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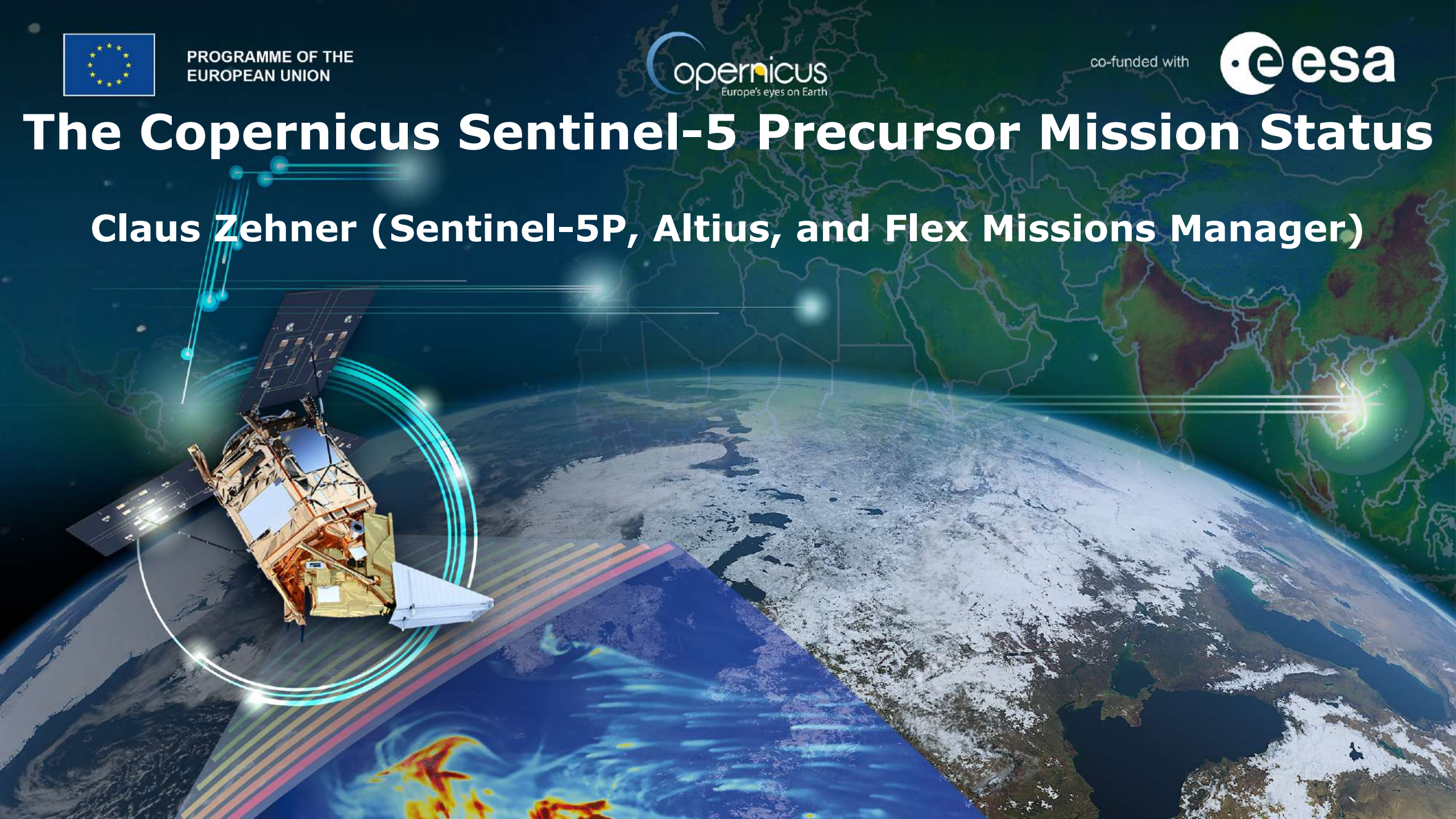
The Copernicus Sentinel-5 Precursor Mission Status

Claus Zehner (Sentinel-5P, Altius, and Flex Missions Manager)



Conference Purpose

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Sentinel-5P Anniversary Celebration with the Community/Exchange on latest results on using Sentinel-5P Data

Key People:

- All of you being present and using Sentinel-5P measurements

Conference Outline:

- 83 orals (12 minutes talk and 3 minutes for questions), after each half day there is the possibility for further questions (Discussions)
- 67 posters (please mount asap) on display all week, Coffee served at the posters
- Lunch is not provided (as mentioned on the Conference Webpage)
- Taxi needed (e.g. to go back to Catania Airport) – please contact Chiara/Lorenza/Rachele
- Photo after each session (chairs & speakers) in front of the Satellite Model

Social Events:

- Icebreaker in Poster room on Monday (drinks and finger food)
- Poster session on Tuesday evening (drinks only)
- Etna Excursion on Wednesday (full day and sponsored by ESA)
- Hosted Dinner in Forza D' Agro (seafood) on Thursday – please inform Chiara/Lorenza/Rachele on any dietary constraints asap

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:** 5.5 x 3.5 km (mission requirement: 7 x 7 km)
- **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
- **National co-funding during Routine Operations** (e.g. on Algorithm Development/QA Monitoring): Belgium, Germany, and The Netherlands
- **Operations Funding:** end 2027
- **Key User:** Copernicus Atmospheric Monitoring Service (ECMWF)

