Sentinel-5p Precursor Mission - Recent Results on Air Quality Monitoring

European Union

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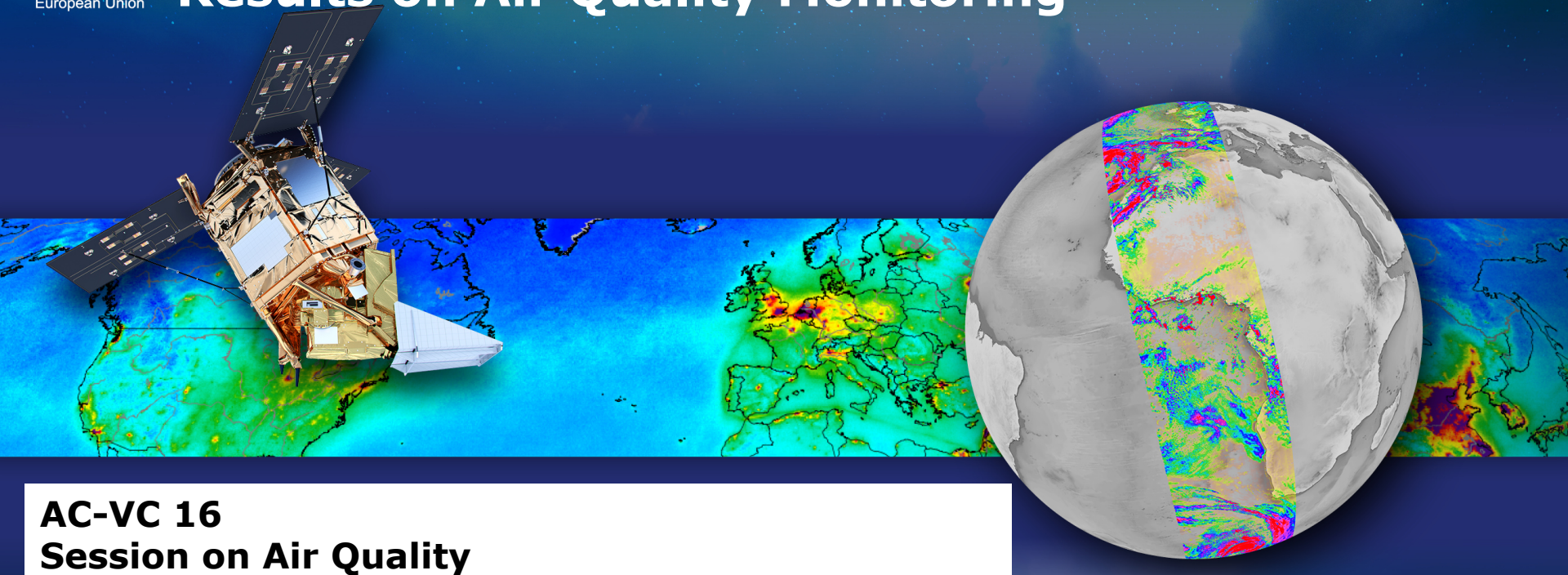

AC-VC 16
Session on Air Quality
C. Zehner/ESA – Sentinel-5P Mission Manager

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Sentinel-5 Precursor: first atmospheric Sentinel Mission

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- **Launched**: 13 October 2017, Plesetks
- **Launcher**: Rockot
- **Main Payload**: TROPOMI (co-funded by The Netherlands and ESA) - Hyper-spectral push-broom imaging spectrometer, 4 spectrometers with 2D detectors with 4000 spectral channels
- **Orbit**: Altitude of 820 km, 227 orbit repeat cycle
- **Daily Global Coverage:** 13:30 ascending node crossing time
- **Spatial Sampling:** in nadir 5.5 x 3.5 km, 24 million ground pixels per day
- **Mission Control**: ESOC
- **TROPOMI Mission Planning:** KNMI
- **Ground Stations**: Svalbard (NOR) and Inuvik (Canada)
- **Operational Data Processing**: DLR (on behalf of ESA)
- **Mission Design Life Time**: ~7 years
- **Mission Objective:** provide measurements for Ozone, Air Quality, and Climate Monitoring and Forecasting

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Sentinel-5P Products

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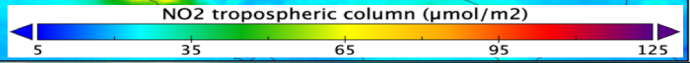
Sentinel-5 Precursor mission operations → in operations since April 2018 and in routine operations since March 2019

