ESA / NASA / JAXA Cooperation on COVID-19

*note electronic supplement is available

AC-VC-16

12 June 2020 at 13:32UT

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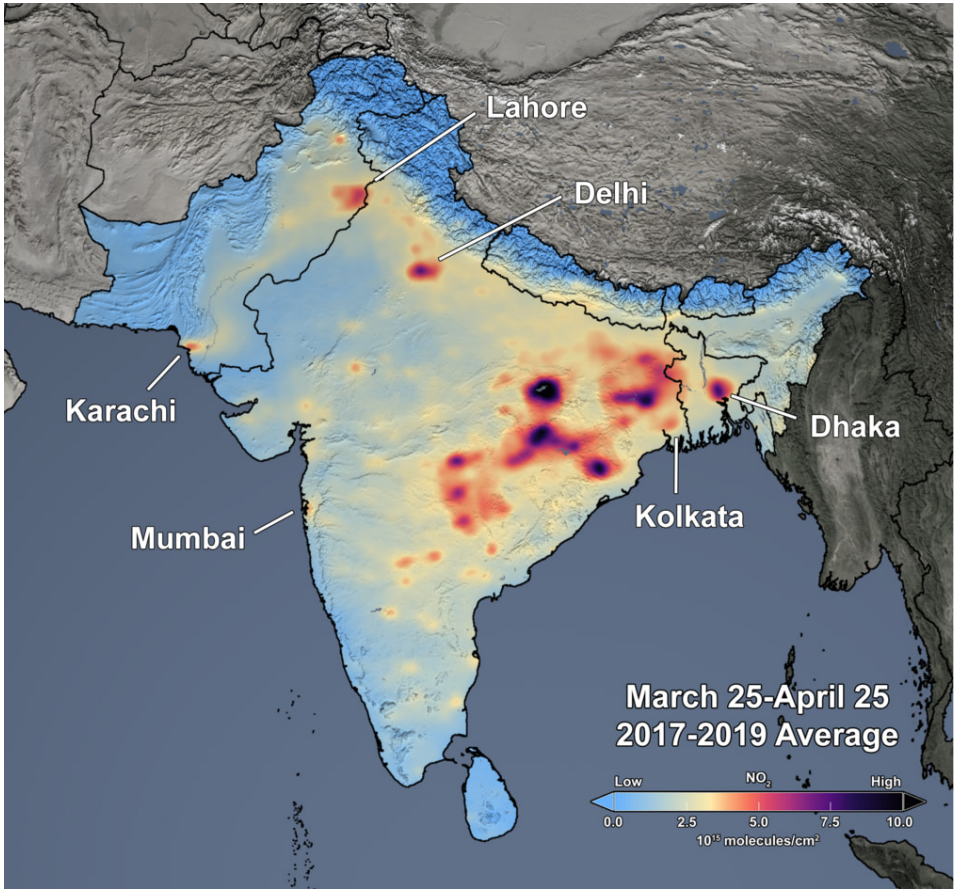
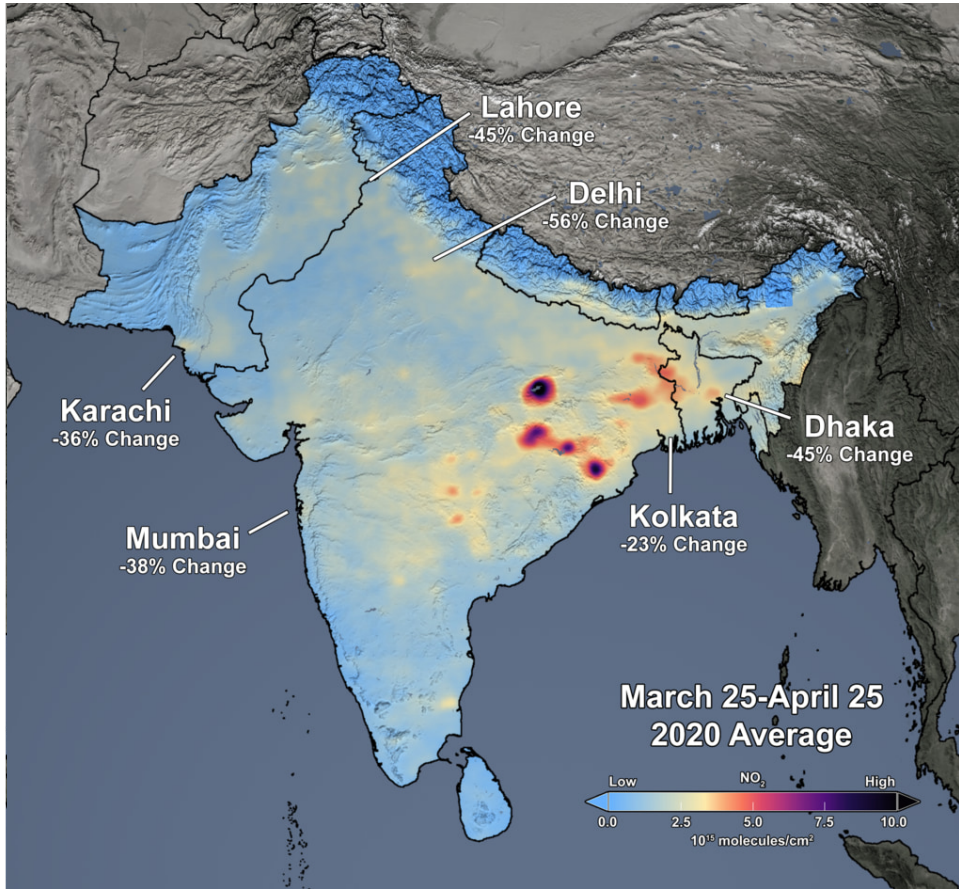
Kuze Akihiko – JAXA