Sentinel-5 Precursor

Mission Objectives

1. Ozone, Air Quality, and Climate Monitoring and Forecasting
2. Extending the time series of GOME, SCIAMACHY, OMI, GOME2 measurements
3. Precursor of the Copernicus Sentinel-4 and Sentinel-5 missions

Sentinel-5P Products

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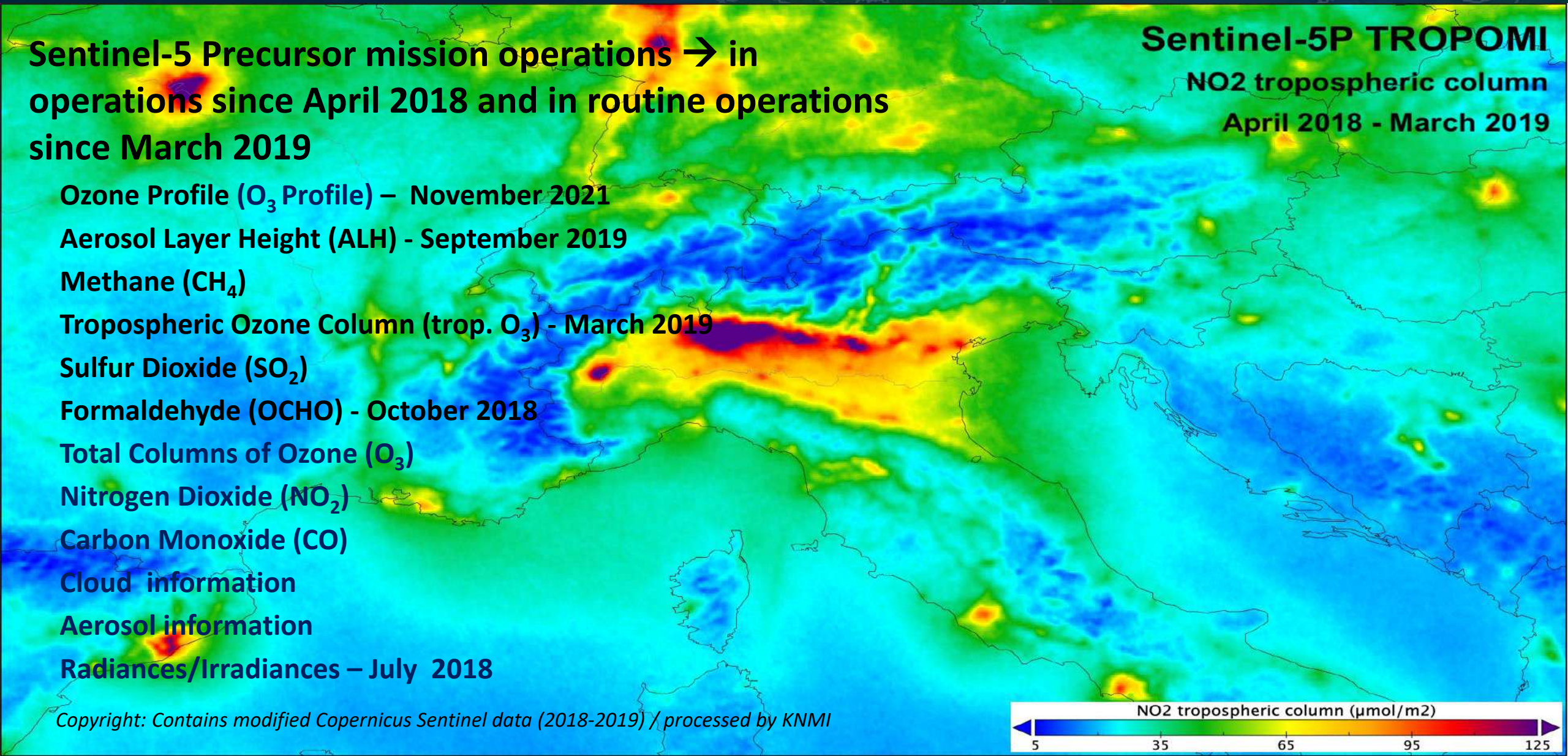
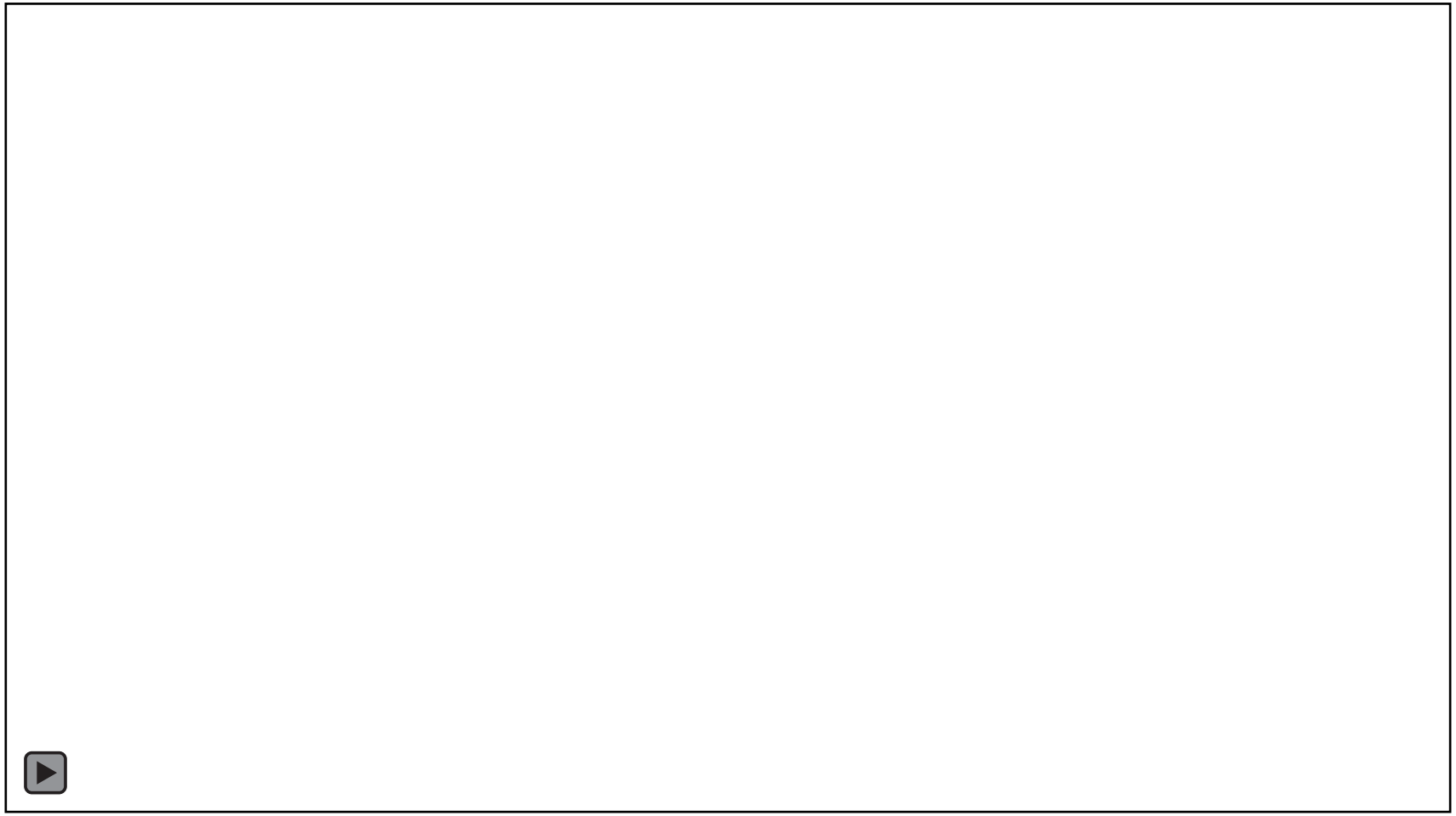
Sentinel-5 Precursor mission operations → in operations since April 2018 and in routine operations since March 2019

