Royal Netherlands
Meteorological Institute
Ministry of Infrastructure
and Water Management

esa

S5P/TROPOMI highlights and synergies with the GEO Constellation

The S5P/TROPOMI Team
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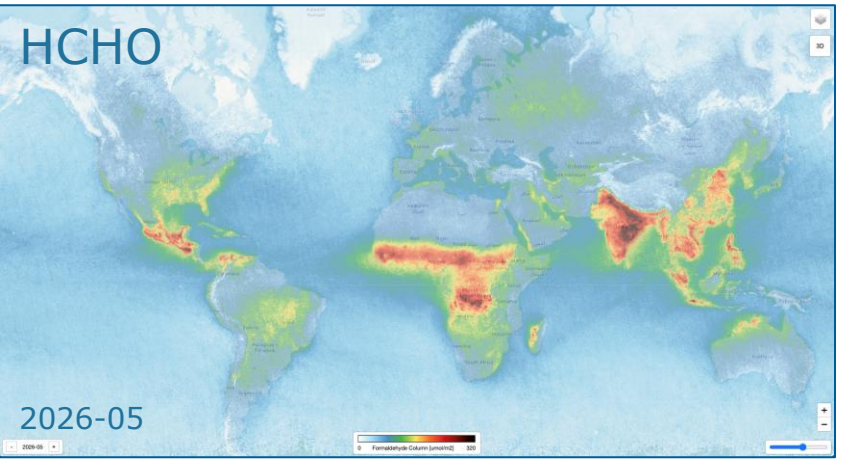
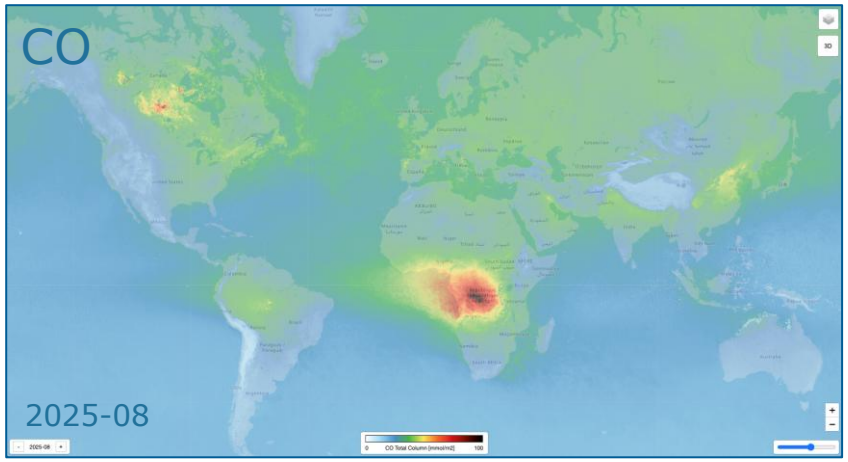
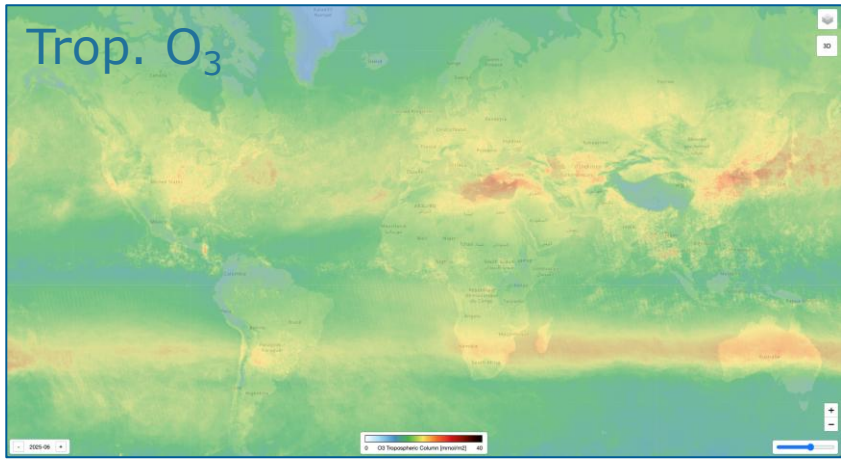
MAX PLANCK INSTITUTE FOR CHEMISTRY

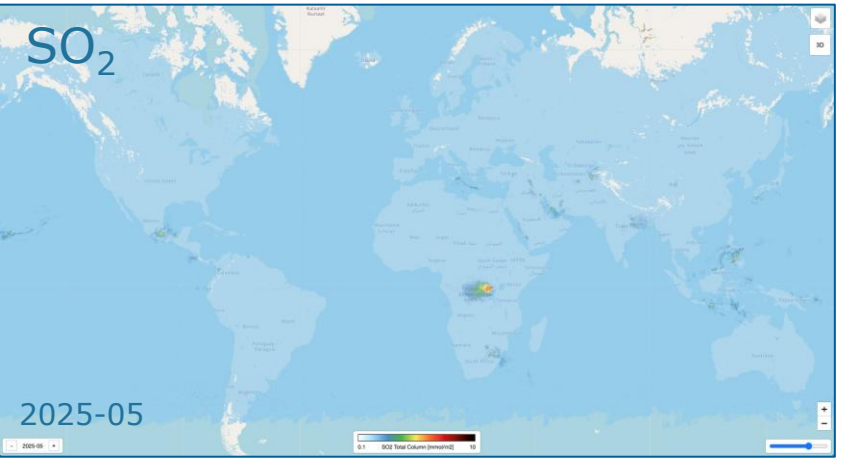
TROPOMI Data Products | Air Quality

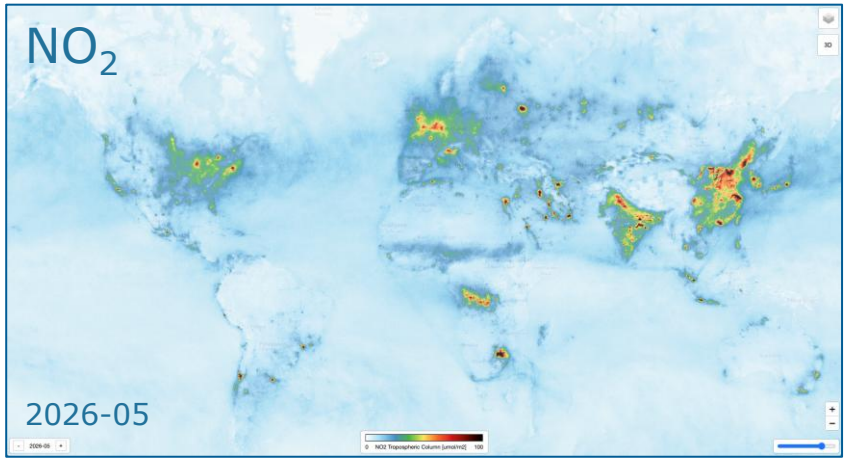
Product	Application	Constellation		
O_3 Profile	Air quality monitoring	S5P/S5/G/T	Oper.	L2
O_3 Tropospheric Column	Air quality monitoring	S4/S5/G/T	Oper.	L2/L3
NO_2	Air quality forecast and monitoring	S4/S5/G/T	Oper.	L2/L3
CO	Air quality forecast and monitoring	S5	Oper.	L2/L3
CH_2O	Air quality forecast and monitoring	S4/S5/G/T	Oper.	L2/L3
SO_2	Air quality forecast and monitoring	S4/S5/G/T	Oper.	L2/L3
Aerosol UV Index	Air quality monitoring	S4/S5/G/T	Oper.	L2/L3
Aerosol Layer Height	Air quality monitoring	S4/S5/G/T	Oper.	L2/L3
Aerosol Optical Depth	Air quality monitoring	S4/S5/G/T	Pre.	L2/L3
CHOCHO	Air quality monitoring	S4/S5/G/T	Pre.	L2/L3
HONO	Air quality monitoring	-	Pre.	L2

