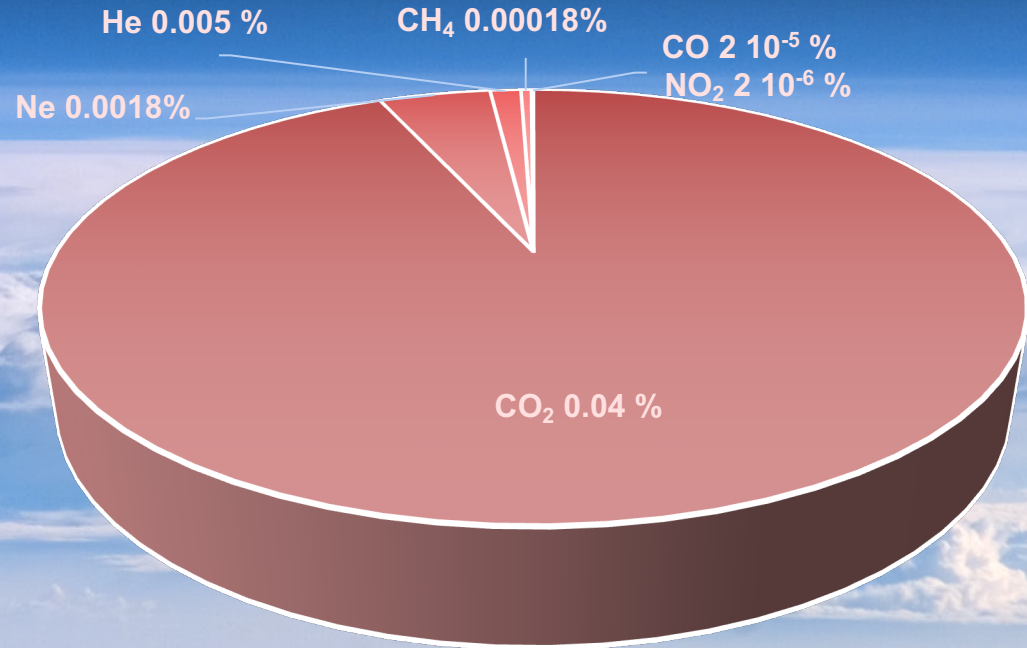
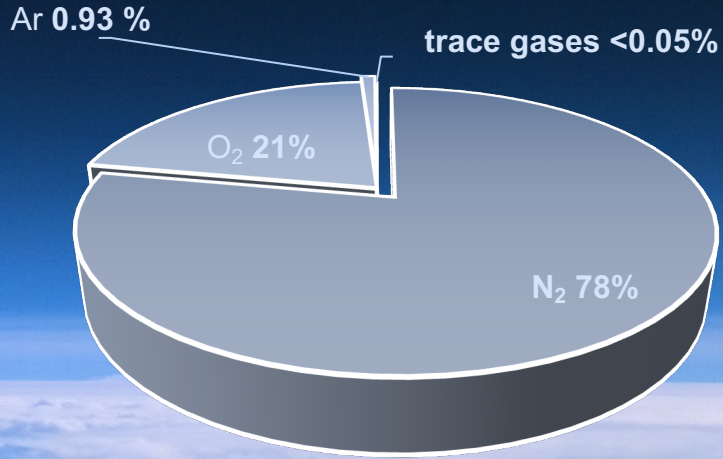


Measuring Air Quality and Greenhouse Gas Emission from Space using TROPOMI: Past, Presence, and Future

