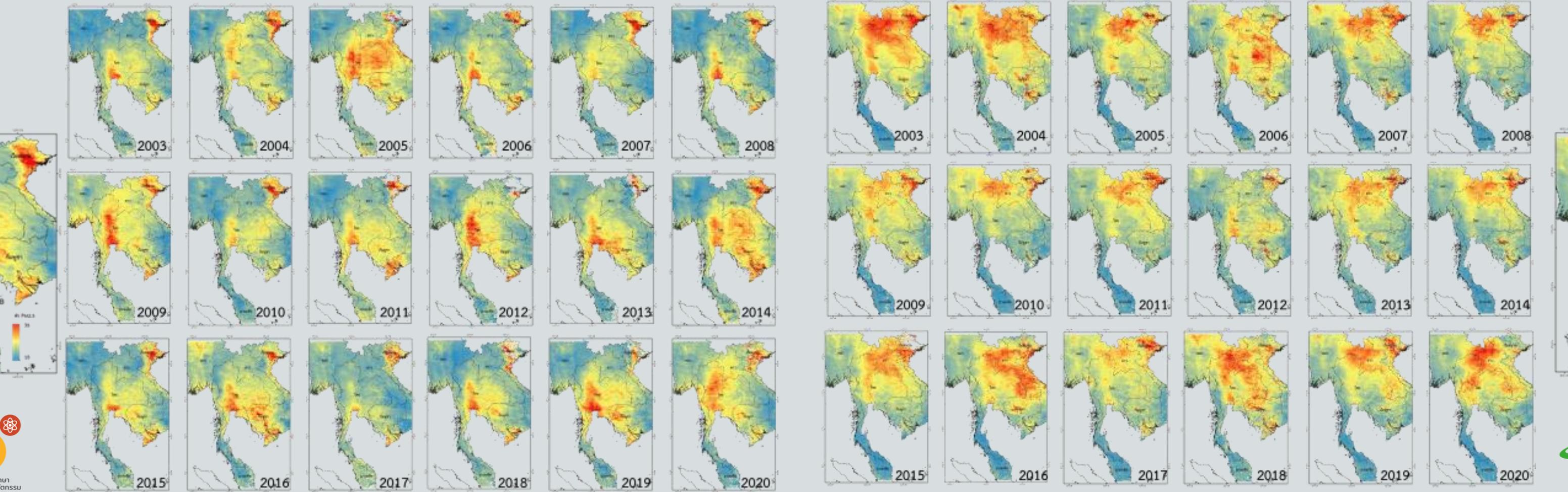


PM 2.5

JAN - FEB

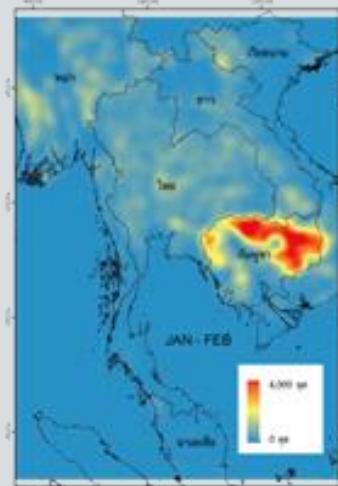


กระทรวงศึกษาธิการ  