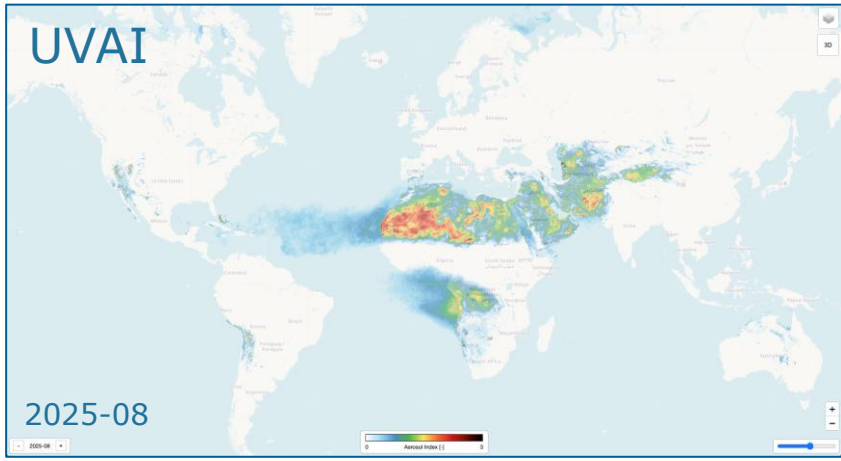

HCHO
2026-05


CO
2025-08

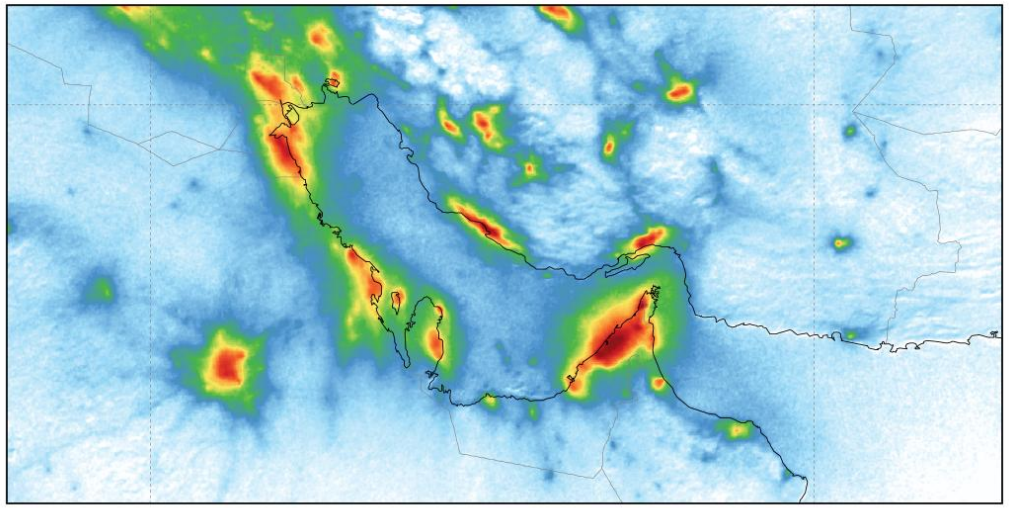

Trop. O_3


SO_2
2025-05


NO_2
2026-05

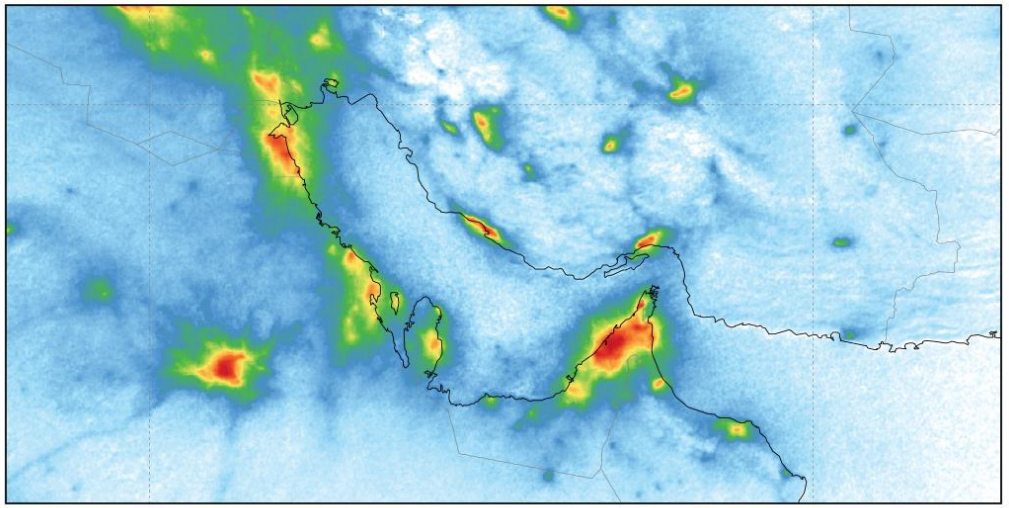

UVAI
2025-08

TROPOMI NO_2 Tropospheric Column
2025 Mar/Apr

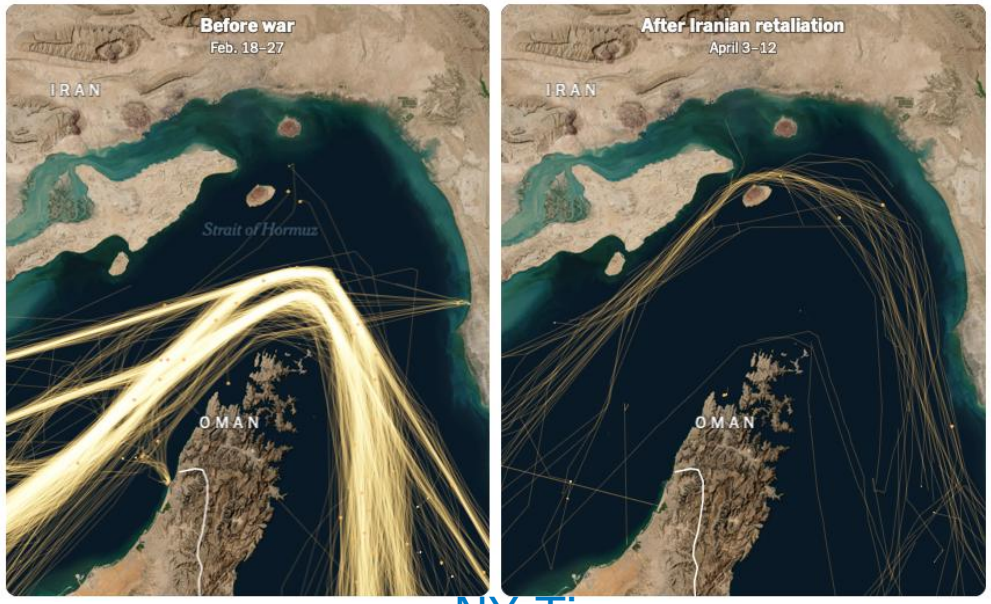


NO_2 Tropospheric Column [µmol m^{-2}]
10 100

TROPOMI NO_2 Tropospheric Column
2026 Mar/Apr

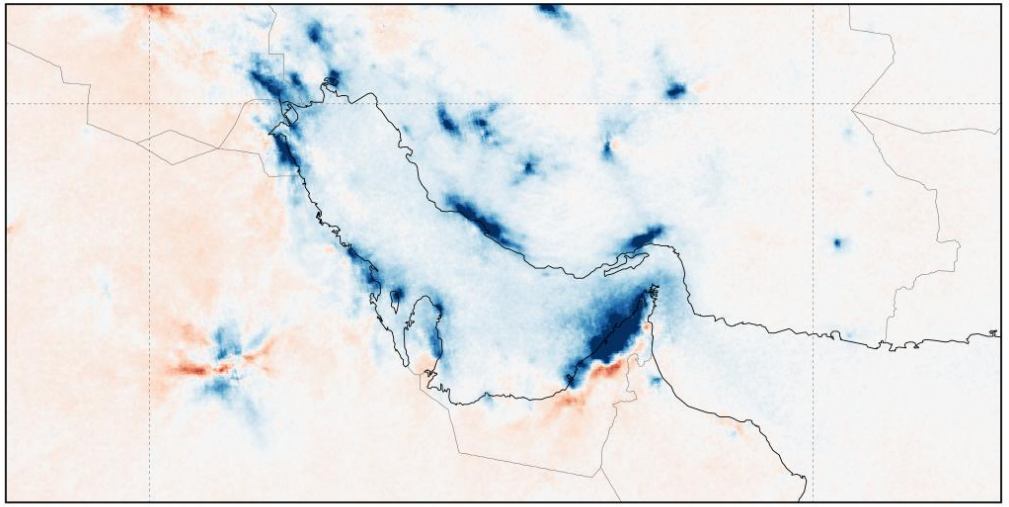


NO_2 Tropospheric Column [µmol m^{-2}]
10 100



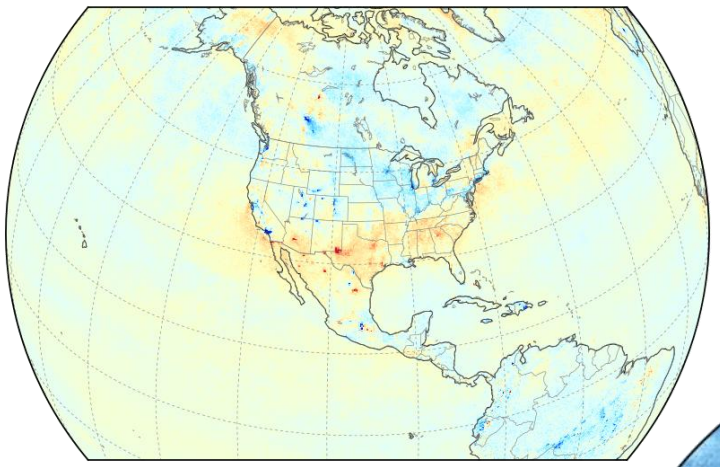
source NY Times

TROPOMI NO_2 Tropospheric Column
2026 Mar/Apr minus 2025 Mar/Apr



NO_2 Tropospheric Column [µmol m^{-2}]
−50 −30 −10 10 30 50

S5P/TROPOMI Difference 2025 minus 2018/2019