Jochen Landgraf, Pepijn Veeffkind
Tobias Borsdorff, TROPOMI L2 team



The Atmosphere



Air quality and climate change:
Problems that require a broader view

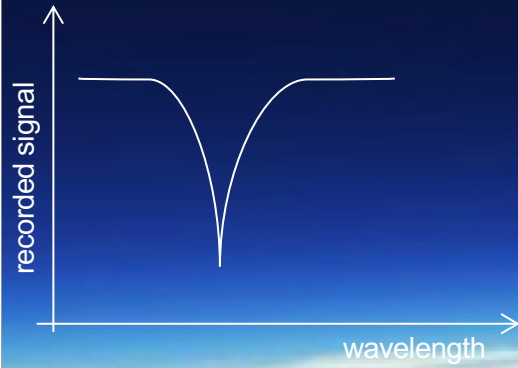


Sun synchronous orbit

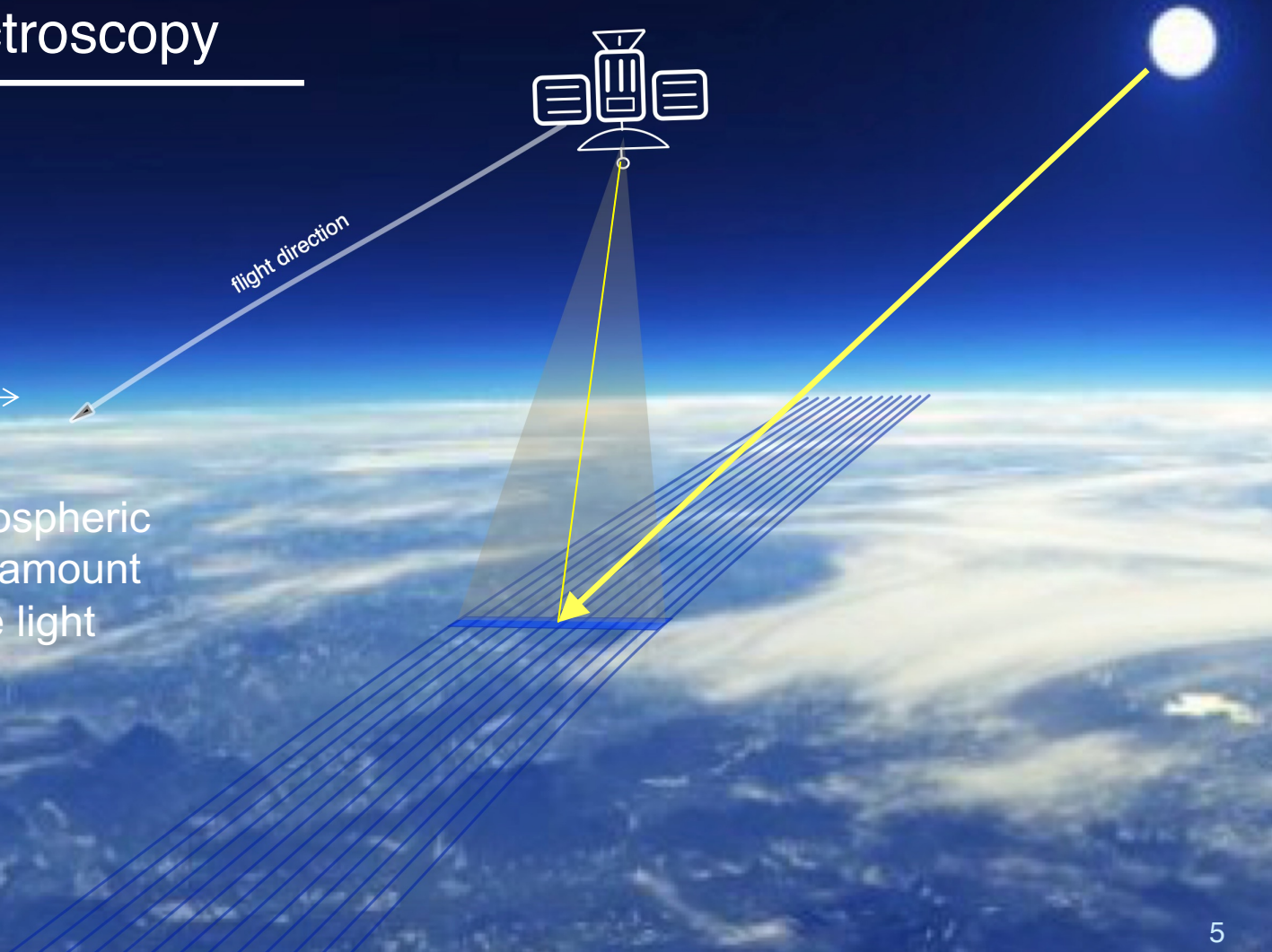


Global coverage within one day

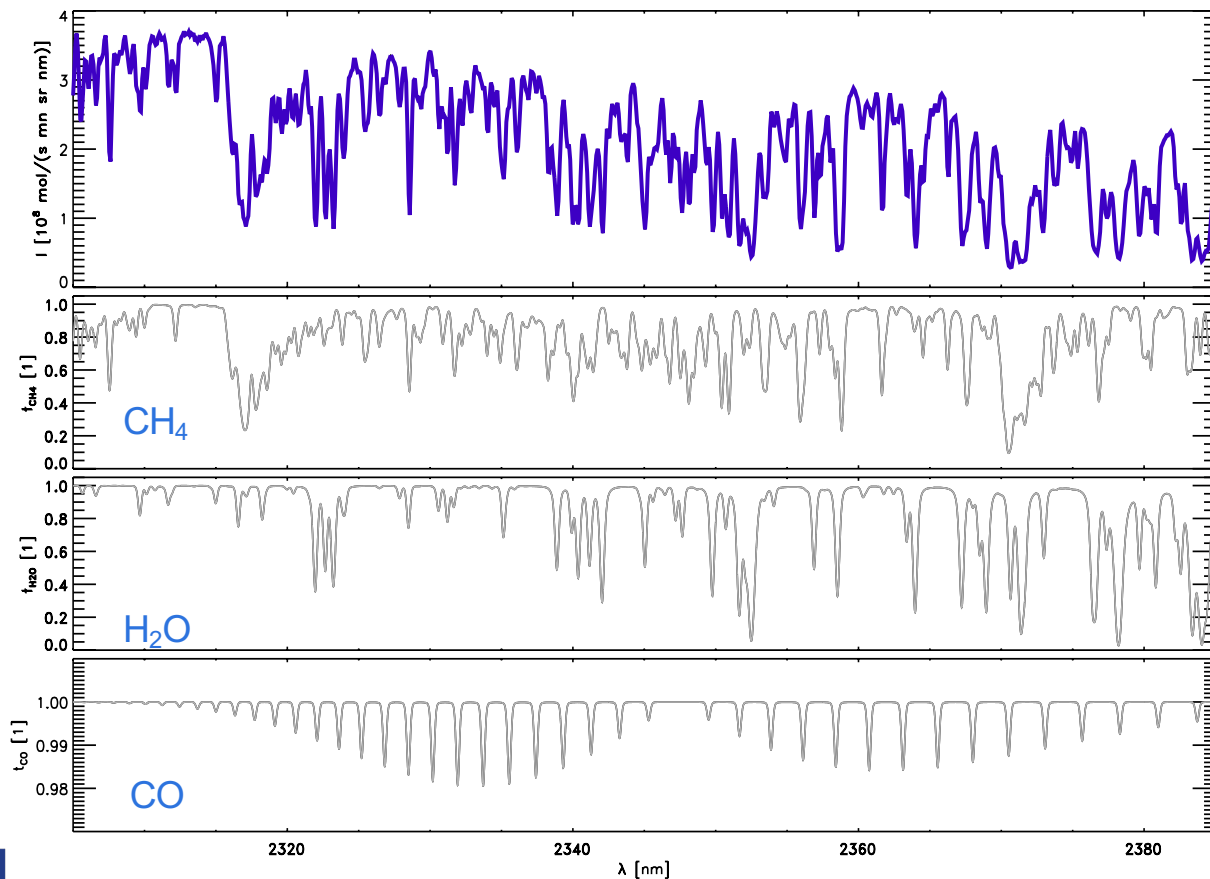
Absorption spectroscopy



The depth of the atmospheric absorption yields the amount of trace gas along the light path.



