Sentinel-5p (S5p) Methane Retrieval

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May 02 2018 - NOAA

Sentinel-5 Precursor
COPERNICUS ATMOSPHERE MISSION IN POLAR ORBIT

The Sentinel-5 Precursor (S-5P) is the first **atmospheric Sentinel** mission focusing on global observations of the atmospheric composition for **air quality** and **climate**.

The TROPOspheric Monitoring Instrument (**TROPOMI**) is the payload of the S-5P mission and was jointly developed by **The Netherlands and ESA**.

S-5P provides **enhanced radiometric sensitivity & spatial resolution** enabling sampling of small-scale variabilities specifically in the lower troposphere.

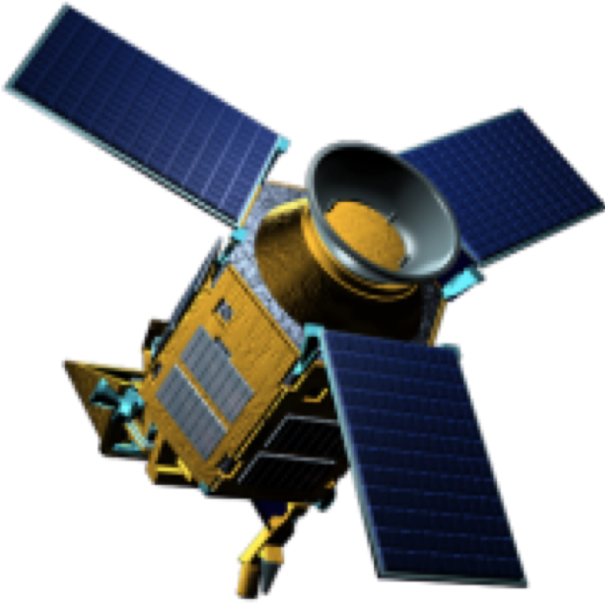
Launched on **Oct. 13 2017** with a **7 years** design lifetime.

Commissioning Phase finalised successfully on 24 April 2018.

Ramp-up Phase started on April 25.

TROPOMI

- UV-VIS-NIR-SWIR nadir view grating spectrometer.
- Spectral range: 270-500, 675-775, 2305-2385 nm
- Spectral Resolution: 0.25-1.1 nm
- Spatial Resolution: 3.5x7km^2
- Global daily coverage at 13:30 local solar time.



Sentinel-5 Precursor Level Products

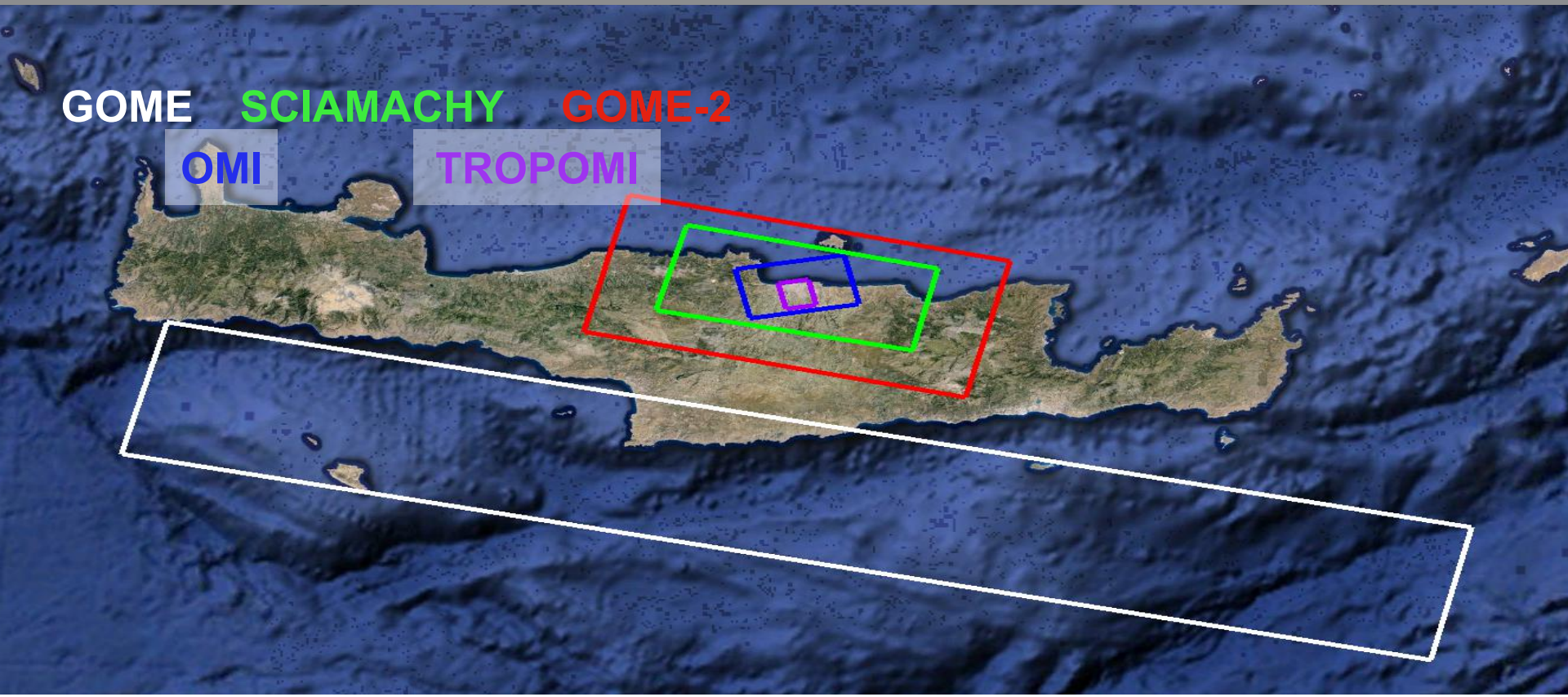
Product	Spectrometer	Application
Ozone	UV, UVIS	Ozone layer monitoring, UV-index forecast, Climate monitoring
NO_2	UVIS	Air quality forecast and monitoring
CO	SWIR	Air quality forecast and monitoring
CH_2O	UVIS	Air quality forecast and monitoring
CH_4	SWIR	Climate monitoring
SO_2	UVIS	Air quality forecast and monitoring, Climate monitoring, Volcanic plume detection
Aerosol	UVIS, NIR	Air quality forecast and monitoring, Climate monitoring, Volcanic plume detection
Clouds	UVIS, NIR	Climate monitoring
UV-Index	UVIS	UV index forecast

