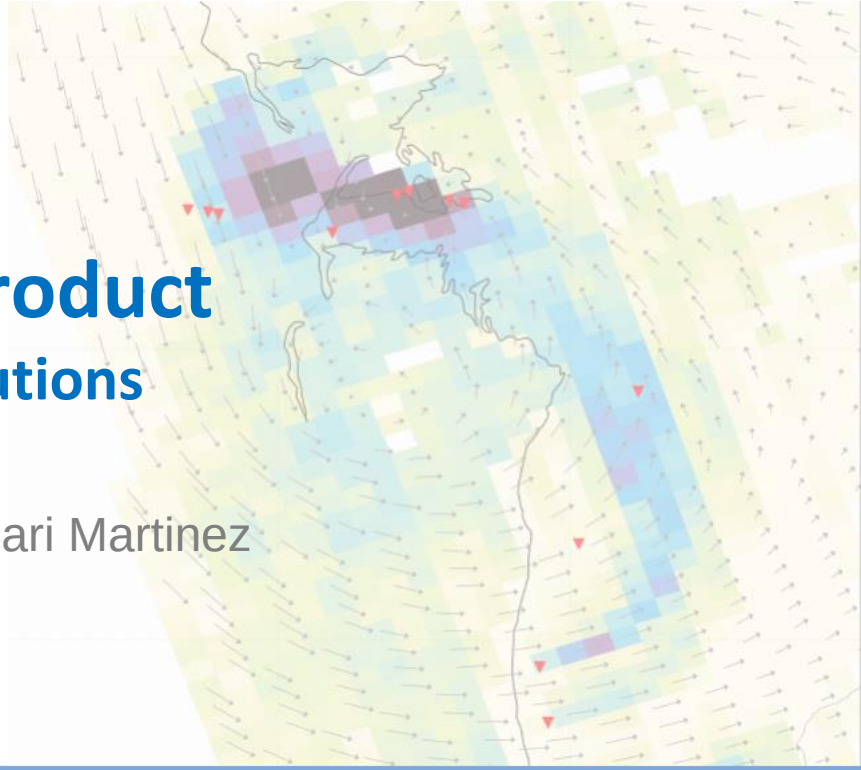


The TROPOMI Methane Product

Development, Challenges, and Solutions

Jochen Landgraf, Alba Lorente Delgado, Mari Martinez Velarte, Tobias Borsdorff

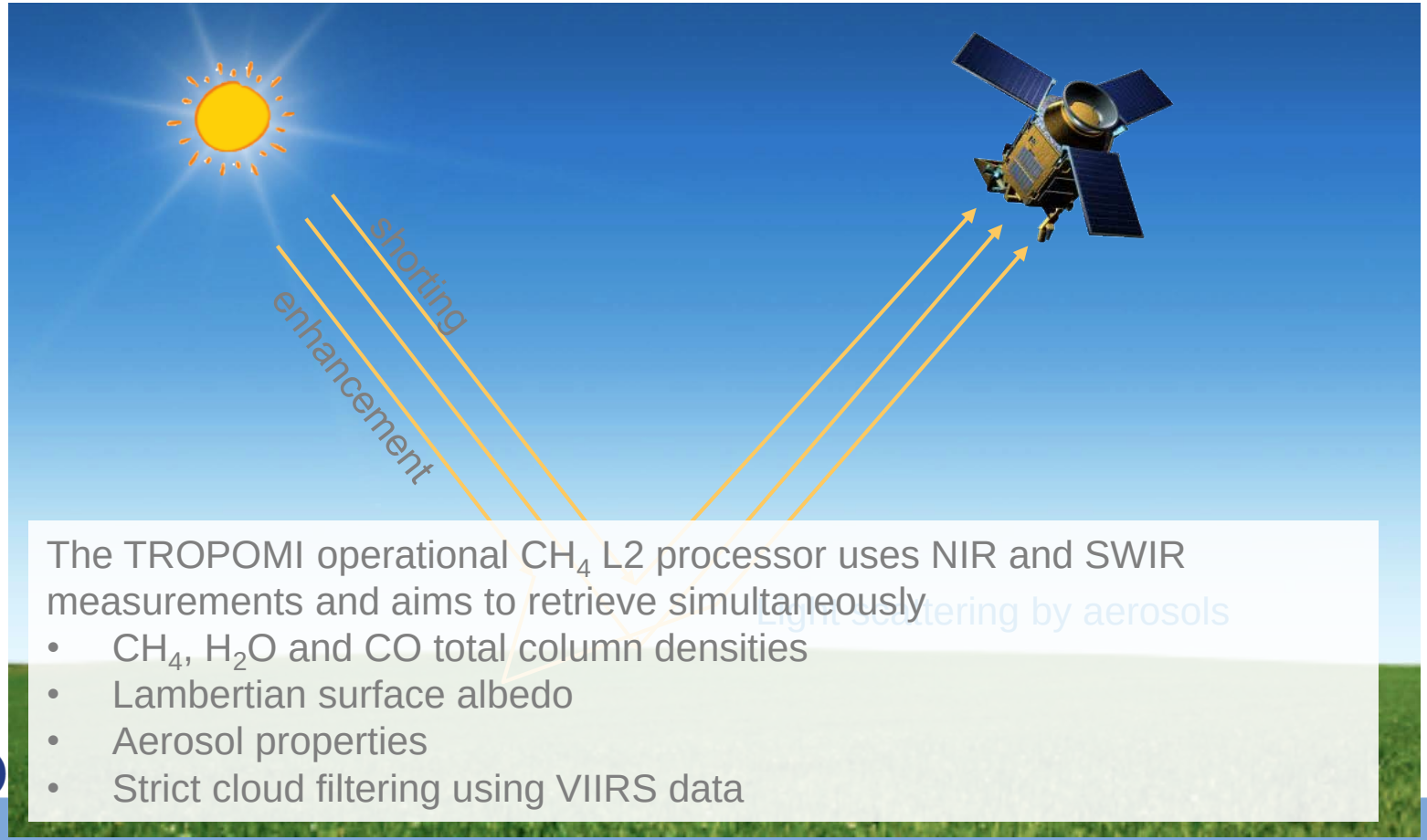
SRON

Netherlands Institute for Space Research

Netherlands Organisation for Scientific Research (NWO)


TROPOMI's Waiting Room
Eumetsat Meteo
2016
TICK