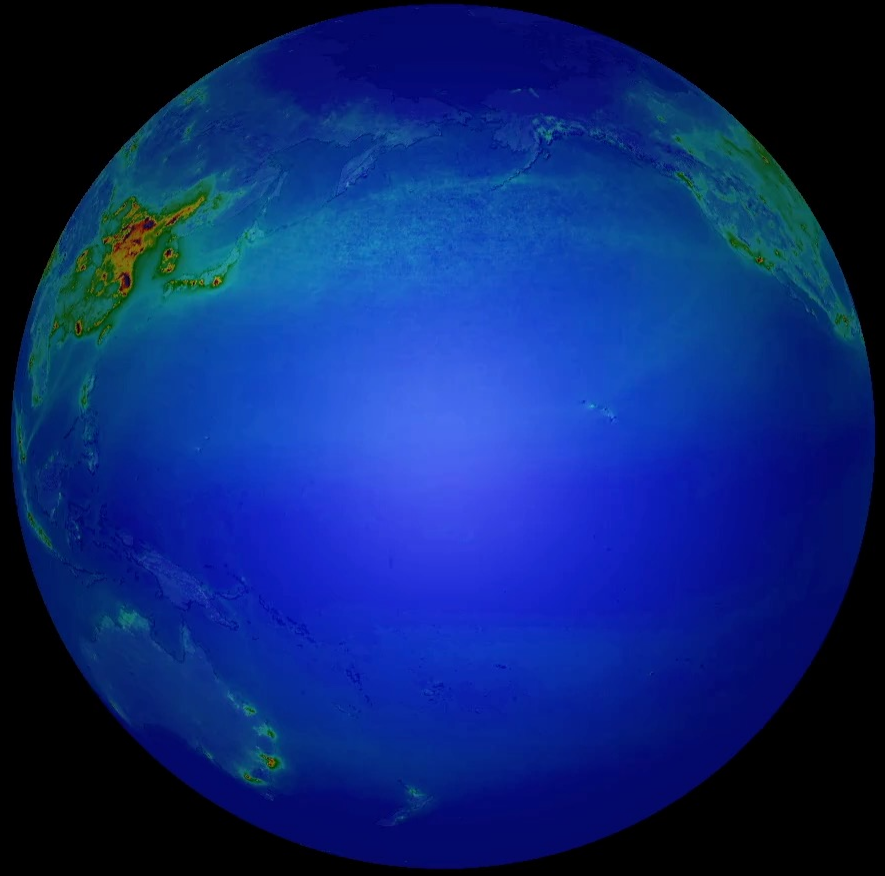
TROPOMI SWIR spectrum

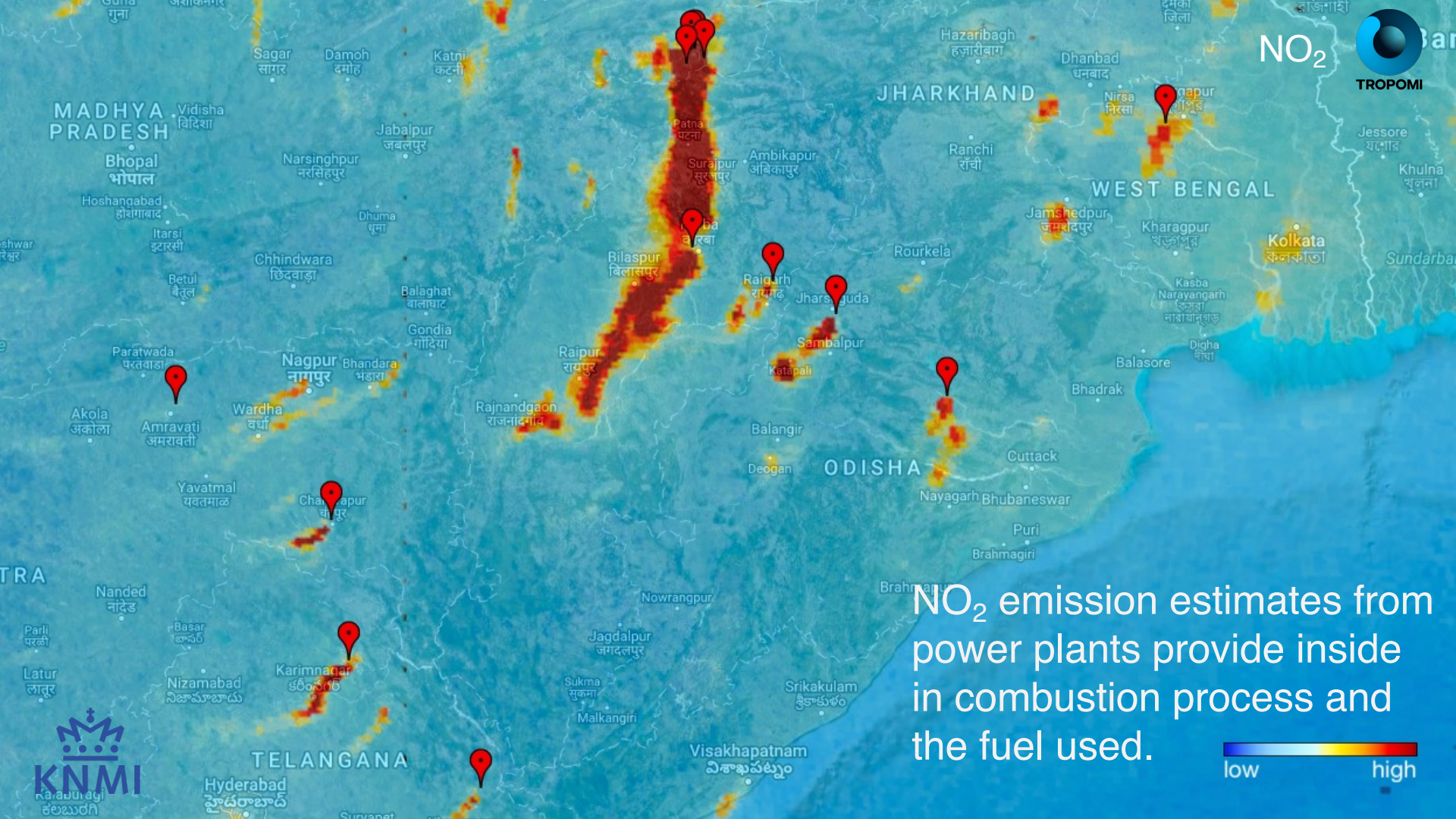


TROPOMI data processing

- TROPOMI Launch 2017, designed for 7 years in space: > 6 years of data
- Spatial resolution $5.5 \times 3.5 \text{ km}^2$ (VIS) and $5.5 \times 7 \text{ km}^2$ (SWIR)
- NO_2 , CO, CH_4 , H_2O retrieval developed in NL (KNMI/SRON)
- 139 Gb/orbit = 2 Tb/day
= 4.4 Pb/6 year
- Development and optimization of data processors requires HPC. SRON uses SURF GRID infrastructure