- **Routine dissemination of global L1B & 2 products over design lifetime**
- **Near real time (NRT) service for most data products (NTC: L1B, CH4, Tropospheric Ozone)**

Sentinel-5 Precursor Product Releases

Product	Main Parameter	Staggered Product Releases to the Public
UV Aerosol Index	Aerosol index	**June 2018**
Cloud Properties	Fraction, optical depth, top height	
Nitrogen Dioxide (NO_2)	Total and tropospheric columns	
Total Ozone (O_3)	NRT total column	
Carbon Monoxide (CO)	NTC total column	
NPP_CLOUD	Cloud mask from VIIRS	
Sulphur Dioxide (SO2)	Total column	**August 2018**
Formaldehyde (HCHO)	Total column	
Tropospheric Ozone	Tropospheric column	
Methane (CH4)	Total column	**October 2018**
Carbon Monoxide (CO)	NRT total column	
Total Ozone (O_3)	NTC total column	
Aerosol Layer Height	Mid-level pressure	**December 2018**
Ozone Profiles	Total and tropospheric profiles	
UV	UV dose	

Improved Spatial Resolution



S-5P vs SCIAMACHY, GOME-2, OMI:

- Smaller pixels: 3.5x7 km^2
- Larger swath-width (2600 km) with daily global coverage

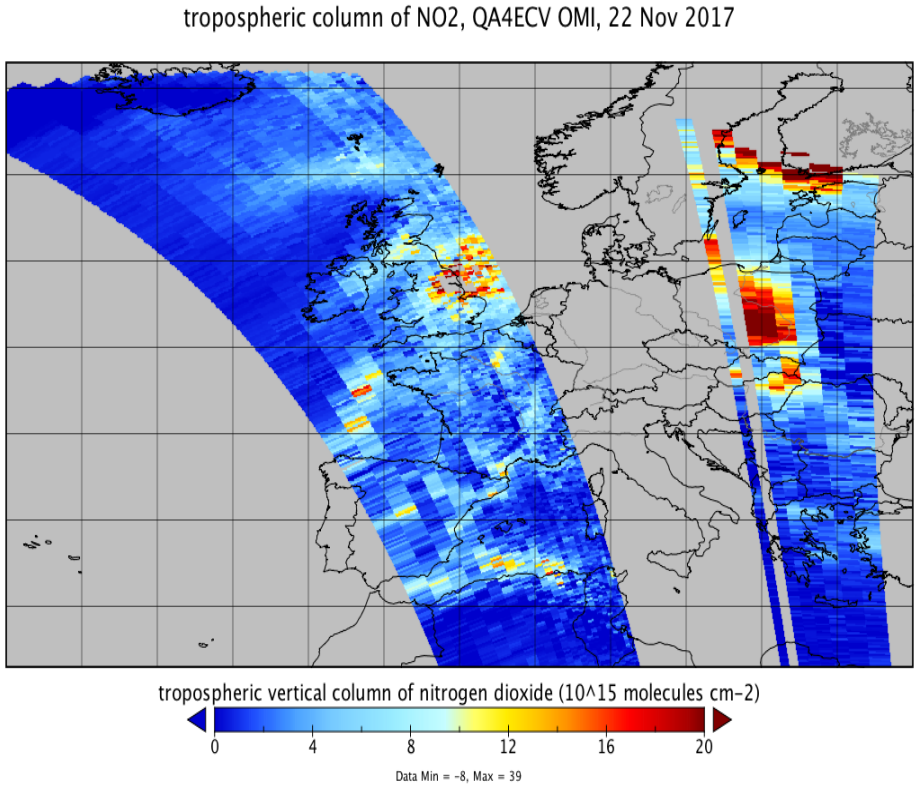
S-5P Data Volume:

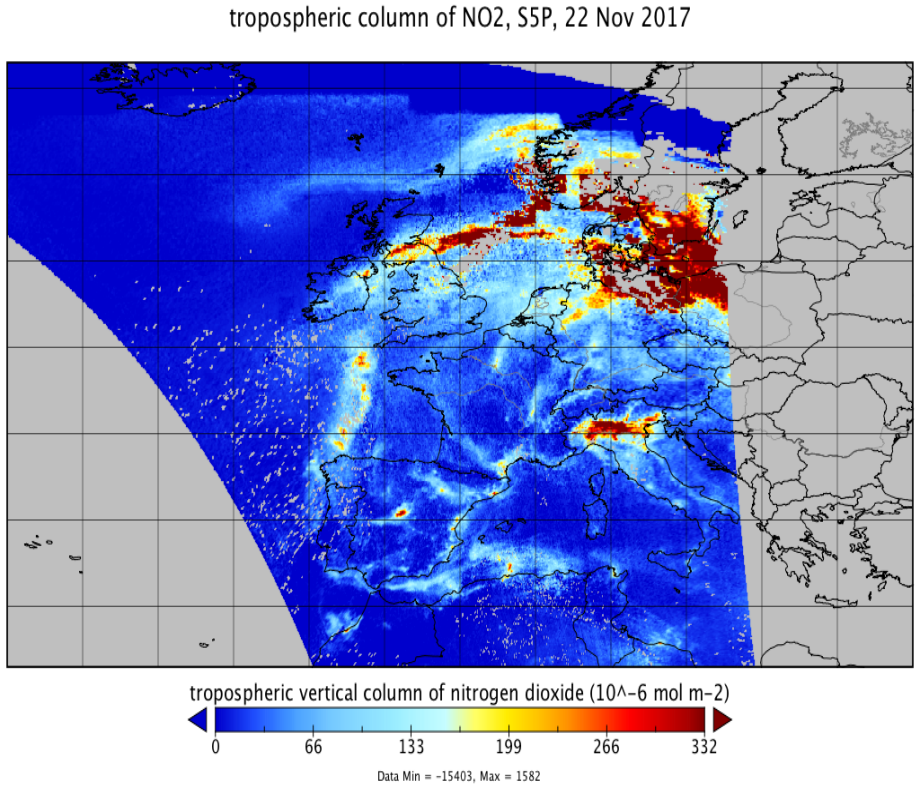
- ~1.5 million ground pixels/orbit
- L1: ~35 Gbyte/orbit
- L2: ~3.5 Gbyte/orbit
- Total: ~ 640 Gbyte/day

Improved Spatial Resolution

Comparison with the new QA4ECV NO_2 product of OMI, 22 Nov 2017

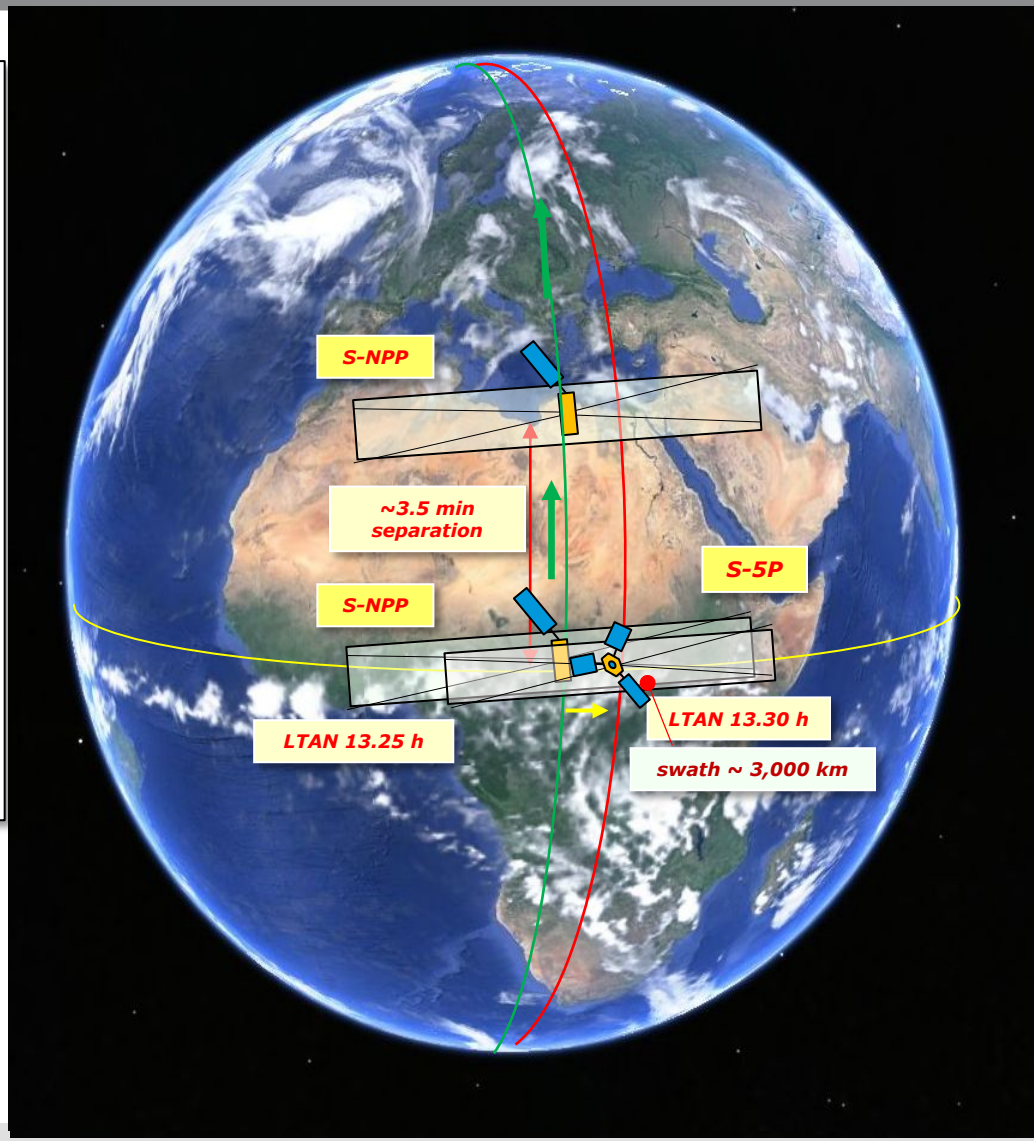
⇒ Same world, stripe amplitude TROPOMI very small, despite much higher resolution (Courtesy: KNMI)