- Ozone Profile (O_3 Profile) – November 2021
- Aerosol Layer Height (ALH) - September 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



Sentinel-5P Ozone Monitoring
Ozone Hole Opening during 2022

https://www.esa.int/Applications/Observing_the_Earth/Copernicus/Sentinel-5P/How_do_satellites_monitor_the_ozone_layer



CAMS Ozone Monitoring
Ozone Hole during 2022

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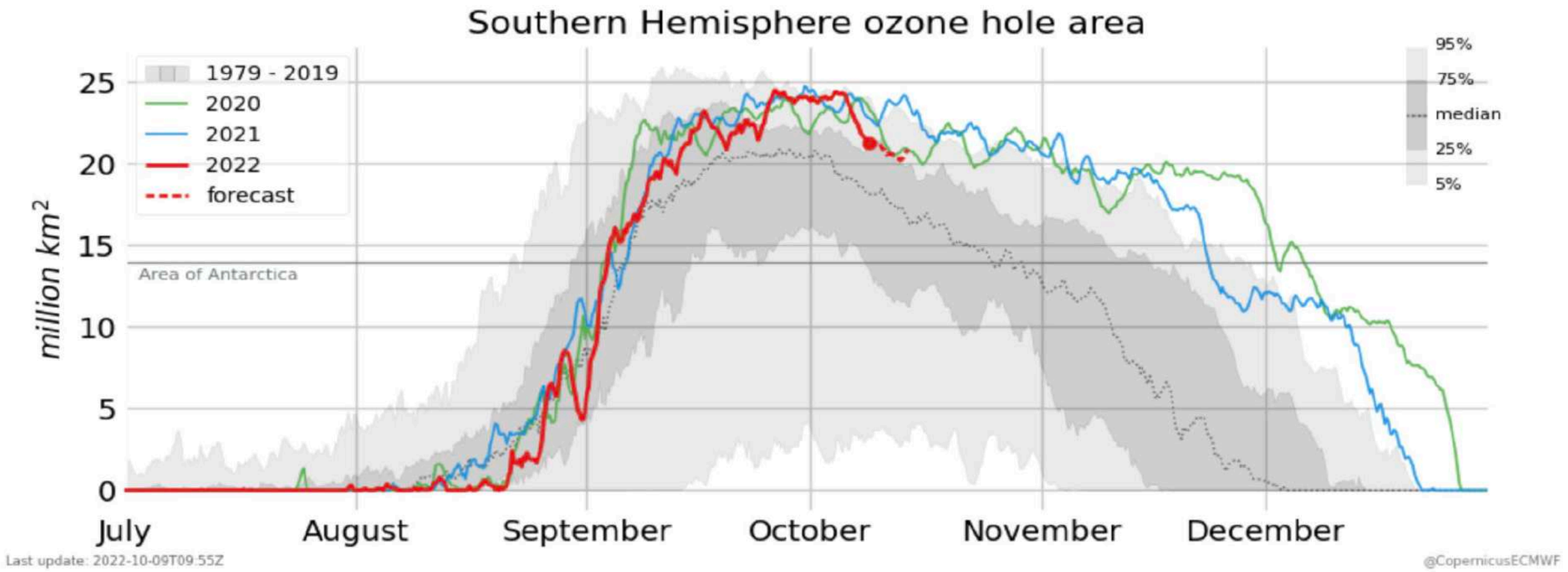
Ozone hole area



