TO BRING ABOUT BREAKTHROUGHS IN INTERNATIONAL SPACE RESEARCH

The Twin Anthropogenic Greenhouse Gas Observers Mission

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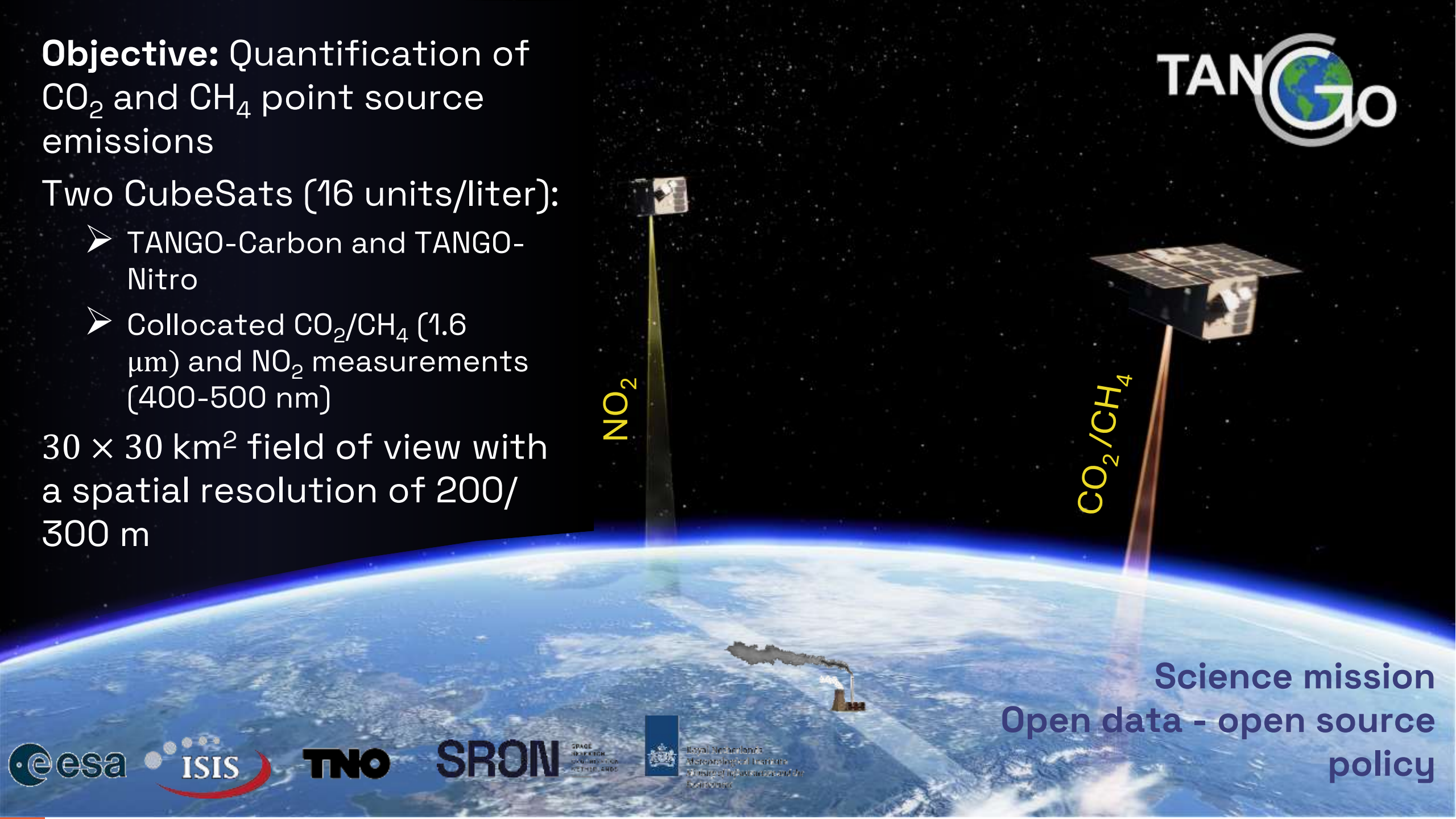
SRON SPACE RESEARCH ORGANISATION NETHERLANDS

Objective: Quantification of CO_2 and CH_4 point source emissions

Two CubeSats (16 units/liter):

- TANGO-Carbon and TANGO-Nitro
- Collocated CO_2/CH_4 (1.6 μm) and NO_2 measurements (400-500 nm)

30 × 30 km² field of view with a spatial resolution of 200/ 300 m



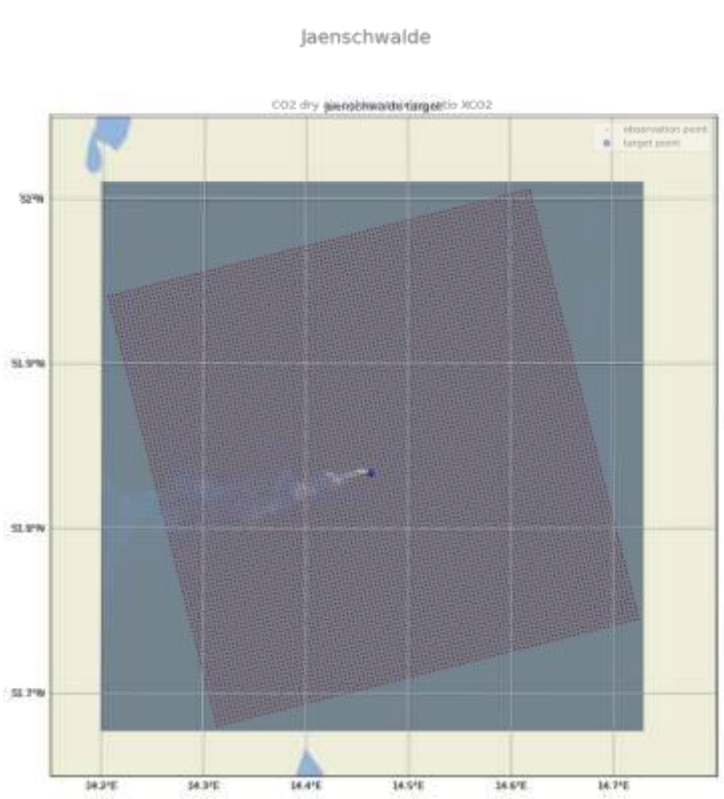
Science mission
Open data - open source policy

