TO BRING ABOUT BREAKTHROUGHS IN INTERNATIONAL SPACE RESEARCH

Sentinel-5 prototype processor: CH4 and CO products

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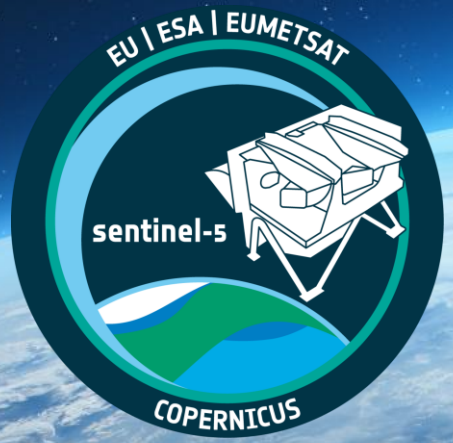
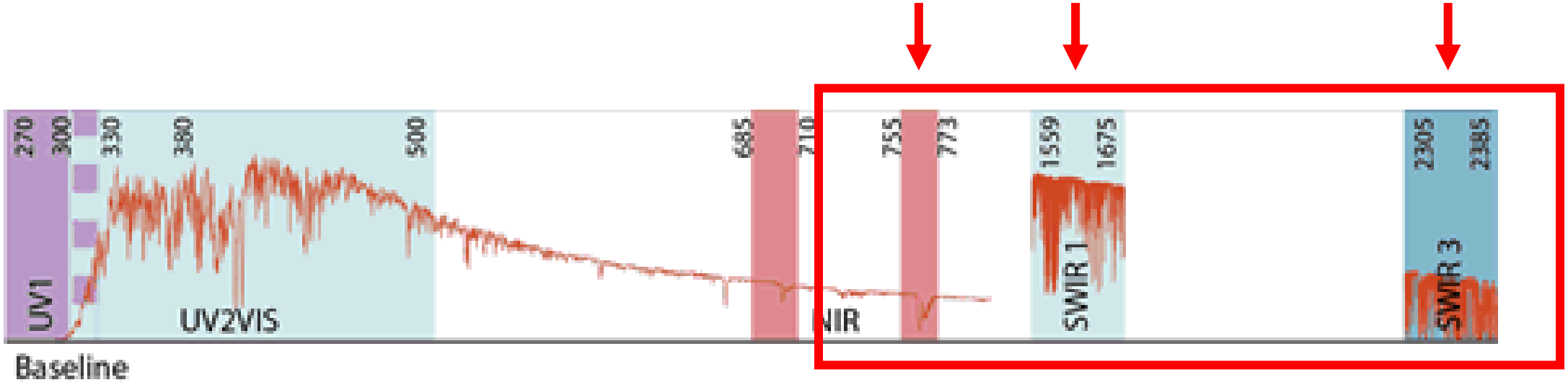


Sentinel 5: overview

- Launched Augustus 2025, currently in Commissioning phase.
- SRON focus: **NIR** (755 nm) and **SWIR** (1.6 µm, 2.3 µm) bands, used for CO and CH4 retrieval.

Sentinel-5 spectrometer (ESA/ATG medialab)