TOCK
TICK TOCK

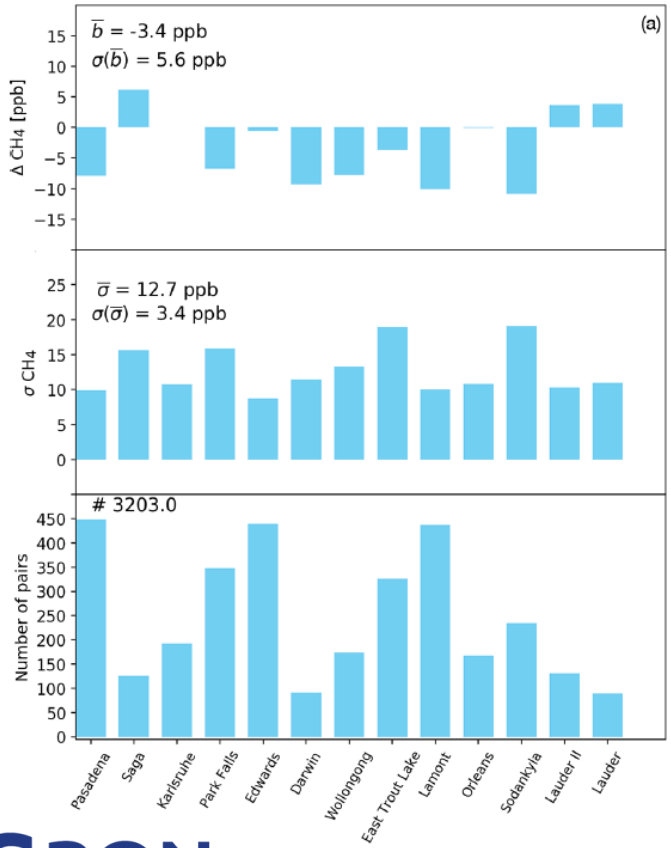
CH_4 Remote Sensing of the Atmosphere

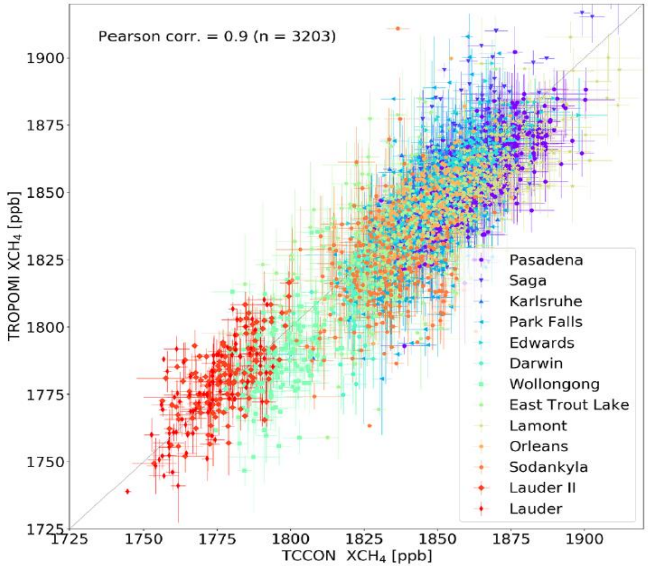


The TROPOMI operational CH_4 L2 processor uses NIR and SWIR measurements and aims to retrieve simultaneously

- CH_4, H_2O and CO total column densities
- Lambertian surface albedo
- Aerosol properties
- Strict cloud filtering using VIIRS data