NO₂



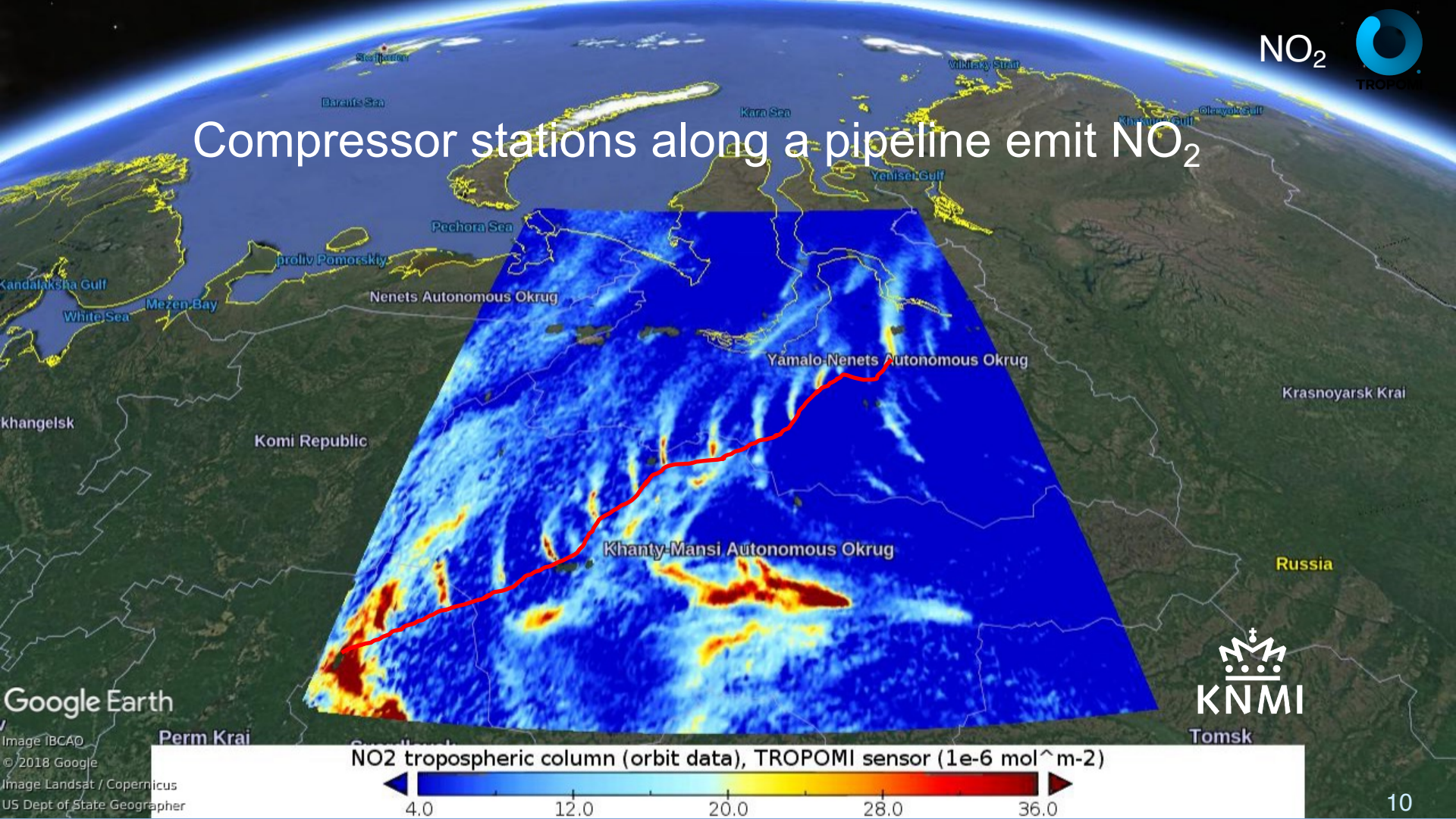
NO₂ emission estimates from power plants provide inside in combustion process and the fuel used.



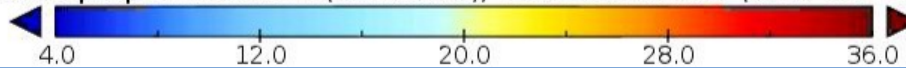
NO₂



Compressor stations along a pipeline emit NO₂



NO₂ tropospheric column (orbit data), TROPOMI sensor (1e-6 mol[^]m-2)