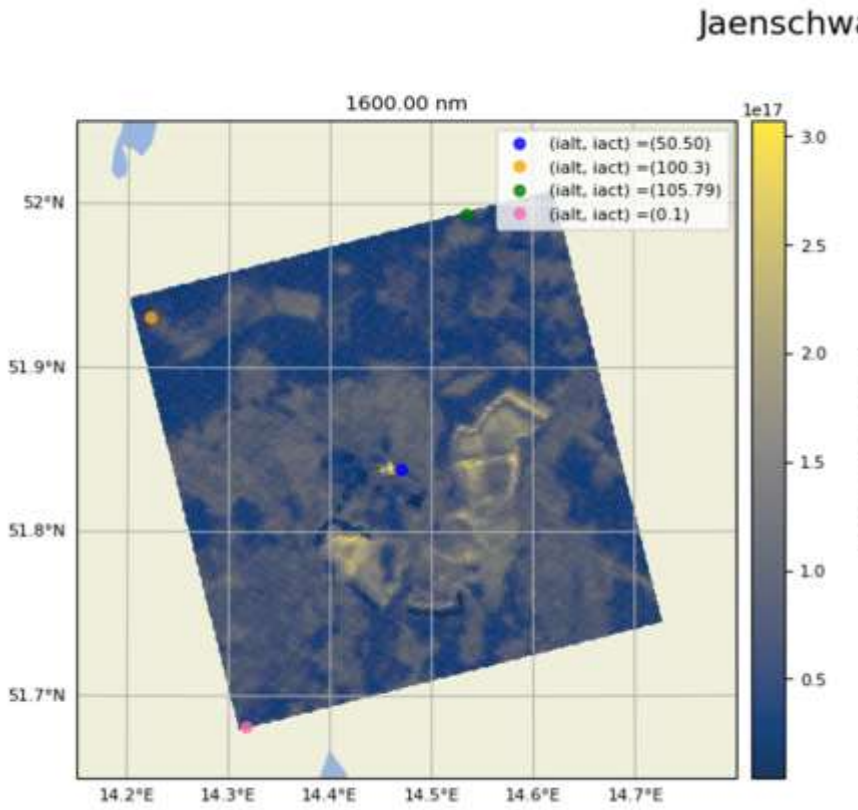
TANGO Plume Observations

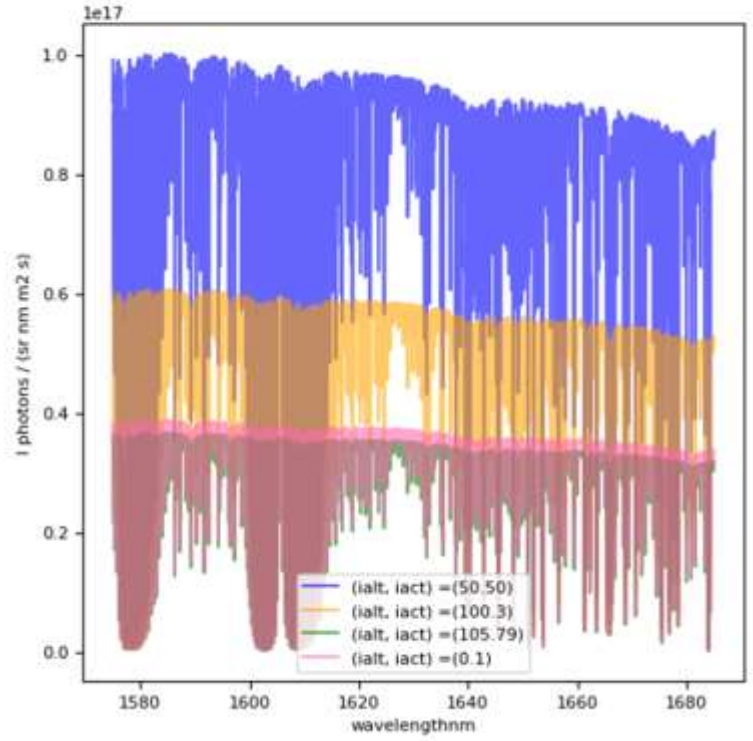
The Dance Moves of TANGO

Full Data Chain Implementation (End-to-End)

