NUS National University of Singapore

CRISP National University of Singapore

Remote Sensing Research for Sustainable Development



03 Sep 2025

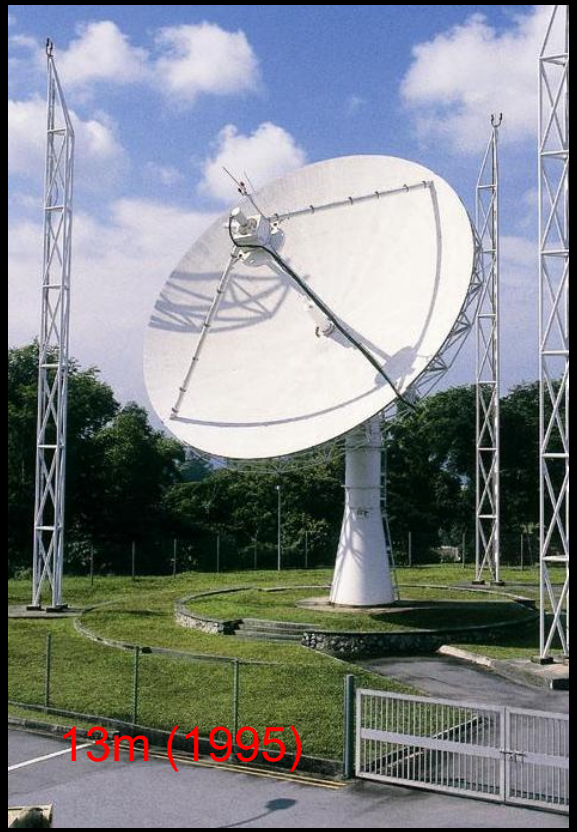
NUS National University of Singapore

CRISP National University of Singapore

Centre for Remote Imaging, Sensing and Processing (CRISP) - started in late 1992

Initial establishment funding from Agency for Science, Technology and Research (A*STAR), hosted in the National University of Singapore (NUS)

CRISP S/X Tracking Antennas



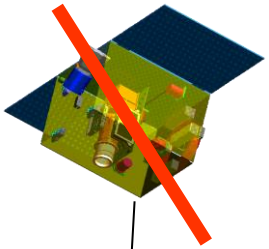




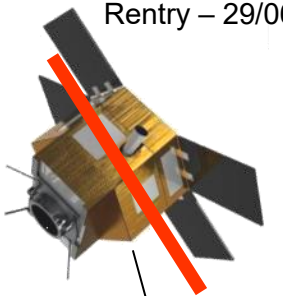


Singapore's Major Earth Observation Satellites

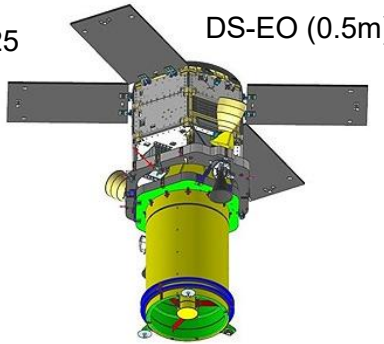
XSAT (10m)
Decomissioned



TeLEOS-1 (1m)
Rentry – 29/06/25



DS-EO (0.5m)



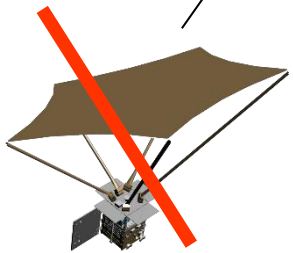
ELITE (Vleo, 0.5m)



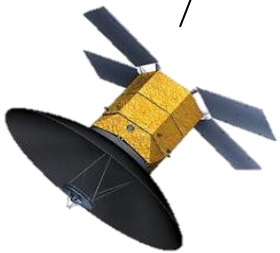
OPTICAL

2011 2015 2022 2023 2026 - 2027

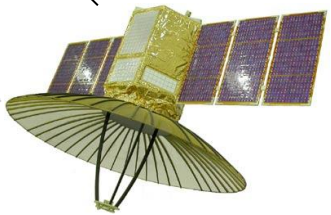
SAR



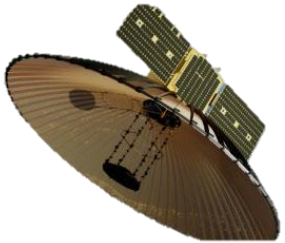
NeuSAR (1m)
Reentry – 01/06/25



TeLEOS-2 (<1m)

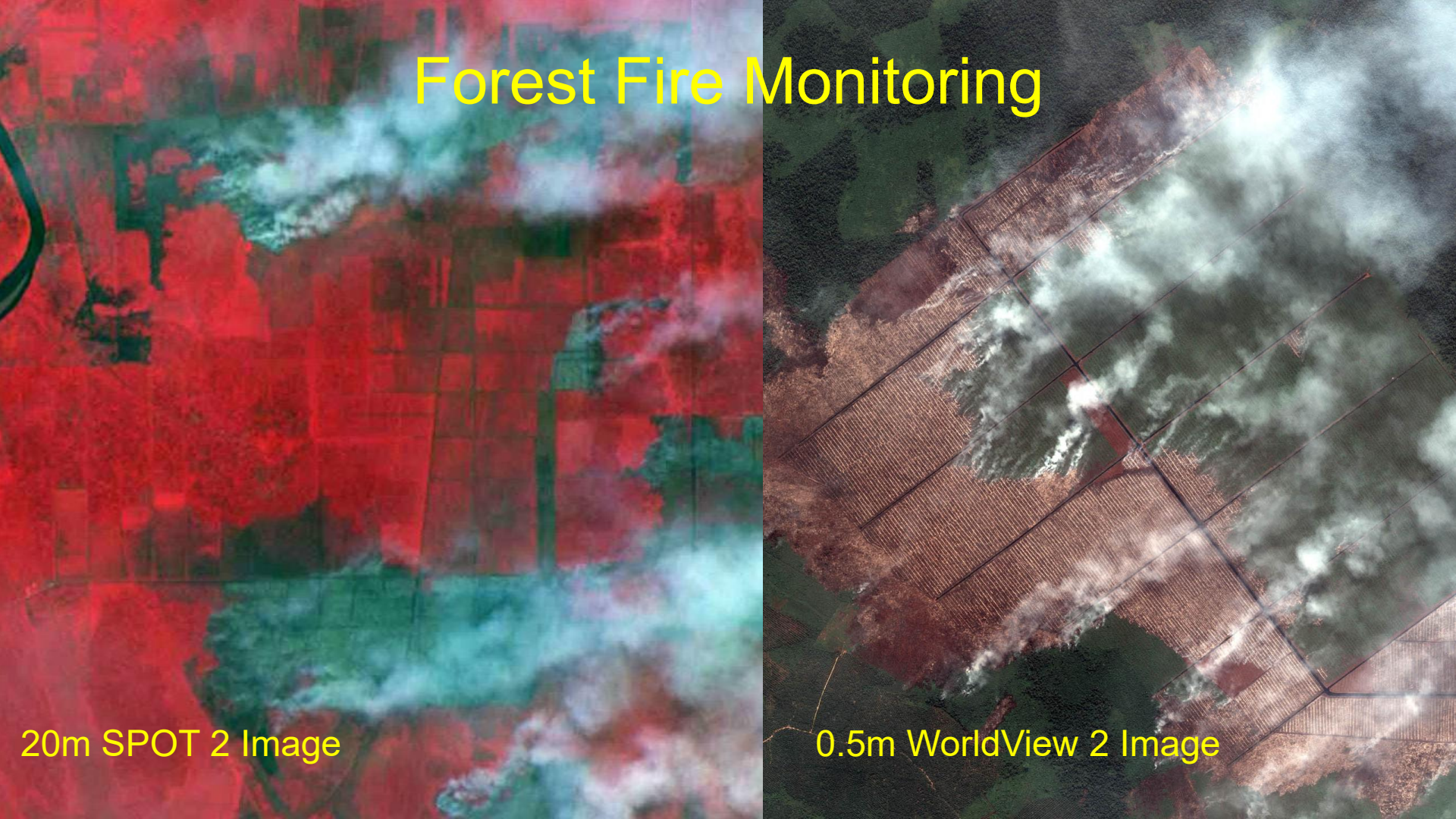


DS-SAR (<1m)