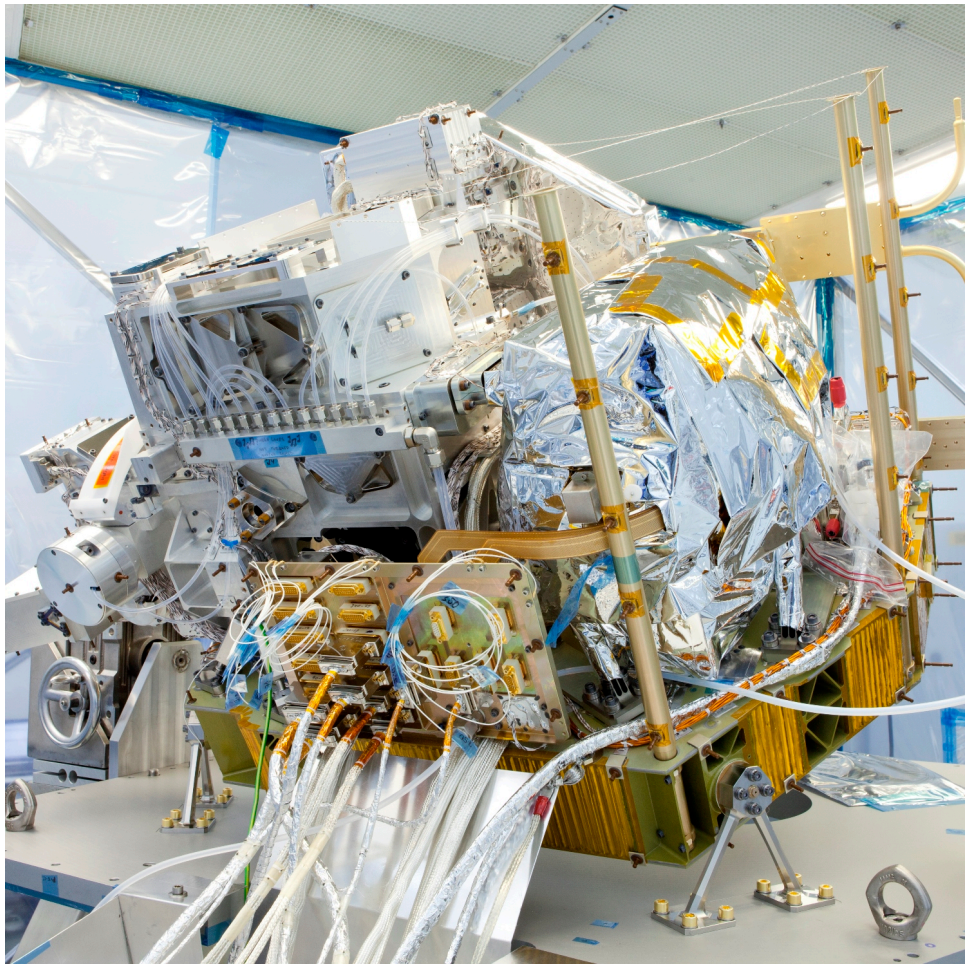
Joint Operation S-NPP + Sentinel 5P

- *CH_4 challenging accuracy requirement (< 2 % TC) -> select only cloud-free pixels*
- *Use Suomi-NPP / VIIRS cloud mask data at high resolution covering TROPOMI SWIR & NIR pixels*
- *'loose' formation S5P + S-NPP -> along track separation 3.5 … 5 min*