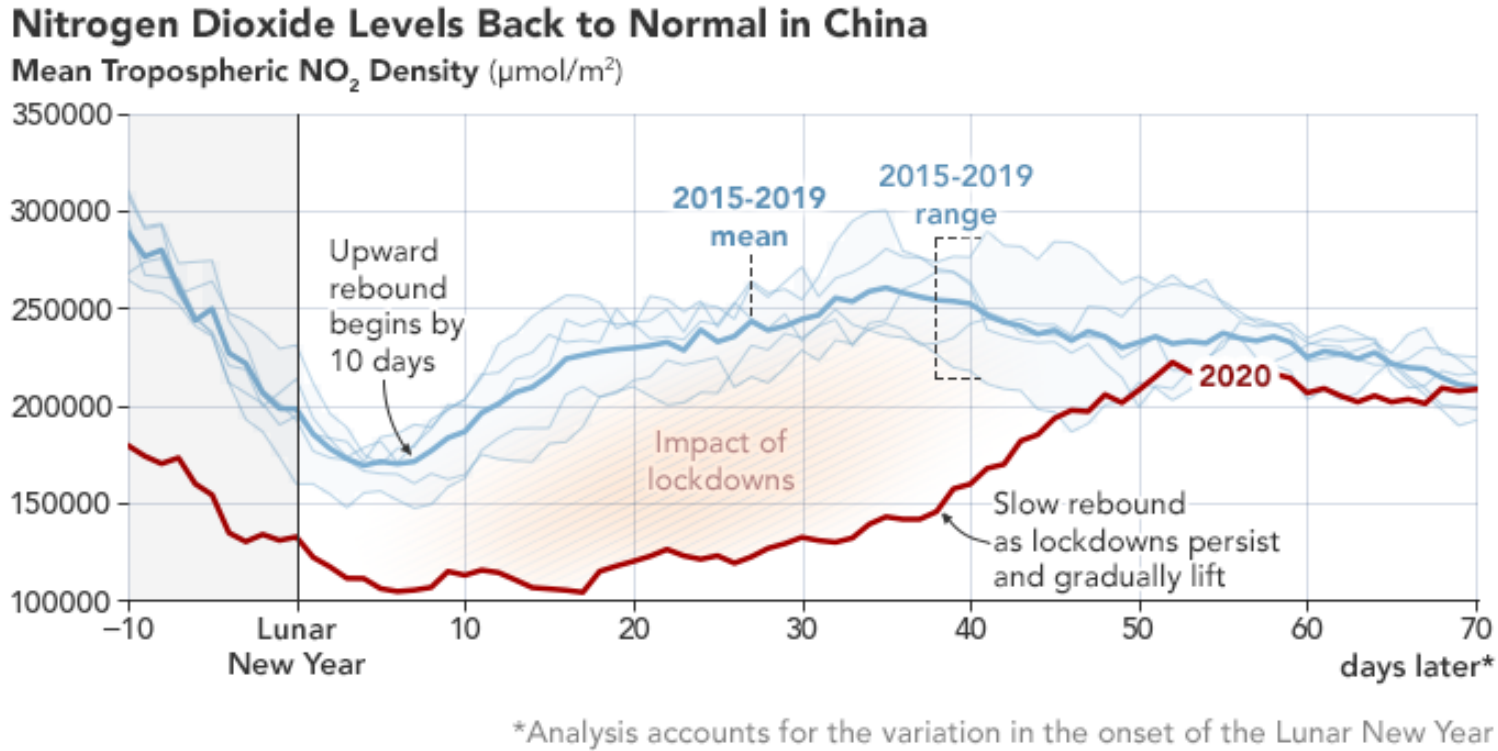
OMI NO_2 – India for 25 March to 25 April