Sentinel-5P TROPOMI
NO2 tropospheric column
April 2018 - March 2019

- Aerosol Layer Height - September 30 2019
- Methane (CH_4)
- Tropospheric Ozone Column (trop. O_3) - March 2019
- Sulfur Dioxide (SO_2)
- Formaldehyde (OCHO) - October 2018
- Total Columns of Ozone (O_3)
- Nitrogen Dioxide (NO_2)
- Carbon Monoxide (CO)
- Cloud information
- Aerosol information
- Radiances/Irradiances – July 2018



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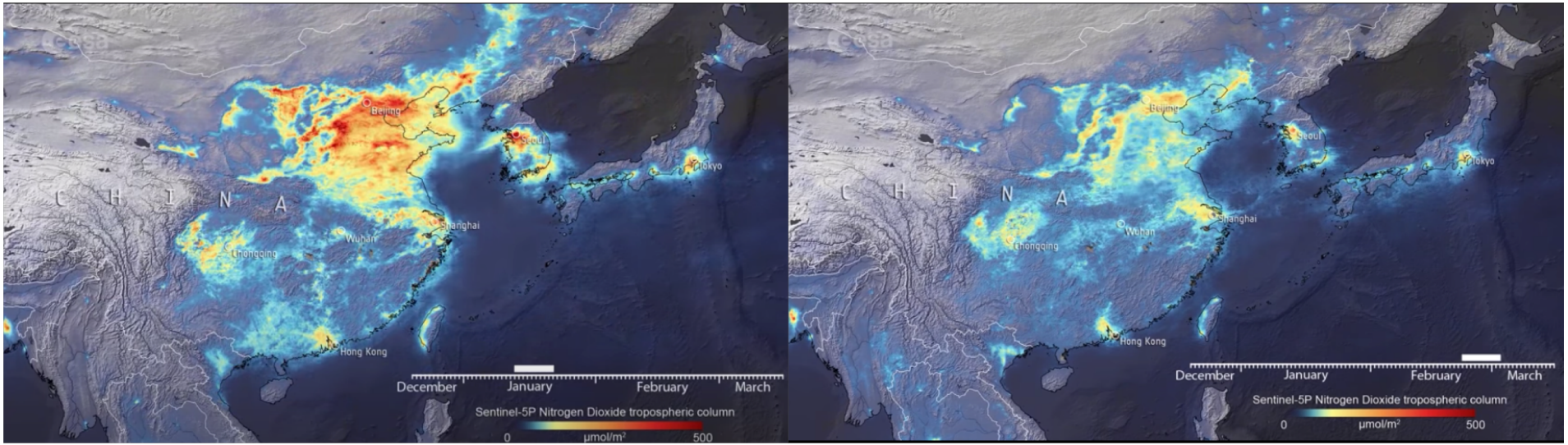
COVID-19 impact as 'seen' by Sentinel-5P

https://www.esa.int/Applications/Observing_the_Earth/Copernicus/Sentinel-5P/COVID-19_nitrogen_dioxide_over_China

Nitrogen Dioxide concentrations over China – ESA Webportal story issued during March 2020



COVID-19 impact as 'seen' by Sentinel-5P (March 2020 - ESA internal Statistics)

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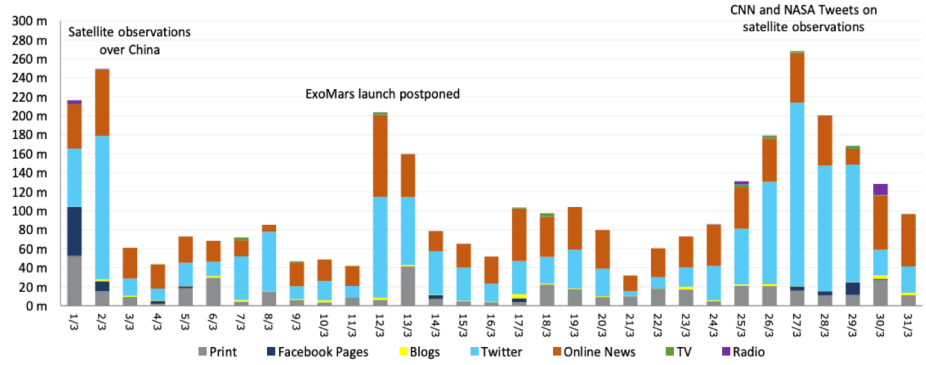
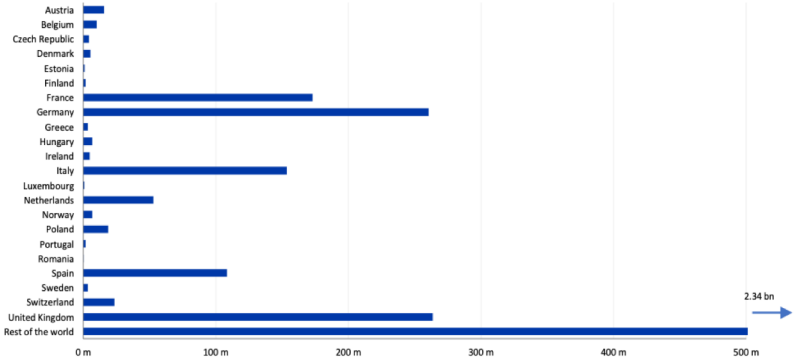
ExoMars and Sentinel-5P drive the media visibility