Geometry Model → Geophysical Scene → Radiation Scene







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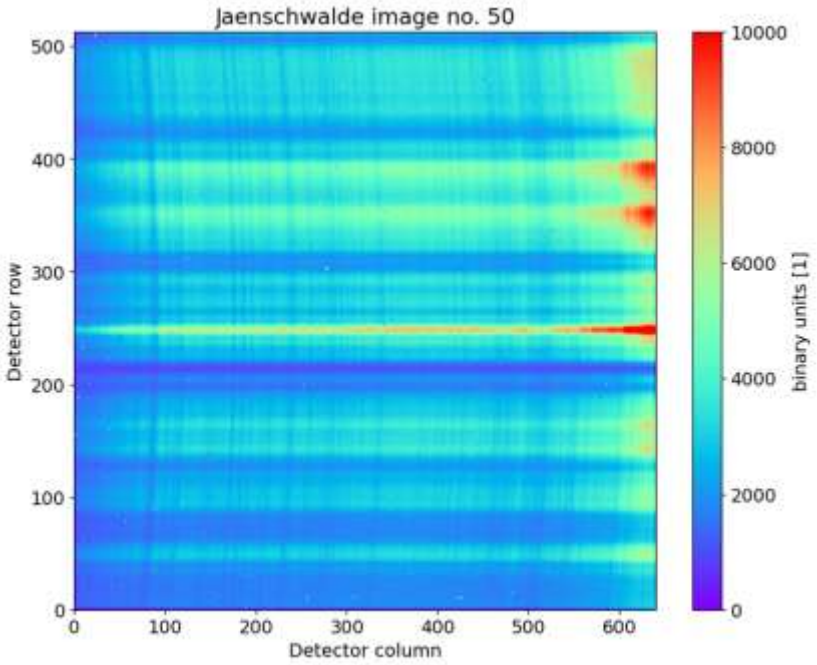
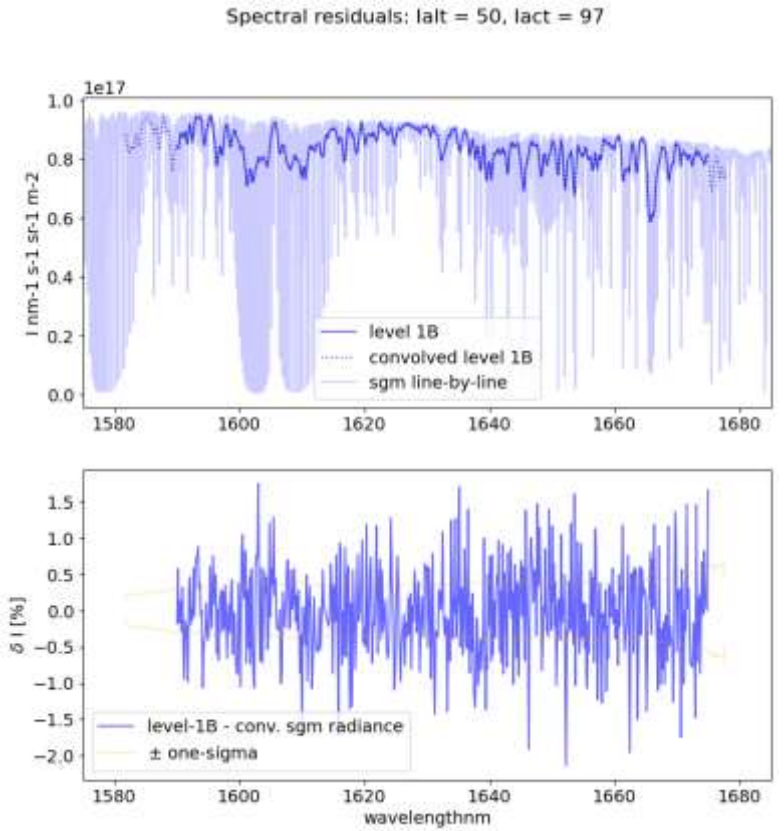
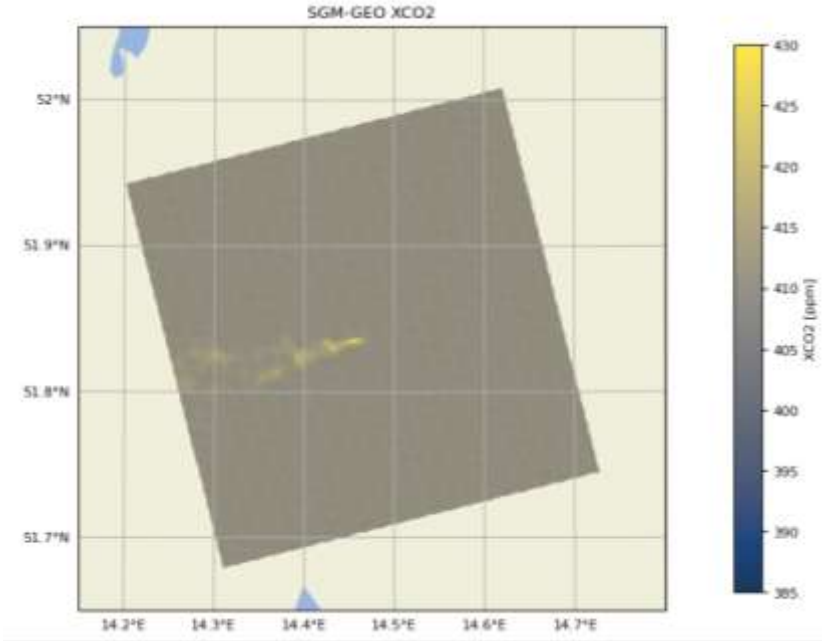
Full Data Chain Implementation (End-to-End)