XCH_4 validation

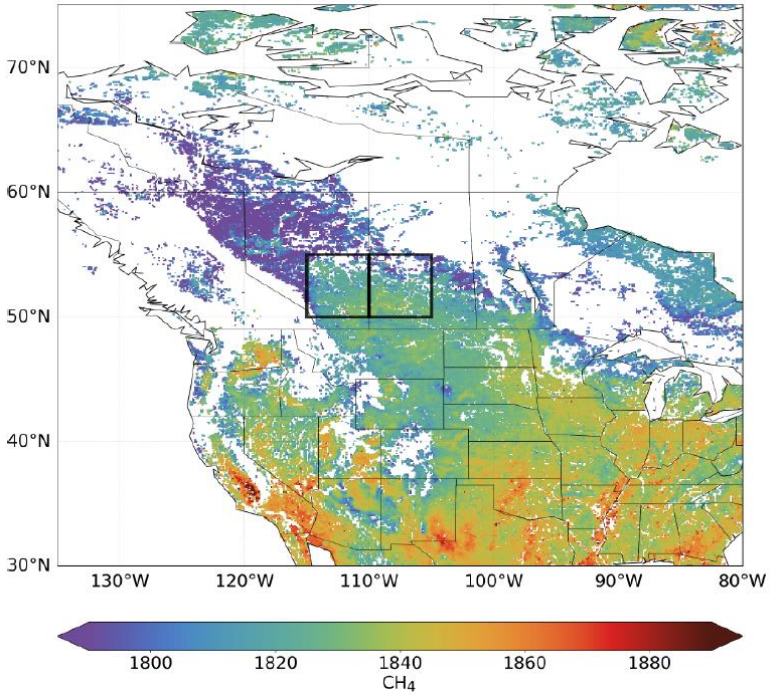


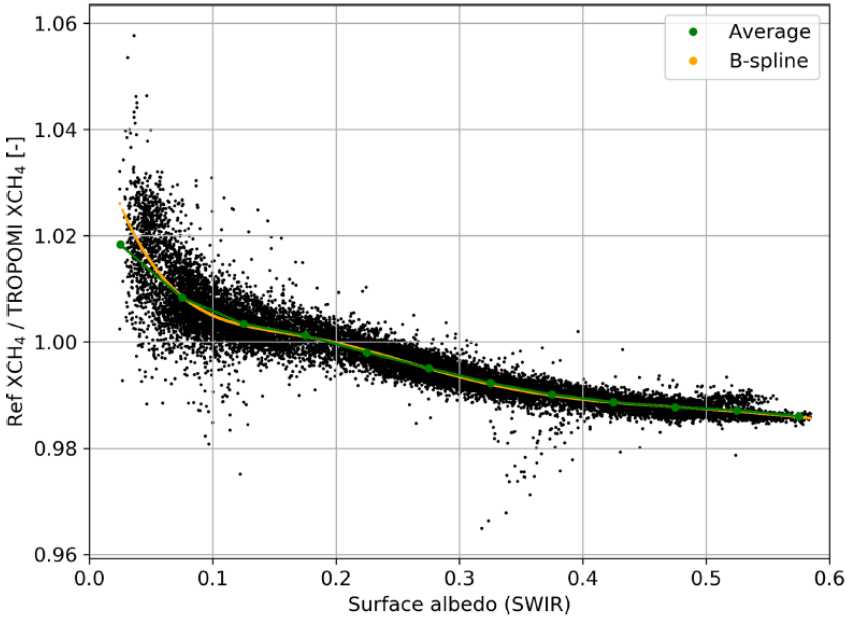


TCCON-TROPOMI comparison indicated good data quality (compliant with mission requirements)