NeuSAR2 (<1m)

Forest Fire Monitoring



20m SPOT 2 Image

0.5m WorldView 2 Image

Measurements, characterization, monitoring and modeling of aerosols properties and transport using satellite data and ground instruments

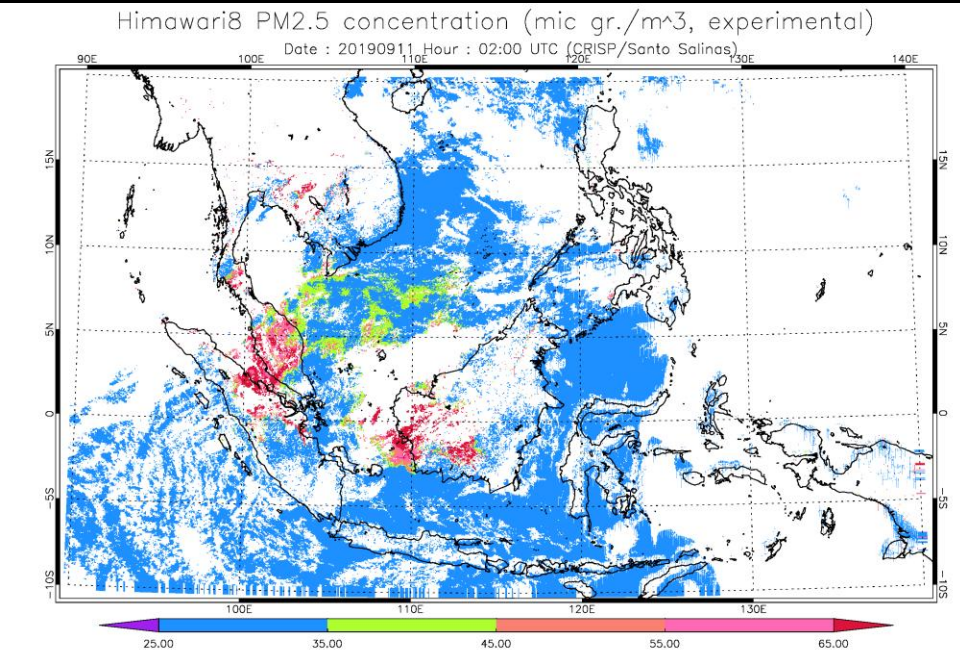

Micropulse Lidar (MPL)


Radiometers

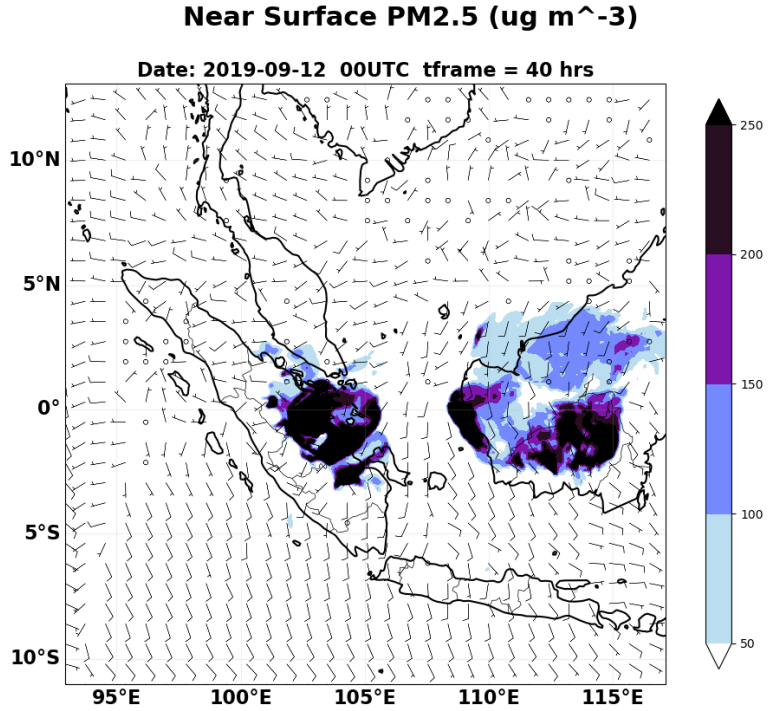

Sun photometer


Pandora spectrometer and AERONET CIMEL Sun-photometer working in tandem at NUS

Regional Air Quality Monitoring and Forecasting

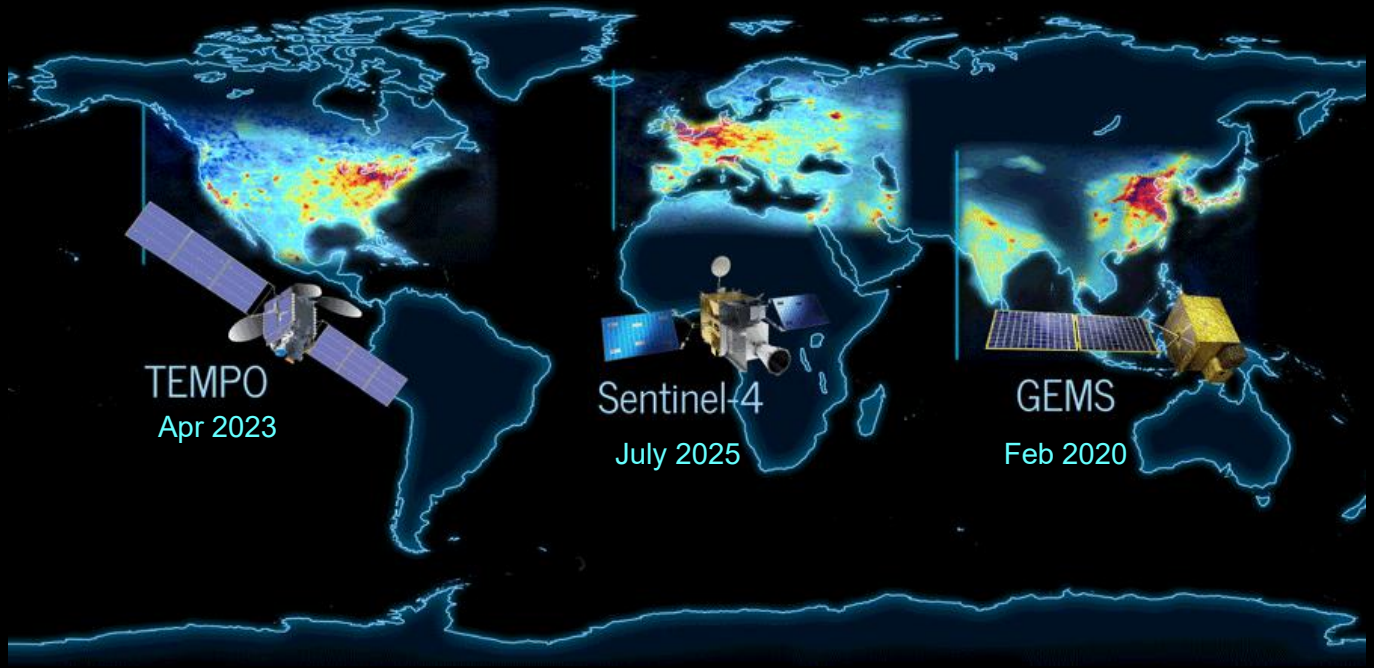


Regional map of PM2.5 based on Himawari8 Aerosol Data Product (11 Sept 2019 02:00 UTC)



WRF-Chem (v.3,6) simulation of regional aerosol dispersion and transport during the 2019 smoke event. Model initialisation at 12 Sept 2019 00 UTC. Snapshot 40 hrs after initialisation

Geostationary Environmental Monitoring Spectrometer (GEMS) and Pandora Asia Network (PAN)