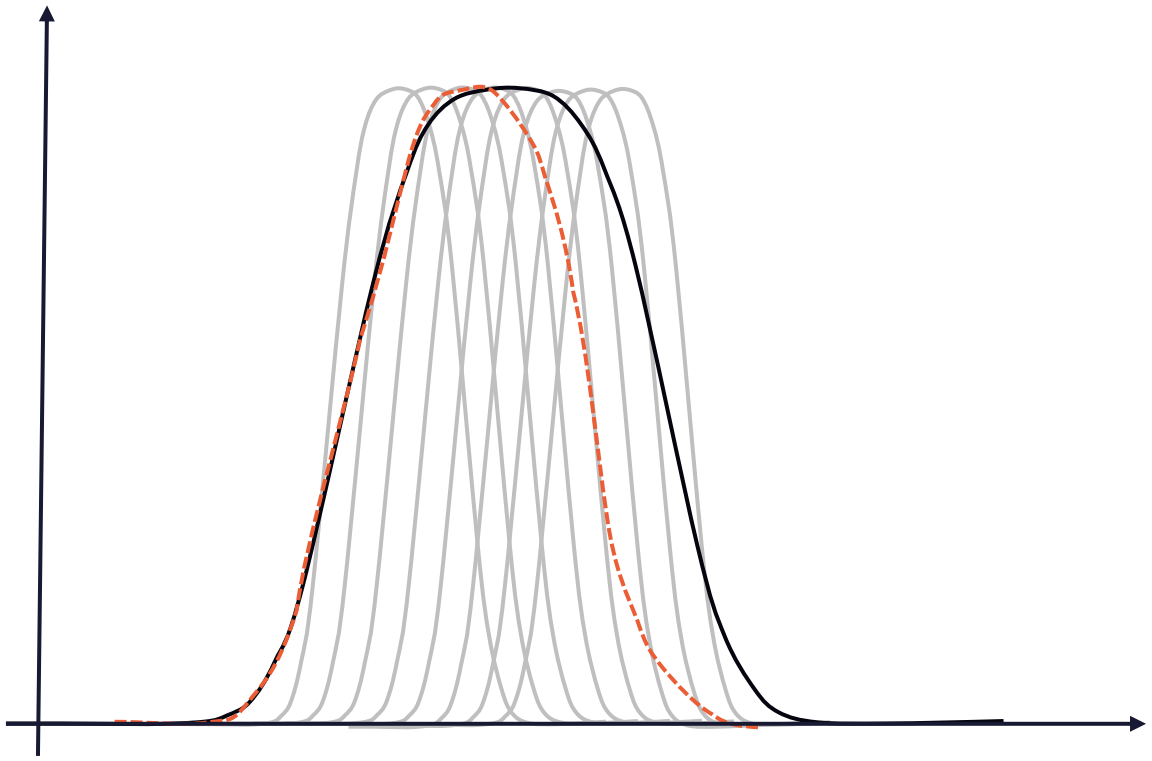
Instrument Model → L1B Processor → L2 Processor







ISRF and the inhomogeneous slit illumination



- The ISRF is the convolution of the point spectral response with the signal variation over the slit
- In lab specified for a homogenous illumination
- Effect is a shift and a shape distortion.

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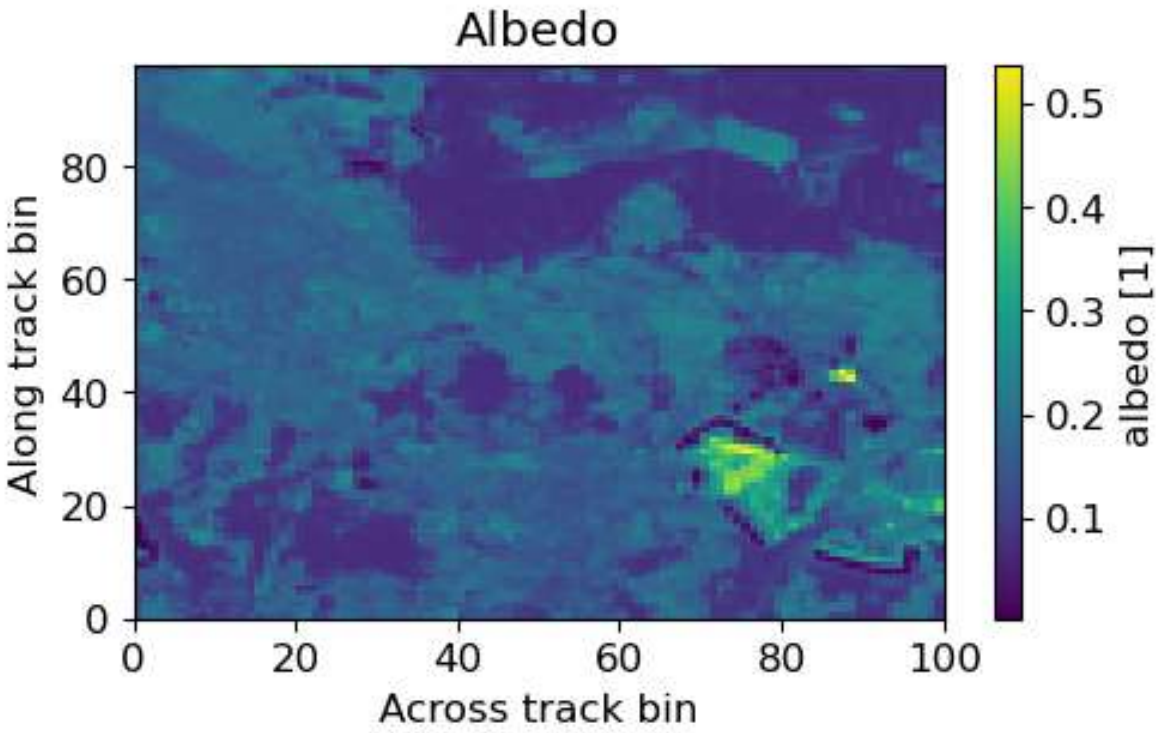
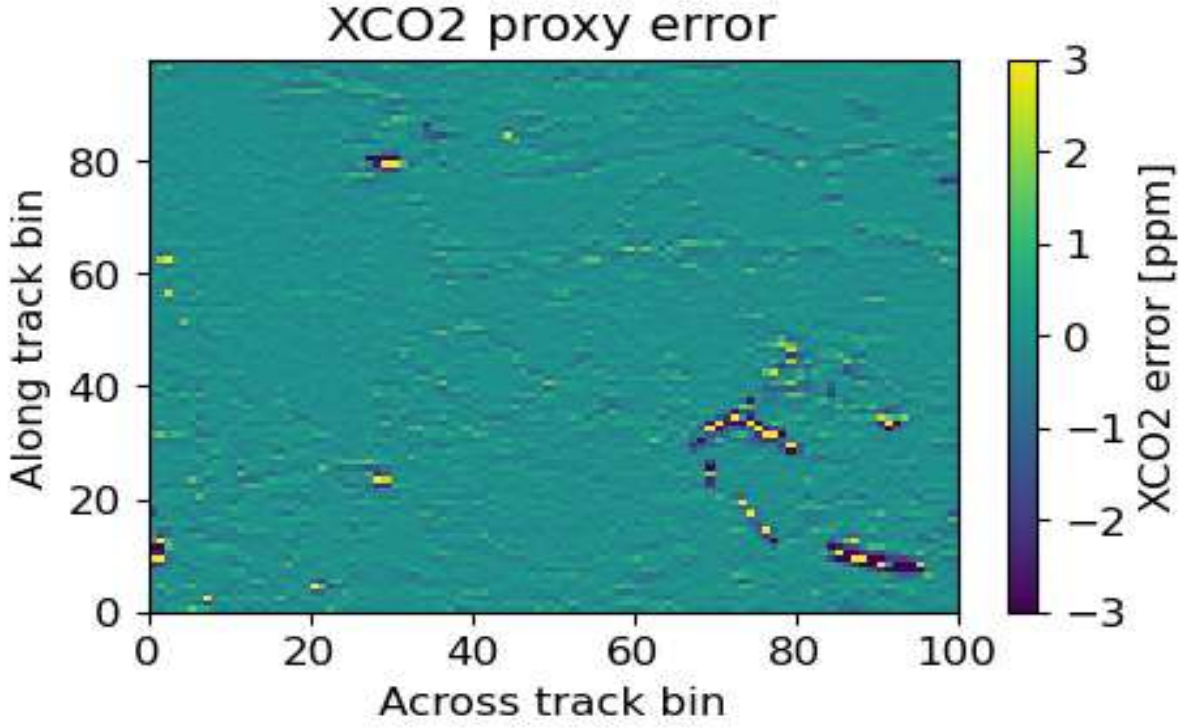
Inhom. Slit Illumination (mitigation by spectral shift)