Visibility by date and by channel (Gross Reach)



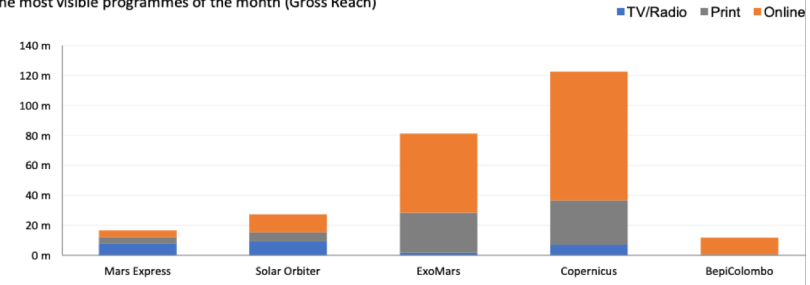
32 % of the visibility generated by ESA member states media

Visibility by country (Gross Reach)



Programmes

Visibility of the most visible programmes of the month (Gross Reach)



	Mars Express	Solar Orbiter	ExoMars	Copernicus	BepiColombo
Gross Reach	16.6 M	27.4 M	81 M	122.5 M	11.8 M
Frequency % out of total 912 M	1.8 %	3 %	8.9 %	13.4 %	1.3 %

Key messages

Italy

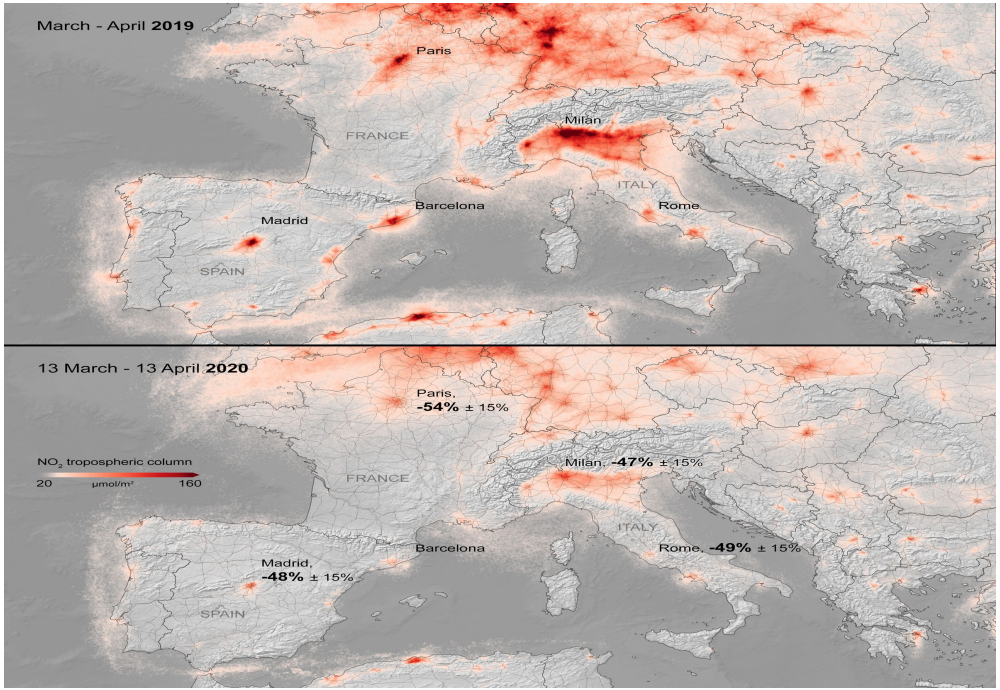
- Italy was overwhelmingly the story which gained most traction in March. 53% of all Facebook posts were focused on NO2 drops in Northern Italy.