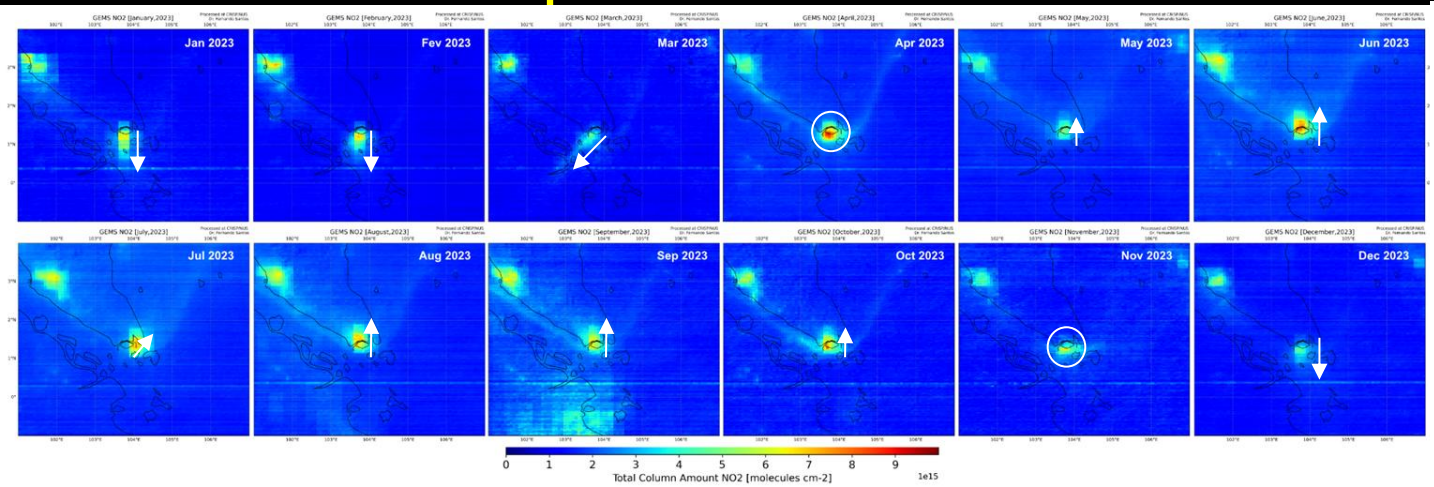


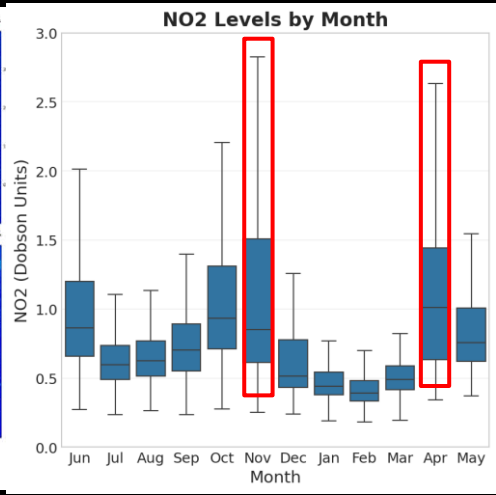
The UV-Visible hyper-spectrometer measures atmospheric composition and other climate forcers such as SO2, NO2, O3, formaldehyde and aerosols.

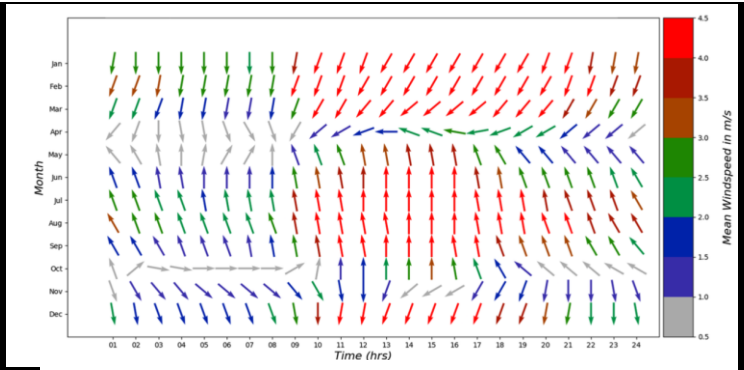
Pandora spectrometer instrument is used to measure columnar amounts of trace gases in the atmosphere.



GEMS composite of NO2 (Jan - Dec 2023): Shift in the wind pattern.







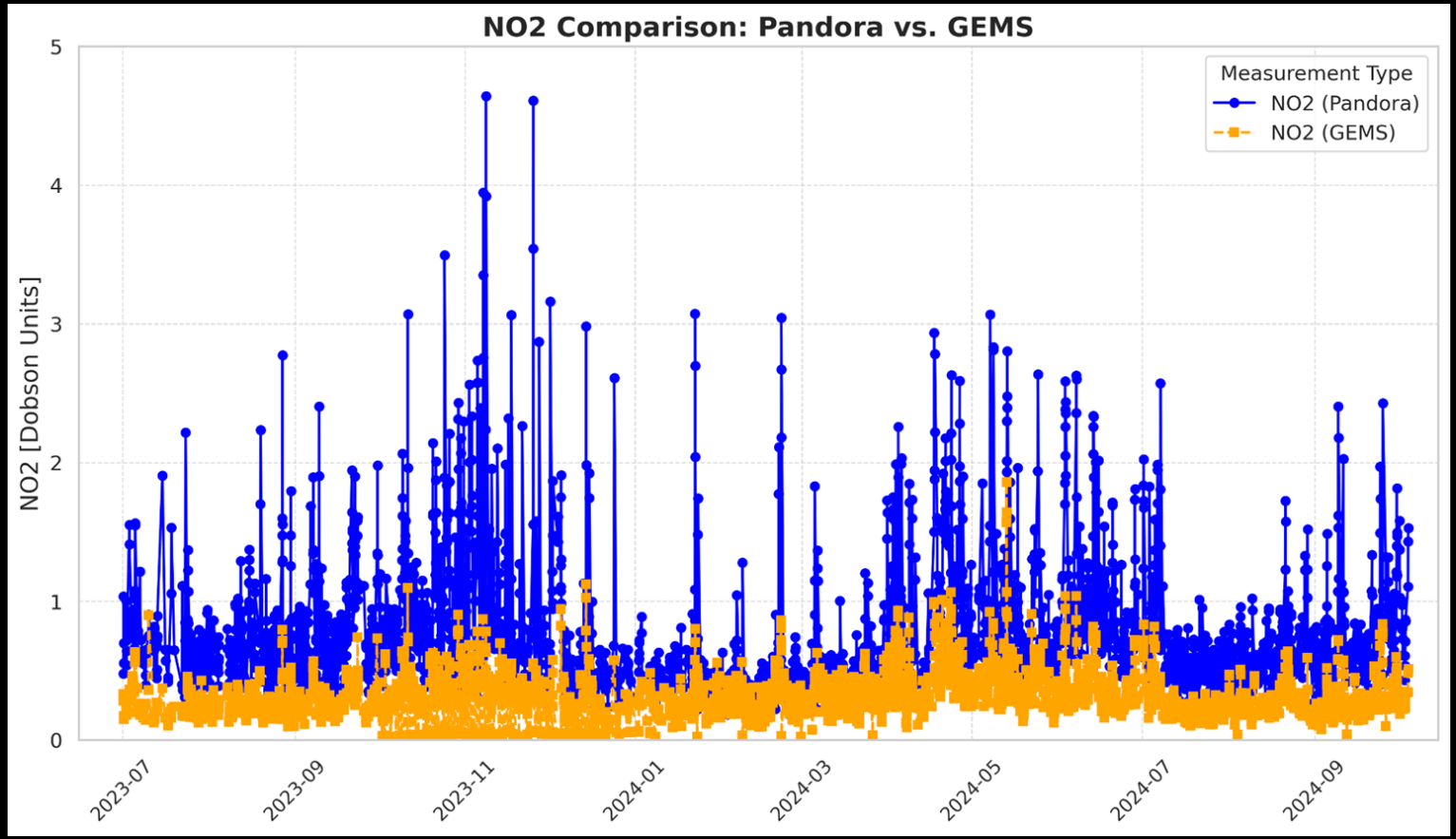
Hourly variation of surface wind speed (m/s) and direction for each month (1991-2020 average). Data from Changi Climate Station.