วิทยาศาสตร์ วิจัยและนวัตกรรม



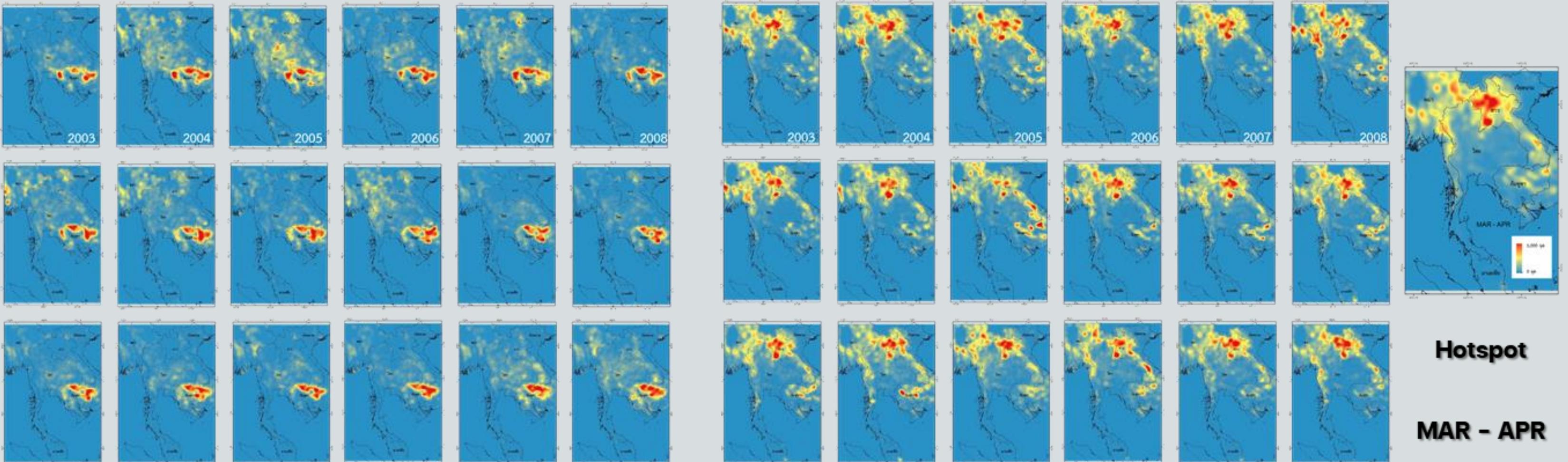
PM 2.5

MAR - APR



Hotspot

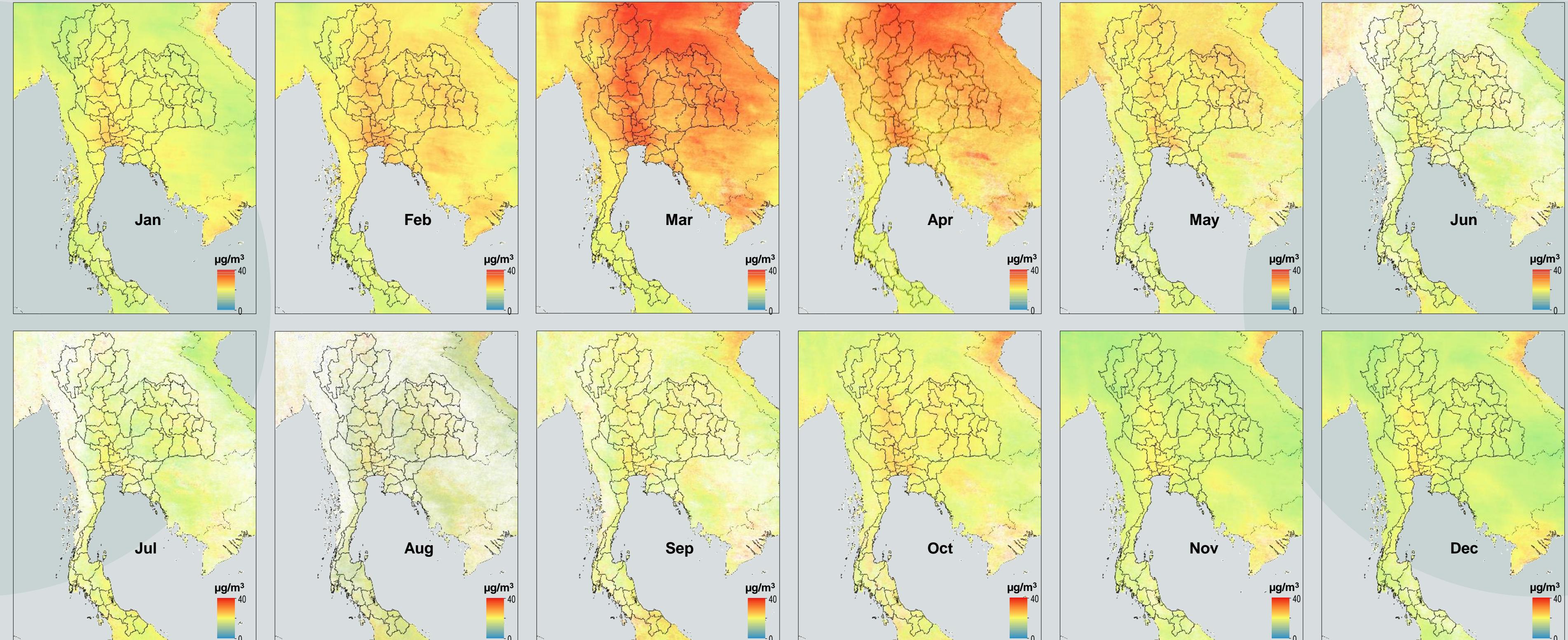