Lorente et al., 2021, M. Sha et al,, 2021

A posteriori bias correction

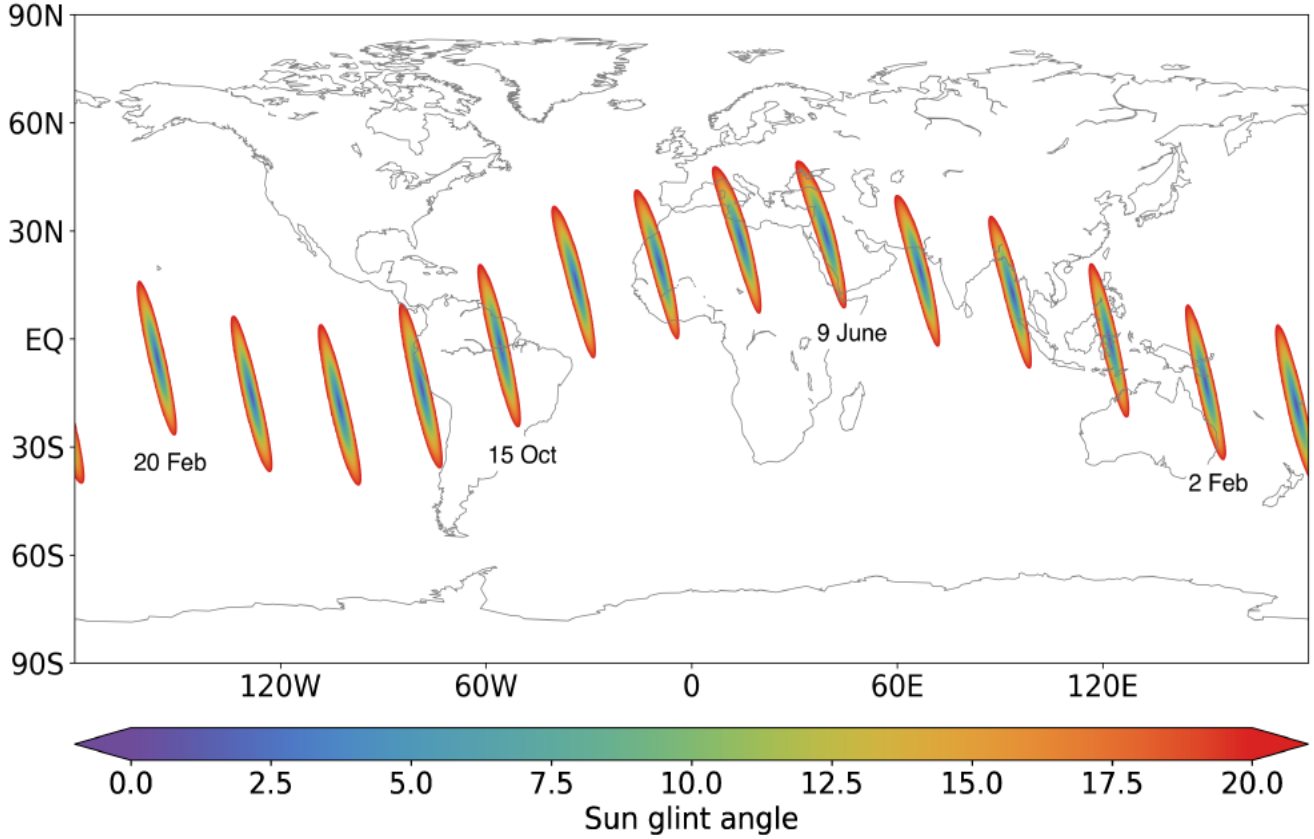




Lorente et al., 2021

TROPOMI and GLINT observations

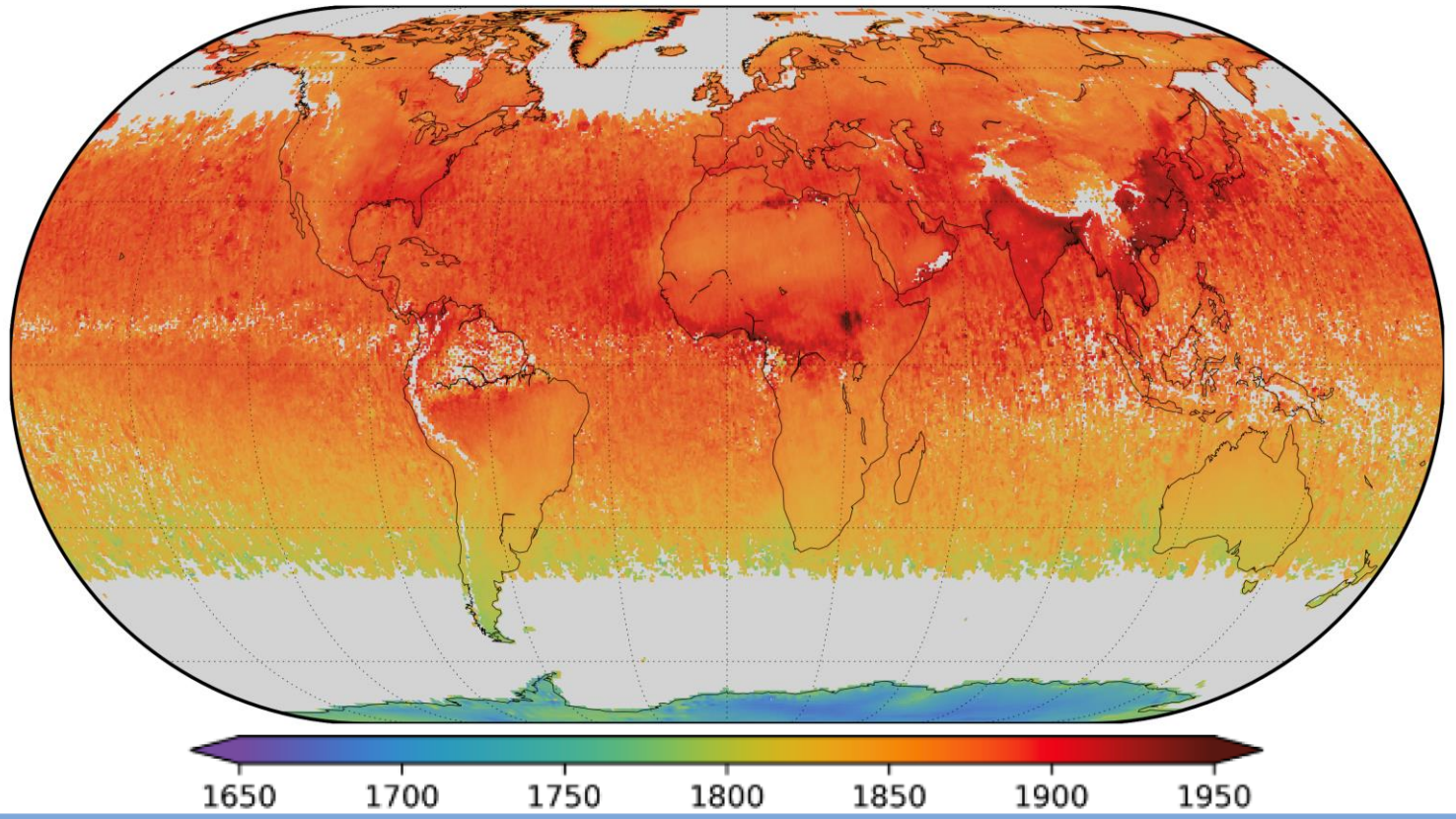
- TROPOMI has no active glint pointing
- Data coverage over the oceans depends on the season.