https://airquality.gsfc.nasa.gov/news





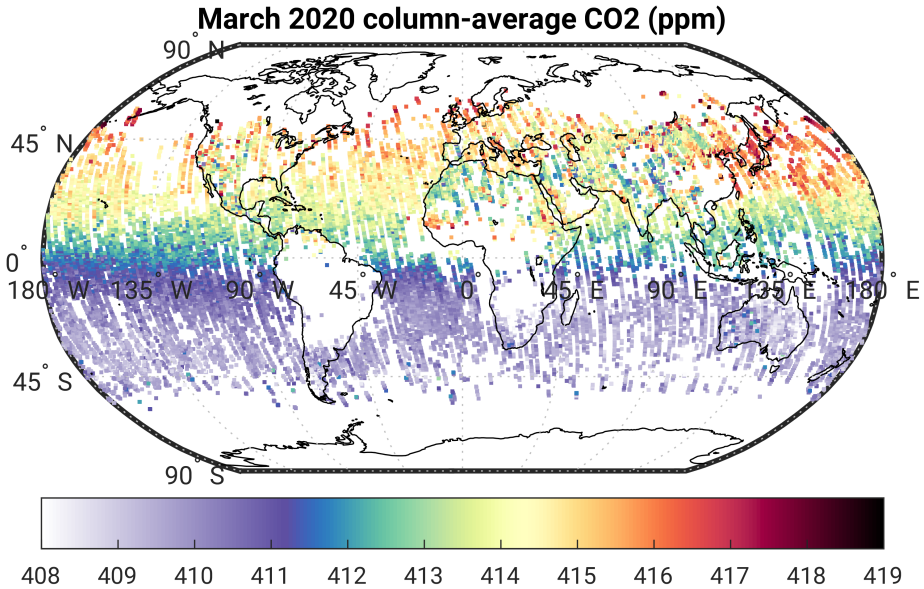
OMI NO_2 Time Series for China

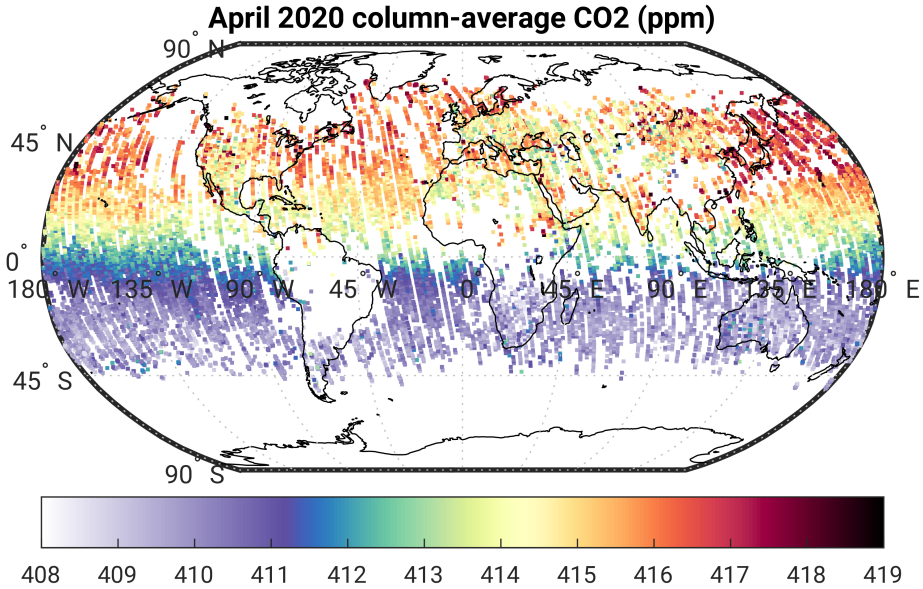


https://earthobservatory.nasa.gov/images/146741/nitrogen-dioxide-levels-rebound-in-china

The Orbiting Carbon Observatory 2 (OCO-2)

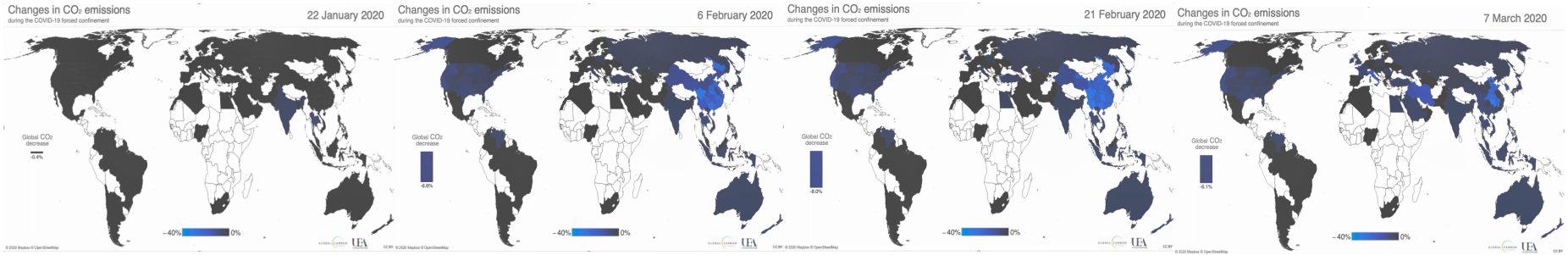
- Launched in 2014, flying in the A-Train
- Measures reflected sunlight in 3 NIR/SWIR bands
- 10 km wide swath, still a step change in coverage
- $\mathcal{O}$(0.5 ppm) precision and accuracy



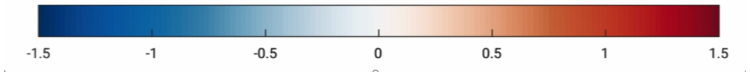


Comparisons of observed XCO_2 and emission changes

XCO_2 decreases seen over Europe, North America, and Asia are correlated with reported CO_2 emissions reductions