JAN - FEB



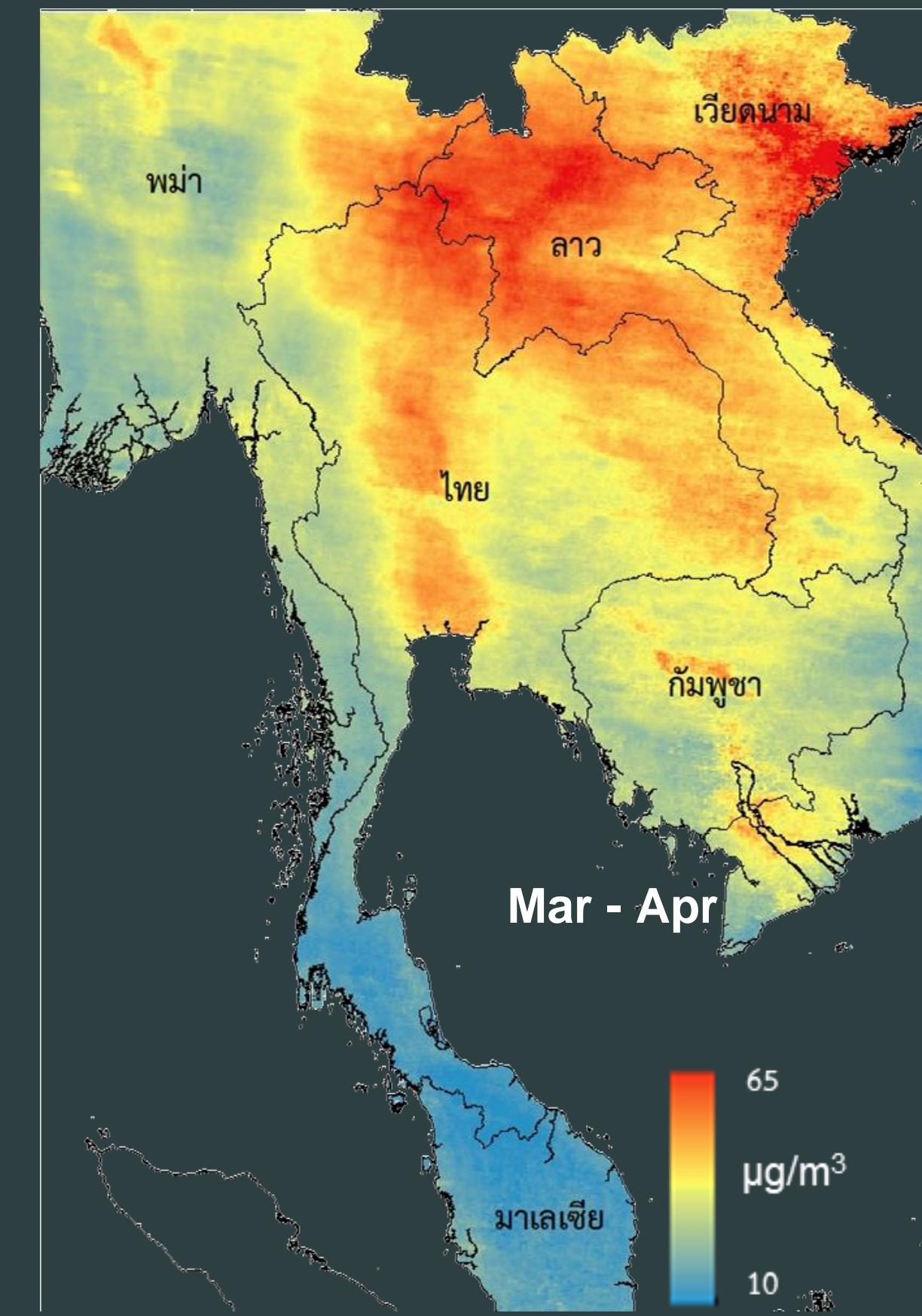
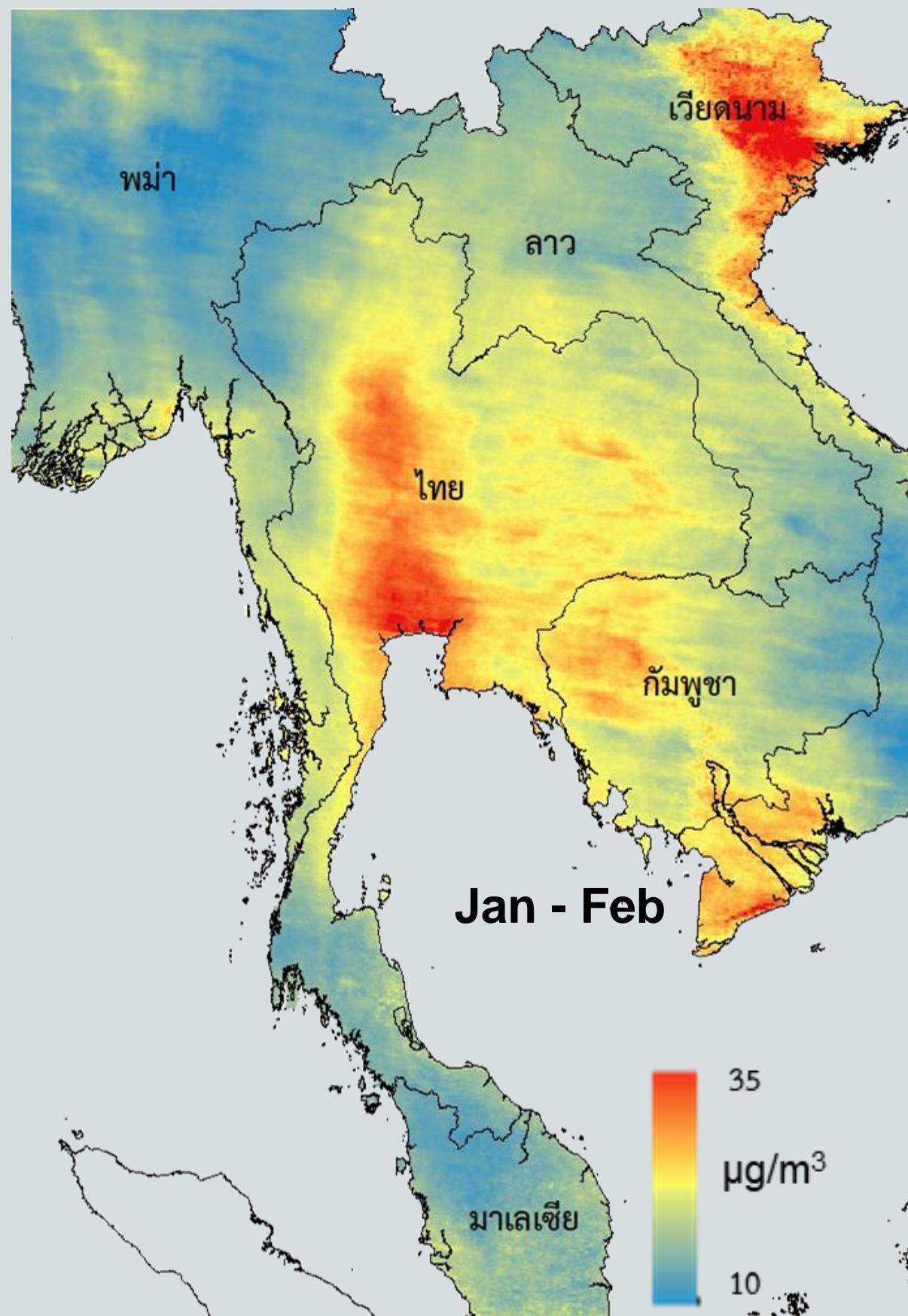
Hotspot