TROPOMI Methane

Assembled TROPOMI instrument



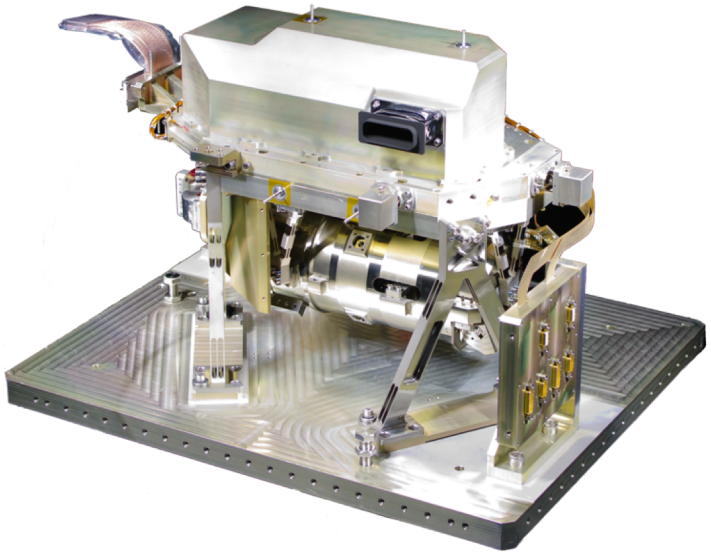
SWIR channel

band: 2305-2385 nm

resolution: 0.25 nm

sampling at sub-satellite point: 7x7 km^2

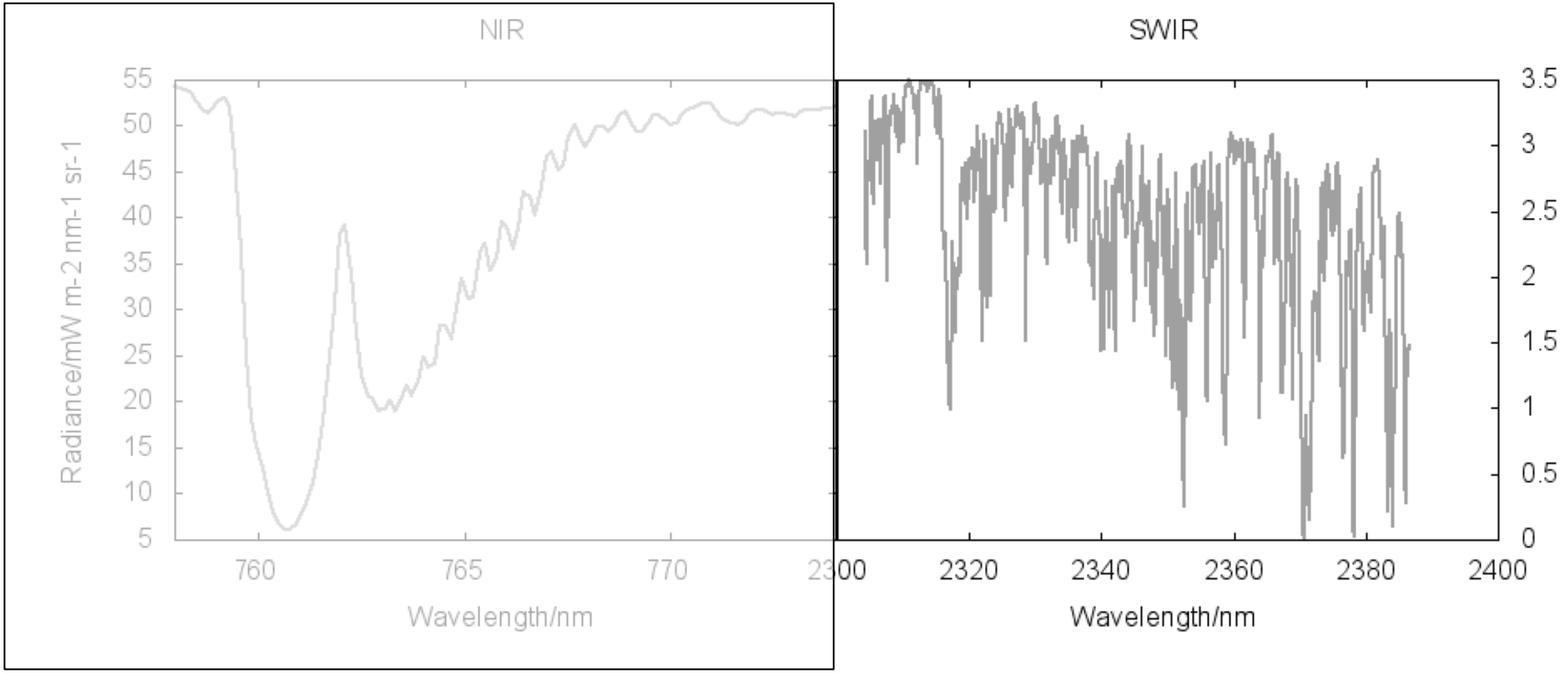
Very stable SWIR performance and instrument in excellent condition.