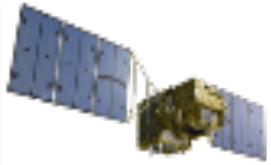
Atmospheric CO_2 differences

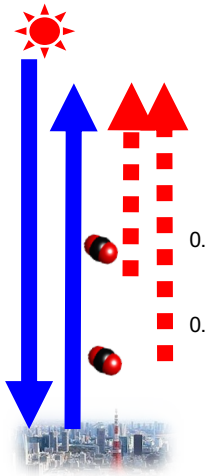


CO_2 Emissions Reductions

XCO_2 anomaly: XCO_2(LT) - XCO_2(UT_{avg}) from GOSAT 4 by 4 target observation

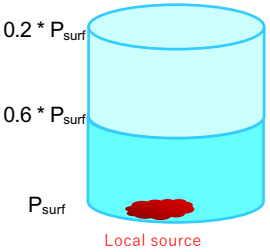
Partial column of lower troposphere (0-4 km)– Monthly-Area averaged upper troposphere (4-12km)





TANSO-FTS
2-layer product

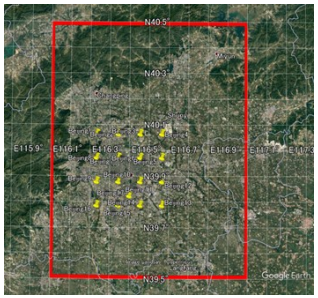
From Simultaneous measurements of SWIR Polarization and TIR



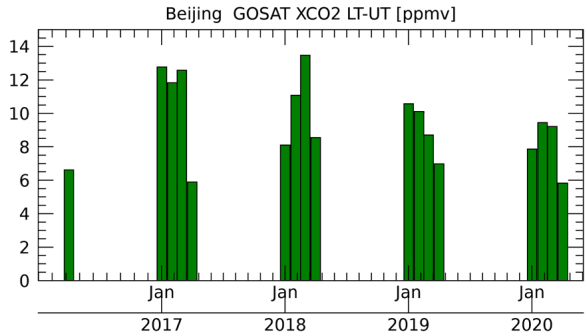
Upper Troposphere (UT)

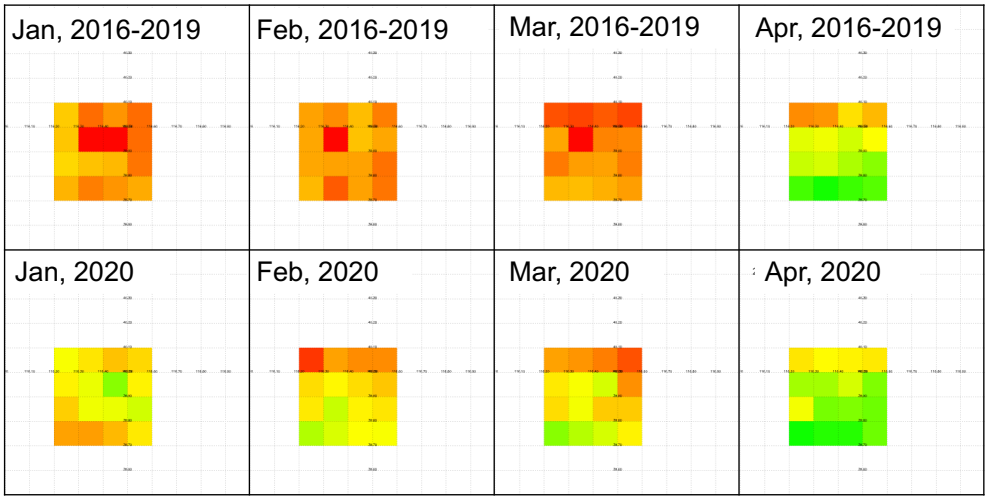
Lower Troposphere (LT)

GOSAT Trend data at target points using 2-axis pointing system
https://www.eorc.jaxa.jp/GOSAT/CO2_monitor/index_Ver.K.V3.html