Impact of Meteorology on Singapore Air Pollution Using Pandora Spectrometer and GEMS Satellite Observations

A synergistic approach combining GEMS satellite observations with Pandora ground-based data was used to investigate the unusually high levels of NO_2, SO_2, and HCHO observed in Singapore (November 2023 and April 2024).

Meteorological conditions likely supported the persistence of stagnant air masses, allowing pollutants to accumulate near the surface.

April and November, highest conc. SO_2, NO_2 and HCHO plume is visible (confirmed by Pandora measurements).

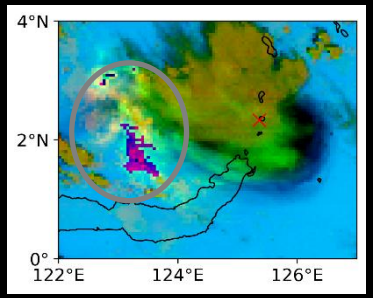


GEMS observation underestimates the NO2 Total Column when compared to Pandora.

Satellite based detection and Characterization of Volcanic Ash Plumes

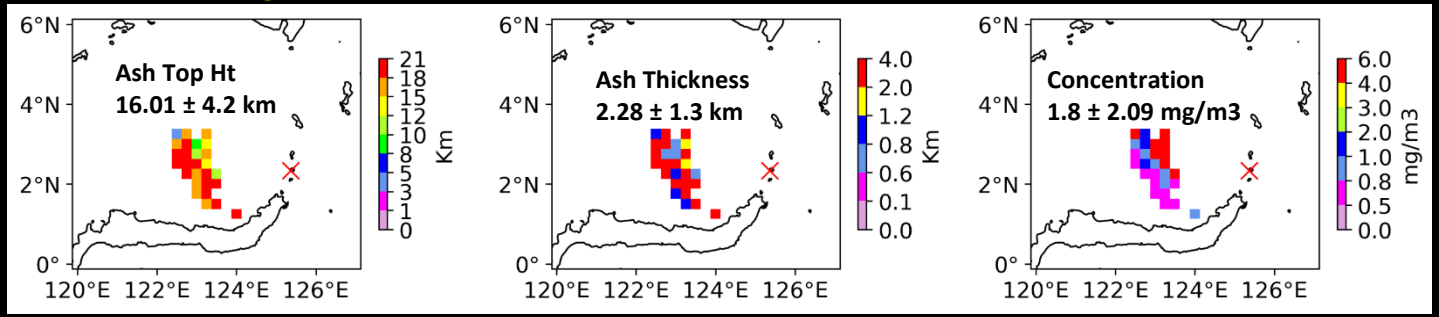
Quantification of volcanic column eruption parameters

Identify volcanic ash cloud using Himawari satellite data → Simulate ash cloud using RTTOV forward model at different ash conditions → Inversion method to estimate ash eruption parameter

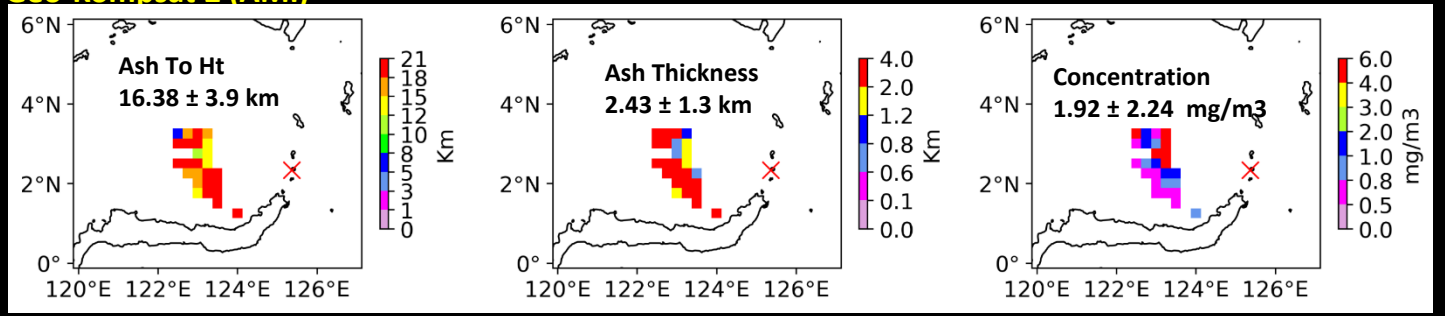


Ruang Volcanic eruption on 17th April, 2024

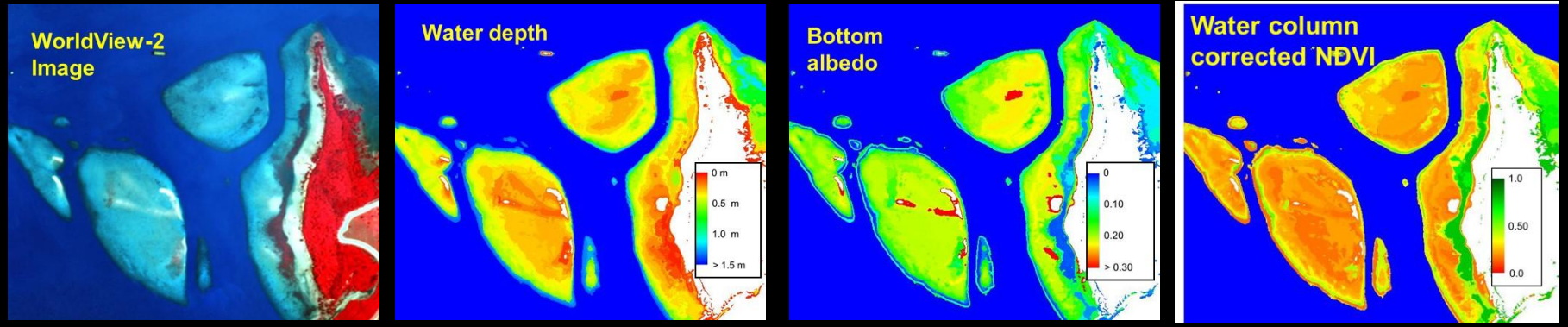
Himawari-8/9 Imager (AHI)



Geo-Kompsat 2 (AMI)



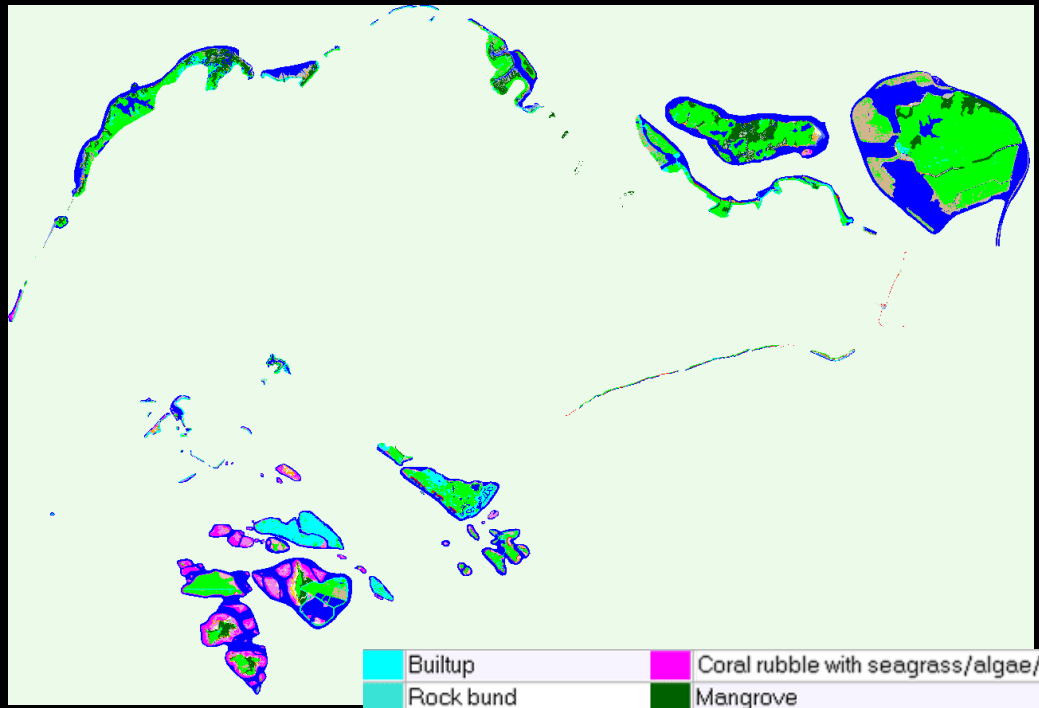
Retrieval of water depth, sea bottom albedo and water column corrected NDVI from satellite images