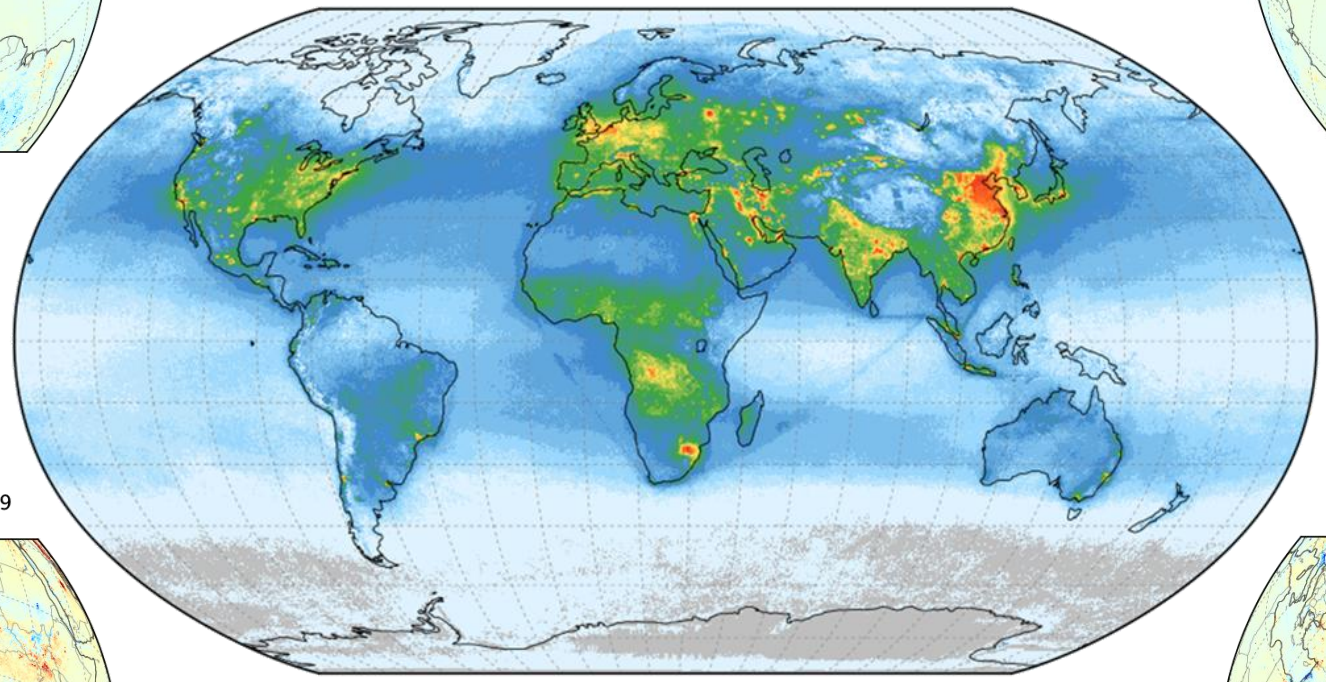


Tropospheric NO_2 Column [µmol m^{-2}]

−15 −10 −5 0 5 10 15

Data Min = −57, Max = 30

TROPOMI NO_2 2025

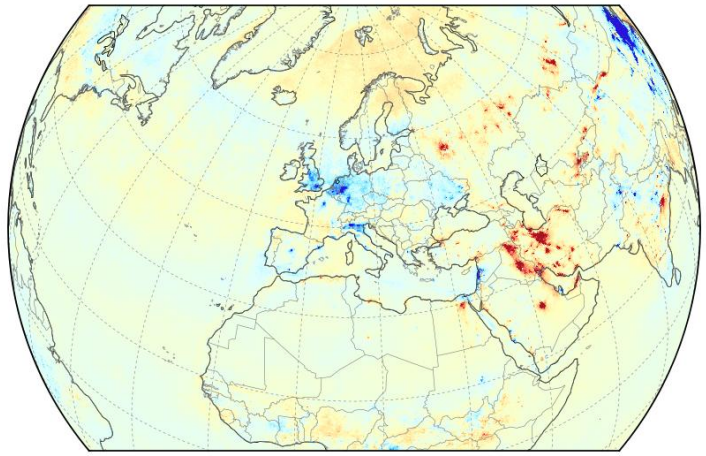


tropospheric NO2 column number density (0.001 m−2.mol)

0.01 0.10

Data Min = −0.04, Max = 0.86, Mean = 0.01

S5P/TROPOMI Difference 2025 minus 2018/2019

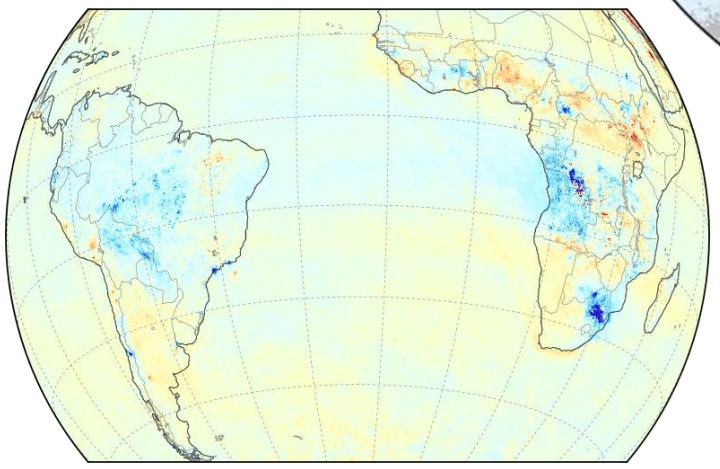


Tropospheric NO_2 Column [µmol m^{-2}]

−25 −20 −15 −10 −5 0 5 10 15 20 25

Data Min = −163, Max = 147

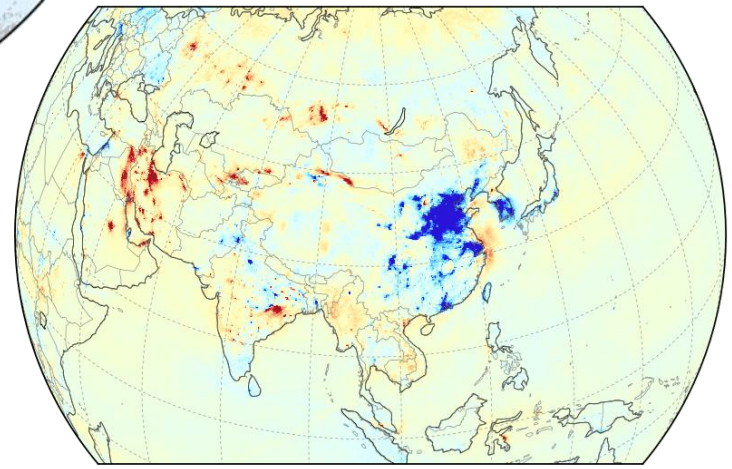
S5P/TROPOMI Difference 2025 minus 2018/2019



Tropospheric NO_2 Column [µmol m^{-2}]

−15 −10 −5 0 5 10 15

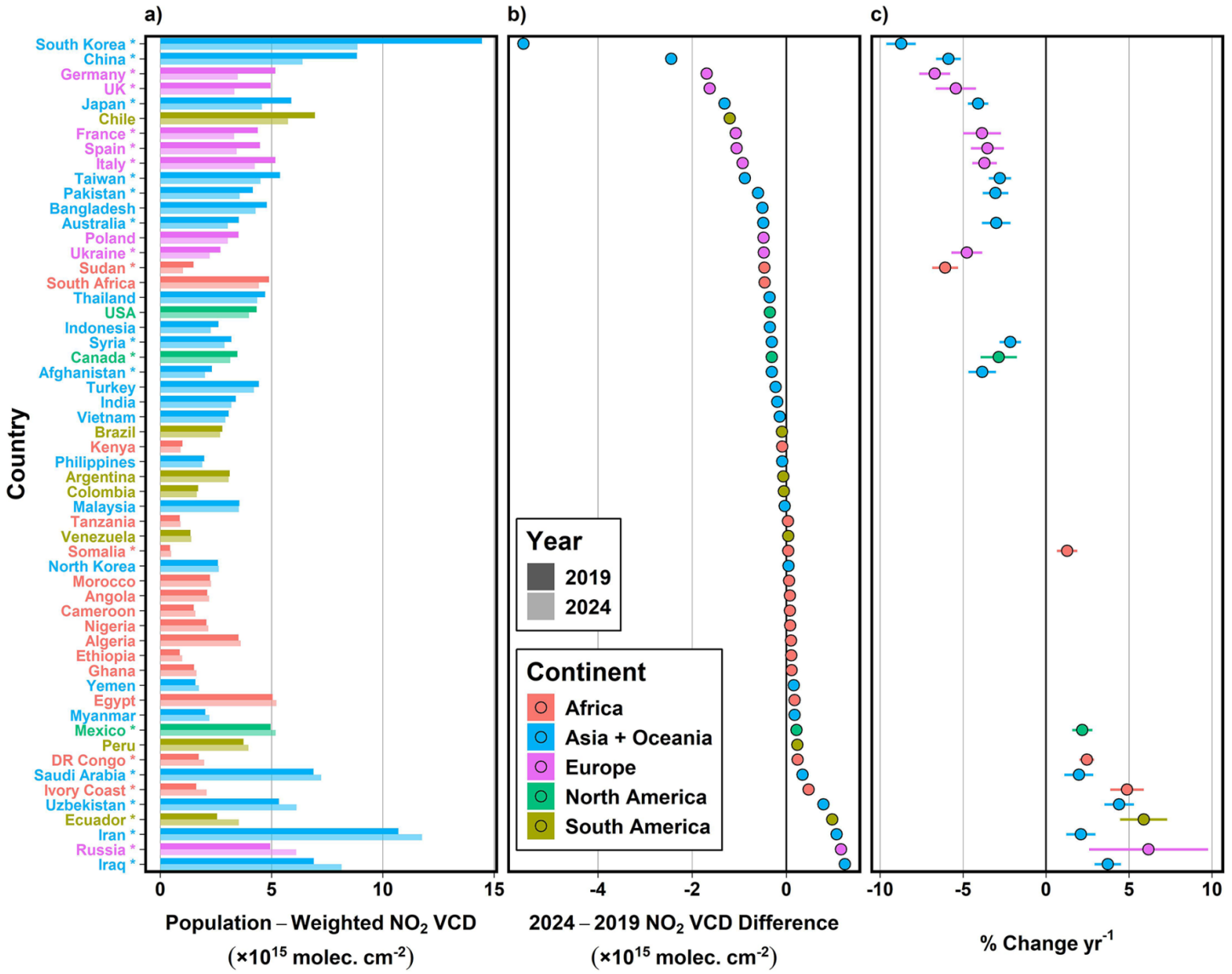
S5P/TROPOMI Difference 2025 minus 2018/2019