Sentinel-5 spectral bands

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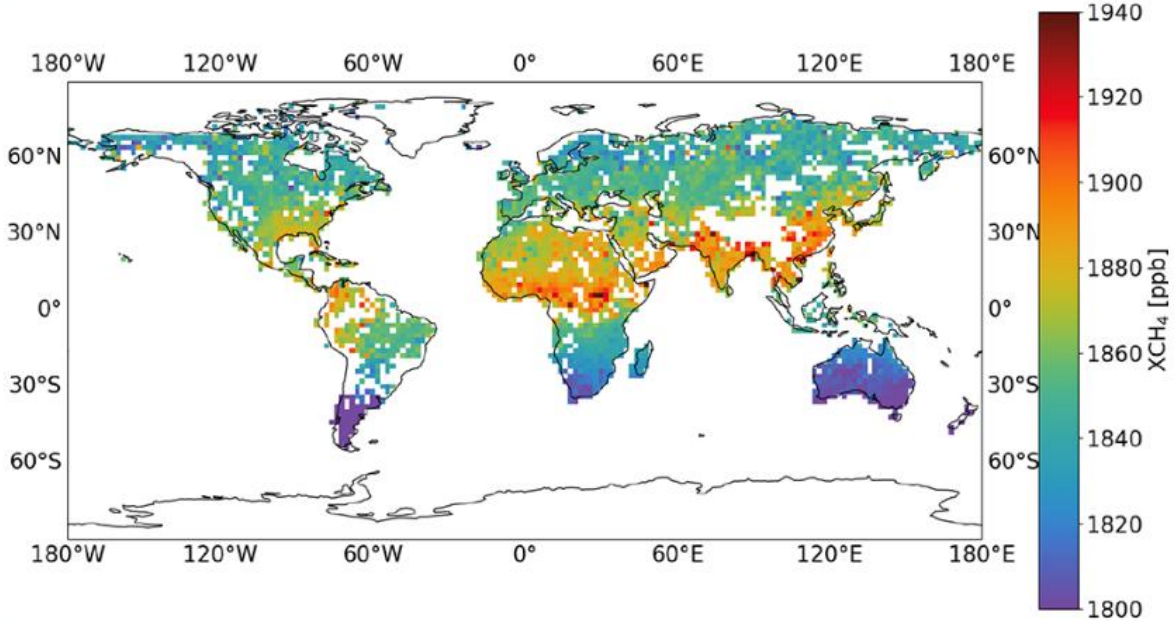
Key differences between Sentinel-5 and Tropomi

- Tropomi only has **NIR** (755 nm) **and SWIR-3** (2.3 µm) band**.**
  - Delivers full-physics product of CH4 and CO
  - Accounts for aerosol and cirrus scattering (Butz, 2009)
- Sentinel-5 has an additional spectral band, the **SWIR-1 (1.6 µm)** band.
  - Delivers flexible full physics product, which optionally incorporates 1.6 µm band.
  - Delivers proxy product for CH4, a non-scattering retrieval in SWIR-1 (Frankenberg, 2005).
    - Scattering correction is quantified by over/underestimation (w.r.t. prior) of CO2 retrieval in same band.

Full-physics and proxy products

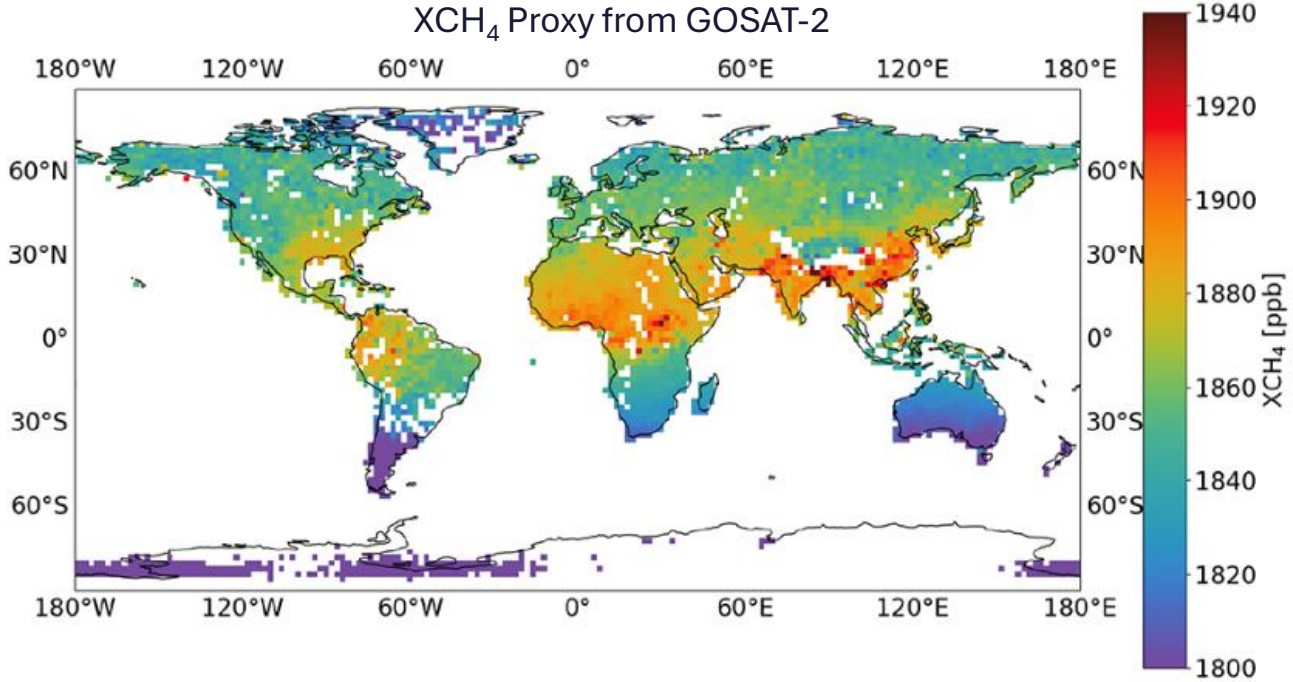
- Sentinel-5 delivers both products because performance characteristics are complementary.
  - Both methods have shown to work with errors <1% on GOSAT and synthetic measurements (Schepers *et al,* 2012, Sentinel-5 ATBD). Excellent performance of full-physics algorithm established for Tropomi and GOSAT-2 (Lorente *et al,* 2021, Barr *et al.*, 2025).
  - Proxy product has better coverage and is less computationally expensive, however it is sensitive to prior CO2 uncertainty.