TROPOMI data coverage (glint and nadir)

March 2018-December 2020

Using a fixed regularization scheme to avoid differences between land and ocean.



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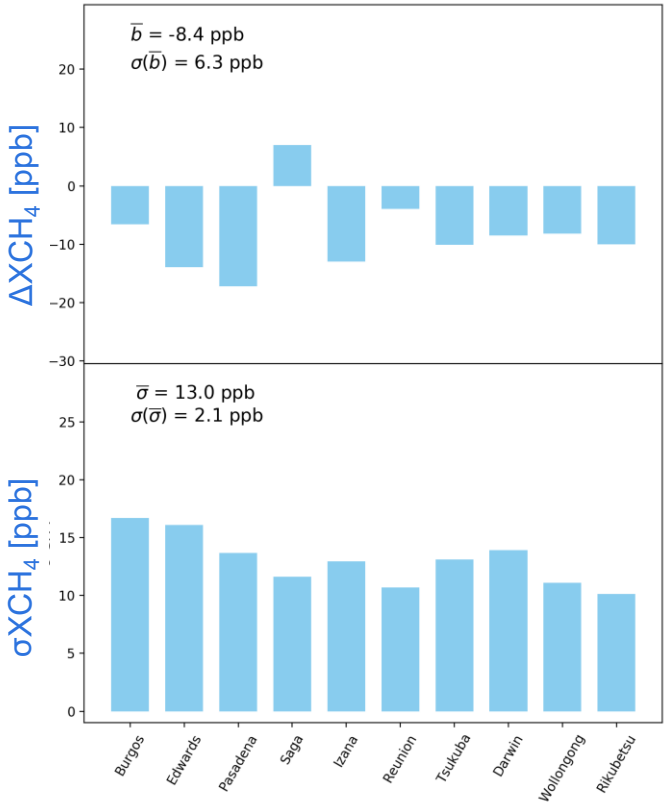
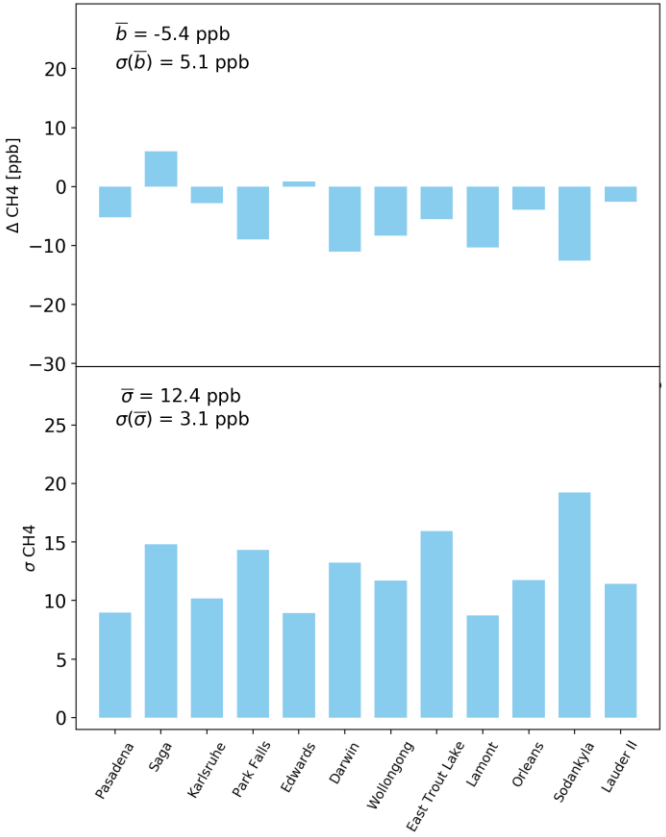
Validation TCCON

Minor differences between ocean glint and land observations.