Tropospheric NO_2 Column [µmol m^{-2}]

−25 −20 −15 −10 −5 0 5 10 15 20 25

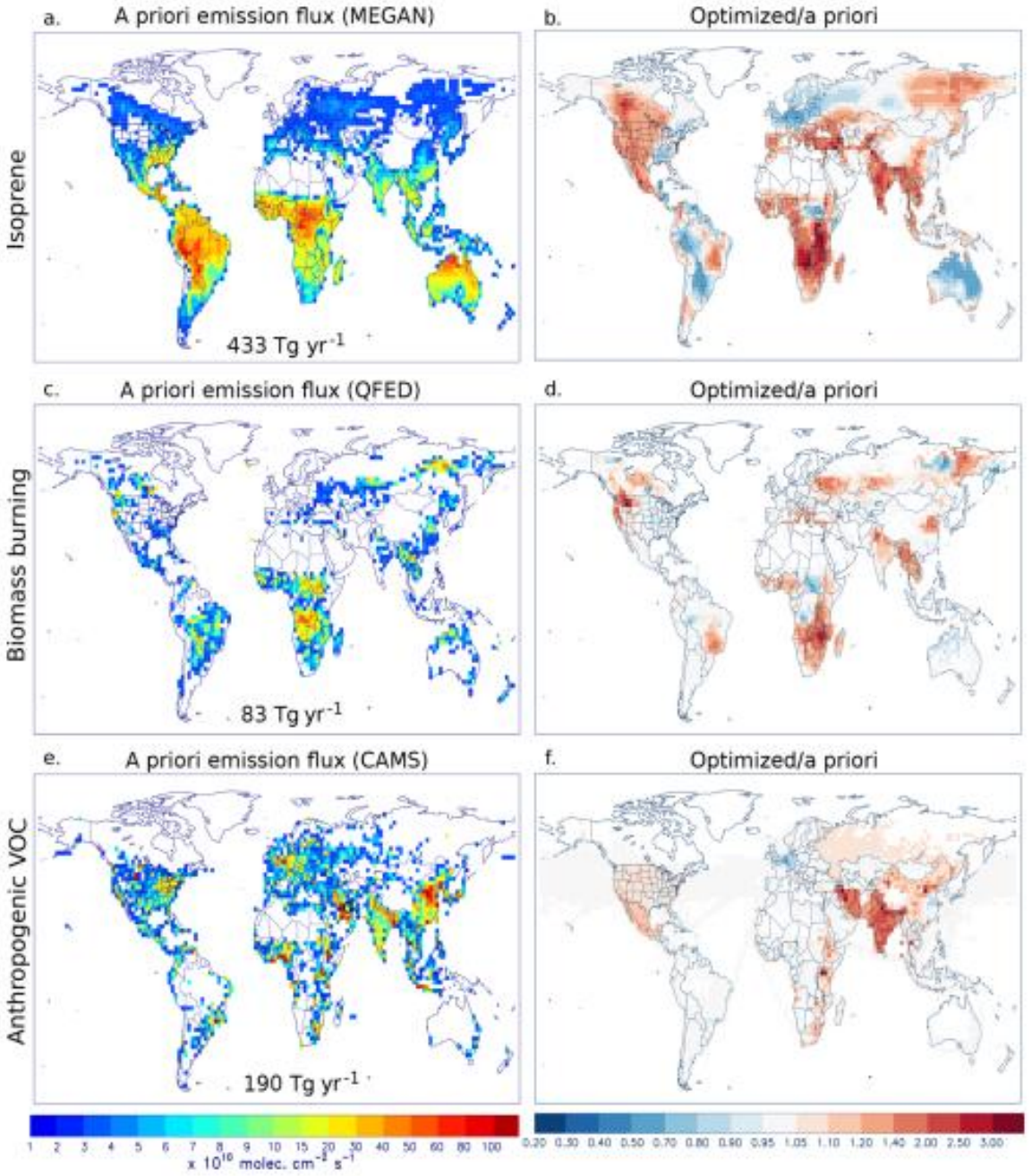
esa TROPOMI Copernicus



Global NO_2 changes between 2019 and 2024 as observed by TROPOMI in urban areas and emerging hotspots, Huber et. al, 2026, George Washington University

Global VOC emissions quantified from inversion of TROPOMI spaceborne formaldehyde and glyoxal data, 2026, Yasmine Sfendla, et al. BIRA

"The global fluxes of isoprene, biomass burning, and anthropogenic VOC emissions are moderately increased by the inversion, by 13 %, 12 % and 20 %, respectively, compared to the bottom-up fluxes, but the inferred changes are significantly more pronounced at regional scale. The excellent top-down HCHO column agreement in Southern Hemisphere Africa is attained thanks to the strong increase of emissions with respect to the bottom-up inventories used in the model across all categories: 85 % more isoprene, 30 % more biomass burning VOCs and 40 % more anthropogenic VOCs."



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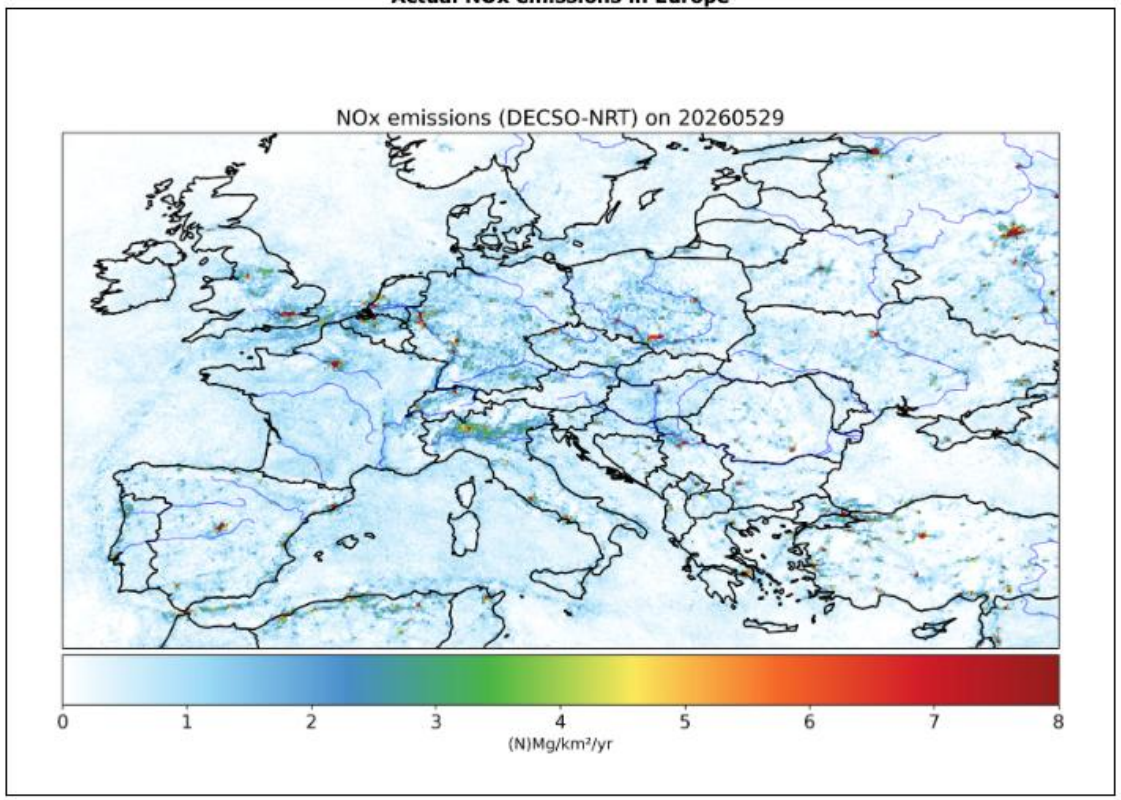
Select instrument: NOx_TROPOMI : Emissions using TROPOMI

NOx emissions in Europe (TROPOMI)

Near-real time NOx emissions derived from TROPOMI tropospheric NO2 column satellite observations. The current DECSO (Daily Emissions Constrained by Satellite Observations) algorithm is version 6.5.