Sentinel-5P: Air Pollution Monitoring

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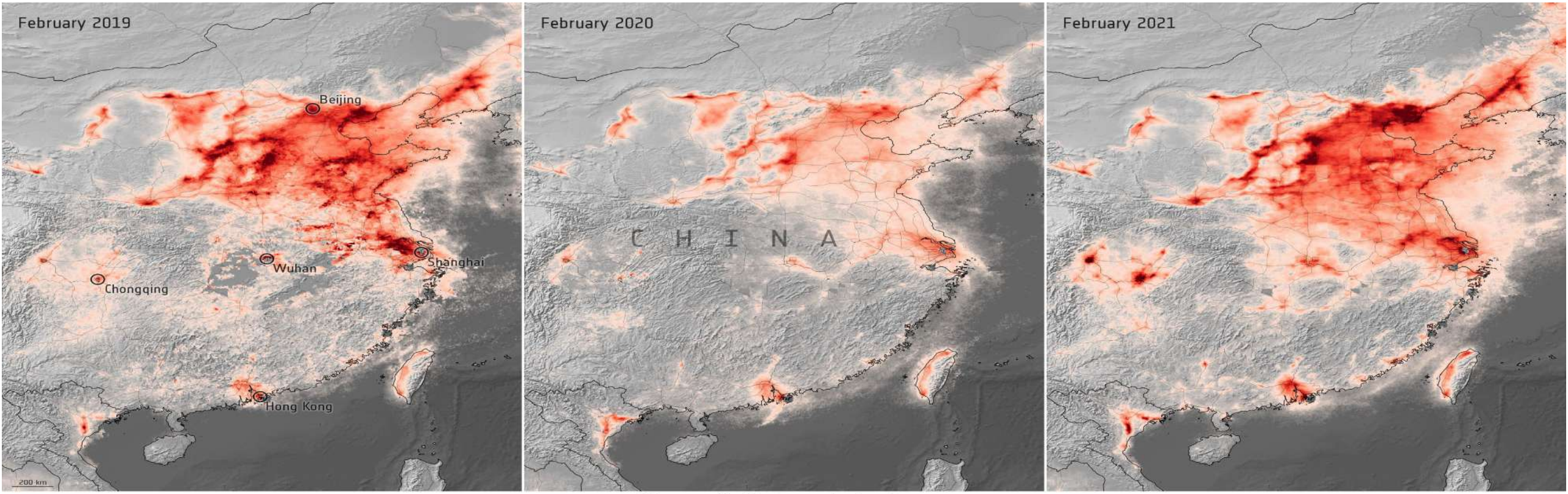
COVID-19 Impact on Air Quality

https://www.esa.int/Applications/Observing_the_Earth/Copernicus/Sentinel-5P/Air_pollution_returning_to_pre-COVID_levels