A physics-based model is used to derive water depth and sea bottom albedo from reflectance measured by a satellite sensor.

All required parameters are derived from the image. No empirical data is needed.

Singapore Coastal Habitats Map



Builtup	Coral rubble with seagrass/algae/coral	Openland
Rock bund	Mangrove	Reef slope
Sandflat	Seagrass medow	Water
Mudflat	Sandflat or mudflat with seagrass/algae	Rocky shore with algae
Lagoon	Other vegetation	Small patch reef
Sandy beach	Sand/rubble	Shallow water

Coastal habitat mapping – Pulau Semakau



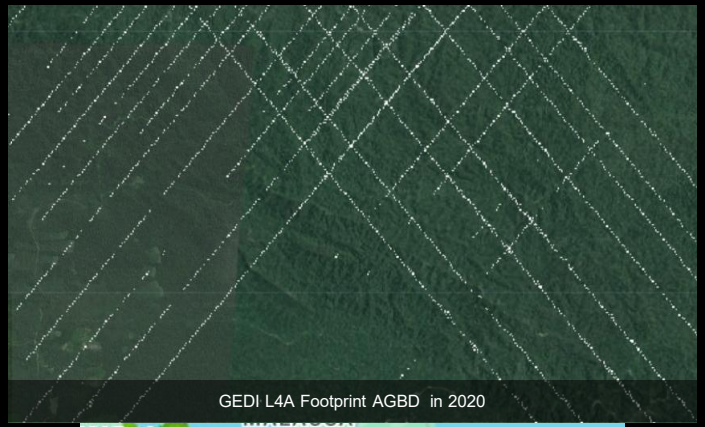






	Builtup		Coral rubble with seagrass/algae/coral		Openland
	Rock bund		Mangrove		Reef slope
	Sandflat		Seagrass medow		Water
	Mudflat		Sandflat or mudflat with seagrass/algae		Rocky shore with algae
	Lagoon		Other vegetation		Small patch reef
	Sandy beach		Sand/rubble		Shallow water