OCEAN



LAND

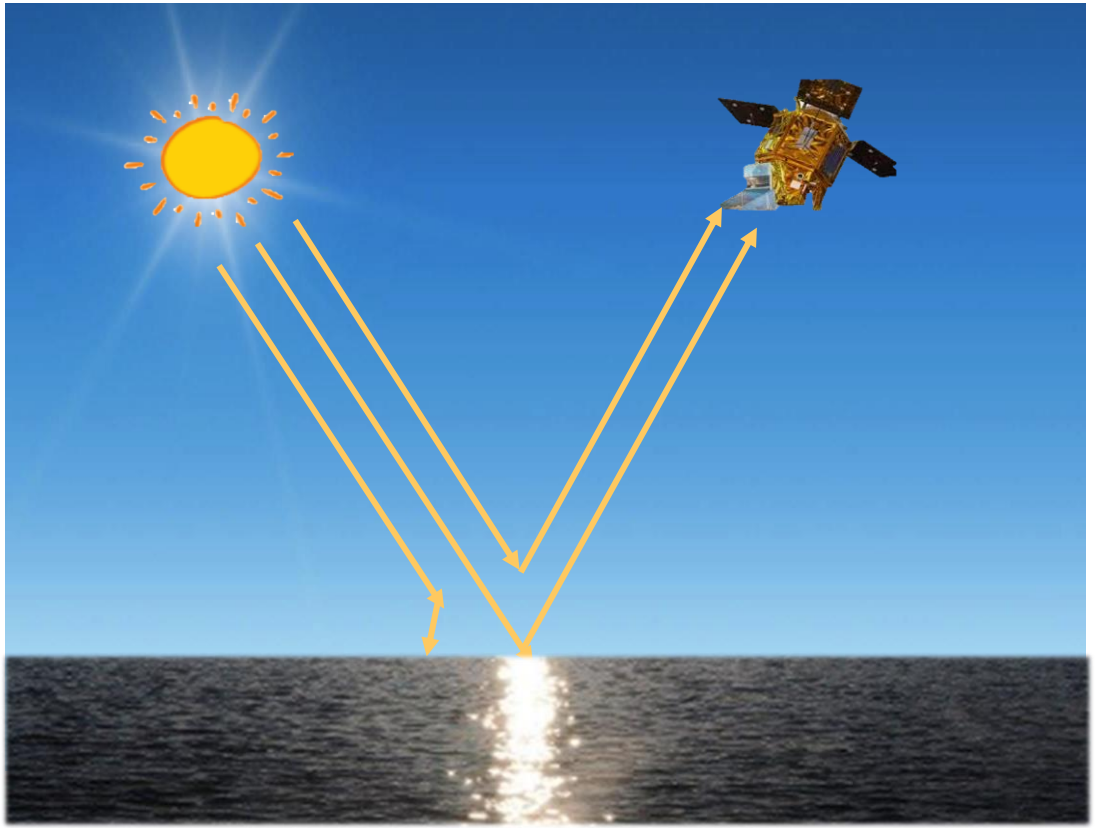


Lorente et al., ATMD, 2022

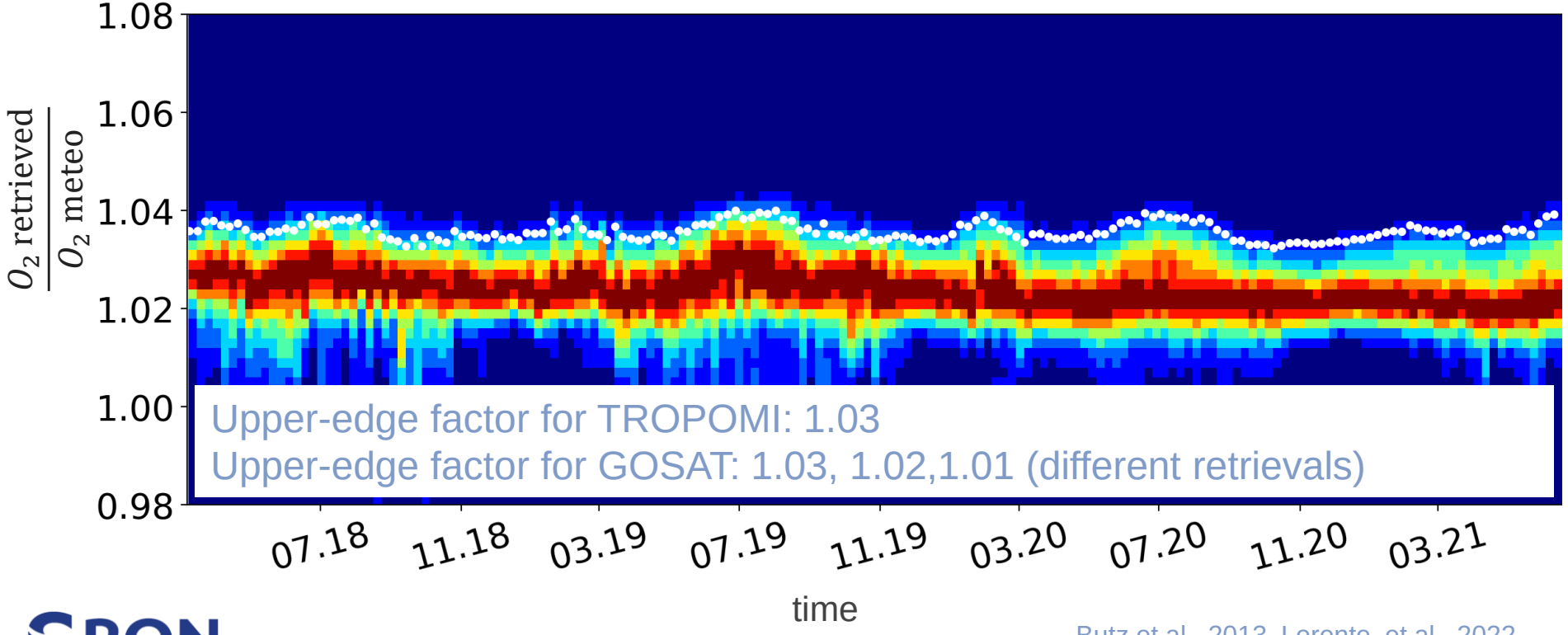
Glint observations over water

The chances of light path enhancement is low because of the dark surface in all scatter geometries other than glint.