XCH_4 Full Physics from GOSAT-2



Barr et al. 2025

XCH_4 Proxy from GOSAT-2



Commissioning Phase

- Commissioning phase expected to run until mid-November.
- Current focus is CH4 (most challenging product).
- Cloud imaging from MetImage expected soon. Currently, we restrict ourselves to case studies on cloud-free granules where we compared directly with Tropomi.
- Rest of this presentation:
  - Main challenges ahead
  - Results of two case studies (desert scene, plume scene).

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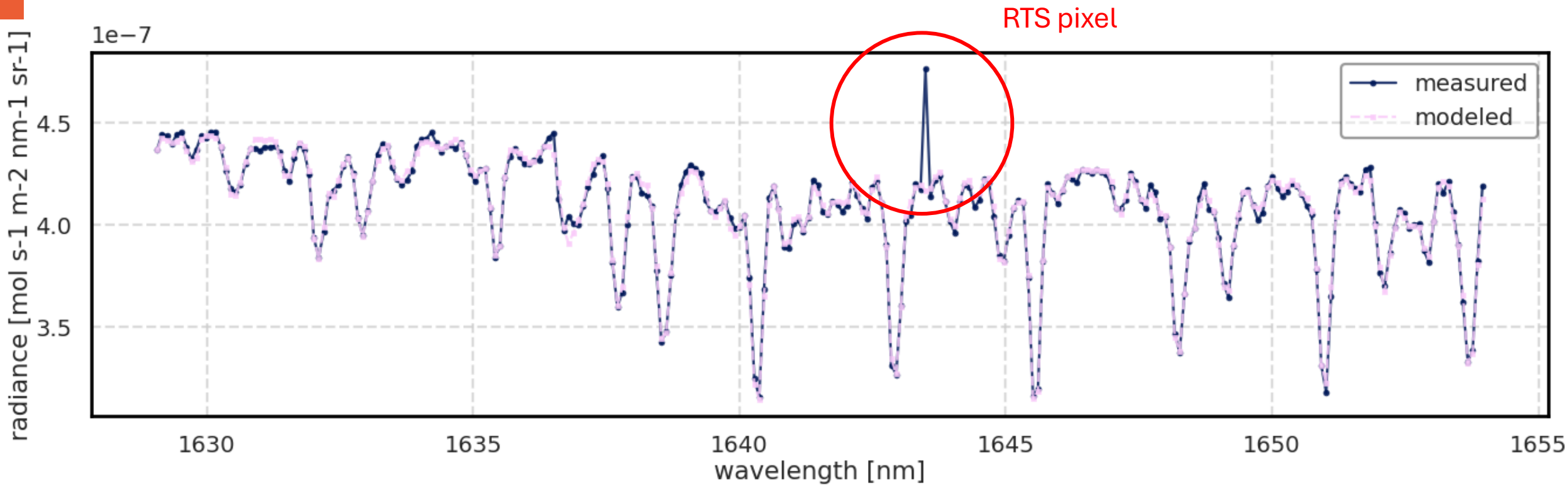
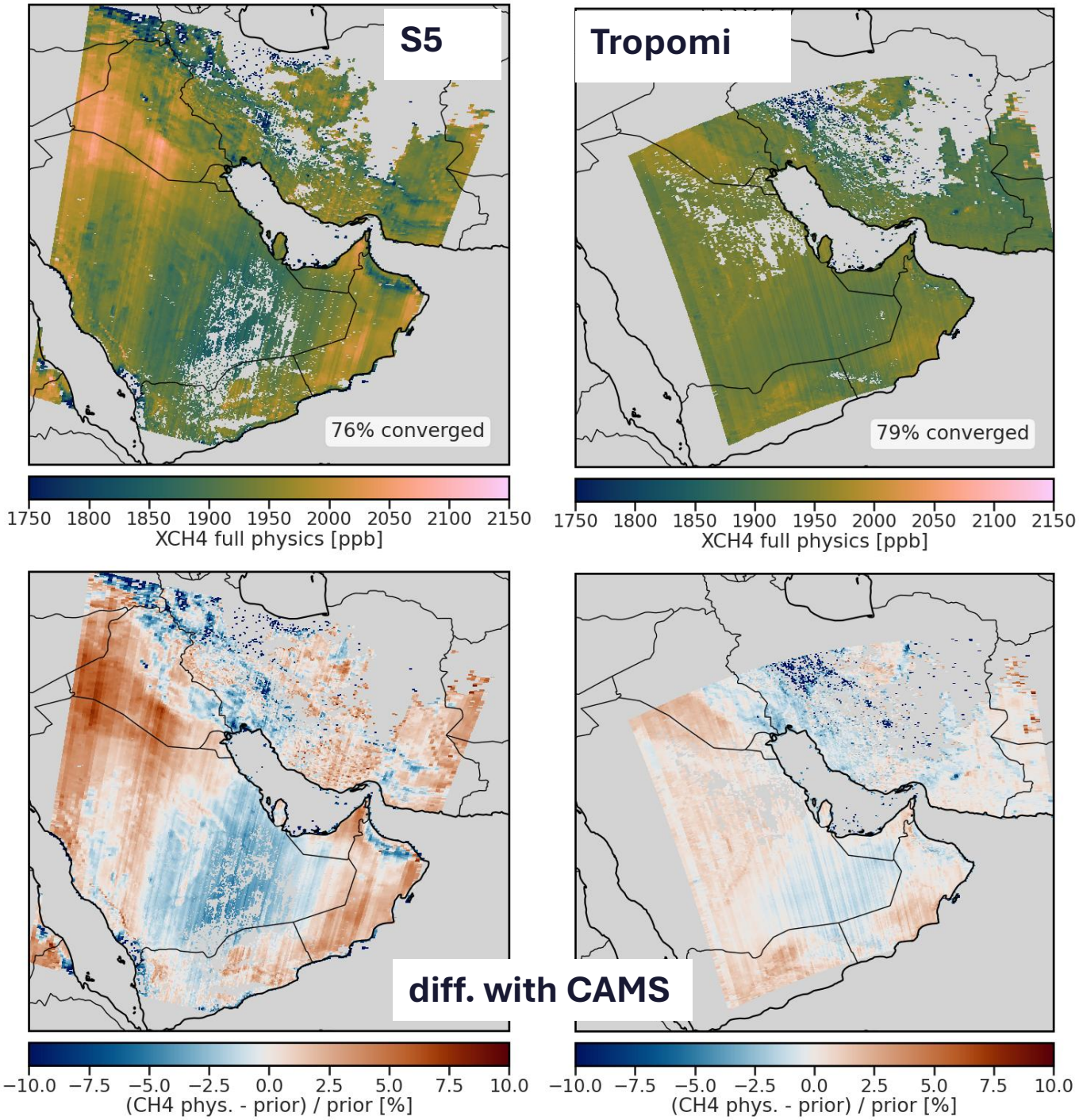
Main challenges

- The quality of the NIR band is very good.
- In the SWIR-1 and SWIR-3 bands, we identified challenges with RTS pixels and straylight.
- For RTS, we have a prototype method based on dark measurements and dynamic filtering during retrieval.
- For straylight, we are working together with ESA and Airbus and expect several L1b updates before end of commissioning.