Google Earth

Image IBCAO

© 2018 Google

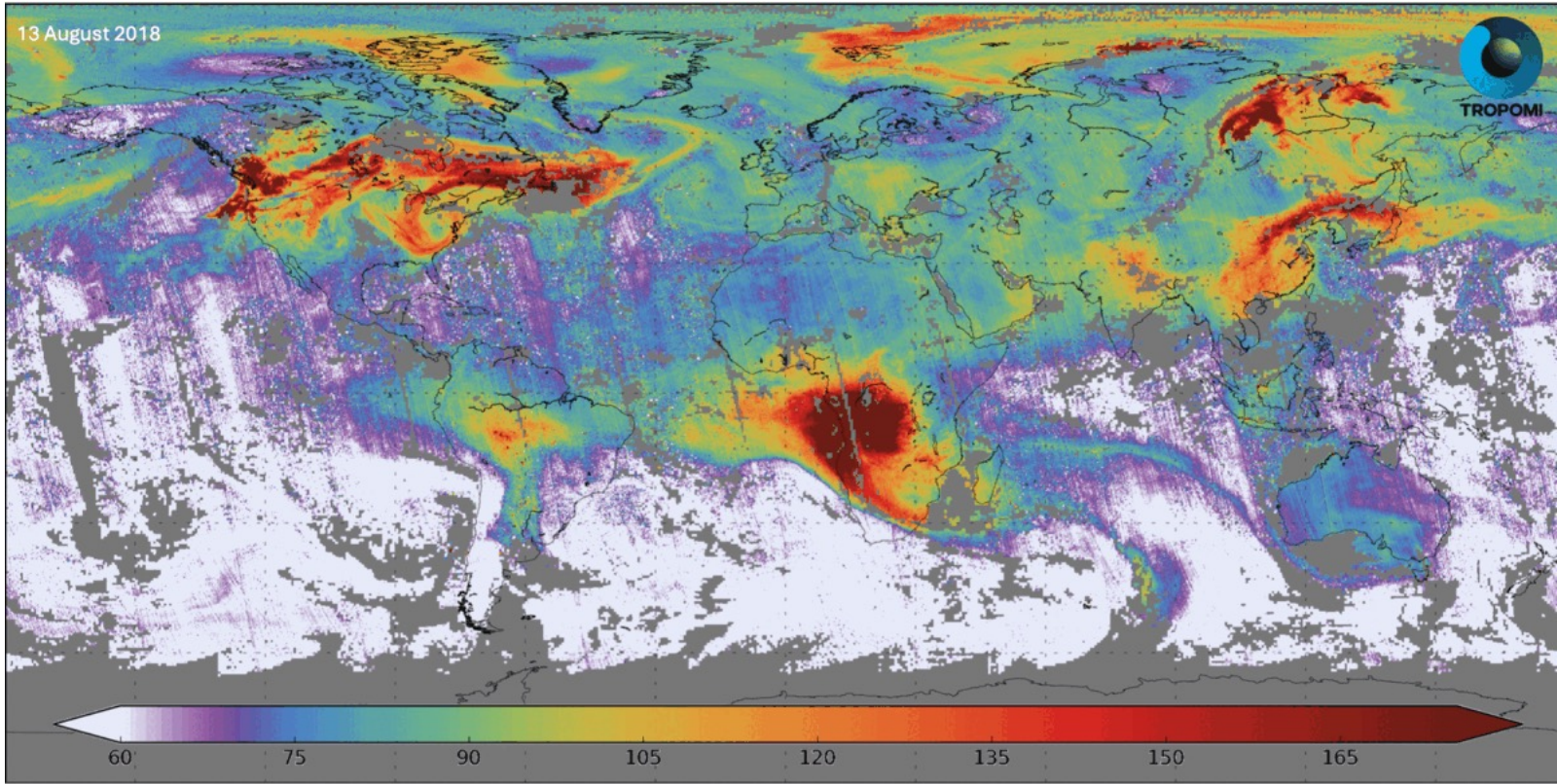
Image Landsat / Copernicus

US Dept of State Geographer



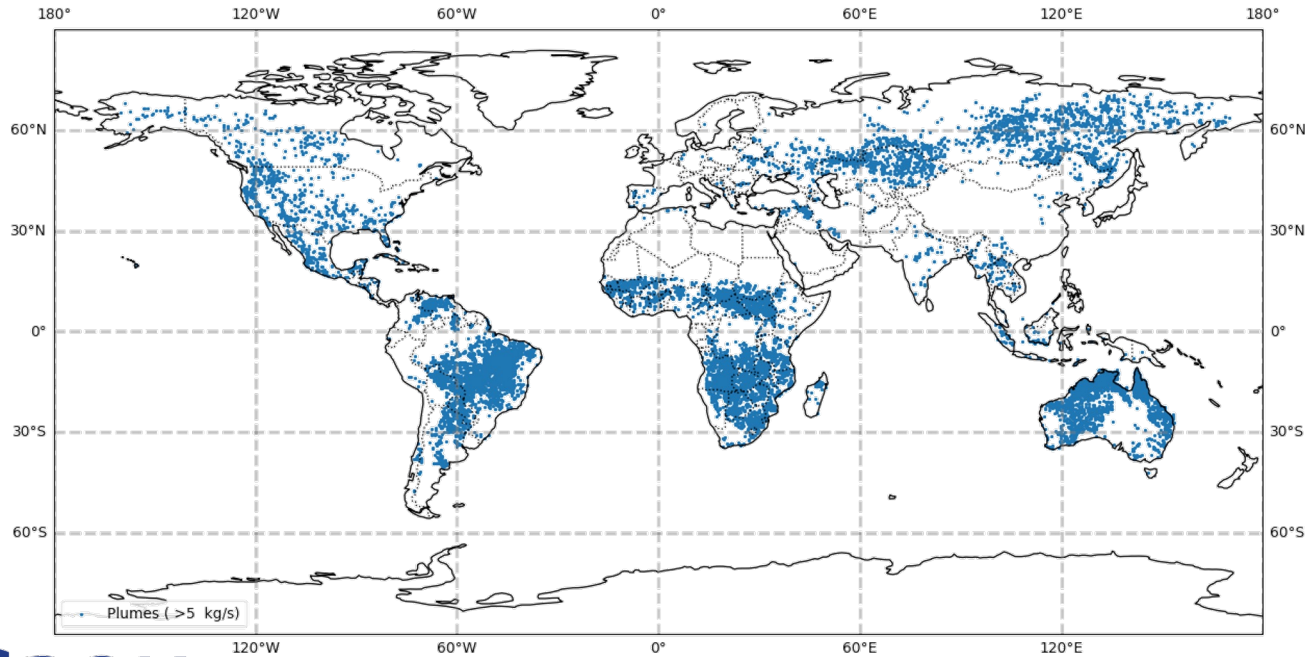
Tomsk

TROPOMI CO: Six consecutive days