⇒Mainly underestimation of retrieved O_2 column from the O_2 A band when aerosol scattering is ignored.

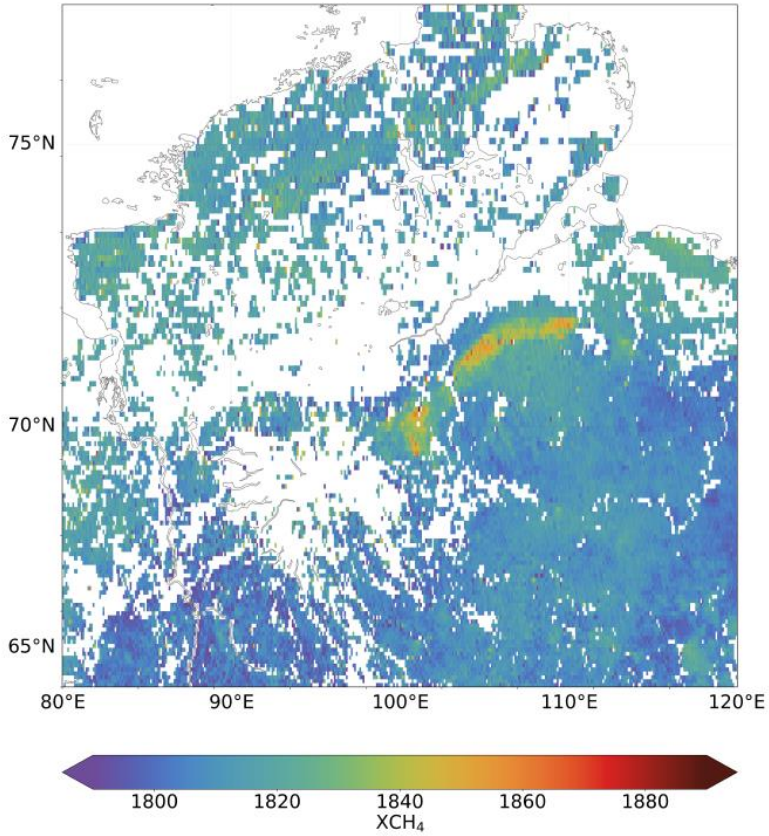


O2-A band: Upper Edge Method



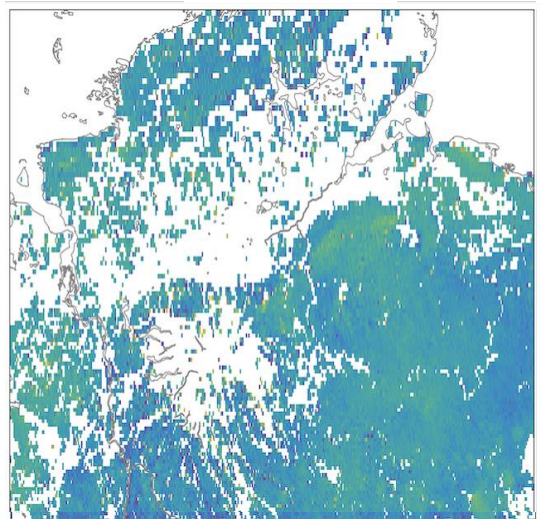
Butz et al., 2013, Lorente et al., 2022

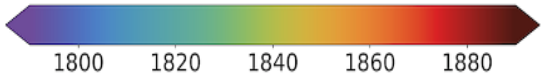
Surface Reflection of Carbonate Rock Formations