Beijing target locations





OBJECTIVES

- Demonstrate the joint capabilities of JAXA-ESA-NASA to observe environmental and economic impacts of COVID-19 from space
- Develop Earth observation data-driven dashboards to clearly communicate indicators to the general public and decision makers
- Leverage the strong cooperation and collaboration among ESA-NASA-JAXA to address a global issue
- Engage the wider public via the Space Apps COVID-19 challenge and other initiatives

AIR QUALITY NO_2 INDICATOR

Objective: Show changes in observed NO2 relative to global/local reactions to COVID-19

Approach: Global and spotlight changes in NO2 observed from Sentinel-5P (2019-Present)

Agency	AOIs	Products	Release Dates
NASA & ESA	Global, San Francisco, Los Angeles, Tokyo, Beijing, New York City, East Coast US, India, Northern Italy, Rome, France/Paris, Spain/Madrid	NO_2 15-day averages, and slider map to show changes between 2020 and baseline years	June 25
		NO_2 Time series (2020 and baseline average from previous years)	TBD
		NO_2 Difference map 2020 – baseline average from previous years	TBD

Indicator WG: ESA: Claus Zehner/Christian Retscher; JAXA: Akihiko KUZE; NASA: Barry Lefer/John Haynes

GHG/CLIMATE CO_2 AND CH_4 INDICATOR

Objective: Show changes in observed CO_2 and CH_4 relative to global/local reactions to COVID-19

Approach: Global CO_2 changes from OCO-2, local changes in CO_2 and CH_4 (for select regions) from GOSAT (2009-Present) and GOSAT-2 (2019-Present)

Agency	AOIs	Products	Release Dates
NASA	Global, US (New York, Los Angeles, San Francisco, Sacramento, Pasadena), Italy, France, Spain, India(Delhi, Mumbai), China (Beijing), Tokyo	OCO-2 Level 3, and difference between 2020 and prior years	June 25
		CO_2 Seasonal Anomaly Plots	TBD
ESA		ESA GOSAT CO_2	TBD
		CO_2 Seasonal Anomaly Plots	TBD
JAXA		GOSAT and GOSAT-2 CO2 Level 2 and differences between 2020 and prior years locally.	June 25
		GOSAT and GOSAT-2 Level 2 CO_2 and CH_4 differences between 2020 and prior years locally.	TBD

Indicator WG: ESA: Christian Retscher/Claus Zehner; JAXA: Akihiko KUZE; NASA: Ken Jucks/Dave Crisp

ECONOMIC ACTIVITIES INDICATORS

Objective: Utilize EO to characterize economic impacts of COVID19. Three major indicators related to production of goods (industrial activity), transport of goods (port and airport activity) and infrastructure development (construction activity) have been identified as economic parameters. These indicators will comprise of qualitative and quantitative information.

Agency	AOIs	Products	Release Dates
NASA	San Francisco, Los Angles , Port of Ghent, Port of Dunkirk, Beijing, Tokyo, Aichi,	Optical based quantification of change in nighttime lights Black marble data products – MODIS/VIIRS	June 25
		Machine learning based approach to detect shipping activity using PlanetScope	June 25
		Time series analysis approach to detect economic impact construction, industry, ports - Sentinel-1 and ALOS-2	Update 1
ESA		Machine learning based estimation of container/bulk aggregate status in port areas (with Sentinel 2)	Update 1
		Analysis of number and type of vessels present in port areas - Sentinel 1, Sentinel 2, Iceye	July 9
JAXA		SAR based detection of inventory - ALOS-2 and Sentinel-1	June 25
		SAR based detection of ship / aircraft detection - ALOS-2, Sentinel-1 with AIS	Update 1

Indicator WG: ESA: Gordon Campbell; JAXA: Takeo Tadono/Shinichi Sobue/Junichiro Ishizawa; NASA: Manil Maskey/Michael Falkowski/Gerald Bawden

AGRICULTURE INDICATOR

Objective: Demonstrate Earth Observation capabilities to monitor COVID19 impact on agricultural production contributing to transparency in global food sector. Lock-down & border closure could affect harvest or planting activities. Interrupted food supply chains & export restrictions could cause instability in local and global markets, despite positive crop season outlook