Sentinel-5P Air Pollution Monitoring
Bush-Fire Emissions in Australia

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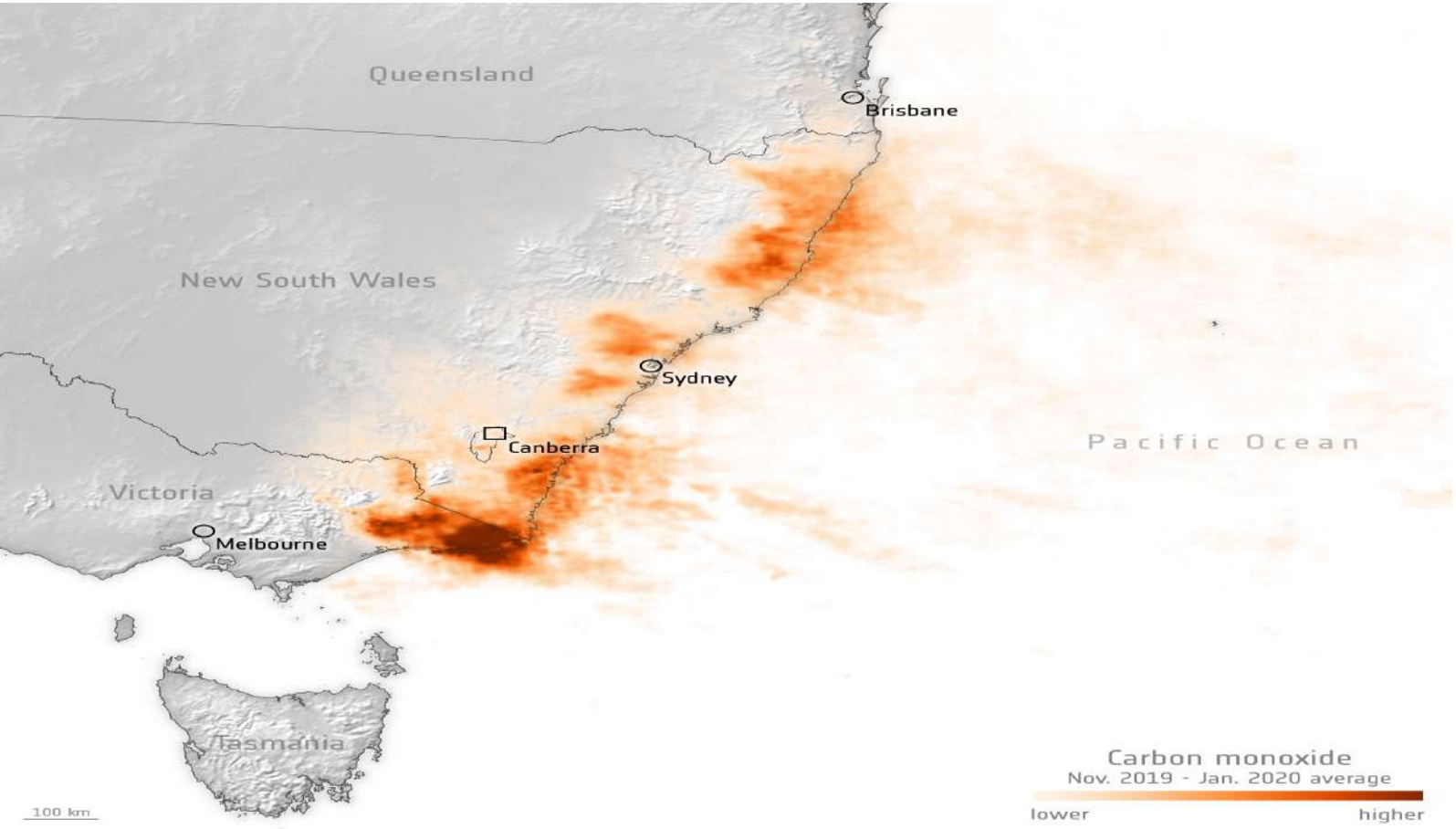
https://www.esa.int/Applications/Observing_the_Earth/Aerosols_released_from_Australian_bushfires_triggers_algal_blooms



these bushfires (Nov. 2019 – Jan. 2020) released CO equivalent to 715 million tonnes of CO2 in just three months

van der Velde, I.R., van der Werf, G.R., Houweling, S. *et al.* Vast CO_2 release from Australian fires in 2019–2020 constrained by satellite. *Nature* **597,** 366–369 (2021). https://doi.org/10.1038/s41586-021-03712-y

CO measurements - Credits: contains modified Copernicus data (2019/20) processed by SRON