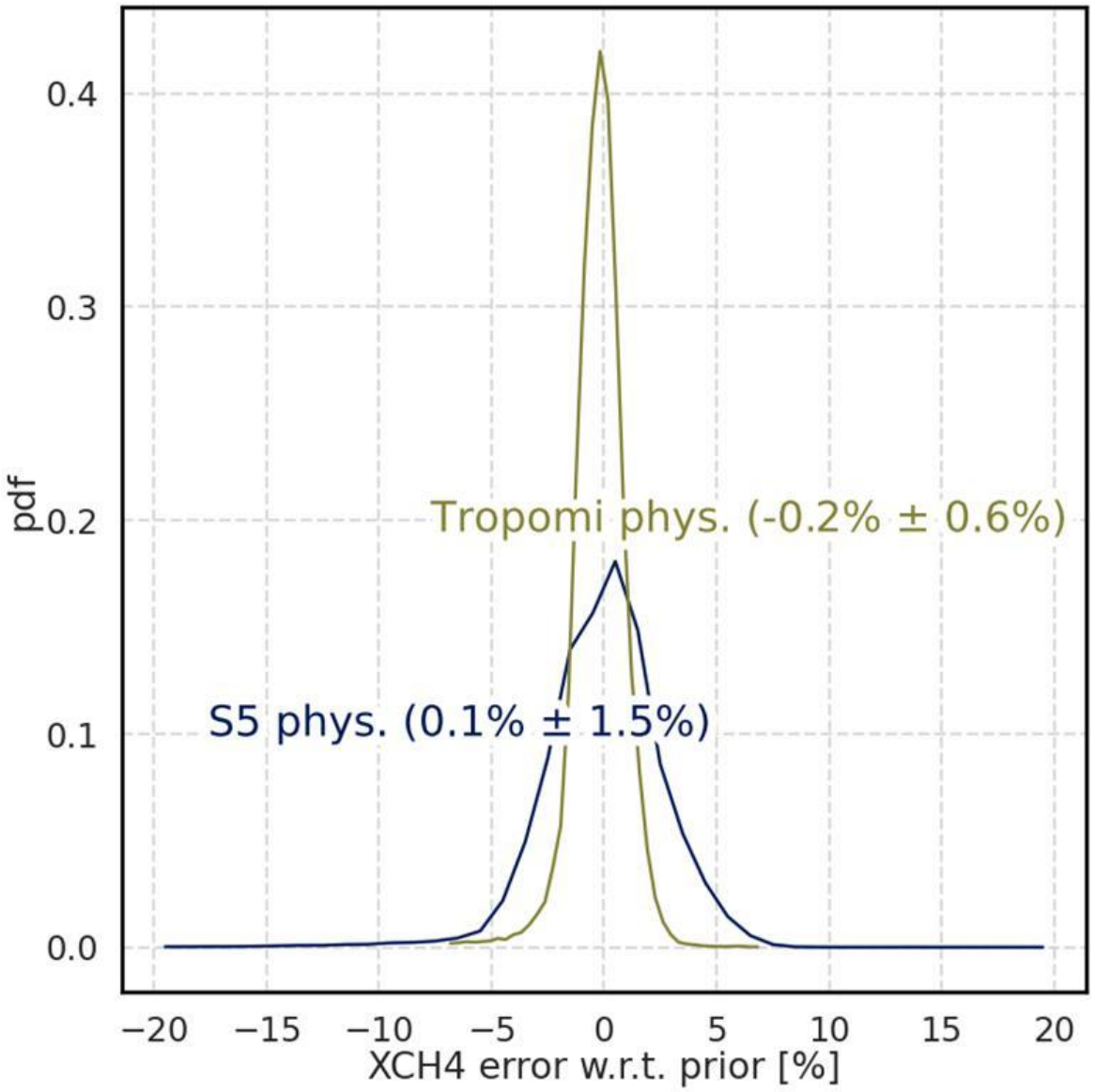
Case study 1: comparison with Tropomi on desert scene