RMSE:
without spectral shift XCO_2 error 1.4 ppm
with spectral shift XCO_2 error 0.57 ppm

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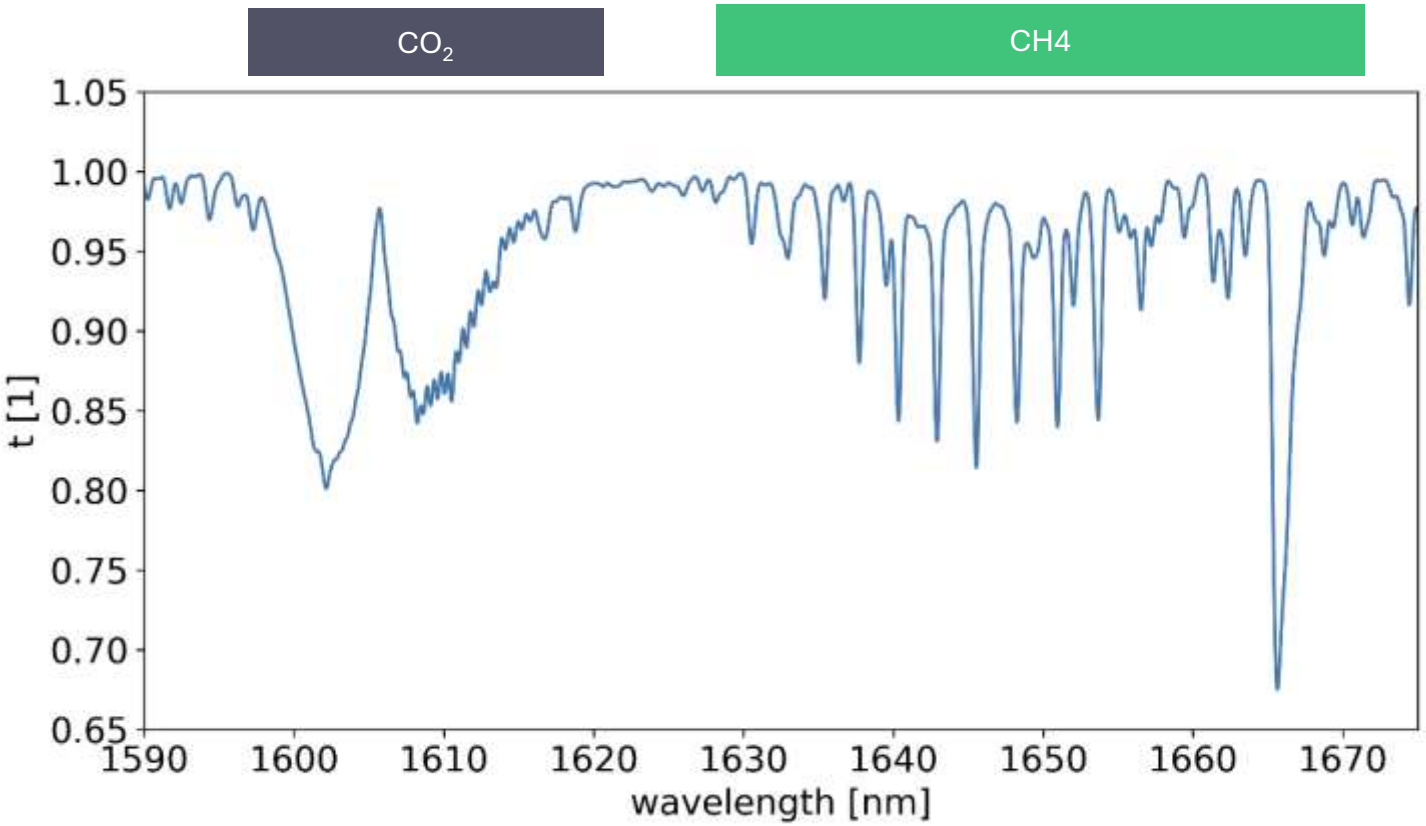
The Proxy Retrieval Methods