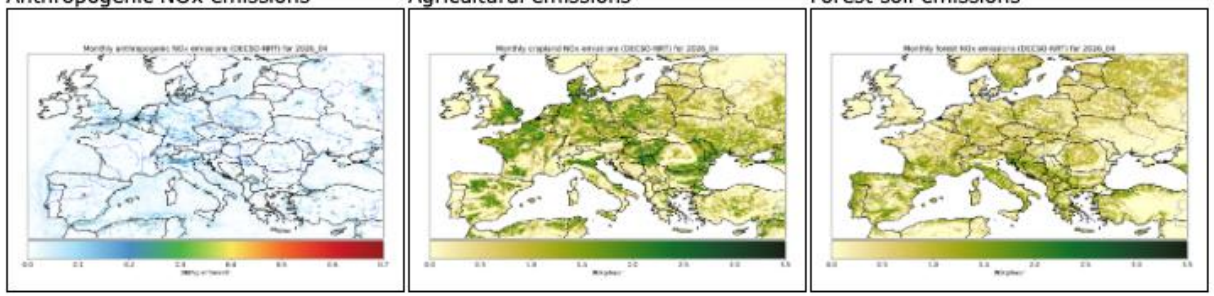
A service of the Sentinel User Programme of ESA (DECSO-NRT-EUROPE project).

Actual NOx emissions in Europe



Monthly NOx emissions of last month

Anthropogenic NOx emissions | Agricultural emissions | Forest soil emissions



https://www.temis.nl/emissions/region_europe/decso_nrt.php

Mission	Spatial Coverage	Agency	Status
Sentinel 5P/TROPOMI	Global PM	EU	Operational
Sentinel 5/UVNS	Global AM	EU	Commissioning
GEMS	SE-Asia	NIER	Operational
TEMPO	N-America	NASA	Operational
Sentinel 4/UVN	Europe	EU	Commissioning
NOAA NPP/20/21[1]	Global PM	NOAA	Operational
Fengyun/3F[1]	Global AM/PM	CMA	Operational

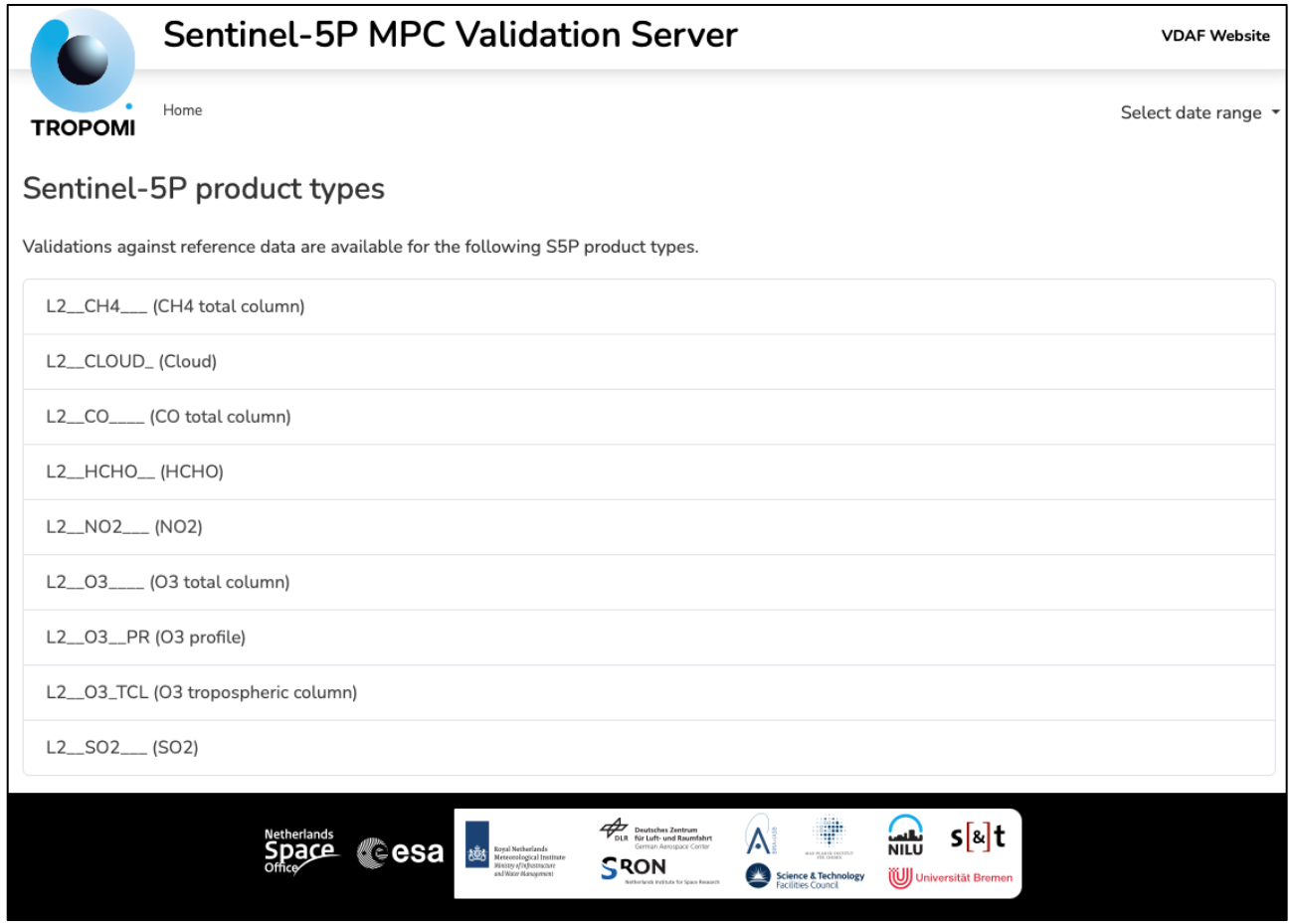
1) Limited spatial resolution and spectral coverage

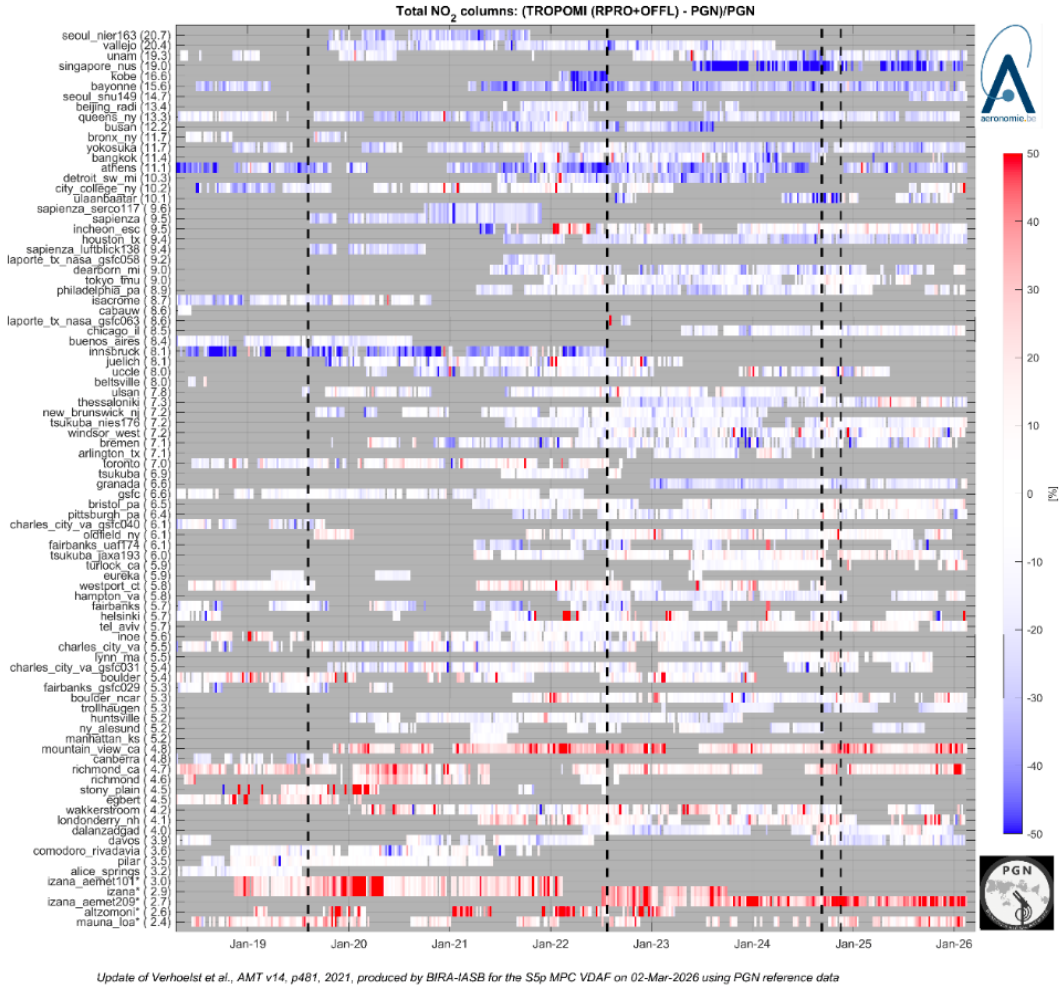
Constellations Activities
harmonization & intercomparison