China

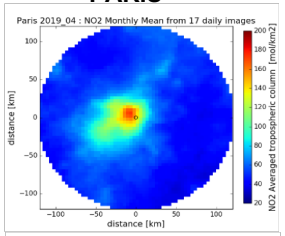
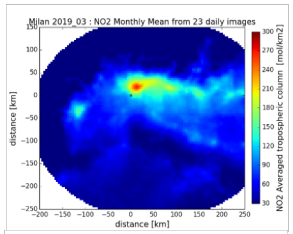
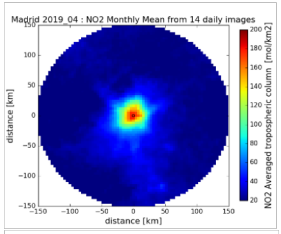
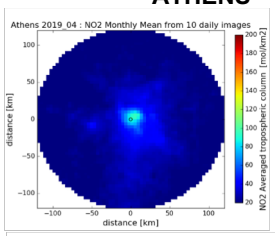
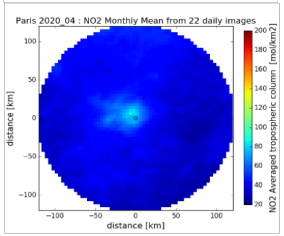
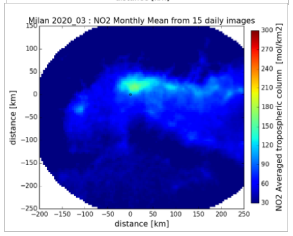
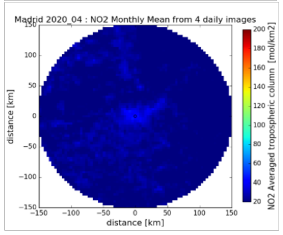
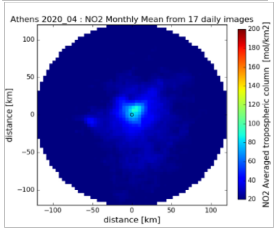
- China also featured prominently, though the posts looked at increasing emissions after the lockdown was relaxed. 12% of all Facebook posts focused on China.

COVID-19 impact as 'seen' by Sentinel-5P

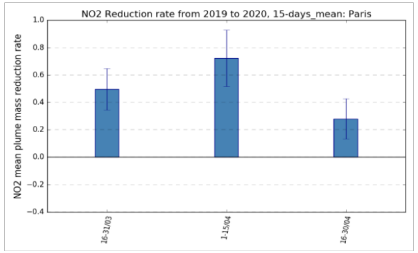
http://www.esa.int/Applications/Observing_the_Earth/Copernicus/Sentinel-5P/Air_pollution_remains_low_as_Europeans_stay_at_home



- From ESA S5P measurements of the **air pollutant NO_2 from space**, we have assessed the impact of the human activity reduction on air pollution by comparing the first 4-months periods of 2019 and 2020 on a daily, weekly and monthly basis for 4 major cities in Europe

	PARIS	MILAN	MADRID	ATHENS
2019 monthly averages				
2020 Monthly averages				

Reductions in the pollution level (using NO_2 tropospheric column as a proxy) have been observed from Mid March and for April 2020 (52% +/-9% for Paris; 28% +/-8% for Milan region; 54% +/-16% for Madrid; not significantly observed for Athens), as compared to the same periods in 2019



PARIS : Reduction rates of the NO_2 plume mass fortnightly mean between 2019 and 2020 from mid-March to end of April, and corresponding uncertainty