Radiance measurements in the 1.6 μm band



Proxy retrieval approach:

$$\mathrm{XCH_4^{pro}} = \frac{[\mathrm{CH_4}]}{[\mathrm{CO_2}]}\mathrm{XCO_2^{mod}}$$

$$\mathrm{XCO_2^{pro}} = \frac{[\mathrm{CO_2}]}{[\mathrm{CH_4}]}\mathrm{XCH_4^{mod}}$$

+ Only minor aerosol induced error
+ Both CH_4 and CO_2 product
- Difficulties to interpret mixed sources
- Precision is a factor ~1.5 lower than that of $[CH_4]$ and $[CO_2]$

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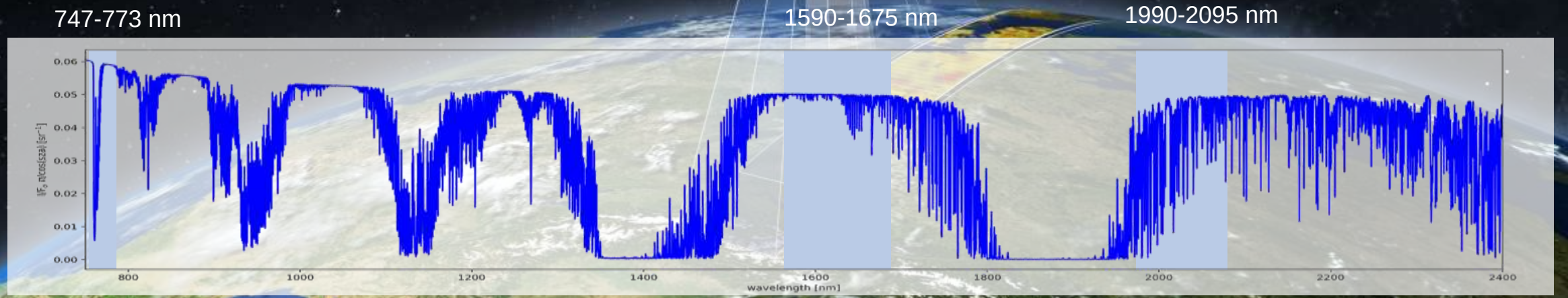
Copernicus CO2M mission

XCO_2 single soundings on 2×2 km^2 pixels with global coverage

1. **Four band spectrometer CO2I**
2. **Cloud imager CLIM**
3. **Multi-Angle Polarimeter MAP**