- We selected a cloud-free desert scene (Arabian Peninsula)
- We evaluate Tropomi data with Sentinel-5 algorithm setup.
- We find:
  - Comparable convergence rate
  - Comparable stripiness



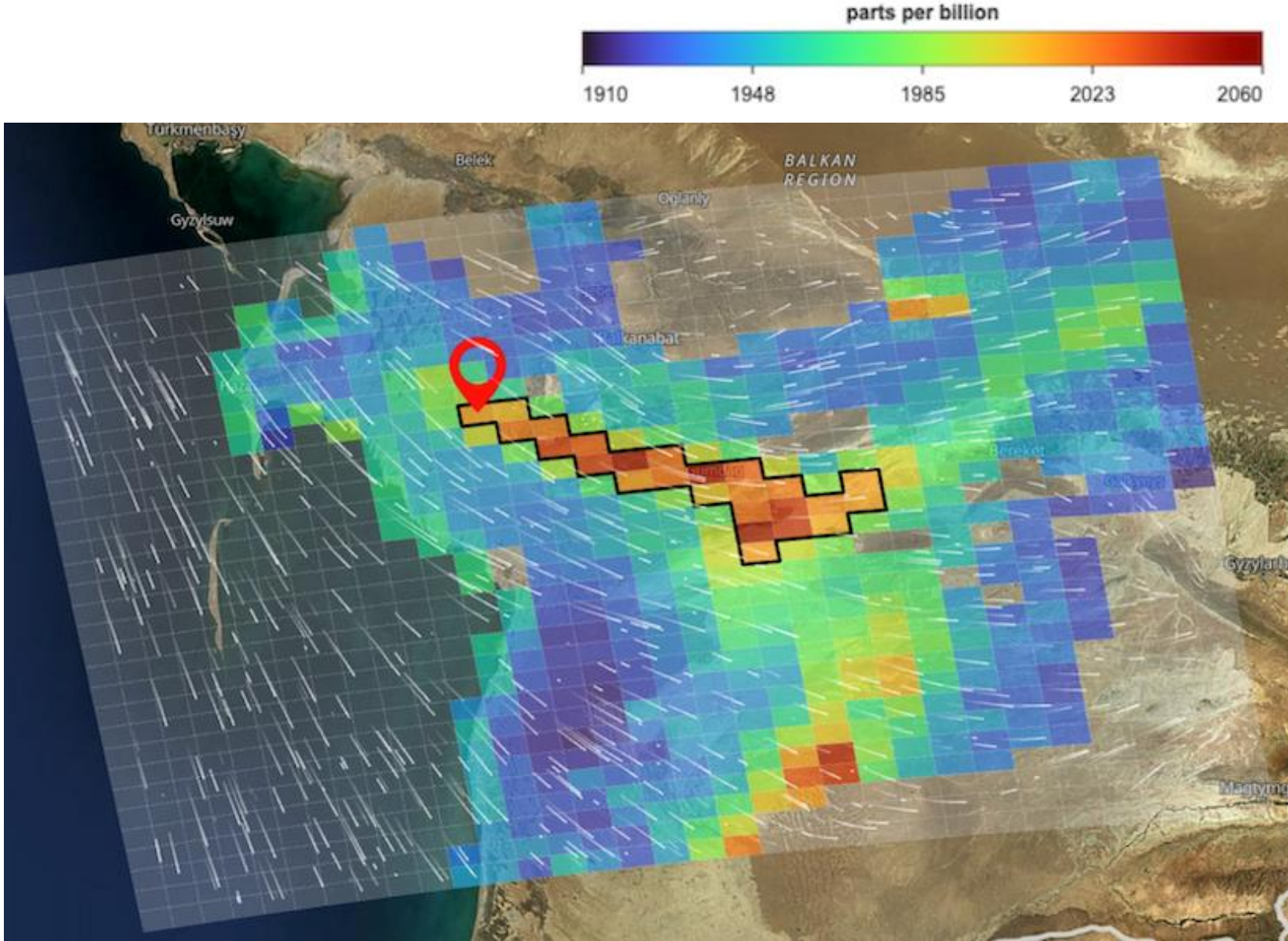
Case study 1: S5 comparison with Tropomi on desert scene

- We apply a provisional simple bias correction (scale by constant) due to known straylight issue.
- We find this acceptable at this stage, given that we expect several L1B updates that will improve radiometric quality.