MAR - APR

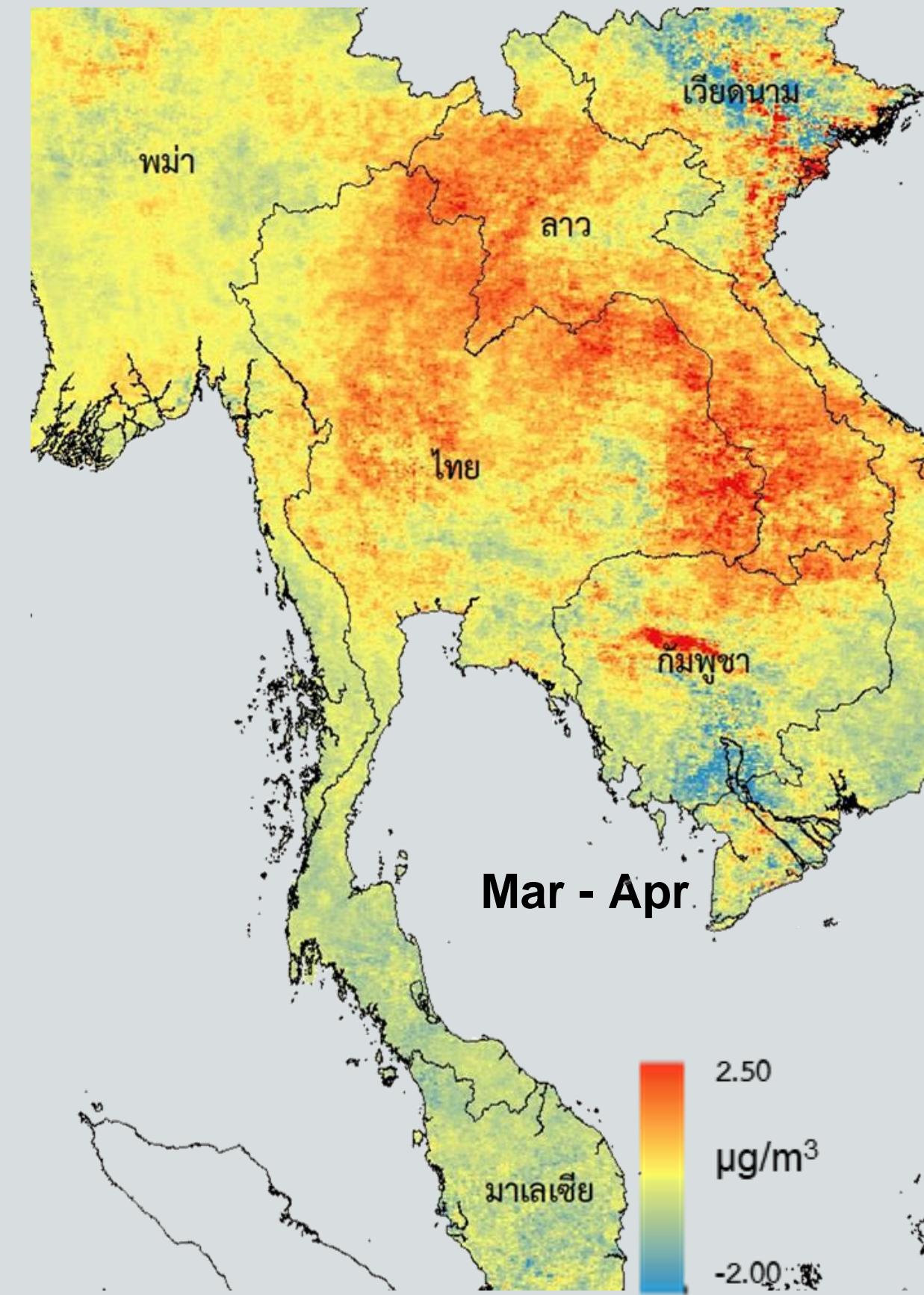
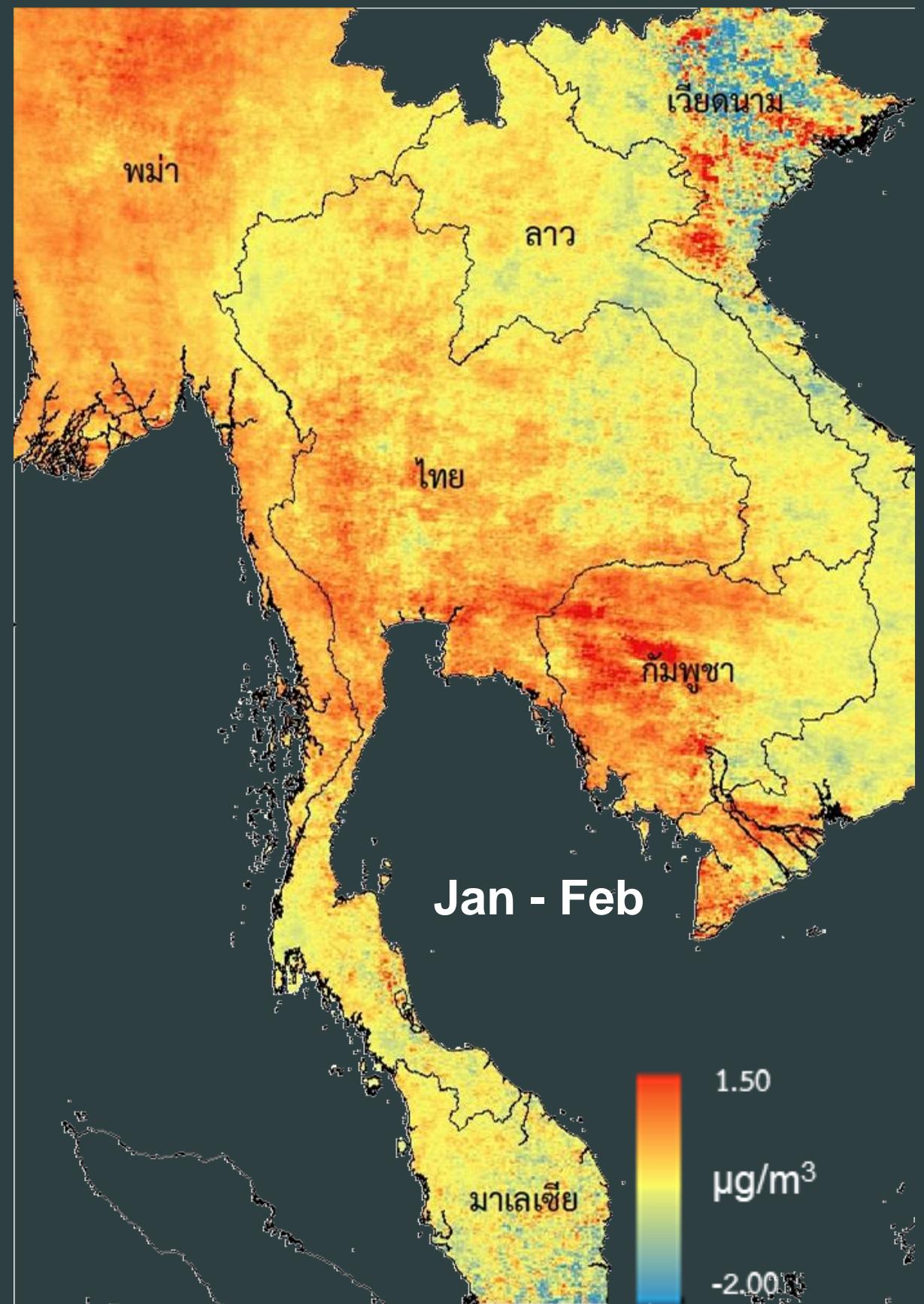
# The monthly average of PM2.5: 2002 - 2020