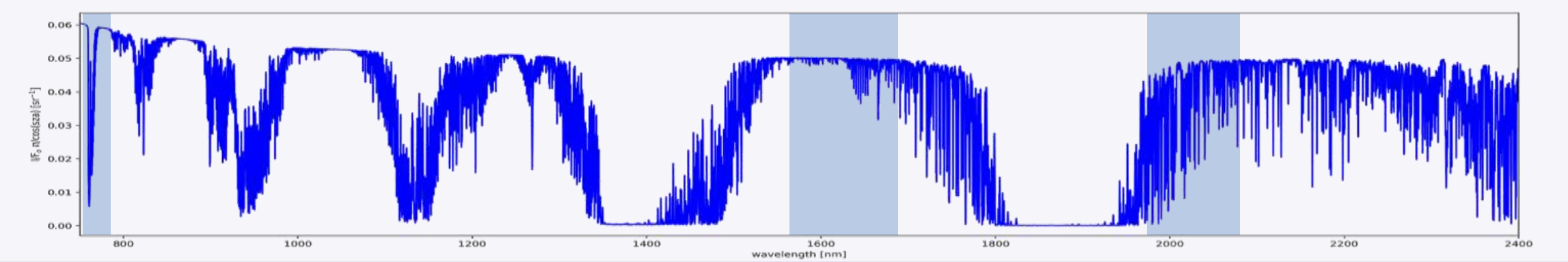


CO2M and TANGO synergy

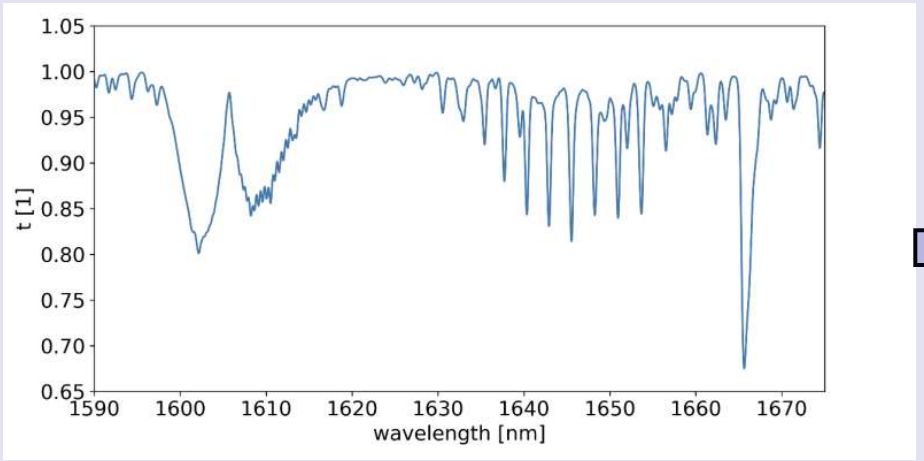
747-773 nm

1590-1675 nm

1990-2095 nm

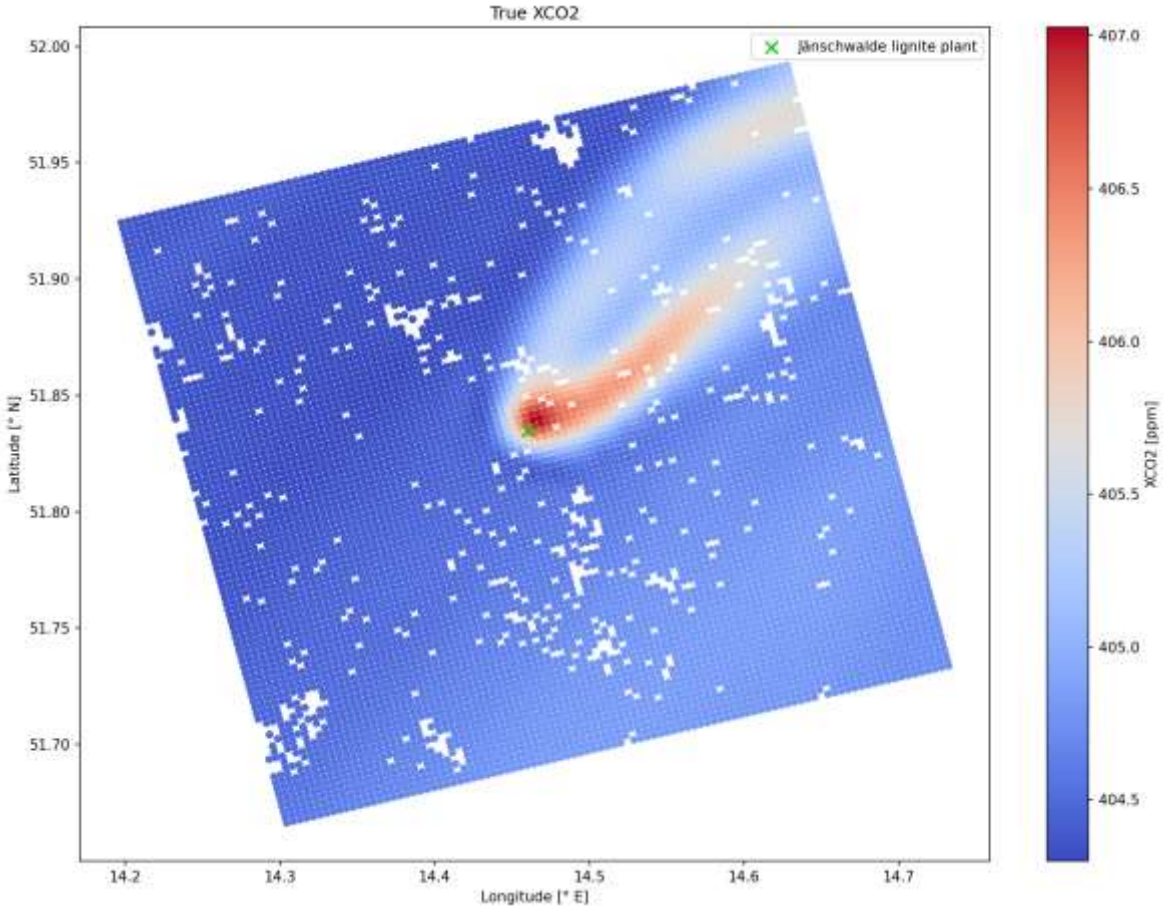


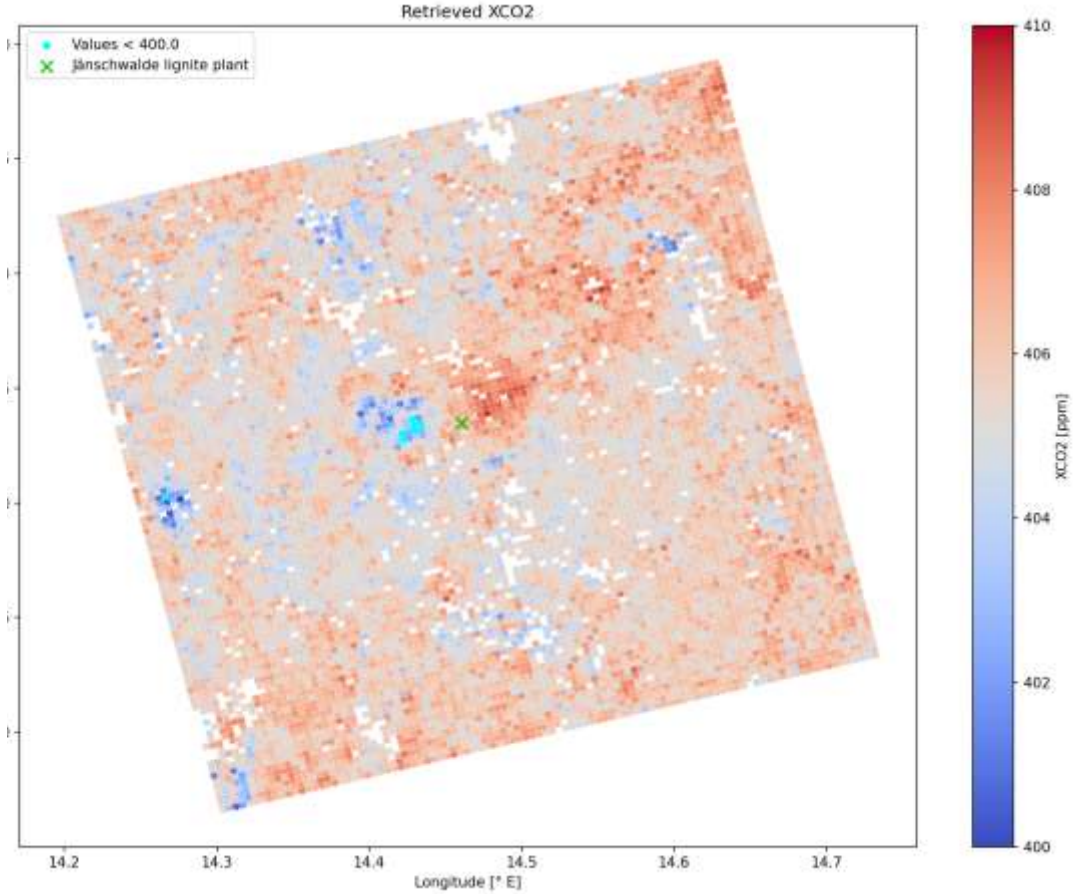
CO_2, CH_4 on a 2×2 km^2, aerosol product on a 4×4 km^2