- Algorithms
  - Methods & evolution, auxiliary data, etc.
- In-flight Calibration approach
  - Calibration methods
  - Solar irradiance reference spectra
  - Vicarious calibration methods and targets
- In-flight Validation approach
- Data formats

Mission	Agency
Sentinel 5P/TROPOMI	EU
Sentinel 5/UVNS	EU
GEMS	NIER
TEMPO	NASA
Sentinel 4/UVN	EU
NOAA NPP/20/21	NOAA
Fengyun/3F	CMA

Validation

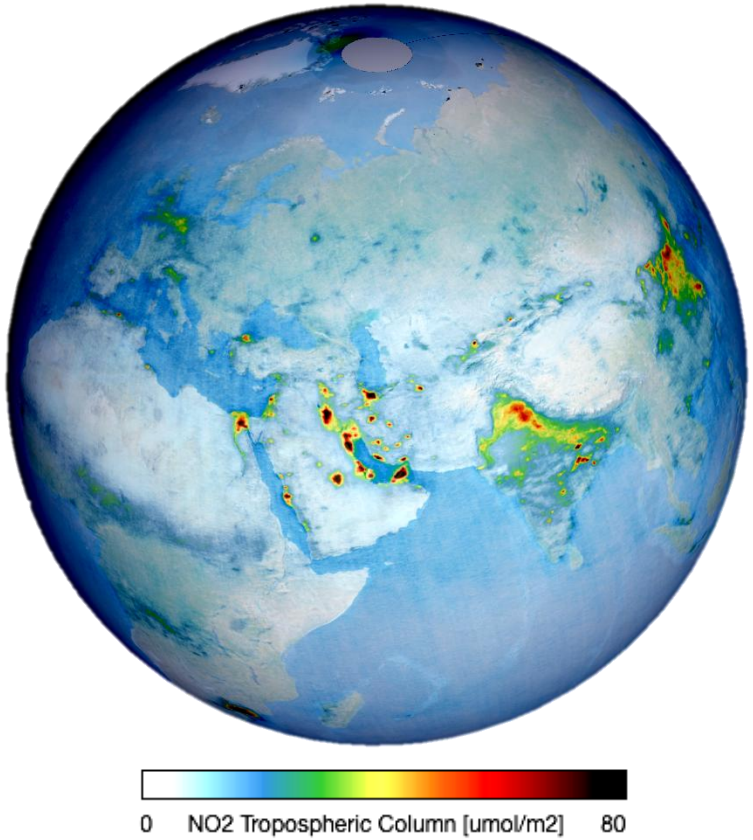




Update of Verhoelst et al., AMT v14, p481, 2021, produced by BIRA-IASB for the S5p MPC VDAF on 02-Mar-2026 using PGN reference data

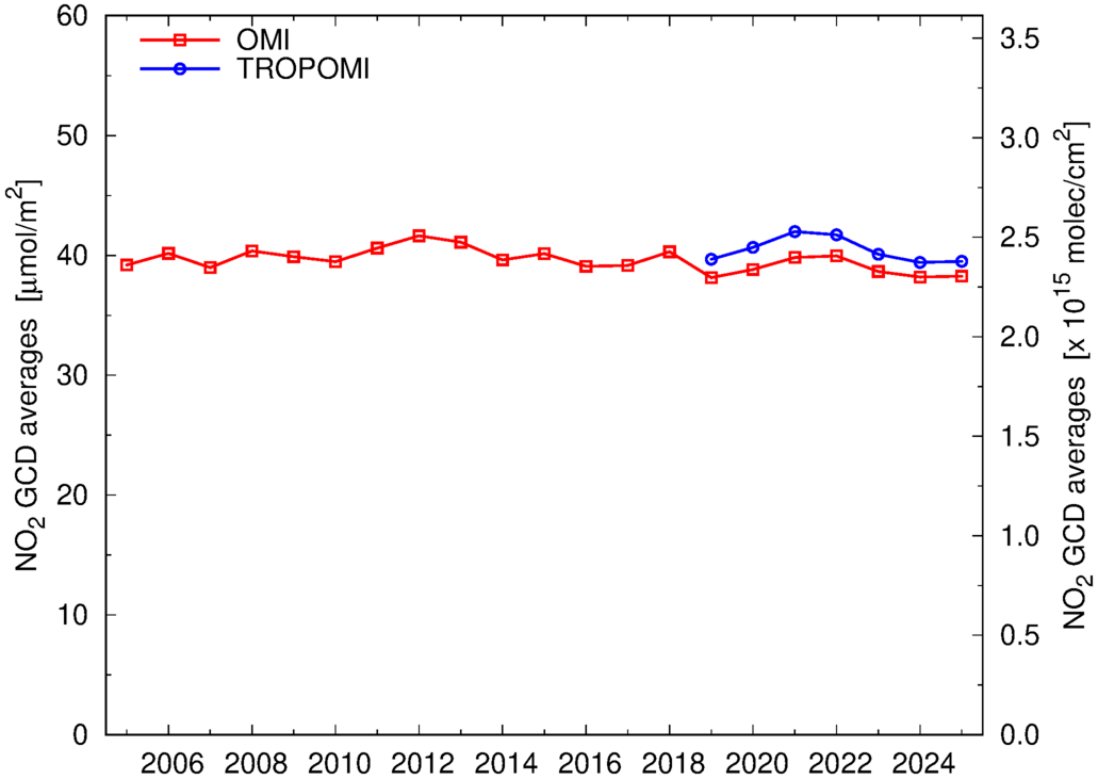
OMI Nitrogen Dioxide

NO_2 Tropospheric Column April 2025



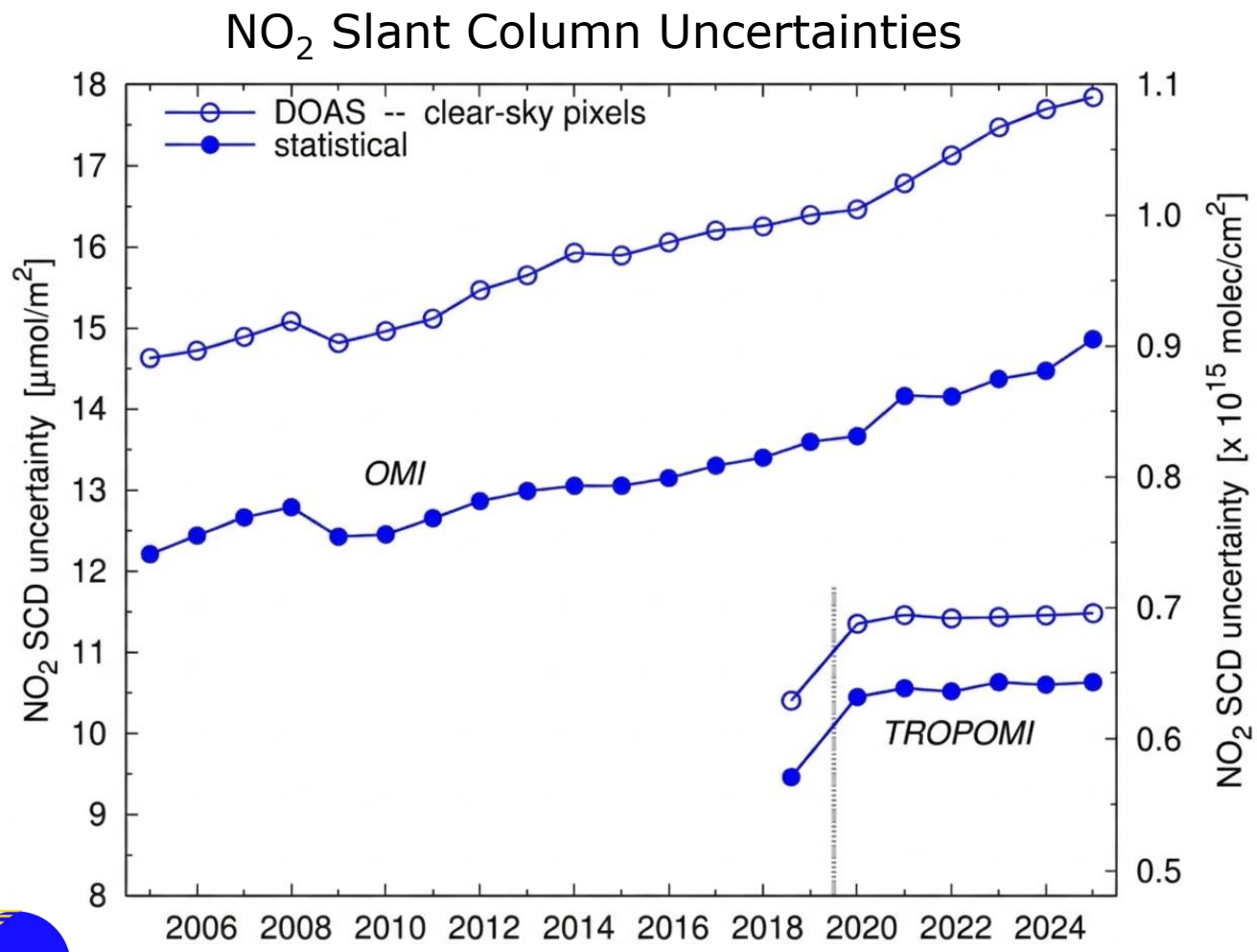
Mean OMI NO2 Tropospheric Column for April 2025 over Europe, the Middle East, and Asia