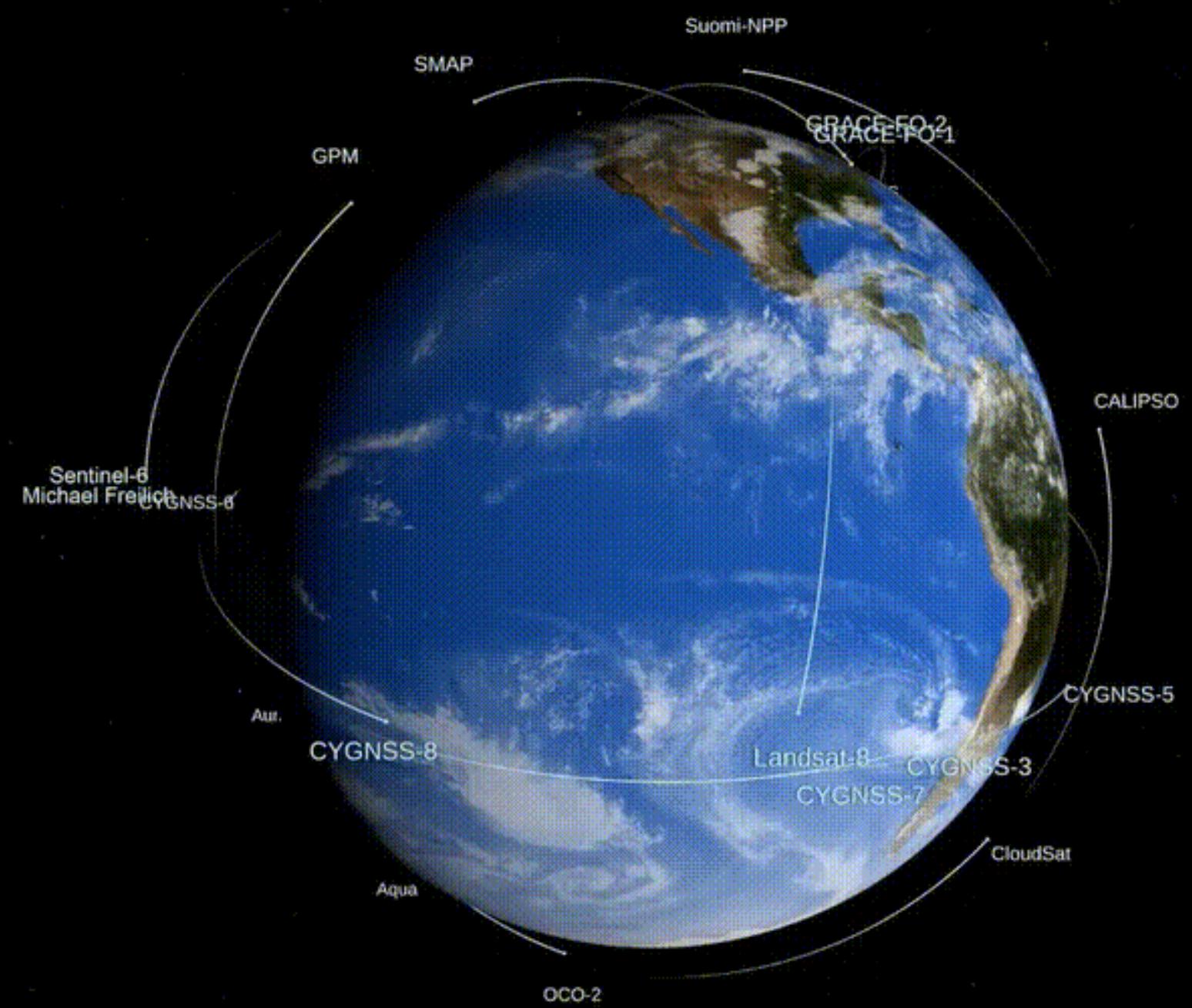
# The monthly average of PM2.5: 2002 - 2020