Agency	AOIs	Products	Release Dates
NASA	Global, Sacramento, Spain, Lower Mekong	Crop outlook map - Time series data of MODIS, GPM, LANDSAT-8	Update 1
		Rice planting and growth status - Landsat-8, Sentinel-2, Sentinel-1, ALOS-2	Multiple
ESA		Crop outlook map - Time series data of Sentinel-2	Update 1
		Crop planting, productive area and harvesting status - Time series data of Sentinel-2	Update 1
JAXA		Crop outlook map - Time series data of GCOM-W, GCOM-C, GPM	Update 1
		Machine learning based approach to detect rice crop planting and growing status - Time series of ALOS-2 and Sentinel 1 with NDVI derived from GCOM-C, Sentinel-2 and Landsat-8	Update 1

Indicator WG: ESA: Benjamin Koetz/Patrick Griffiths; JAXA: Kei Oyoshi/Shinichi Sobue; NASA: Brad Doorn/Michael Falkowski

WATER QUALITY INDICATOR

Objective: Assess through different indicators the effect of decreased human activities during the lockdown, and subsequent economic recovery on inland and coastal water quality.

Approach: generate anomaly maps and time series analyses of Water Quality parameters (Chlorophyll concentration, Total Suspended Matter), taking into account natural variability.

Agency	AOIs	Products	Release Dates
NASA	North Adriatic Sea, San Francisco Bay, Long Island Sound, Rhone Delta, Barcelona coasts, Tokyo Bay, Kobe-Osaka	Anomaly maps and Time series of Chlorophyll-a and total suspended matter (TSM) utilizing MODIS and Landsat.	June 25
ESA		Maps and Time series of Chlorophyll-a anomaly with respect to climatological values from Sentinel-3 and from a multi-mission product (including S-3, MODIS, VIIRS)	June 25
			Update 1 *(Barcelona Coasts)*
JAXA		Anomaly maps and Time series of Chlorophyll-a and total suspended matter (TSM) utilizing SGLI.	June 25

Indicator WG: ESA: Marie-Helene Rio; JAXA: Hiroshi Murakami; NASA: Laura Lorenzoni

Summary

JAXA – ESA – NASA are working together to new combined tool:

- June 25 – Tri-Agency Dashboard Release v1
  - Air Quality NO_2, Climate CO_2, Night Lights, Airport Activity, Port Activity, Water Quality
- July TBD – Tri-Agency Dashboard Release v1.1
  - Adds agriculture, expands water quality and substantially expands economic activity (ports, construction, industry and ports)

Some Useful Links

https://race.esa.int/
https://earth.esa.int/web/guest/missions/esa-eo-missions/sentinel-5p
https://maps.s5p-pal.com/
https://so2.gsfc.nasa.gov/no2/no2_index.html
https://airquality.gsfc.nasa.gov/News
https://www2.acom.ucar.edu/news/covid-19-impact-asian-emissions-insight-space-observations
http://www.esa.int/ESA_Multimedia/Videos/2020/03/Coronavirus_nitrogen_dioxide_emissions_drop_over_Italy
https://www.esa.int/Applications/Observing_the_Earth/Copernicus/Sentinel-5P/Coronavirus_lockdown_leading_to_drop_in_pollution_across_Europe
https://atmosphere.copernicus.eu/flawed-estimates-effects-lockdown-measures-air-quality-derived-satellite-observations?q=flawed-estimates-effects-lockdown-measures-air-quality-satellite-observations
https://airquality.gsfc.nasa.gov/caution-interpretation
https://www.eorc.jaxa.jp/GOSAT/GPCG/index_GOSAT2.html
https://www.eorc.jaxa.jp/GOSAT/CO2_monitor/index_Ver.K.V3.html
https://oco.jpl.nasa.gov
https://oco.jpl.nasa.gov/oco-2-data-center/