COVID-19 impact as 'seen' by Sentinel-5P

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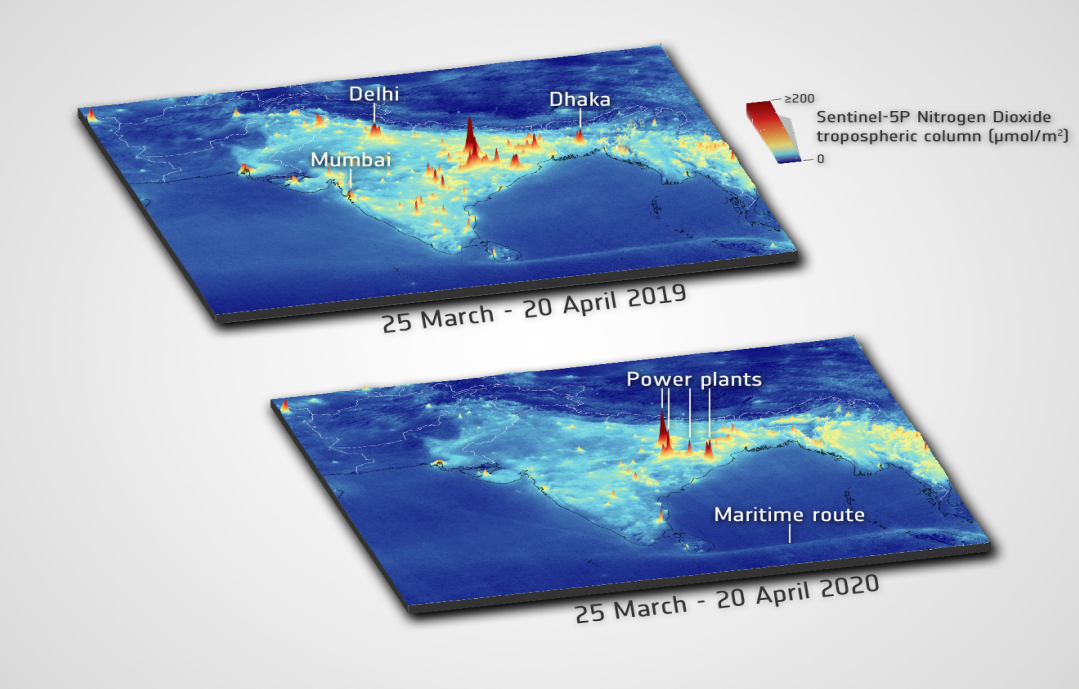
http://www.esa.int/Applications/Observing_the_Earth/Copernicus/Sentinel-5P/Air_pollution_drops_in_India_following_lockdown



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‘COVID-19’ NO2 Sentinel-5P Mapping Service (PAL)

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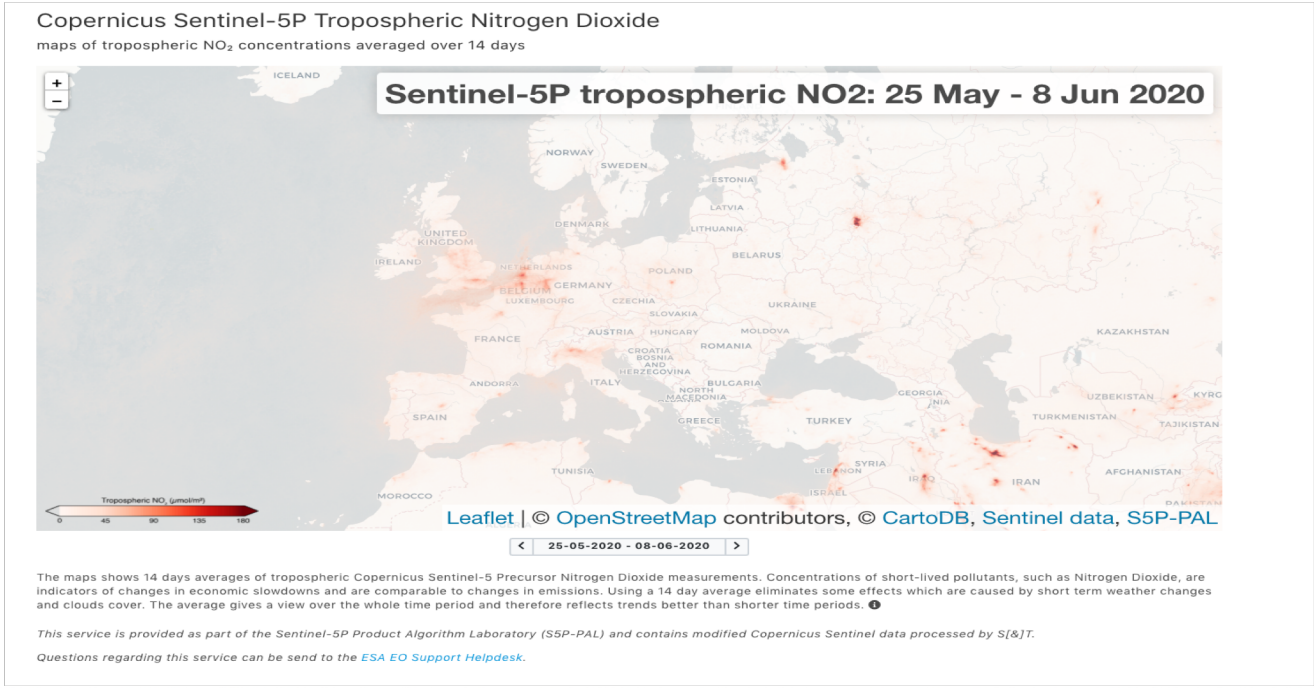
https://maps.s5p-pal.com/ as part of the S-5P Product Algorithm Laboratory