# The trend of PM2.5 concentration: 2002 - 2020



# Satellite and PM2.5 Monitoring/Controlling/Resolving support

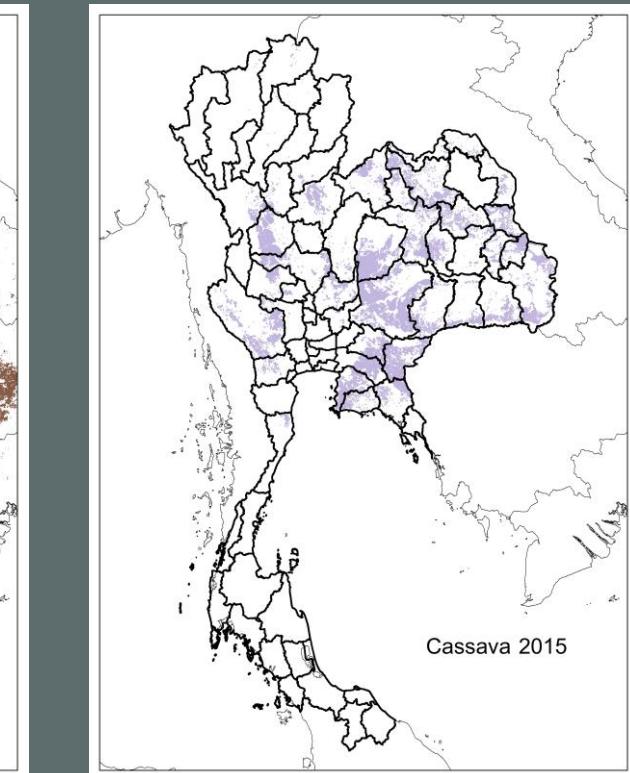
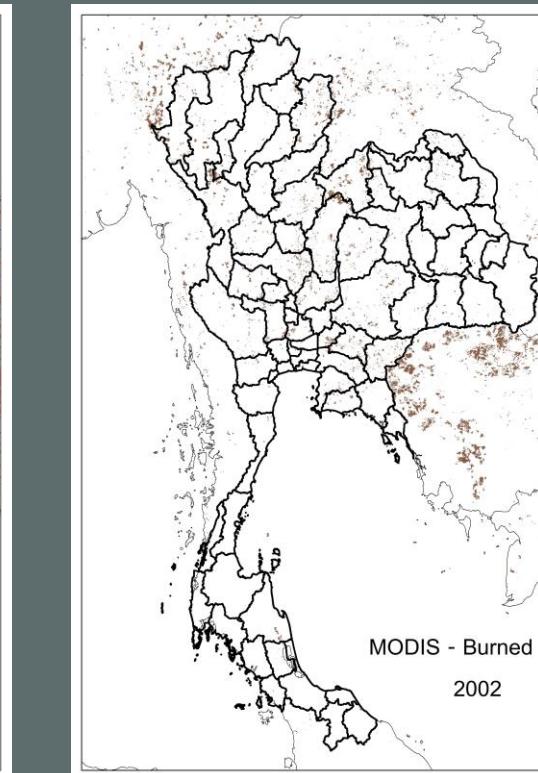
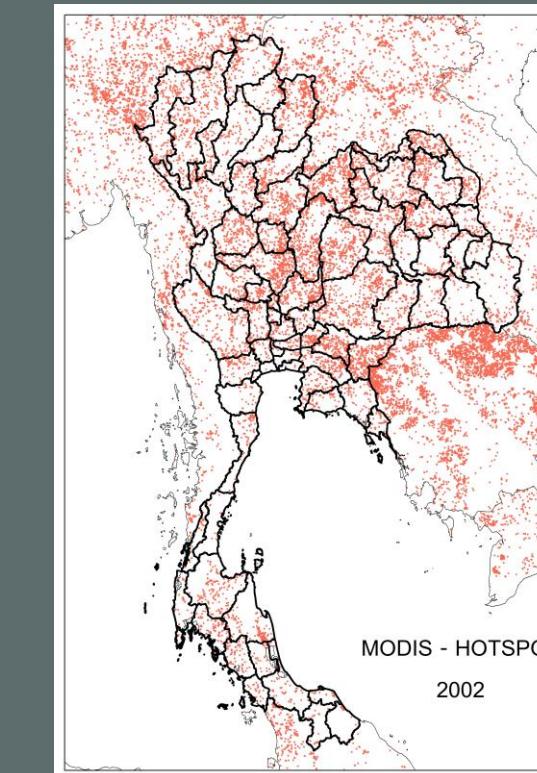
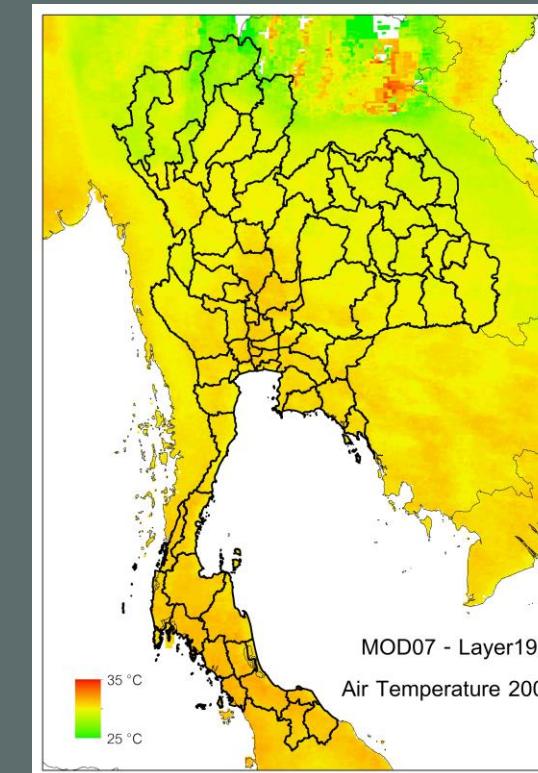
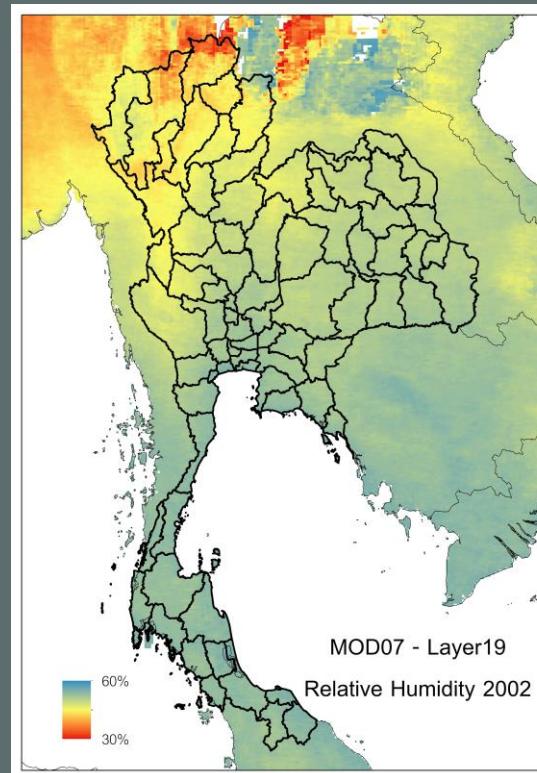
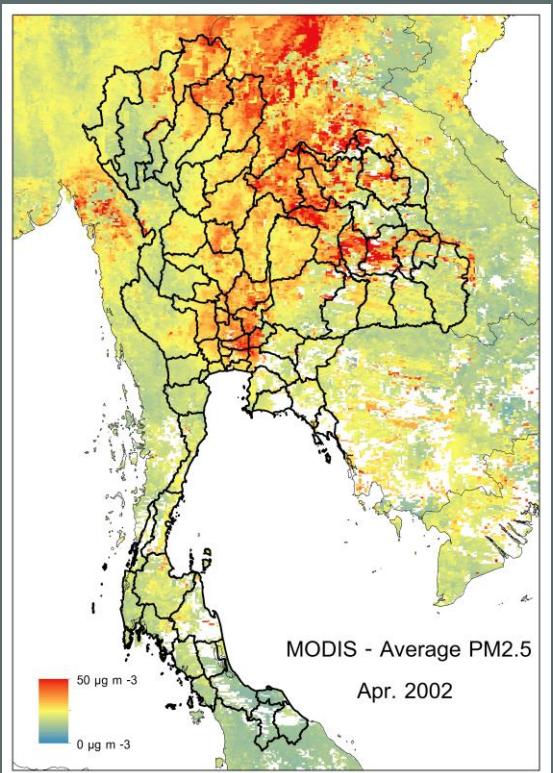