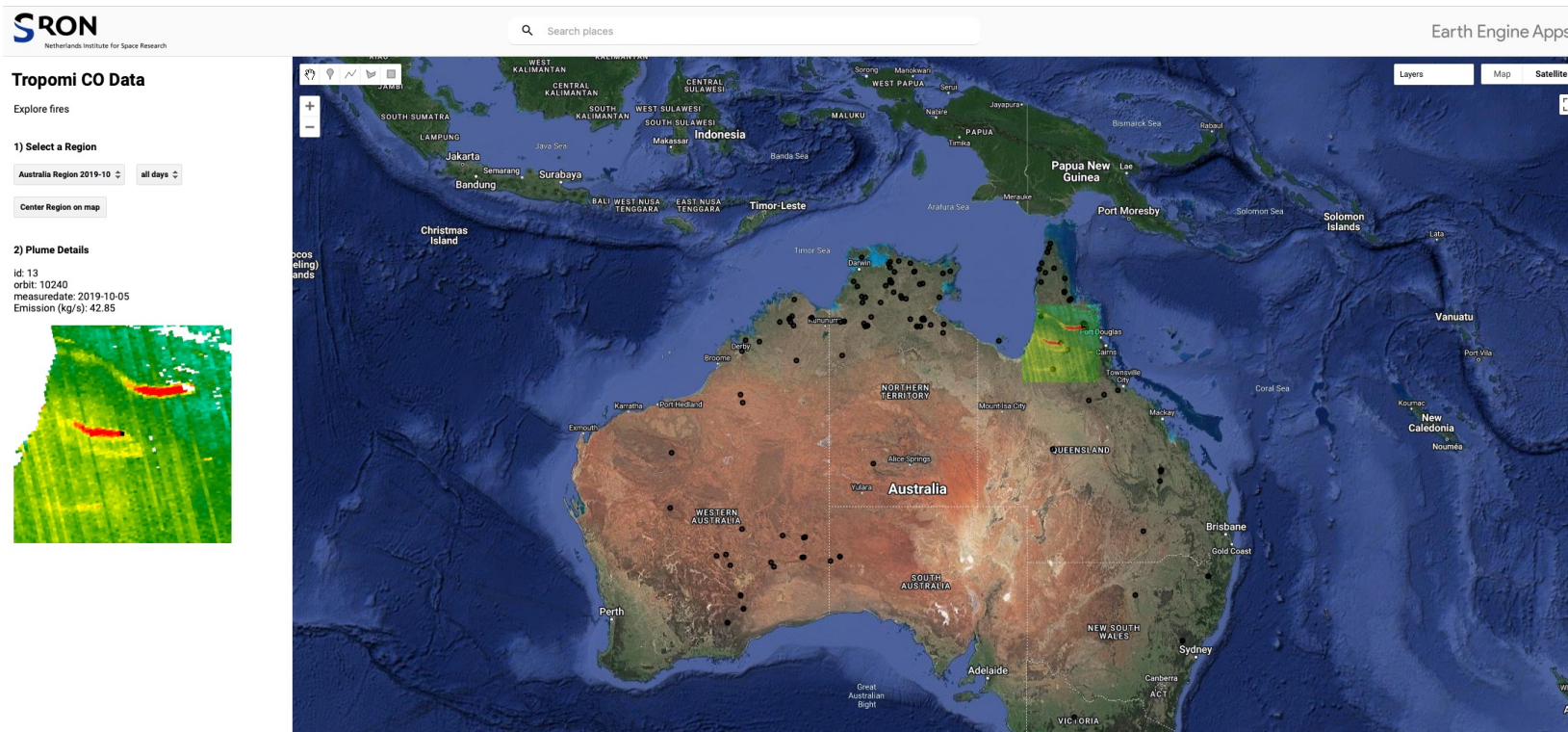
CO plumes from localized fires

- **“Wildfires are a result of temperature conditions, of soil moisture conditions; and, of course, something has to start it.”**