Sentinel-5P GHG Methane Monitoring Coal Mines over Poland

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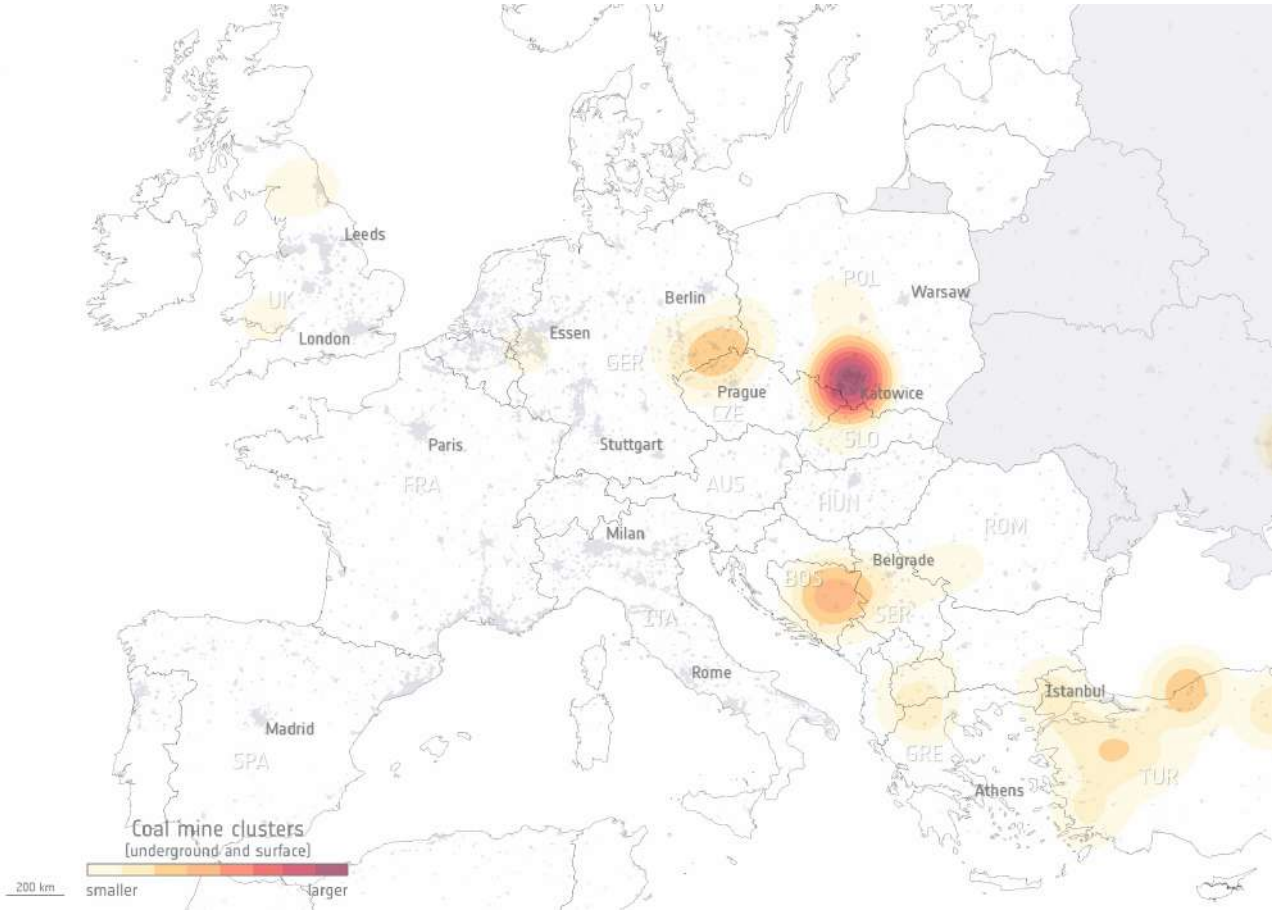
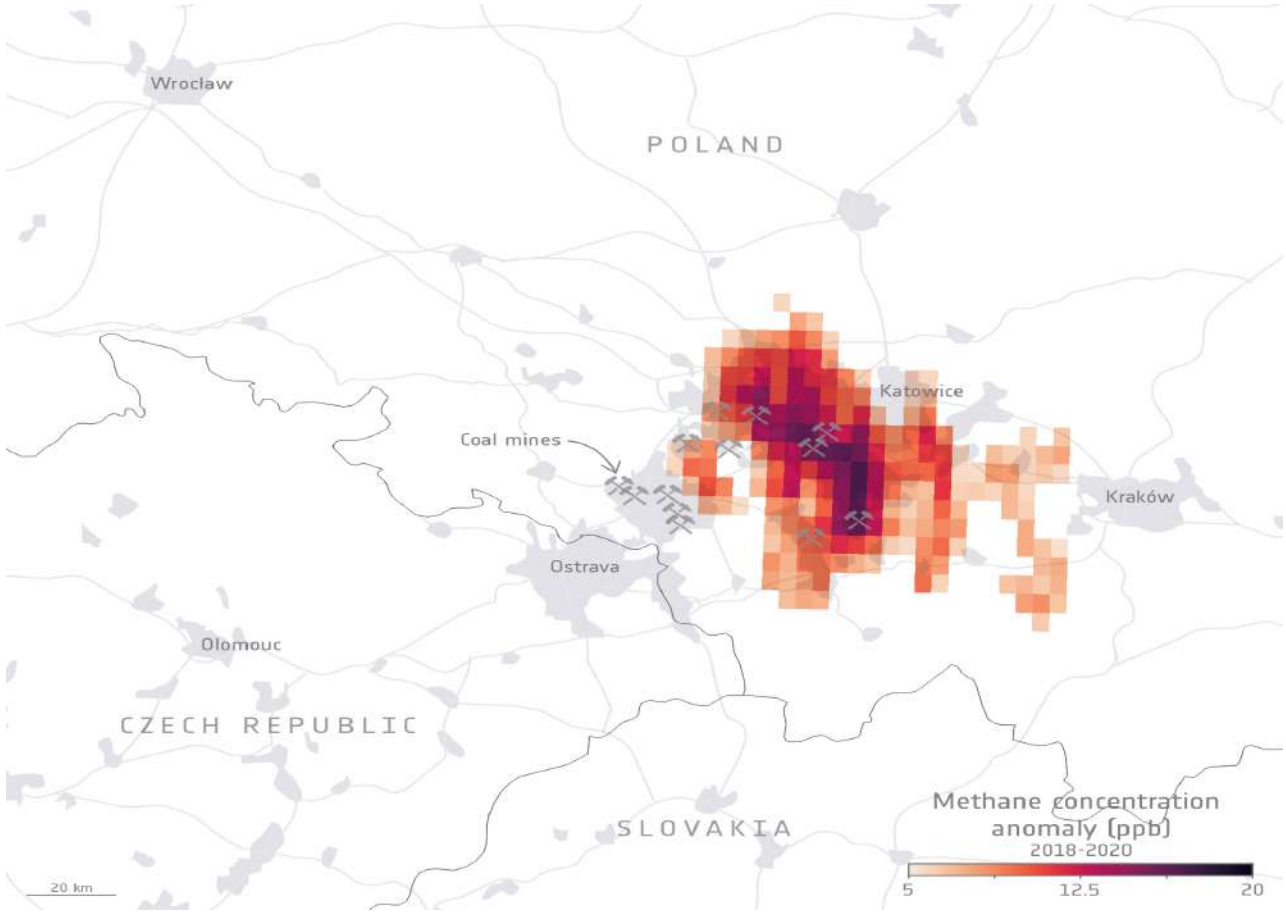
https://www.esa.int/Applications/Observing_the_Earth/Copernicus/Sentinel-5P/Methane_detected_over_Poland_s_coal_mines





GHG Methane Monitoring Synergy with GHGSat (ESA TPM Mission)