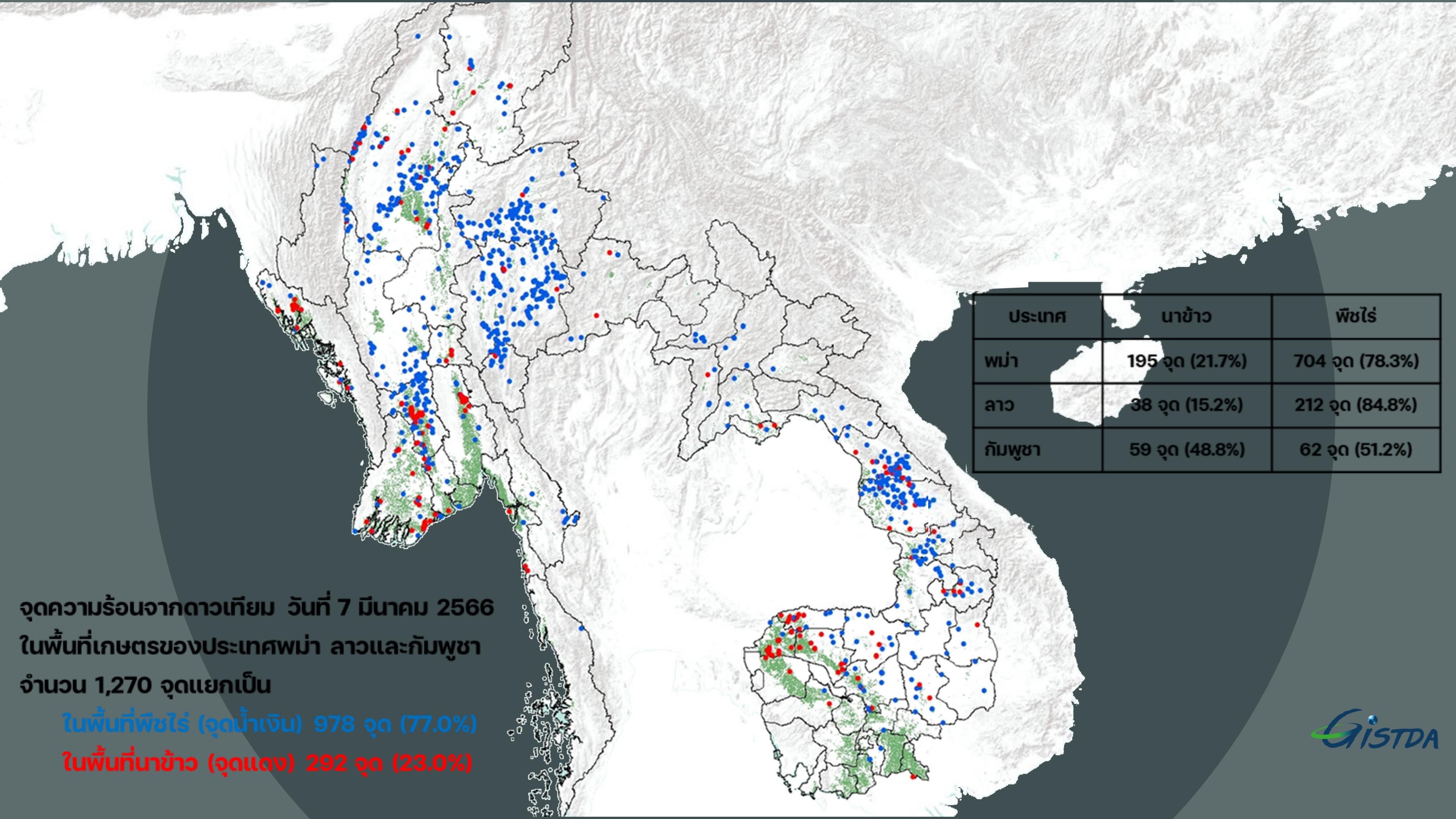
The rise/role of  
Satellite Remote Sensing

Excellent Spatial and Temporal  
Coverage

Allowing better: Monitoring  
Mapping  
Modelling  
Managing

# Satellite and PM2.5 Monitoring/Controlling/Resolving support





## Upper-air Atmosphere



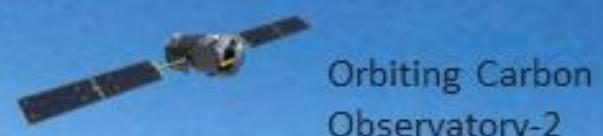
The Global Climate Observing System (GCOS) currently specifies 54 ECVs, of which about 60 percent can be addressed by **satellite data**.