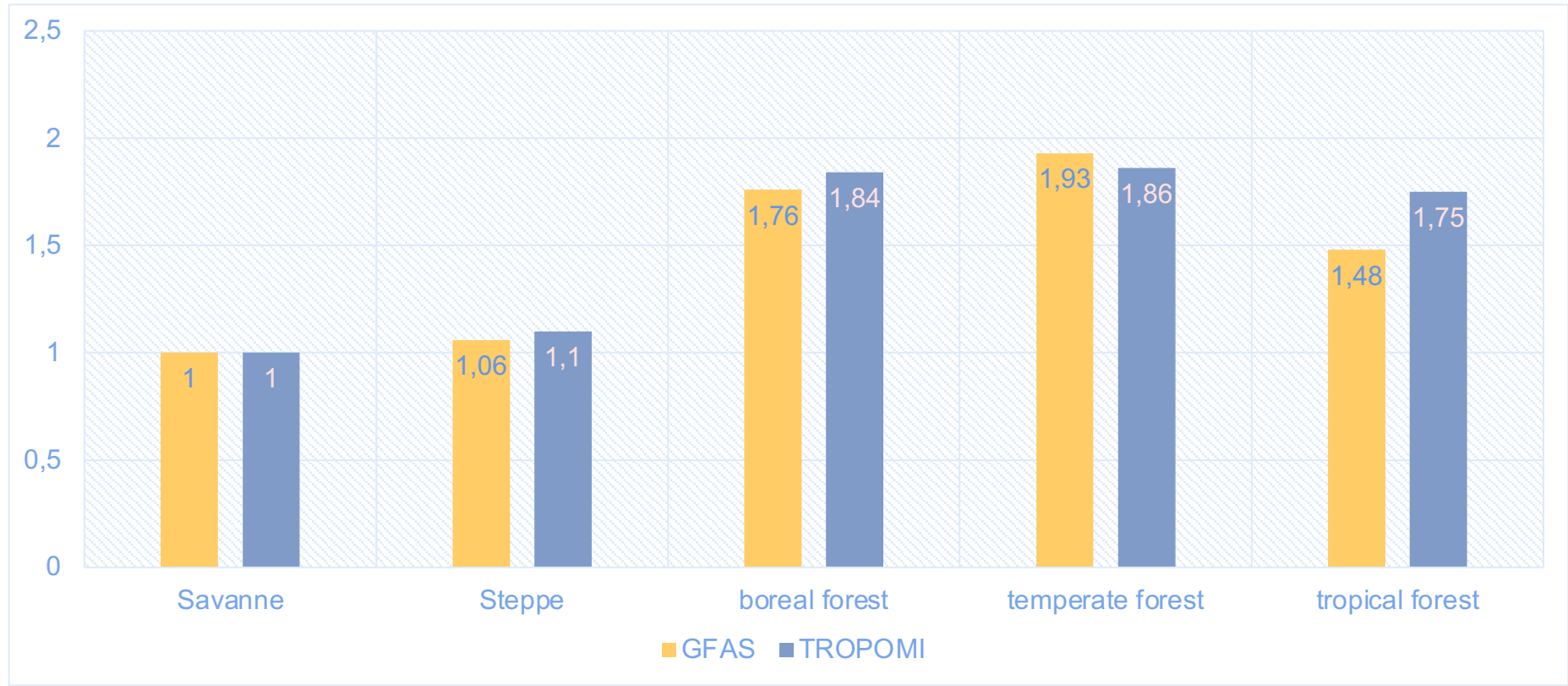


John P. Holdren

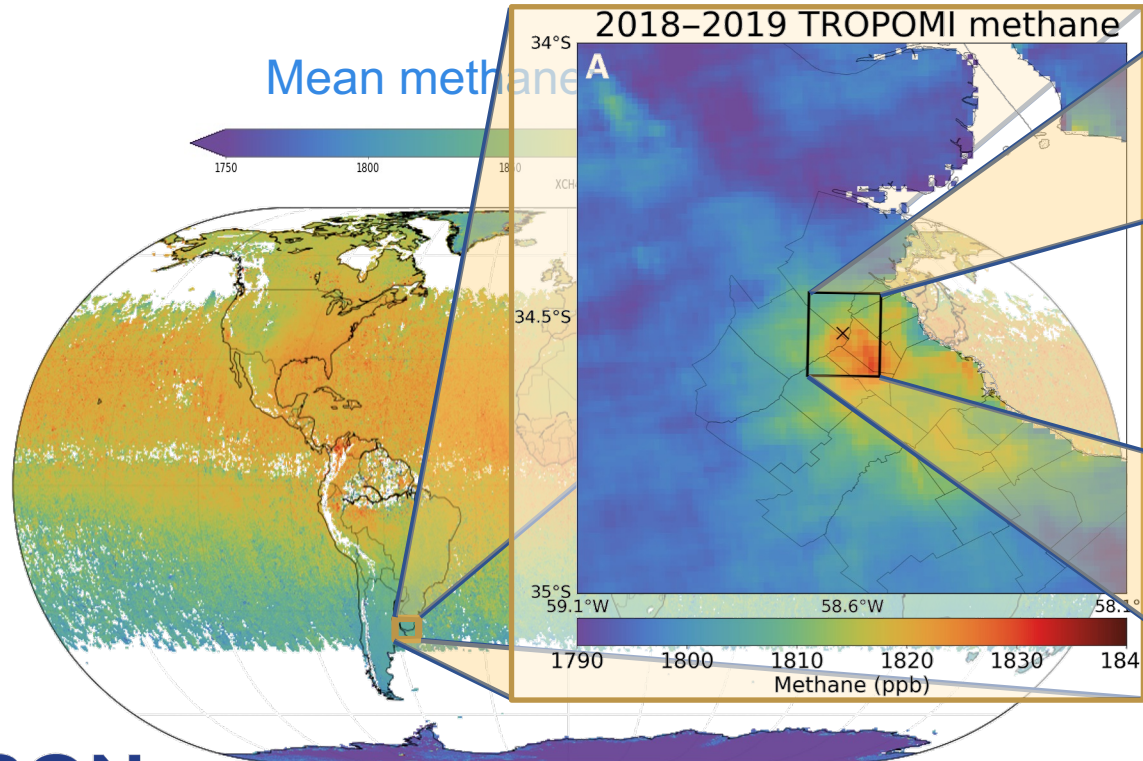
Small fire emissions: An Earth engine app