https://www.sron.nl/tropomi-swir-monitoring

TROPOMI Methane

SWIR and SWIR+NIR processing options

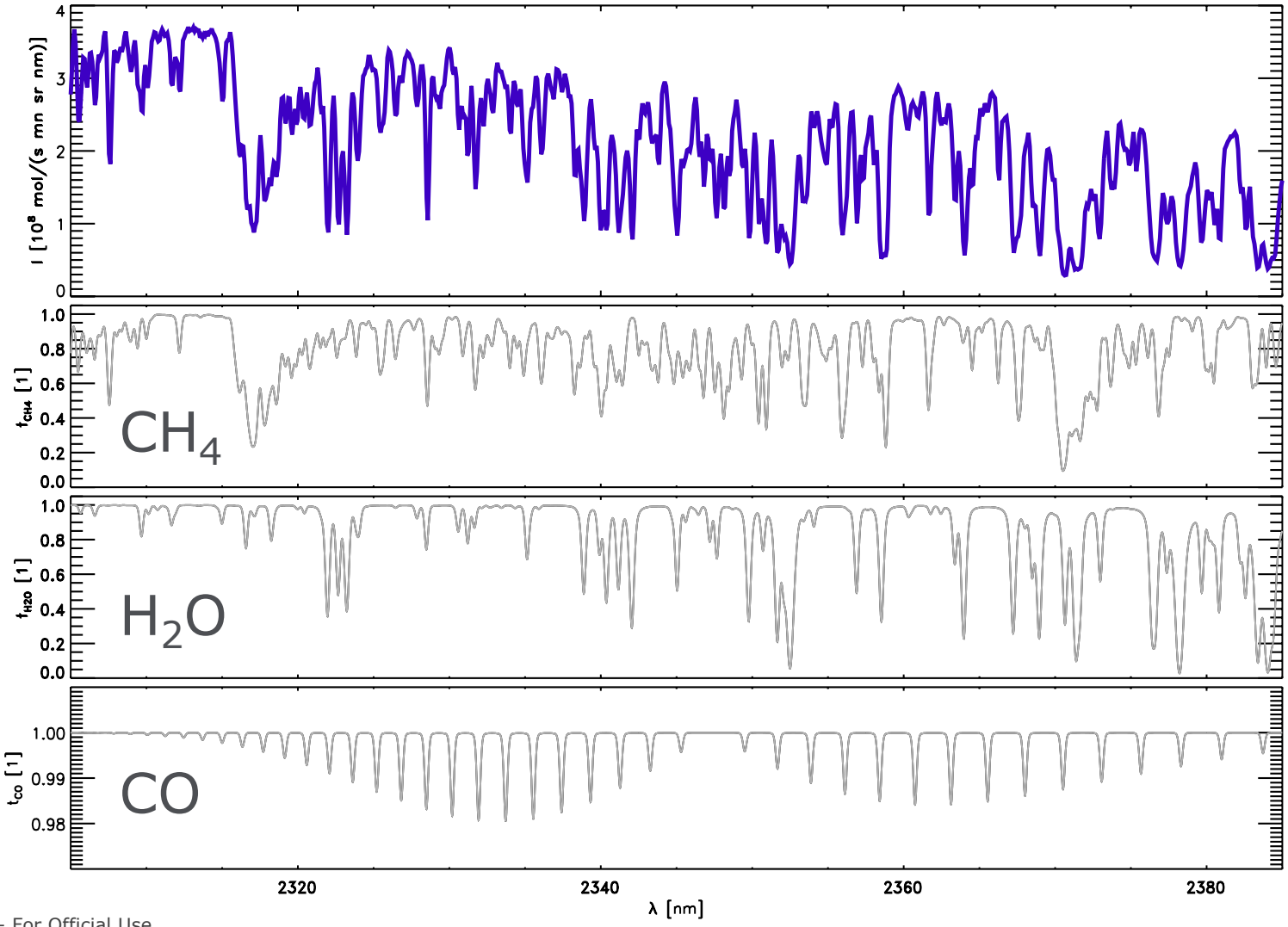


Currently, the NIR does not add significant information to the SWIR one-band retrieval. All presented results for one-band approach.