The maps shows 14 days averages of tropospheric Copernicus Sentinel-5 Precursor Nitrogen Dioxide measurements. Concentrations of short-lived pollutants, such as Nitrogen Dioxide, are indicators of changes in economic slowdowns and are comparable to changes in emissions. Using a 14 day average eliminates some effects which are caused by short term weather changes and clouds cover. The average gives a view over the whole time period and therefore reflects trends better than shorter time periods.

This service is provided as part of the Sentinel-5P Product Algorithm Laboratory (S5P-PAL) and contains modified Copernicus Sentinel data processed by S[&]T.

Questions regarding this service can be send to the ESA EO Support Helpdesk.

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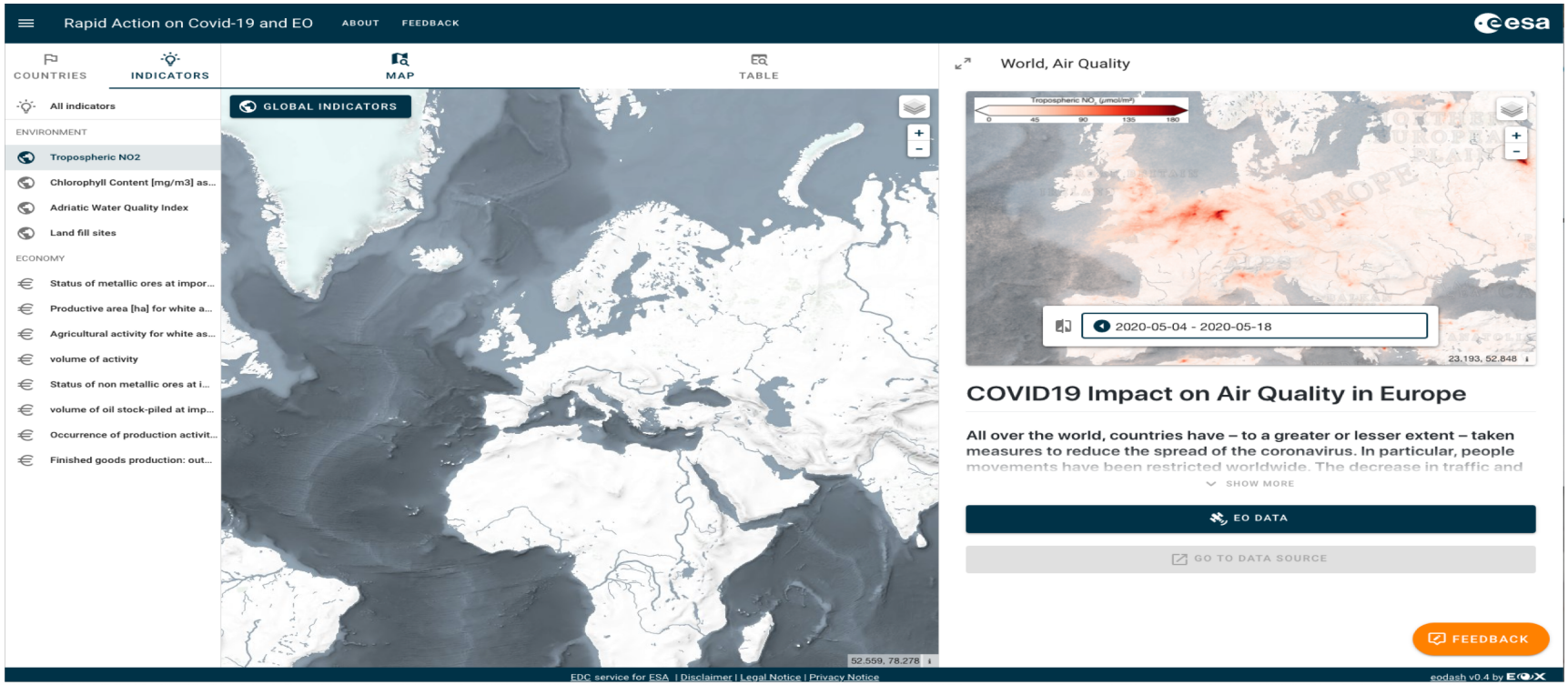
ESA RACE Dashboard (https://race.esa.int/)
Rapid Action on Coronavirus and EO for the EC