Time Series over Tropical Pacific Ocean



Geometric column density (GCD) averages over a 30° tropical latitude range (i.e. it moves north-south with the season) of Pacific Ocean orbits. Daily average values are averaged over calendar years. The TROPOMI GCD is 1.5 to 2e-6 mol/m^2 larger than the OMI GCD, or about 5%, which is well within the average uncertainty on the GCD.

OMI Nitrogen Dioxide Uncertainty



The NO_2 slant column density (SCD) is the result of the spectral fitting of the Level 1B data. The SCD uncertainty can be computed using propagation of instrument noise or derived of clean background regions. The timeseries of uncertainty show an increase of <25% over the entire OMI mission lifetime.

OMI
KNMI-FMI-NASA

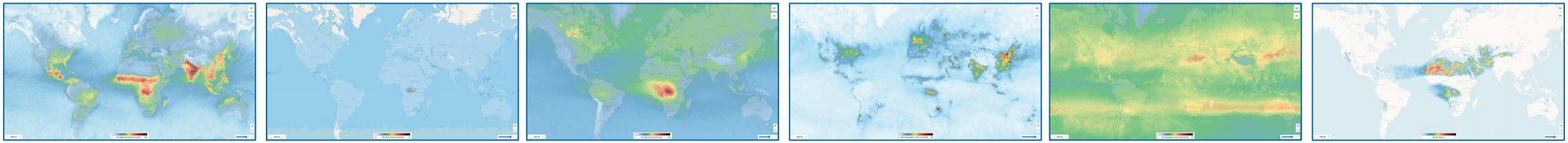
TROPOMI

S5P/TROPOMI Continuation after 2027

- **Orbital synergy**
  The early afternoon orbit of S5P perfectly complements the morning orbit (09:30 LT) of the MetopSG-I (Sentinel-5) platforms. Together, they will enable twice-daily global observations that capture crucial diurnal variations, particularly over the Global South
- **Preserving a 30-Year Climate Data Record**
  Operating in an early afternoon orbit (13:30 LT), S5P seamlessly continues the time series initiated by the OMI instrument in 2004.
- **Unmatched Spatial Resolution for Global Measurements**
  The Sentinel-4 and Sentinel-5 missions should be viewed as complementary to S5P, not as direct replacements. S5P possesses superior spatial resolution — more than 2.5 times finer than S5 and 3 times finer than S4 (at 45°N) in the UV-VIS bands, and 1.3 times finer than Sentinel-5 in the SWIR bands.
- **Essential Commissioning Support**
  Extending S5P provides the necessary temporal overlap required to commission both Sentinel-5 and the upcoming CO2M mission.

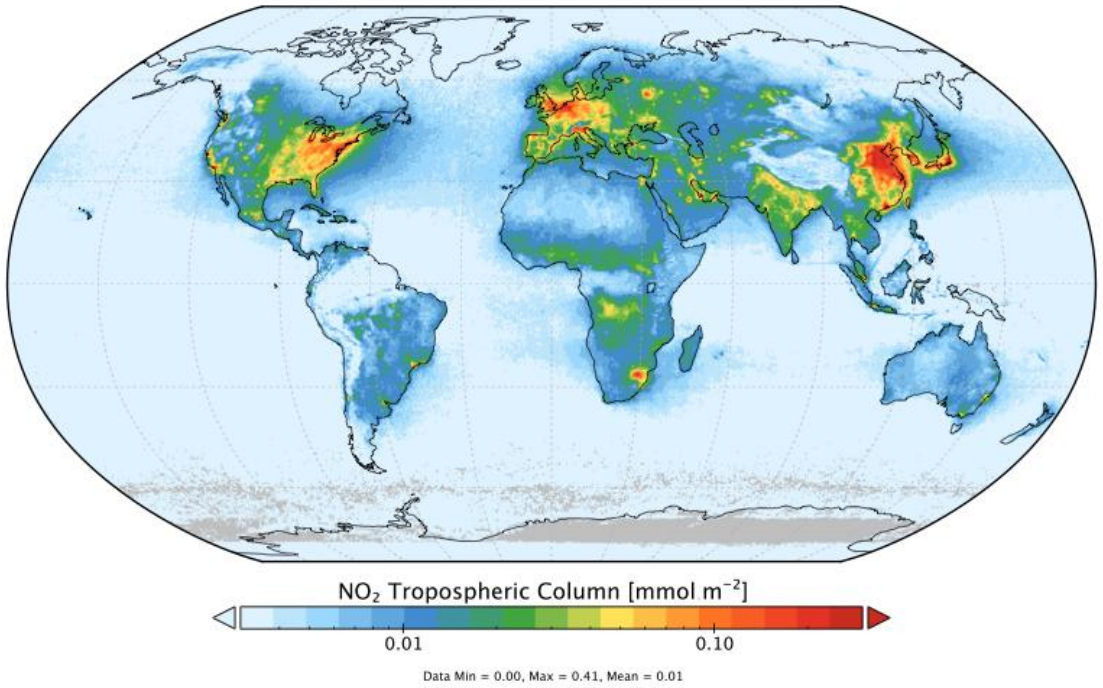
Summary

- Succes of TROPOMI is based on continuous evolution of data products and strong support for routine CAL/VAL by experts.
- The successful elements should be pursued for Sentinel 4 & 5 to ensure a harmonized high-quality data record.
- S5P/TROPOMI and Sentinel 5/UVNS jointly provide 2 measurements per day globally, including the global South.
- S5P/TROPOMI needs community support for mission extension beyond 2027.