Above Ground Biomass (AGB) Estimation for Peatland region in Sumatra, Indonesia



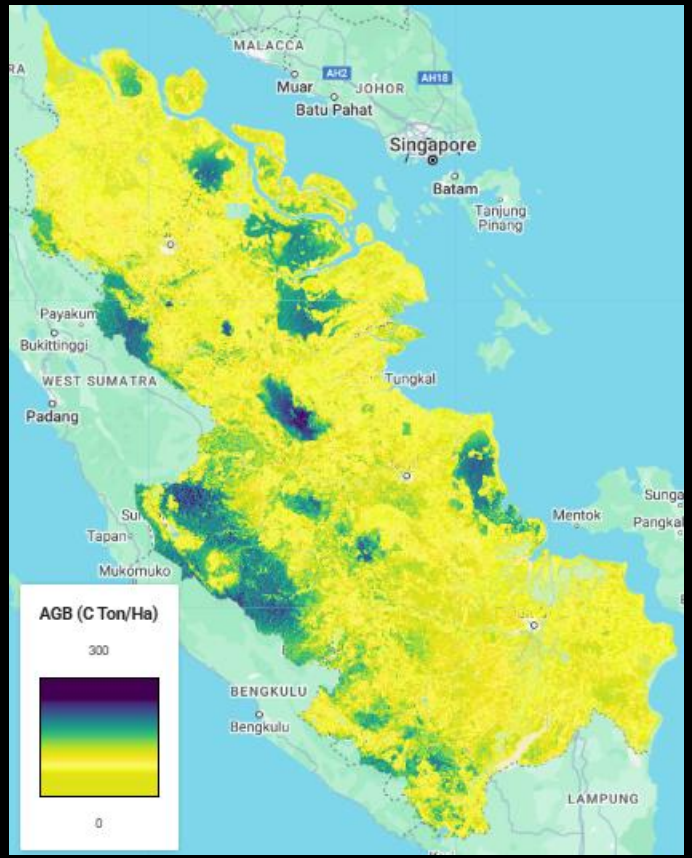
GEDI L4A Footprint AGBD in 2020



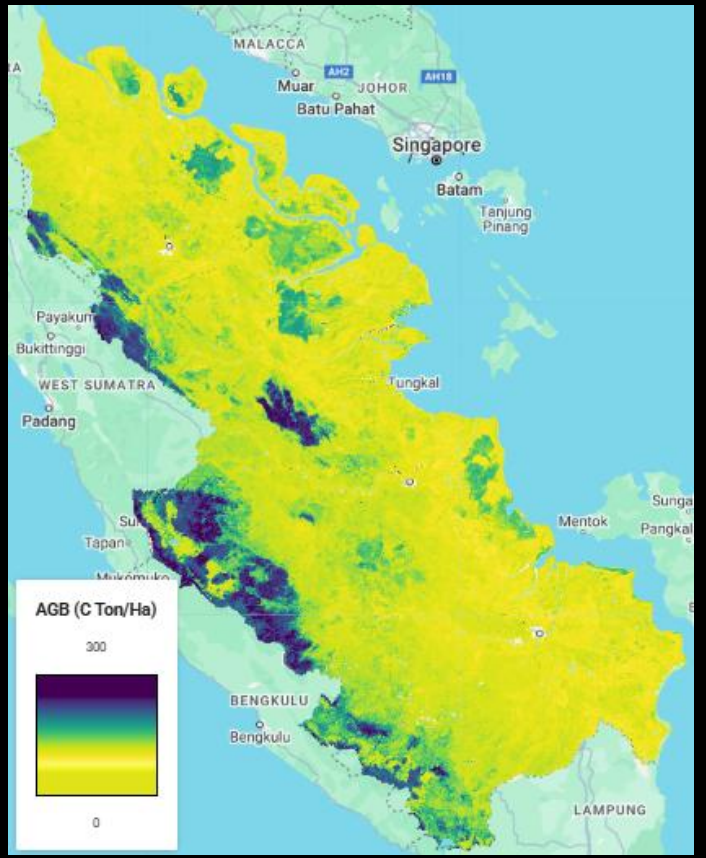
Sentinel-2 Composite in 2020



Comparison with ESA CCI Global Forest AGB Dataset



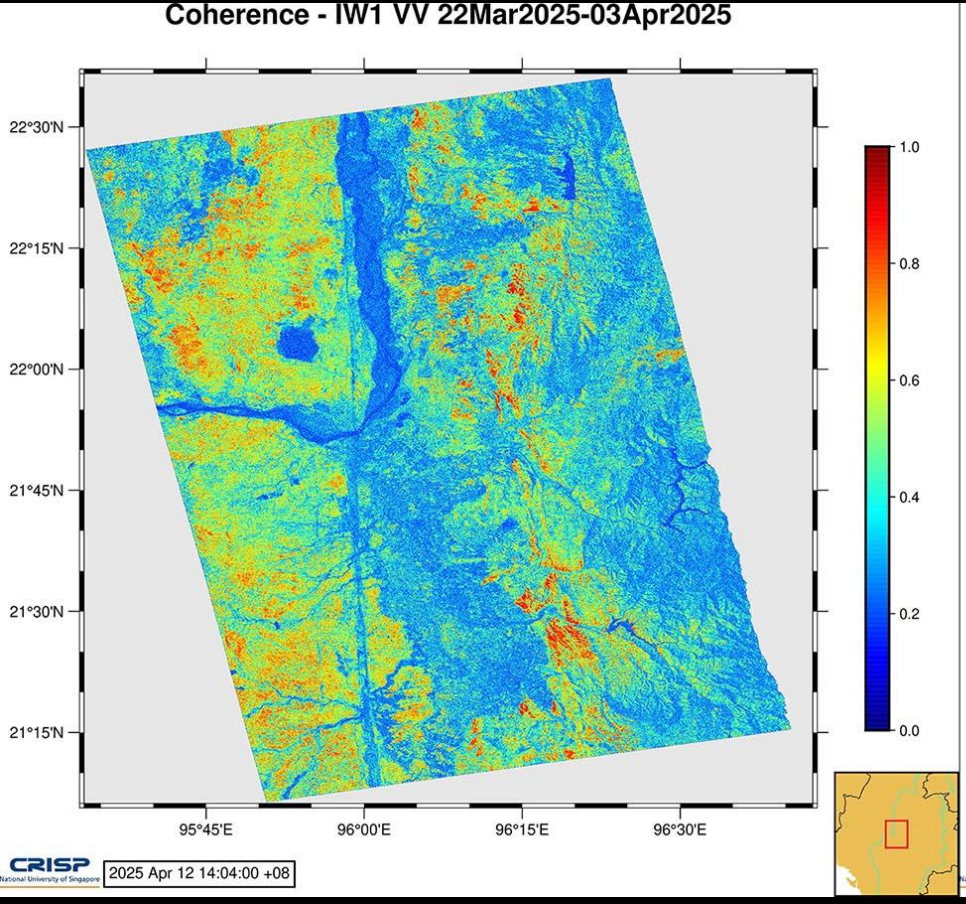
ESA CCI AGBD Map (Ref: Santoro, M.; Cartus, O. (2024): ESA Biomass Climate Change.)

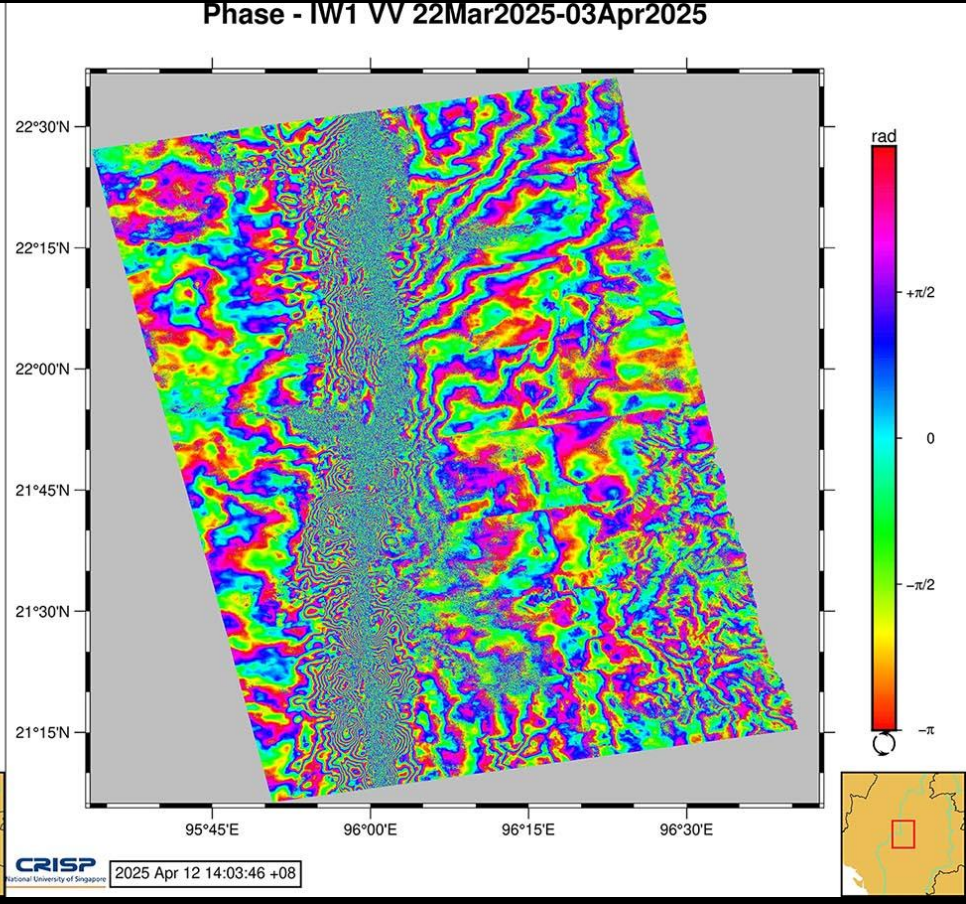


S2+GEDI Predicted AGBD Map

InSAR Monitoring of Myanmar Earthquake

(28-Mar-25)