European Union



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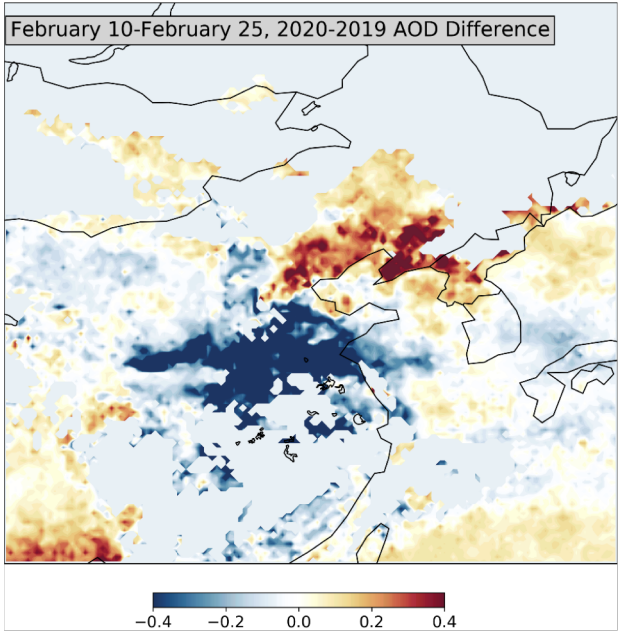
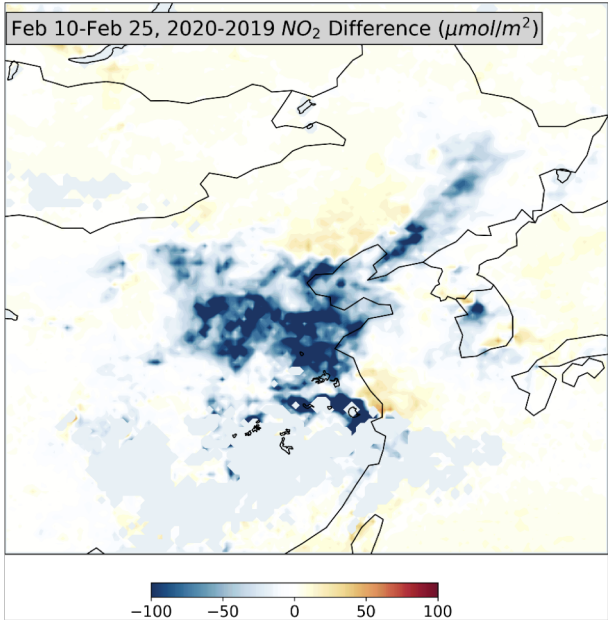
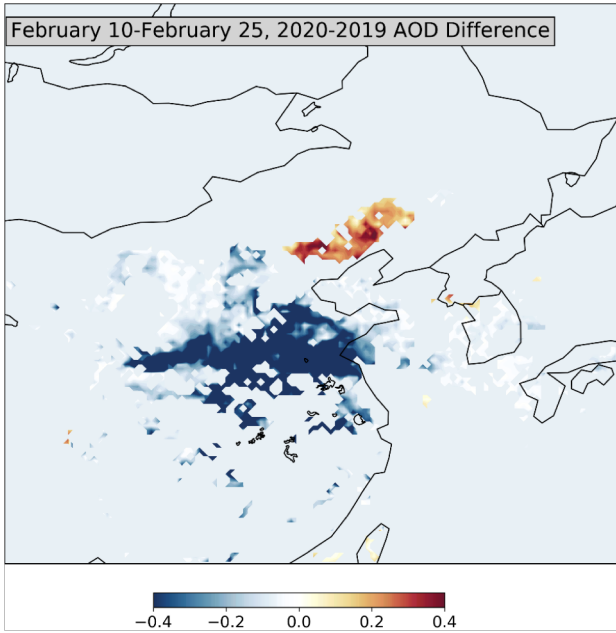
Examining SNPP VIIRS AOD Changes due to COVID-19 Lockdown using S5P TROPOMI NO_2 as a Filter







SNPP VIIRS AOD difference between 2020 and 2019 showing decrease in AOD in Hubei province where COVID-19 related shutdown was 100%. Increase in AOD due to transported smoke and/or increase in emissions in 2020 compared to 2019