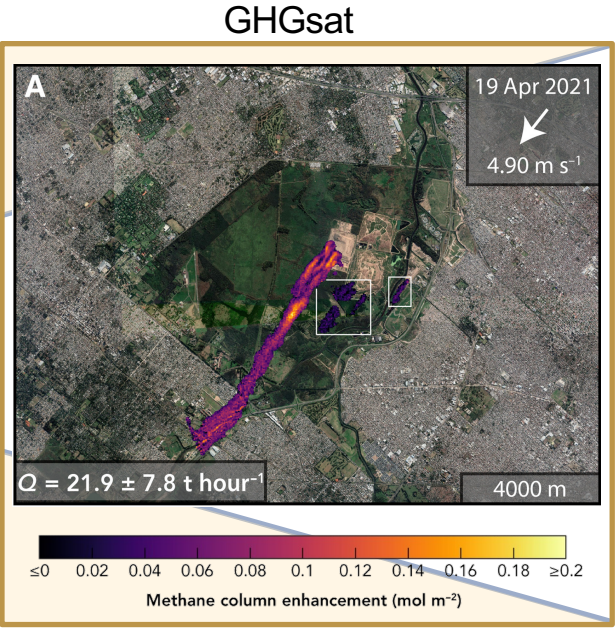
Relative emissions depend on fire type



TROPOMI CH₄: A Survey and a Targeted Mission



Borsdorff, Valerte

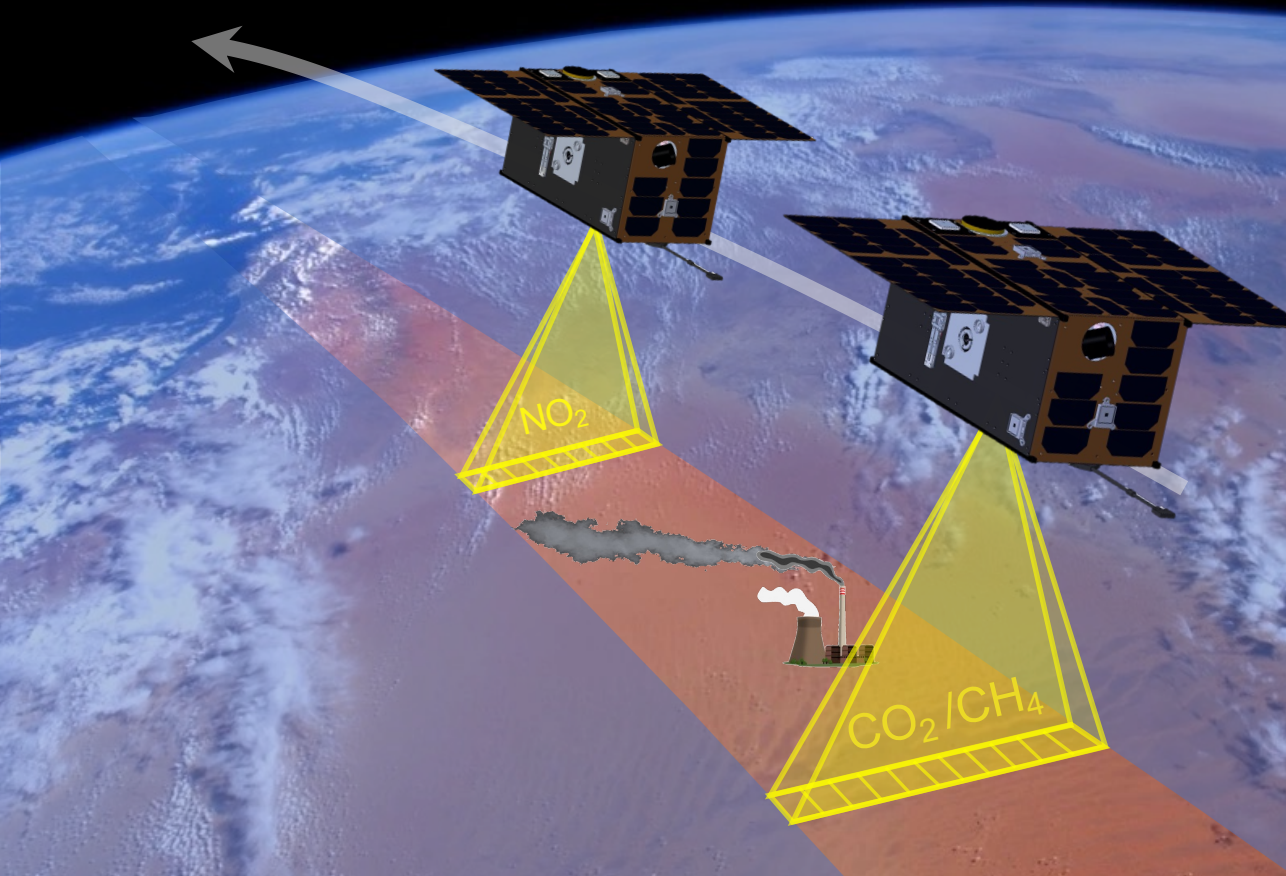


Maasackers et al., Science, 2022



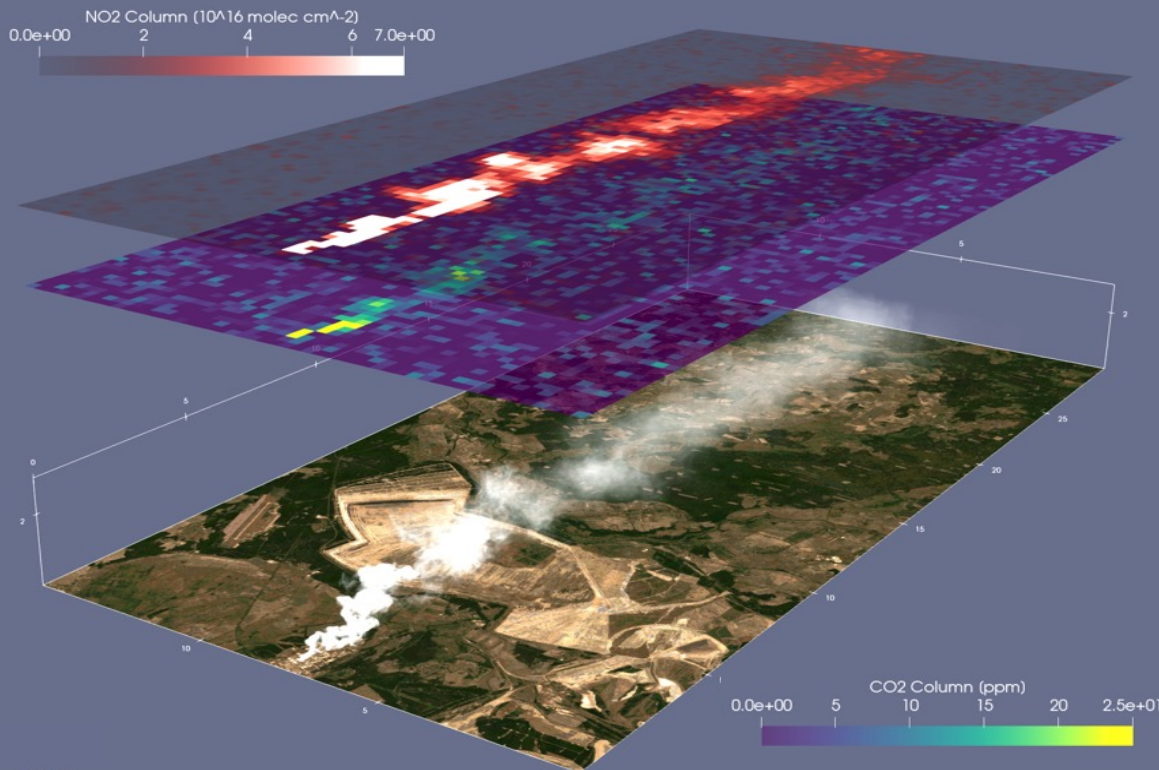


Two CubeSats (16 U): TANGO-Carbon and TANGO-Nitro



- Collocated CO₂/CH₄ and NO₂ measurements
- 30×30 km² field of view with a spatial resolution of 180/ 300 m
- Science mission
- Open data - open-source policy
- To be implemented into the ESA's SCOUT program

TANGO is a Targeted Mission



Jämschwalde, East Germany



TANGO measures:

- CO₂ and CH₄ total column concentrations at spatial resolutions of individual industrial facilities worldwide.
- Collocated NO₂ tropospheric column concentrations to detect the plume air masses

Going big, going small?

*It's the combination that
makes the difference!*