## Surface Atmosphere



# Essential climate variables (ECVs)

## Atmospheric Composition



Orbiting Carbon Observatory-2



Greenhouse Gases Observing Satellite

## Anthroposphere



ECOsystem Spaceborne Thermal Radiometer Experiment on Space Station



## Biosphere



Soil Moisture and Ocean Salinity



## Hydrosphere



Surface Water and Ocean Topography



Topex/Poseidon and Jason-1,2, and-3 satellites



## Surface Ocean Physics



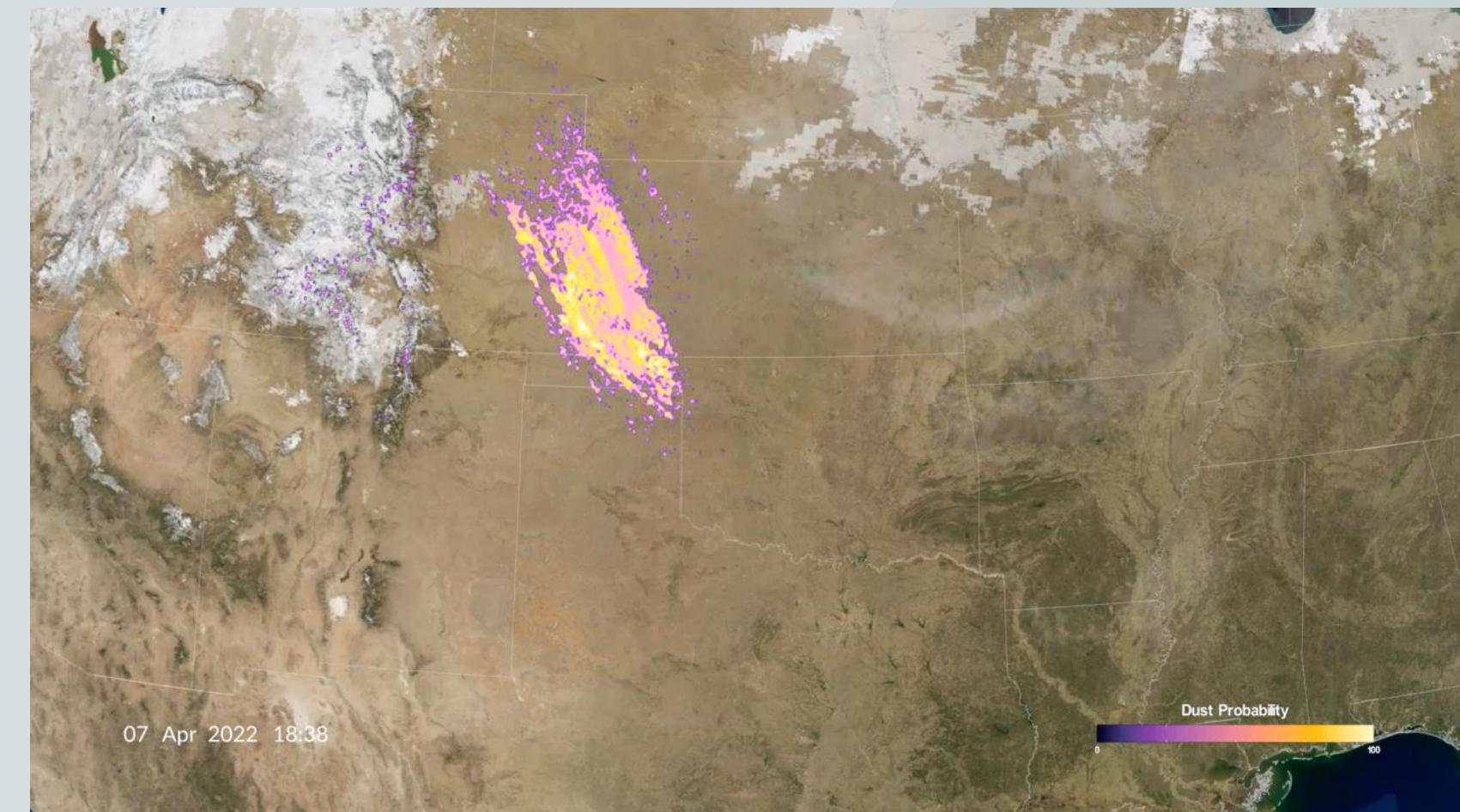
## Ocean Biogeochemistry

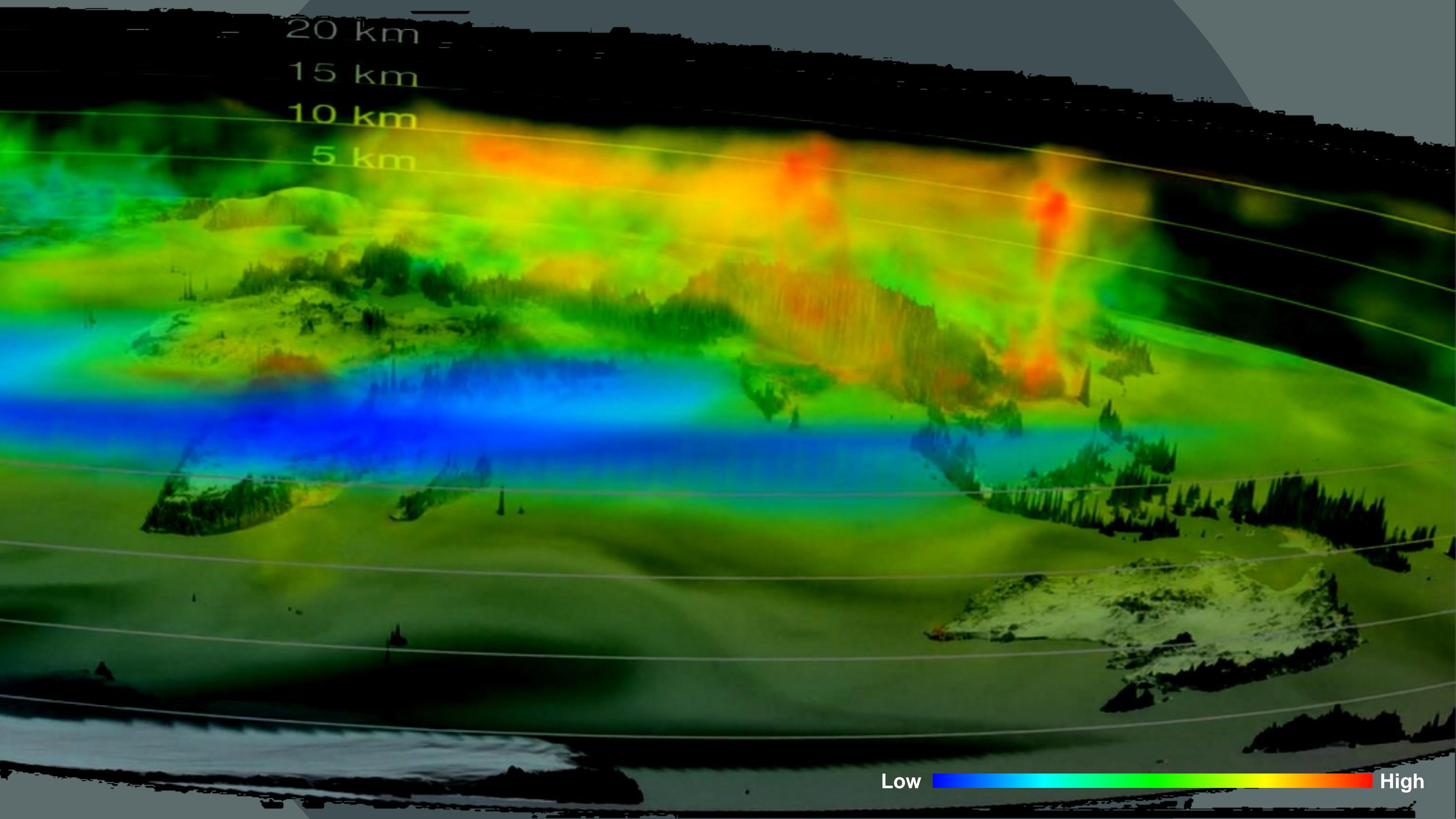


## Subsurface Ocean Physics



# Satellite and PM2.5 Monitoring/Controlling/Resolving support





Low

High

# Thank you!

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<https://www.facebook.com/gistda>