Use NO2 to filter AOD data

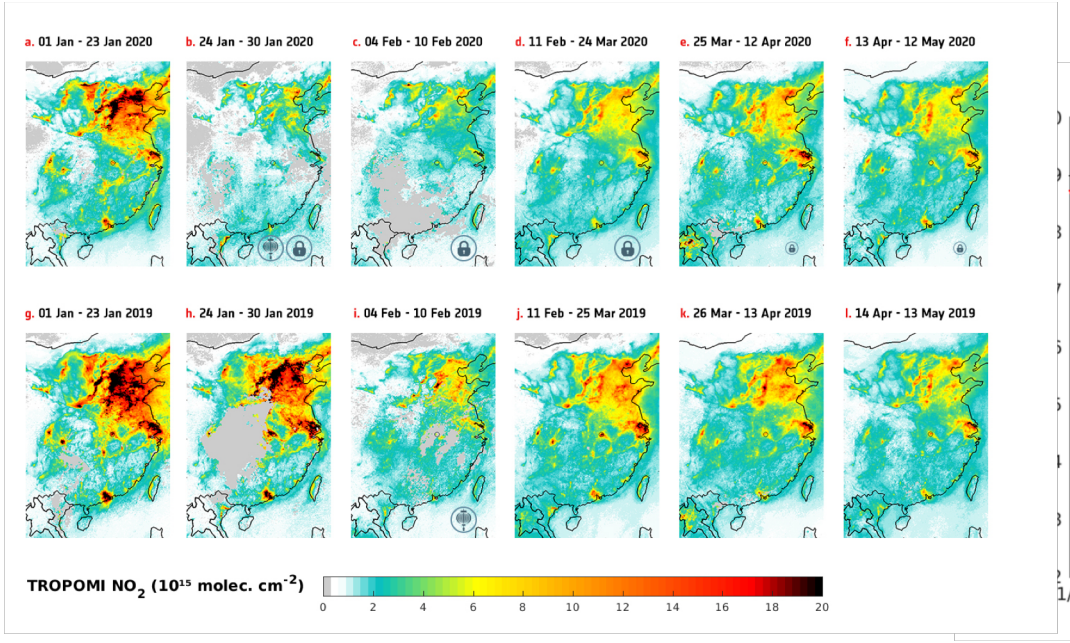
- NO_2 > 12 µmoles/m2
- ΔNO_2 > 5 µmoles/m2 with criteria that both AOD and NO_2 should either co-increase or co-decrease

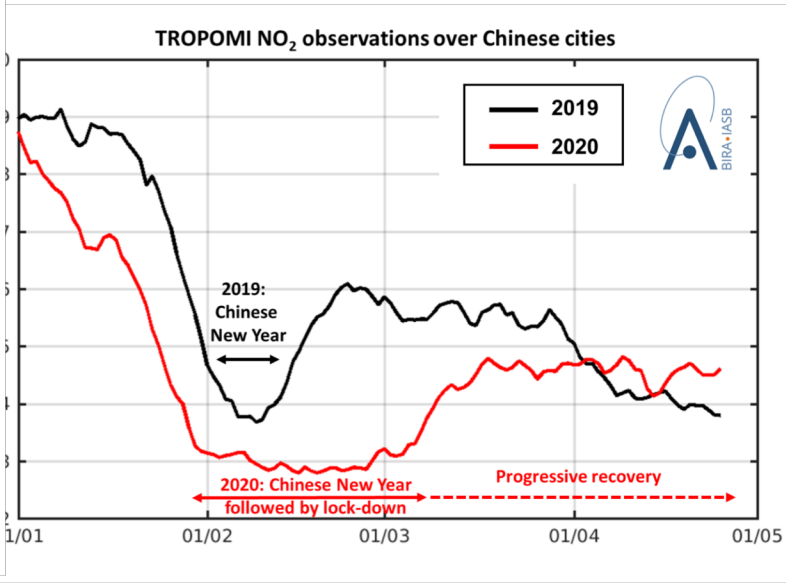
Capture AOD changes when source sector for aerosols/aerosol precursors and NO_2 are the same

S. Kondragunta, H. Zhang, Z. Wei (NOAA/NESDIS/STAR)

COVID-19 impact as 'seen' by Sentinel-5P

https://eo4society.esa.int/2020/05/14/is-the-global-covid-19-related-drop-in-no2-pollution-coming-to-an-end/





Back to 'normal' Air Pollution in China