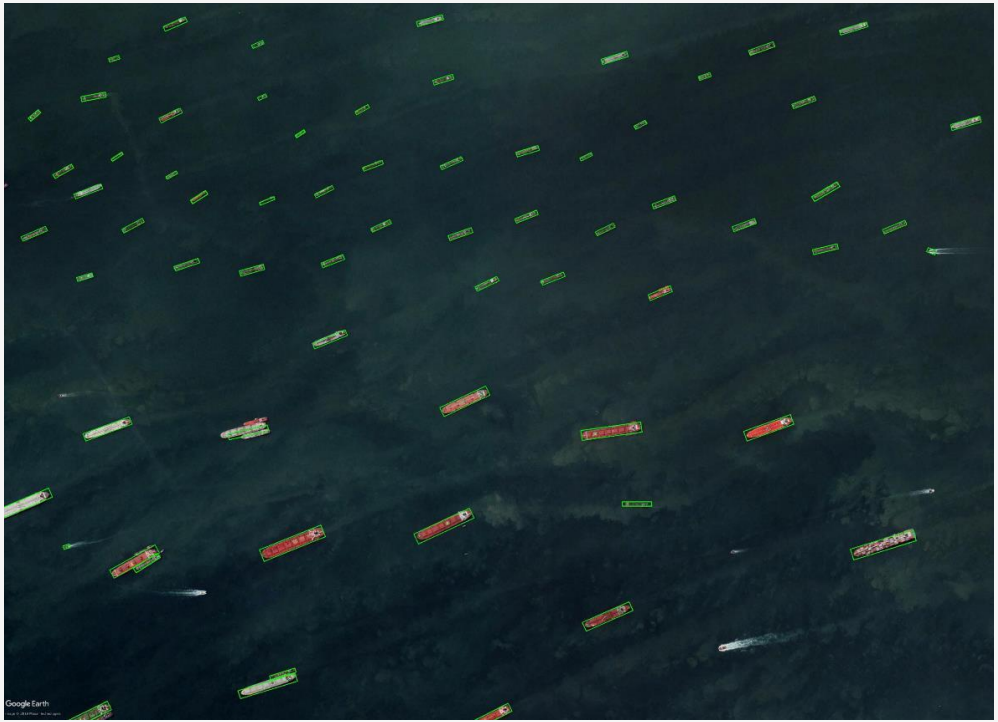


AI -- Airplane Detection using Optical Images

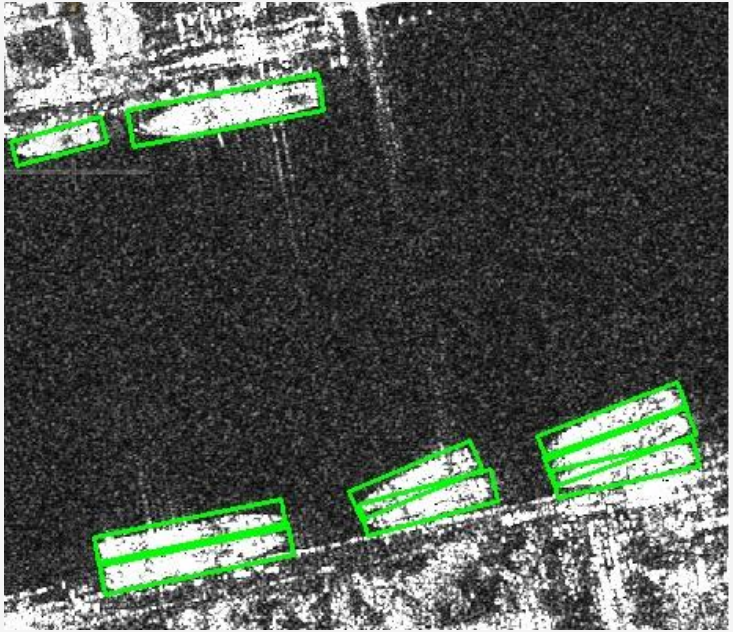




AI -- Ship Detection

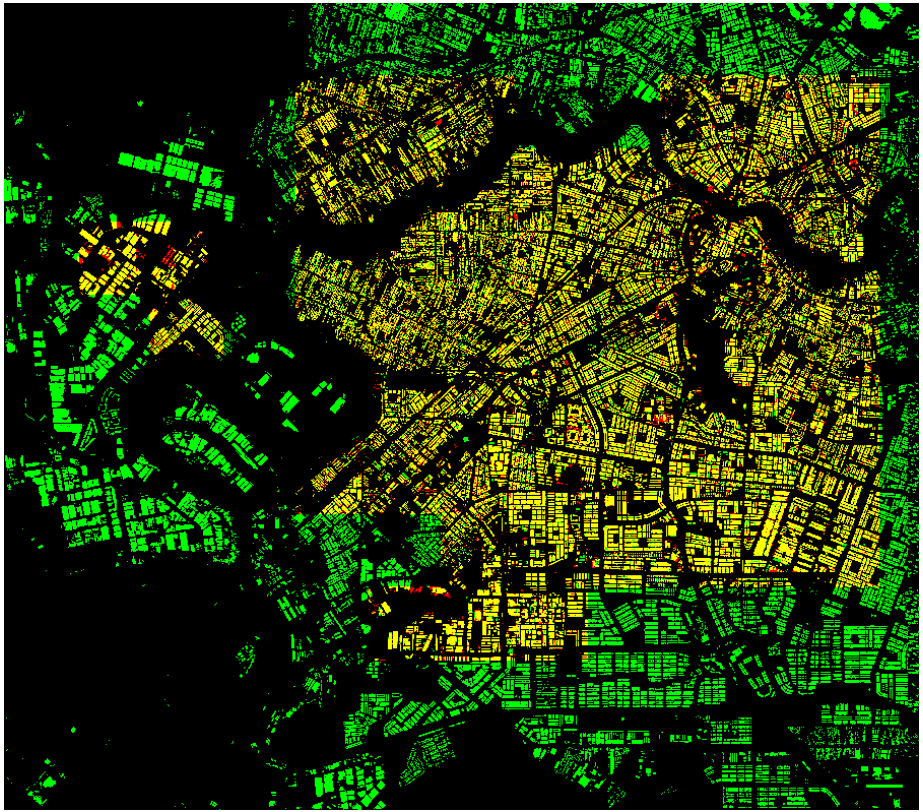


In Optical Images



In SAR Images

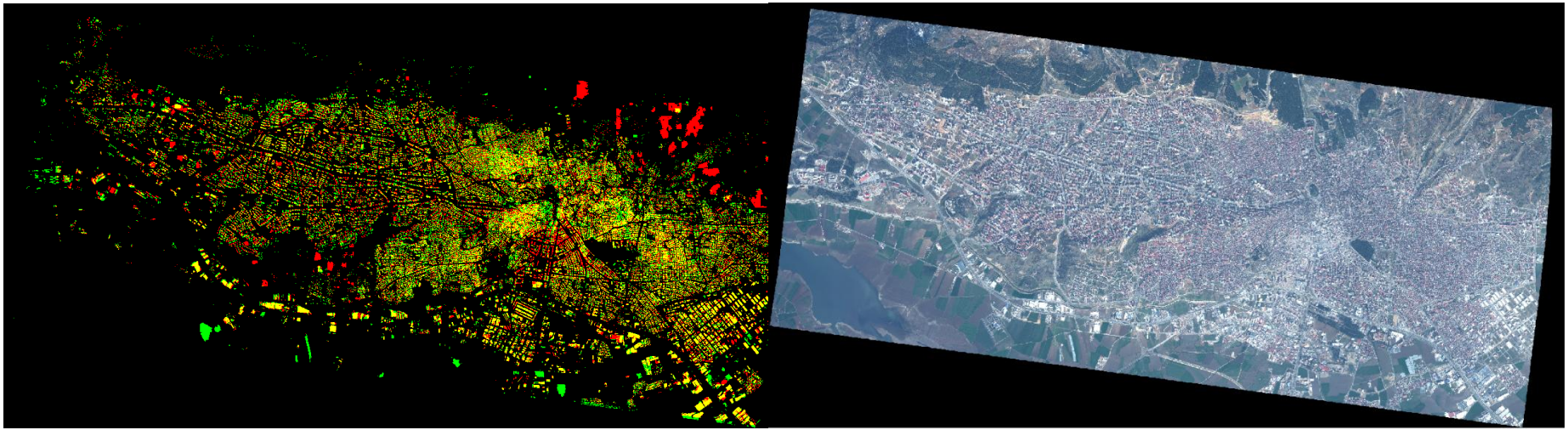
Predicted Building Mask (PortKlang)





2 bands: Red: Bunch mask, Grn: Pred mask
Yellow: common detected area, Red: buildings annotated by Bunch are undetected, Grn: extra buildings detected by model

Predicted Building Mask (Turkey before and after earthquake)



Mask of 2 bands: building mask before earthquake is shown in Red, while mask after earthquake is in Green

Yellow: common detected buildings
Red: buildings destroyed or undetected after earthquake
Green: more buildings detected by model

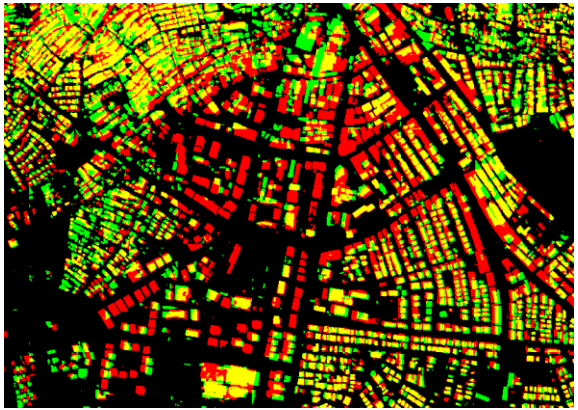
Site 1 (Turkey before and after earthquake)



WV02 on 2022-07-26 (before)



WV02 2023-02-22 (after)