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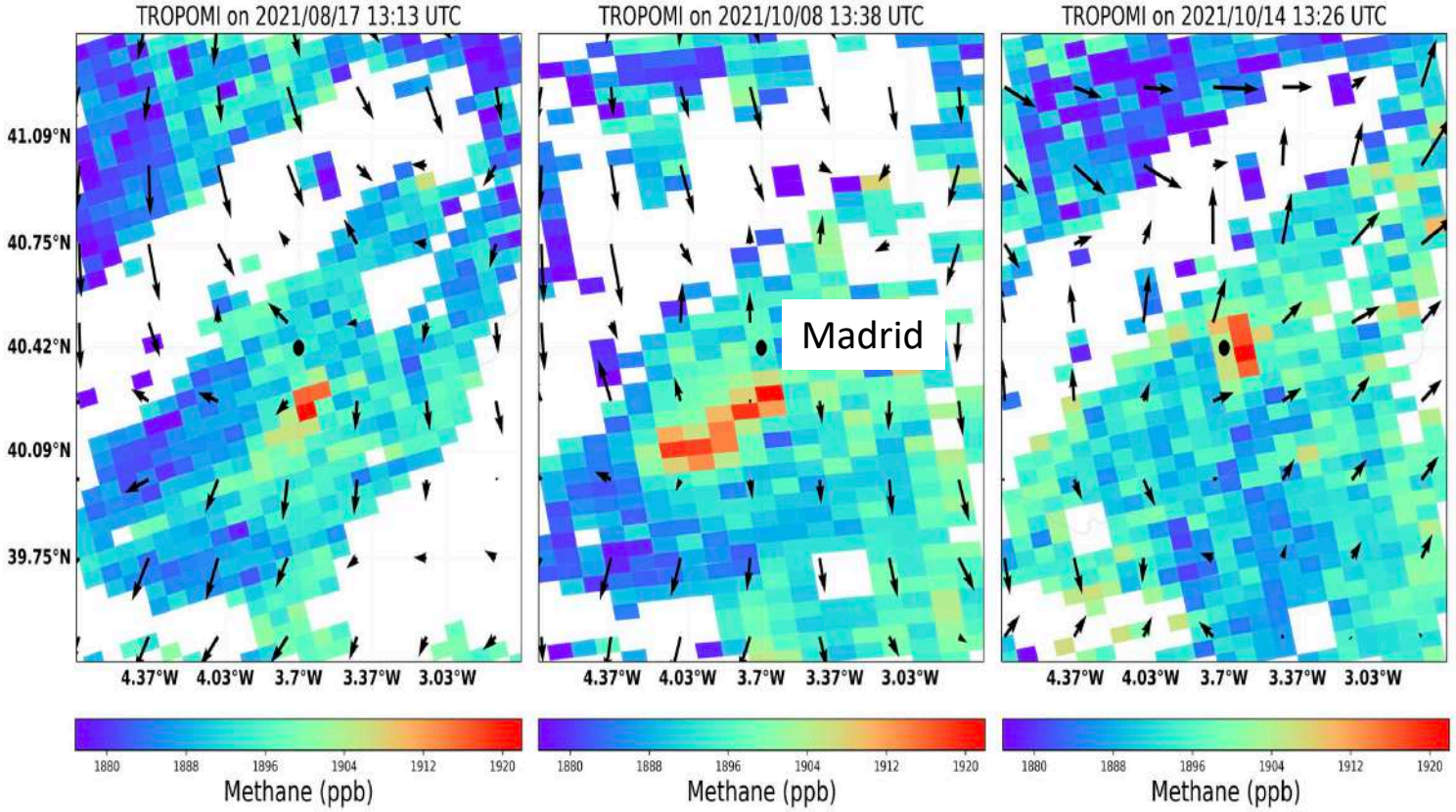
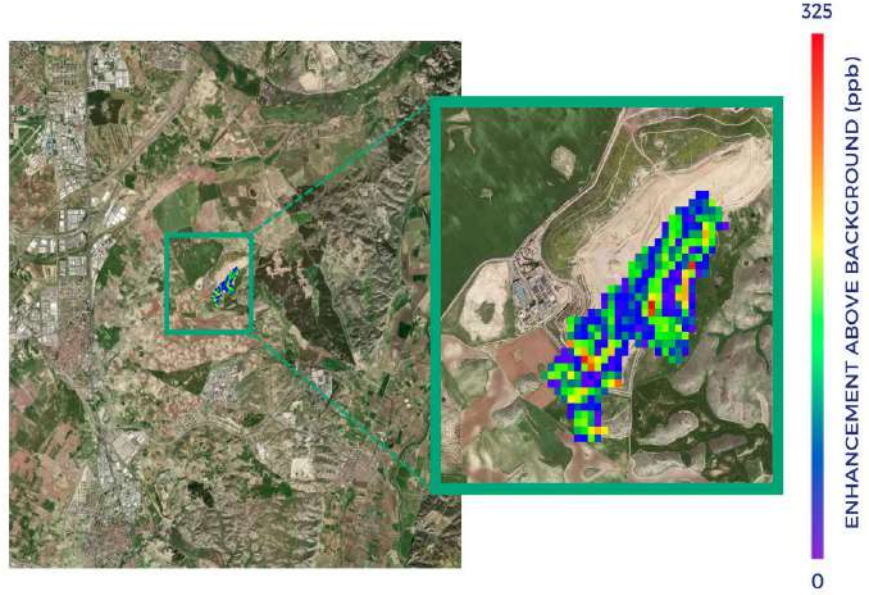
Methane Concentration/Emissions from land fills close to Madrid:
https://www.esa.int/Applications/Observing_the_Earth/Satellites_detect_large_methane_emissions_from_Madrid_landfills