Case study 2: S5 performance on Tropomi-detected CH4 plume

- 20 april 2026, Turkmenistan
- Large methane source from oil extraction (187 +- 71 tons/hr).



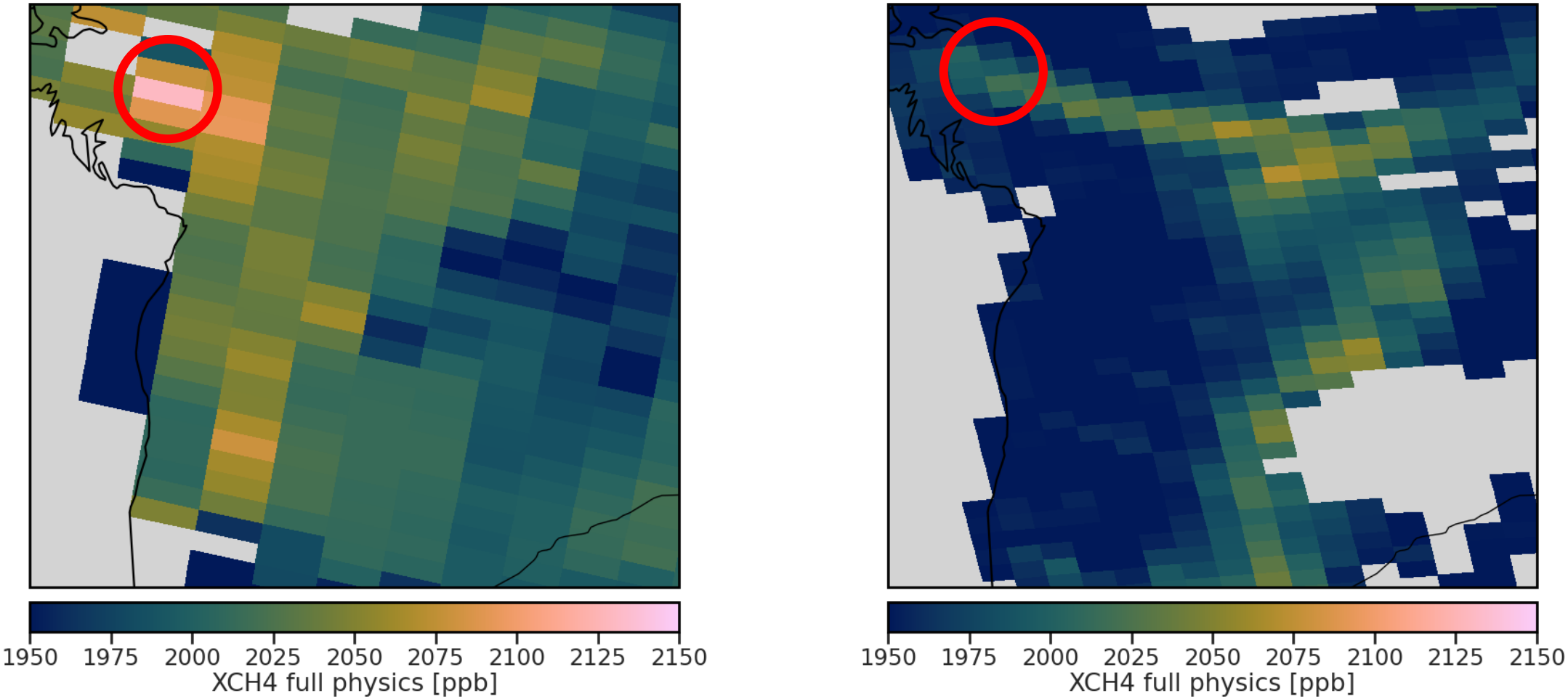
CAMS hotspot explorer service

Case study 2: S5 performance on Tropomi-detected CH4 plume

Sentinel-5

source location

Tropomi



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