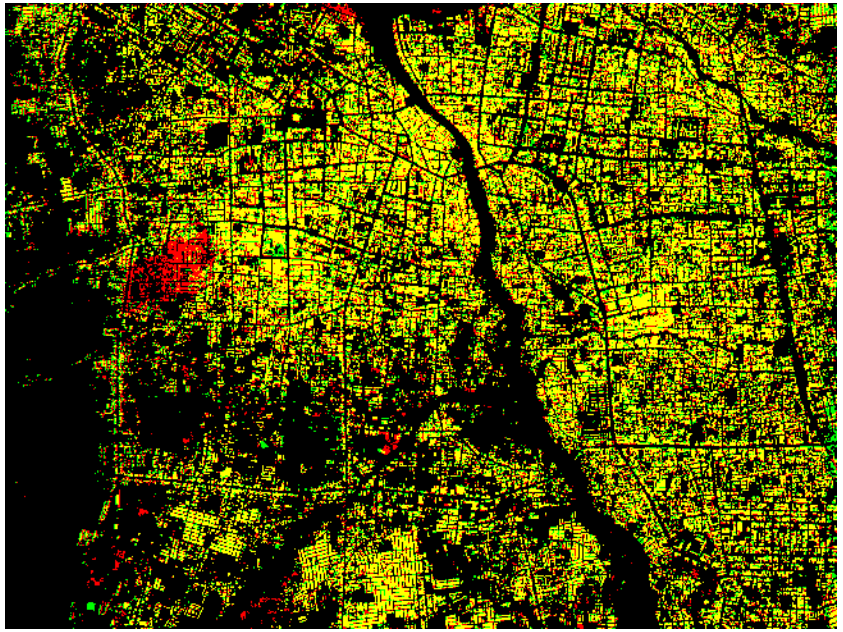
Building masks of before in red, after in green

Yellow: common detected buildings
Red: buildings destroyed or undetected after earthquake
Green: more buildings detected by model after earthquake (more buildings built during the time period)

The disparity is due to the difference between the azimuth and elevation angles of two satellite images.

Predicted Building Mask (Palu before and after earthquake)





Mask of 2 bands: building mask before earthquake is shown in Red, while mask after earthquake is in Green

Yellow: common detected buildings
Red: buildings destroyed or undetected after earthquake
Green: more buildings detected by model

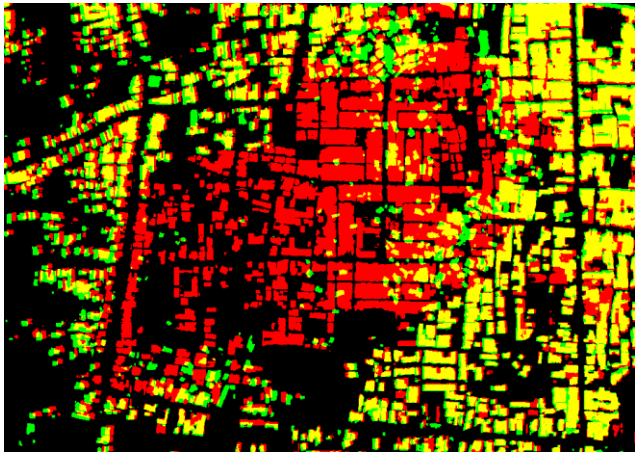
Site 1 (Palu before and after earthquake)



WV04 on 2018-05-25 (before)



WV03 2018-10-02
(after)



Building masks of before in red, after in green

Yellow: common detected buildings, unchanged buildings
Red: buildings destroyed or undetected after earthquake
Green: more buildings detected by model after earthquake

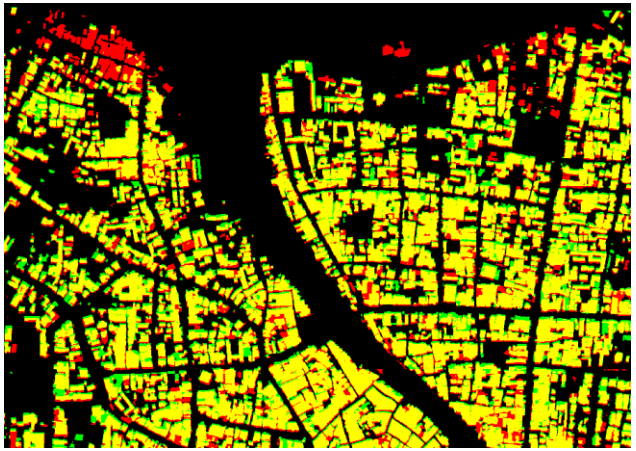
Site 2 (Palu before and after earthquake)



WV04 on 2018-05-25 (before)



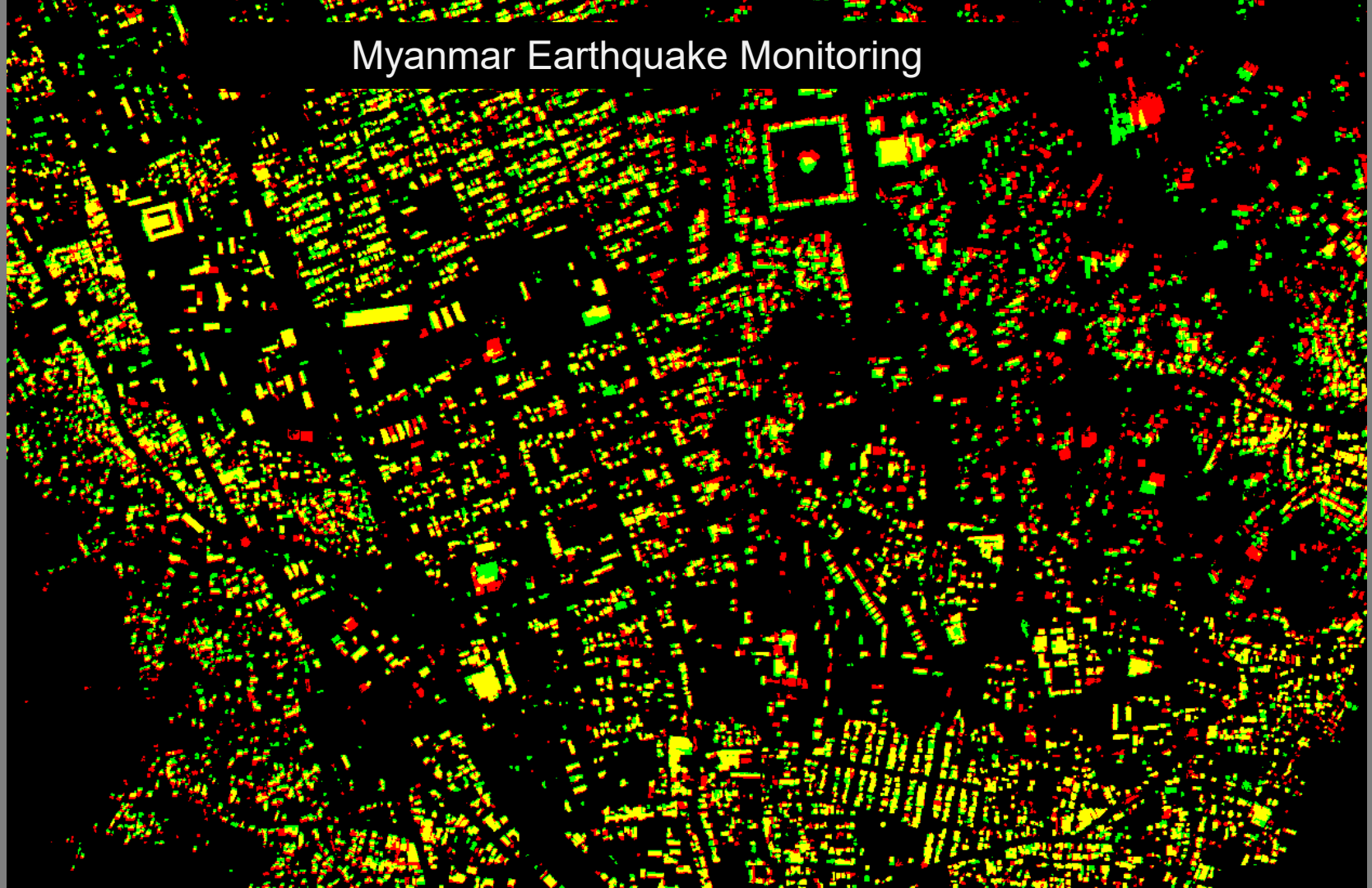
WV03 2018-10-02 (after)



Building masks of before in red, after in green

Yellow: common detected buildings
Red: buildings destroyed or undetected after earthquake
Green: more buildings detected by model after earthquake

Myanmar Earthquake Monitoring



Building Masks (red: pre, green: post)

Thank You