Copyright: Contains modified Copernicus Sentinel data (2021) / processed by SRON



GHGSat Methane Measurements (Oct. 13 2021)
copyright GHGSat

GHGSat AO https://earth.esa.int/eogateway/news/announcement-of-opportunity-for-ghgsat

GHG Methane Monitoring with GHGSat

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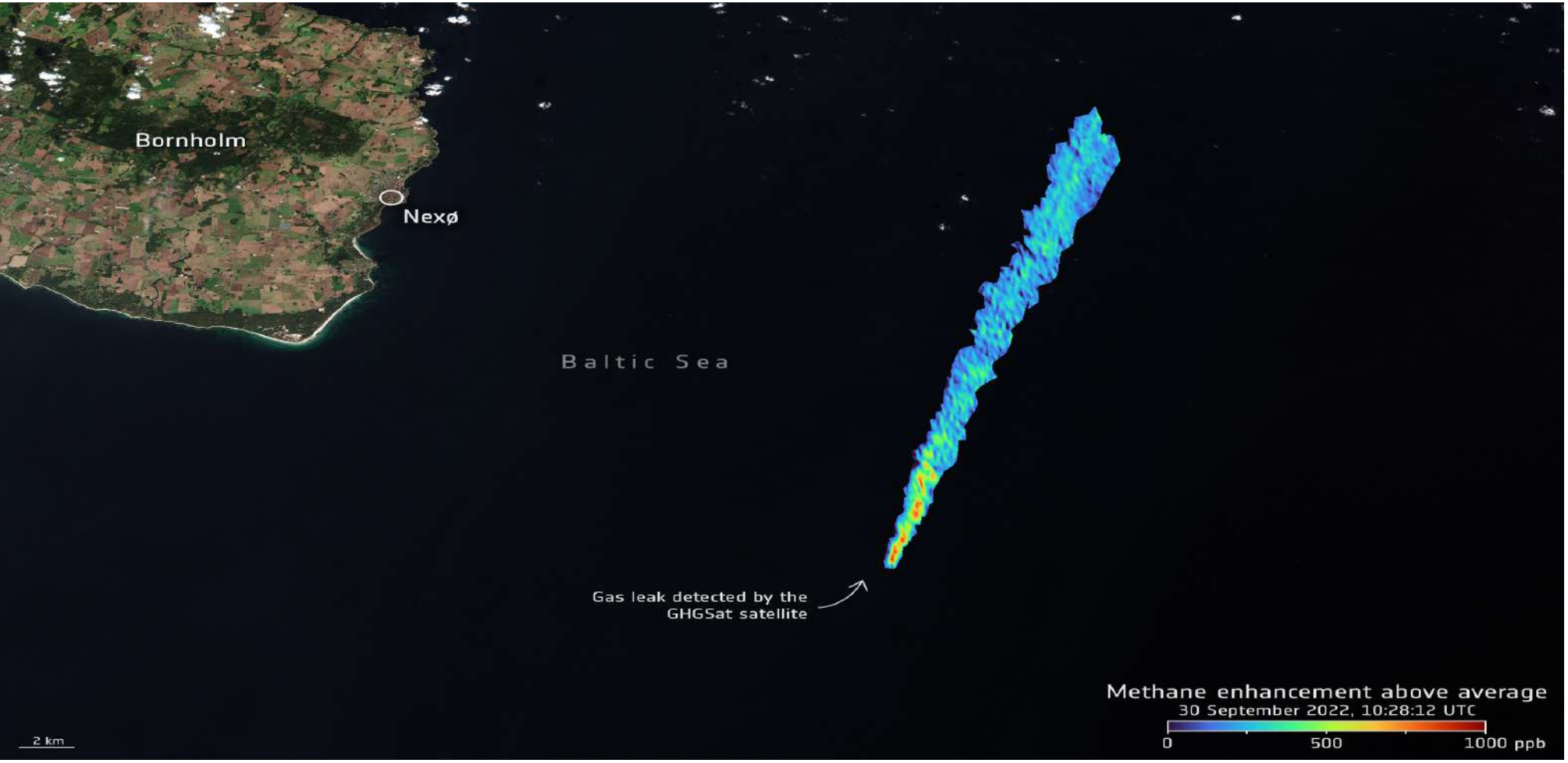
Methane Concentration/Emissions from NordStream Pipeline:

https://www.esa.int/Applications/Observing_the_Earth/Satellites_detect_methane_plume_in_Nord_Stream_leak



On 30 September, the estimated emission rate derived from its first methane concentration measurement was 79 000 kg per hour – making it the largest methane leak ever detected by GHGSat from a single point-source.

Short Term Outlook

Reprocessing of all operational Sentinel-5P Products by the end of this year - https://s5phub.copernicus.eu

- Priorities on Level 2 products as defined by the key user CAMS
- Level 1, Cloud products, Carbon Monoxide done
- Total Ozone started

Pre-operational Products being provided to the user community via the Sentinel-5P Algorithm Laboratory (PAL) - https://data-portal.s5p-pal.com

- Consistent NO2 product (processed with the official processor Version 2.3.1)
- Water Vapour, Bromine Monoxide, and Aerosol Optical Thickness pre-operational products
- Higher level products based on user requests - https://maps.s5p-pal.com/ - Nitrogen Dioxide, Carbon Monoxide, Methane, Sulphur Dioxide

Solve the problem that the current operational Methane product is useless in case of missing S-NPP cloud information (S-NPP problem during this summer!)