TROPOMI Methane

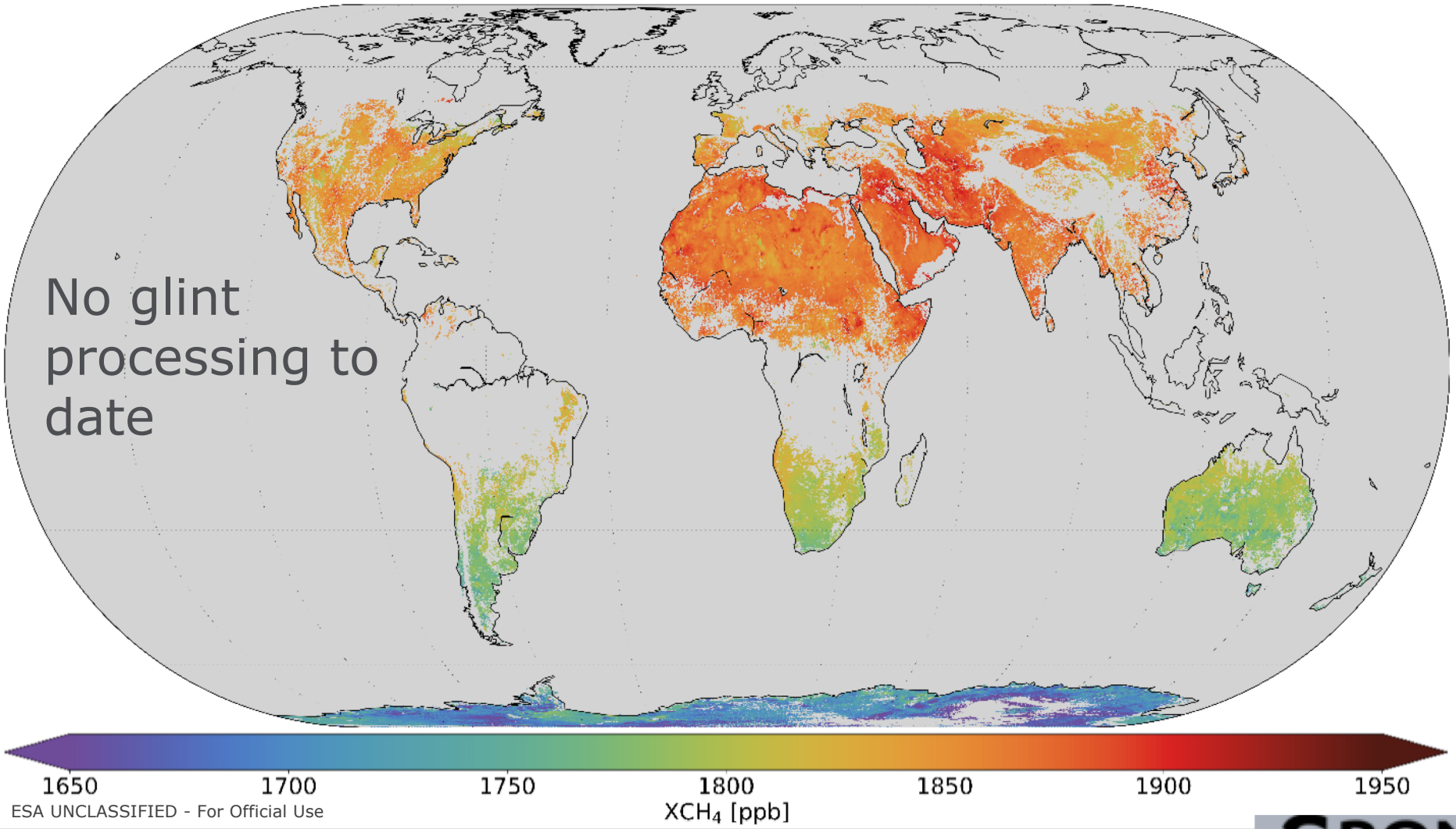
TROPOMI Orbit 525

Transmission simulated



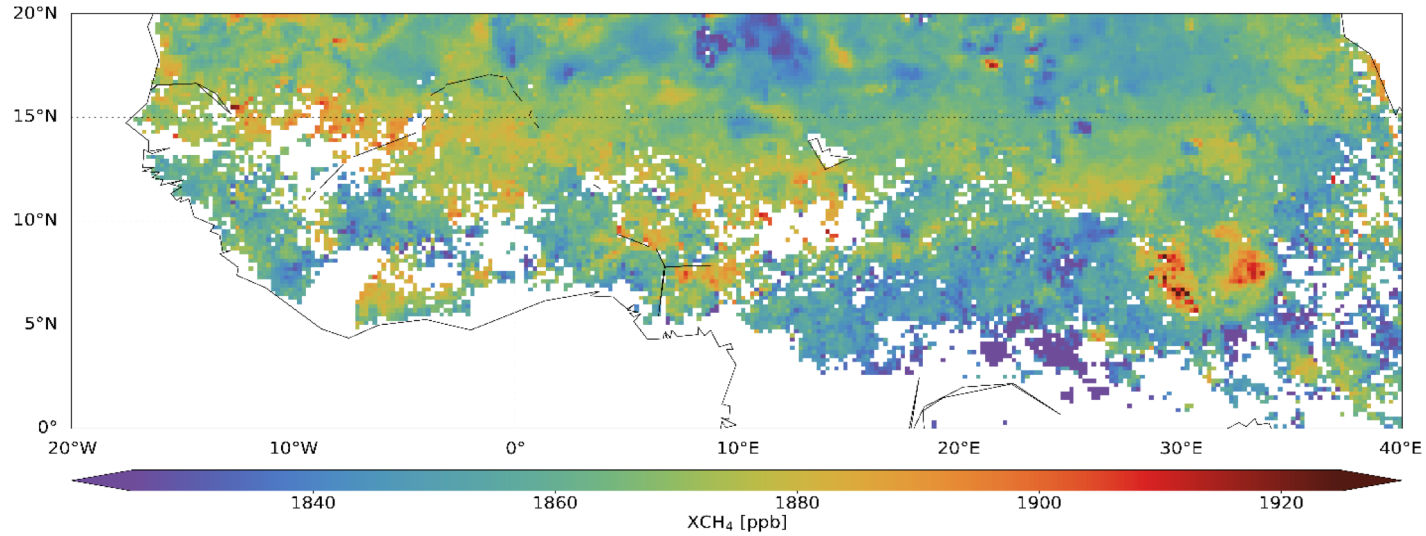
TROPOMI Methane – preliminary results

November 12th to December 30th, 2017

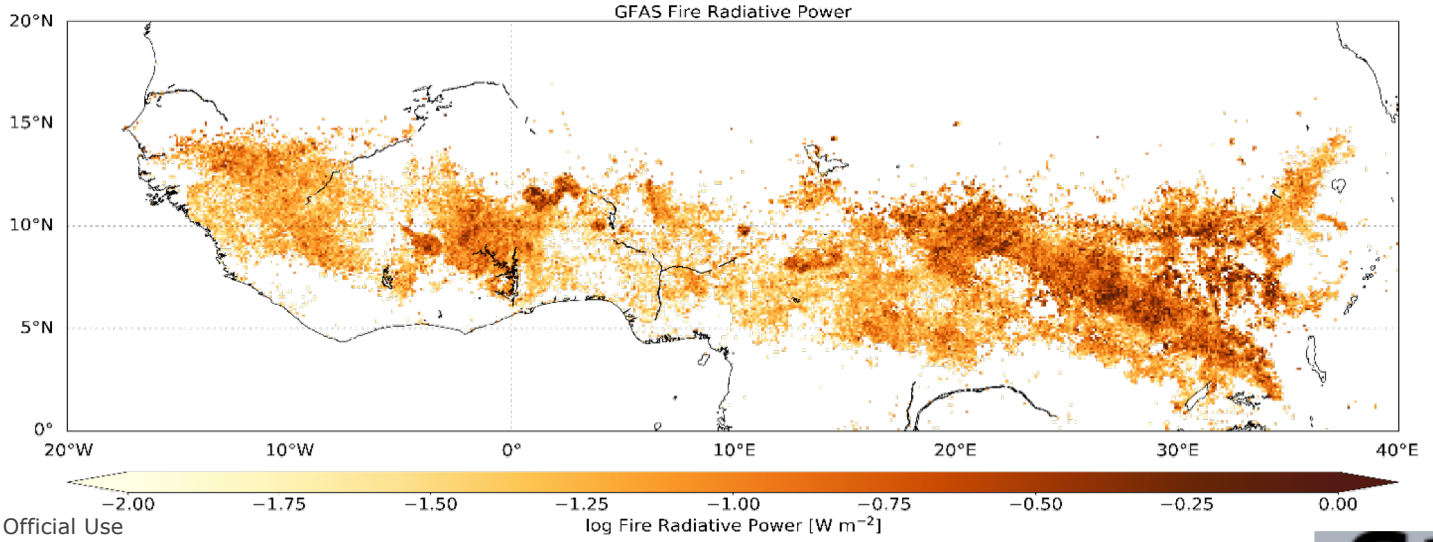


TROPOMI Methane – preliminary results

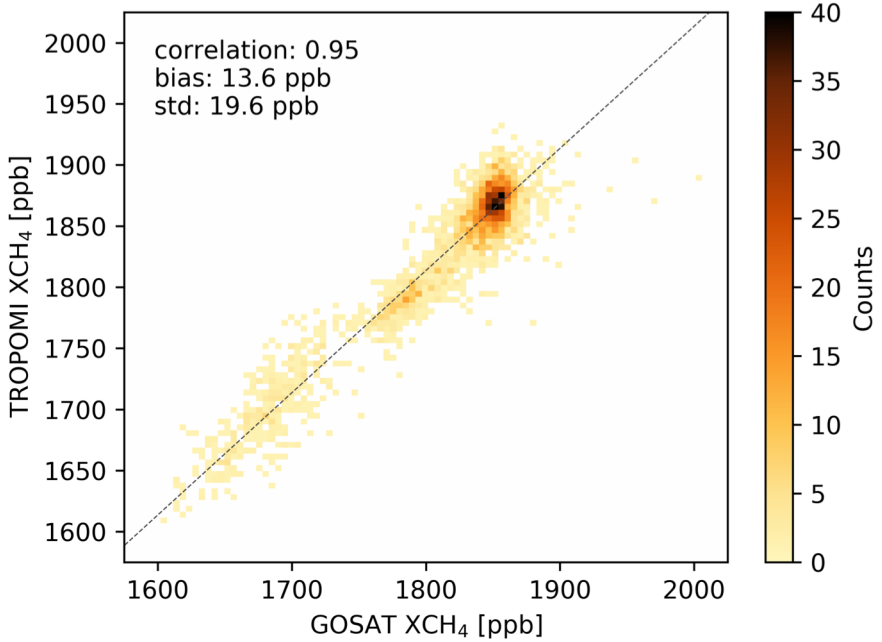
TROPOMI CH_4

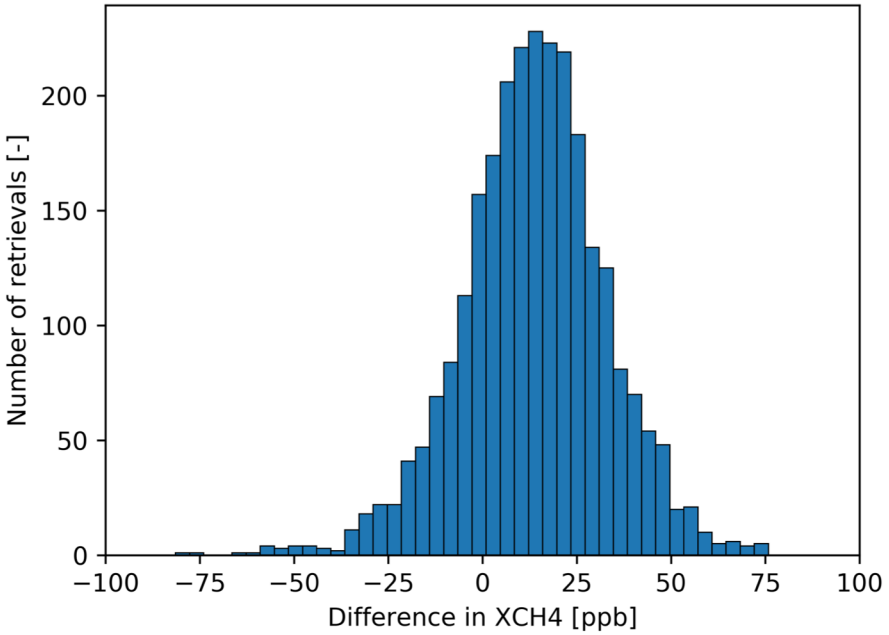


CAMS GFAS



TROPOMI Methane – preliminary validation results - GOSAT





- GOSAT dataset bias-corrected, remaining bias of -6.6 ppb and a standard deviation of 15.5 ppb with respect to TCCON
- A comparison with the GOSAT CH_4 proxy product shows good agreement with a bias of 13.6 ppb, standard deviation of 19.6 ppb

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