CO_2, CH_4 on a 300×300 m^2

CO2M-TANGO synergies (preliminary)





WRF simulations (Uni. Heidelberg)

CO2M + TANGO FP retrieval on 300x300m^2

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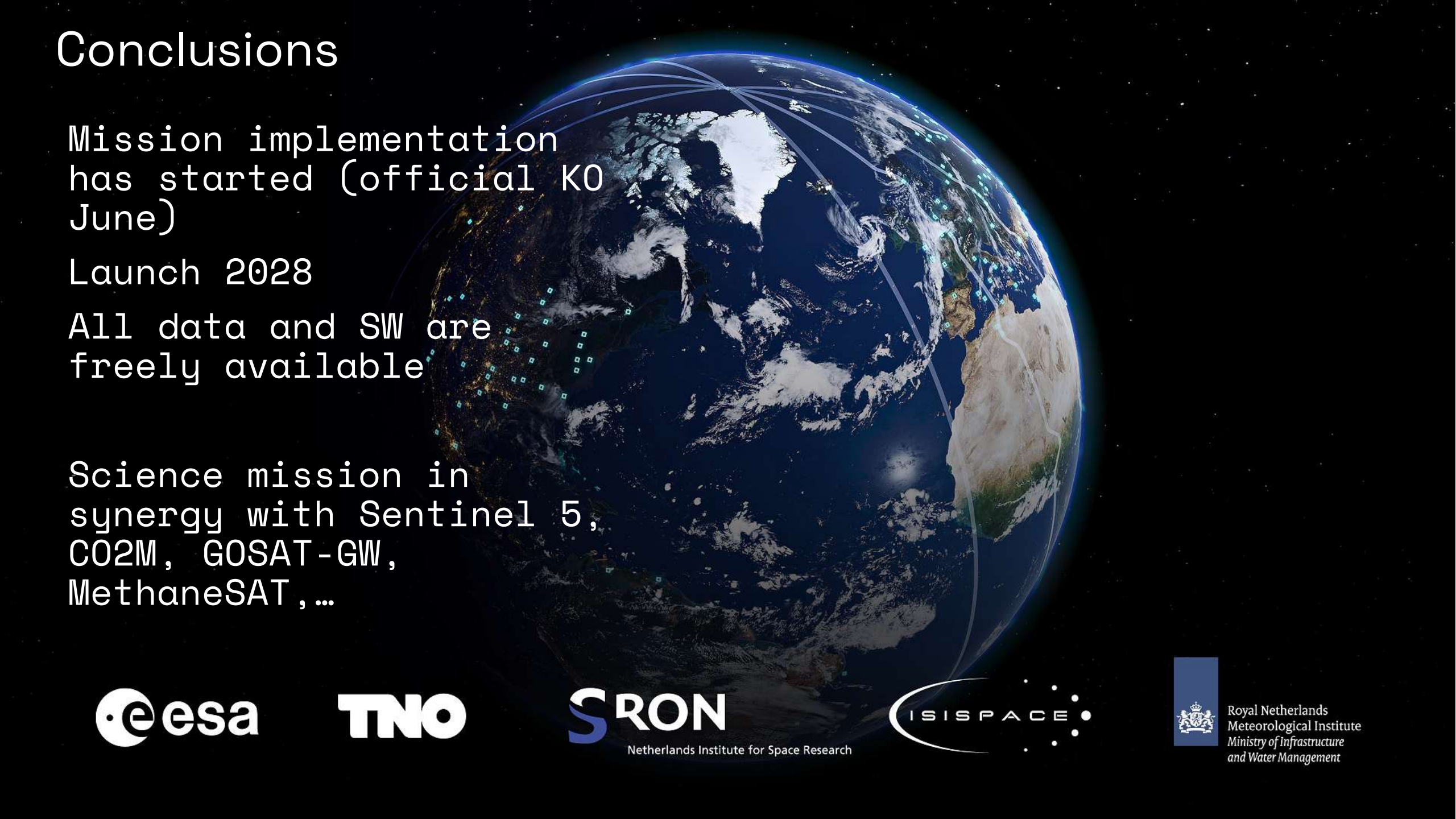
Conclusions

Mission implementation has started (official KO June)

Launch 2028

All data and SW are freely available

Science mission in synergy with Sentinel 5, CO2M, GOSAT-GW, MethaneSAT,…



esa TNO SRON Netherlands Institute for Space Research ISISPACE Royal Netherlands Meteorological Institute Ministry of Infrastructure and Water Management