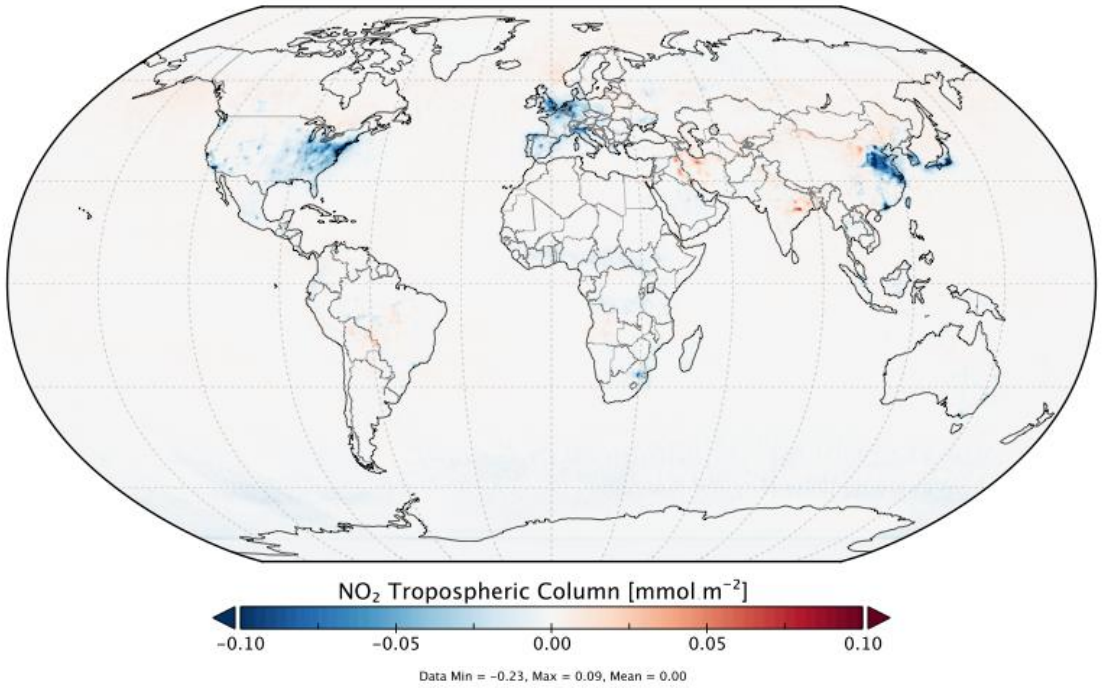


Monitoring NO_2
the success of pollution control policies

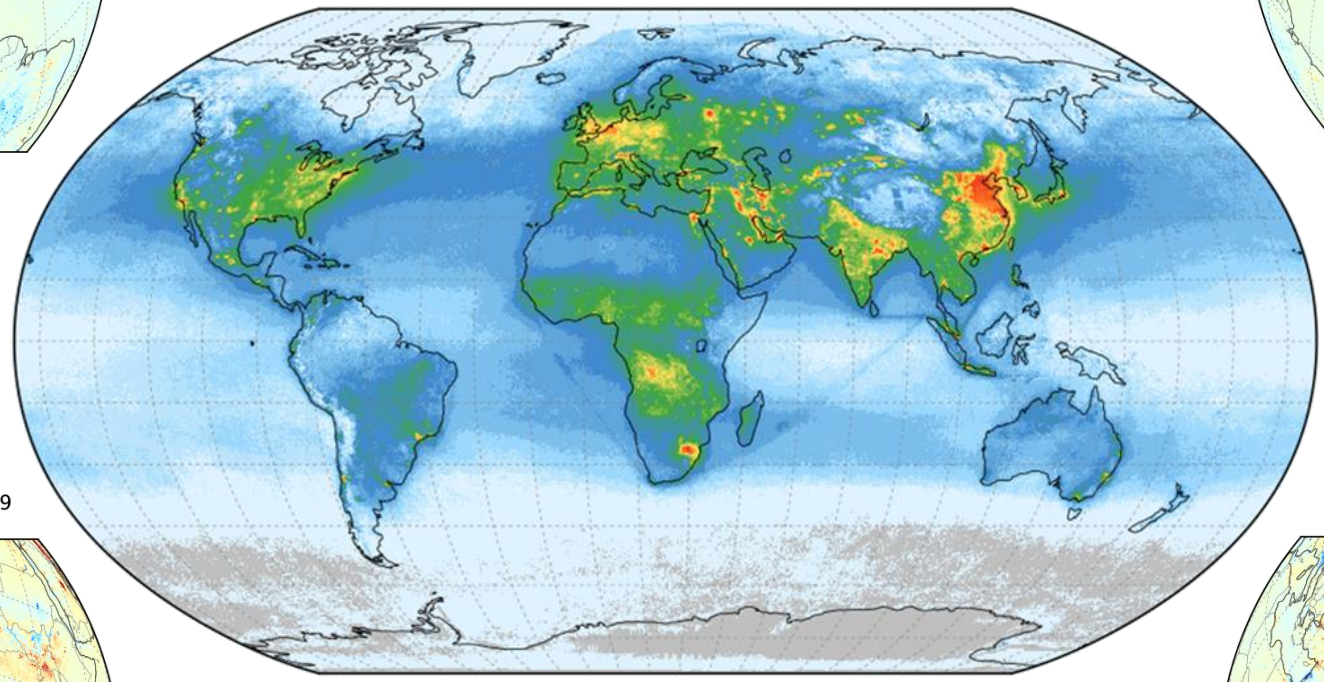
OMI NO_2 (log-scale)
2005



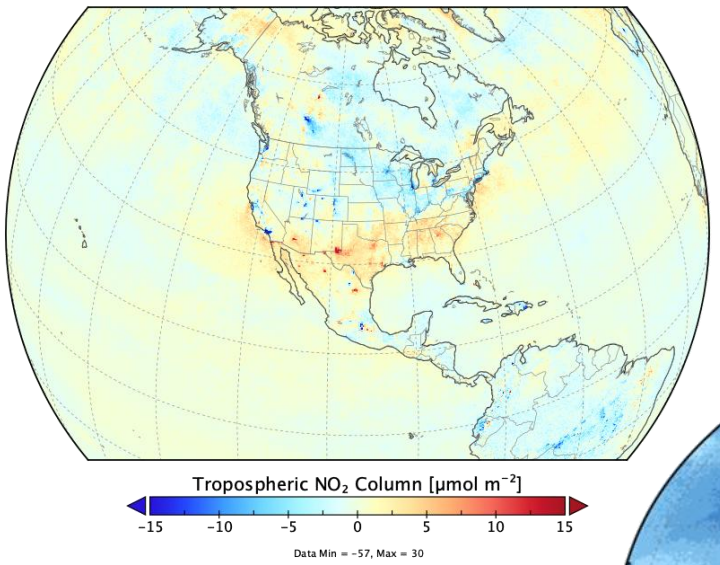
OMI NO_2
2024 - 2005



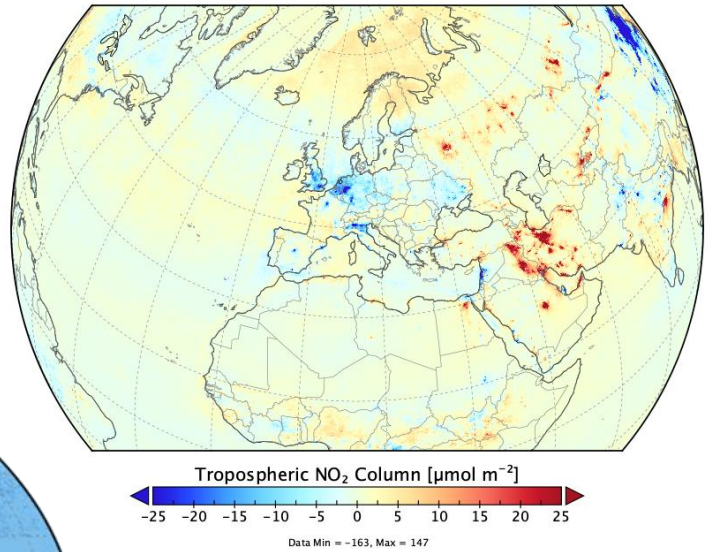
TROPOMI NO_2 2025



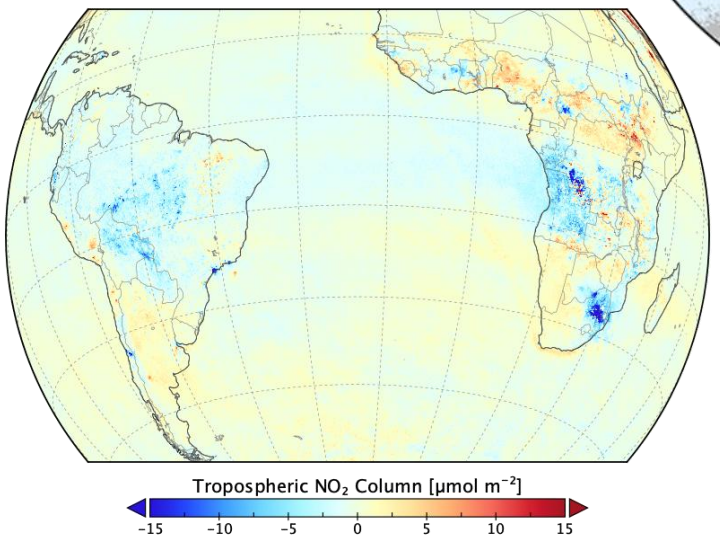
S5P/TROPOMI Difference 2025 minus 2018/2019



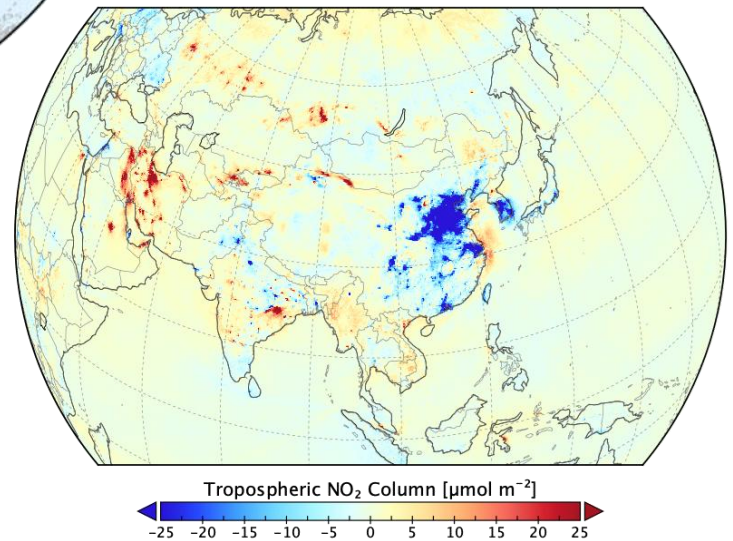
S5P/TROPOMI Difference 2025 minus 2018/2019



S5P/TROPOMI Difference 2025 minus 2018/2019



S5P/TROPOMI Difference 2025 minus 2018/2019



TROPOMI

Copernicus