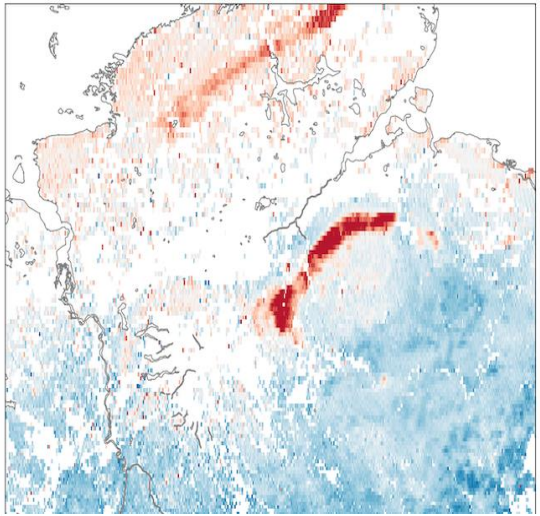
Effect 3rd order polynomial: Siberia

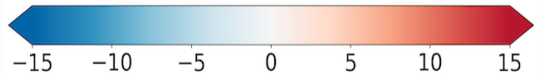
3rd order



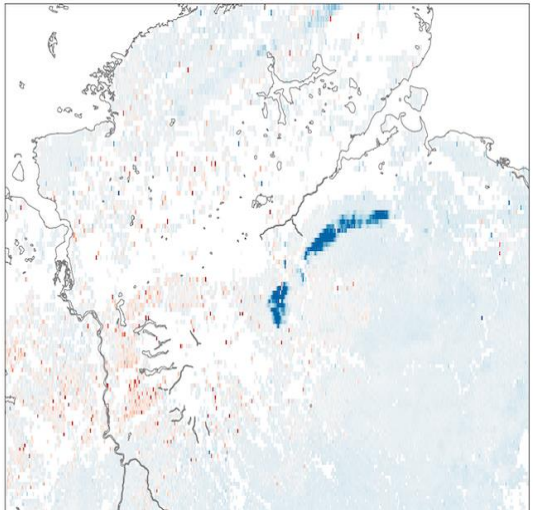


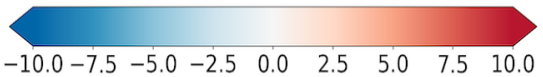
XCH_4





ΔXCH_4

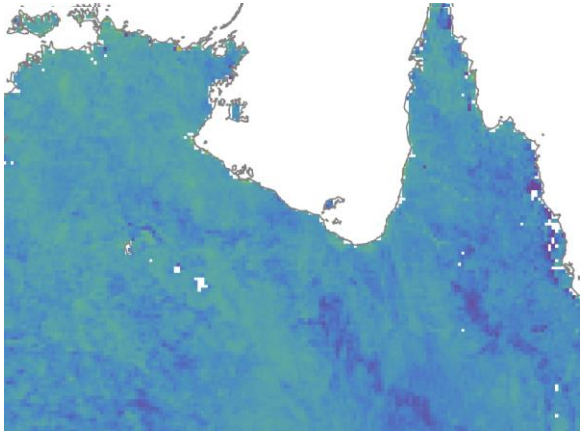


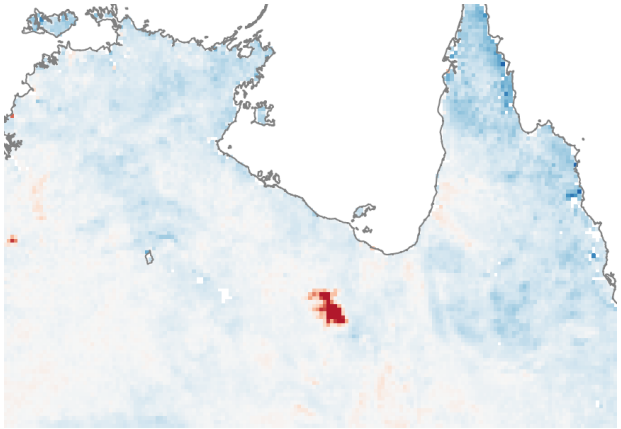


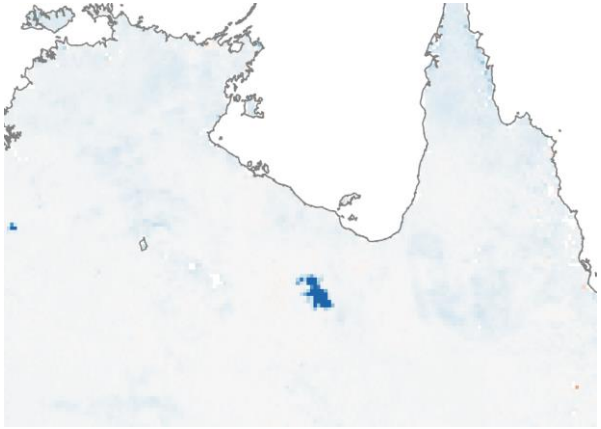
ΔCHI^2

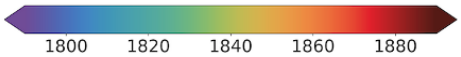
Effect 3rd order polynomial: North-East Australia

3rd Order



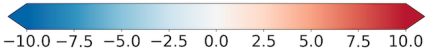






XCH_4

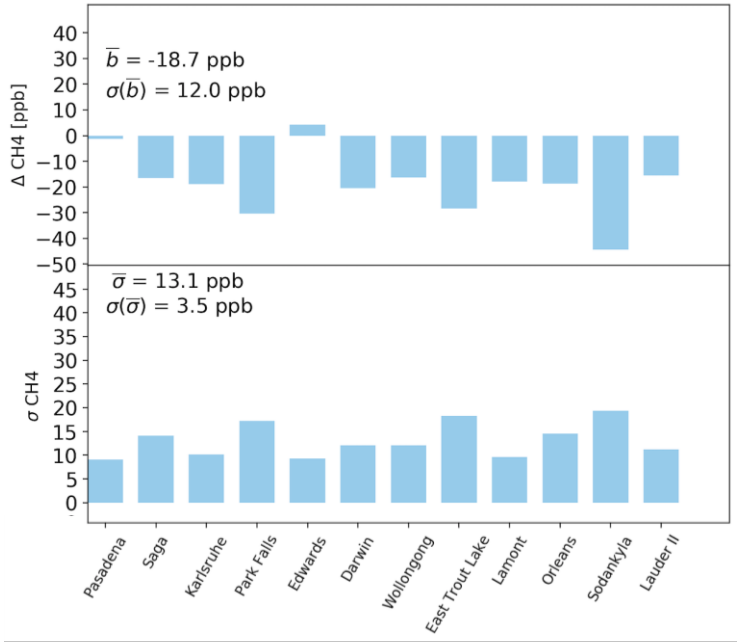
ΔXCH_4



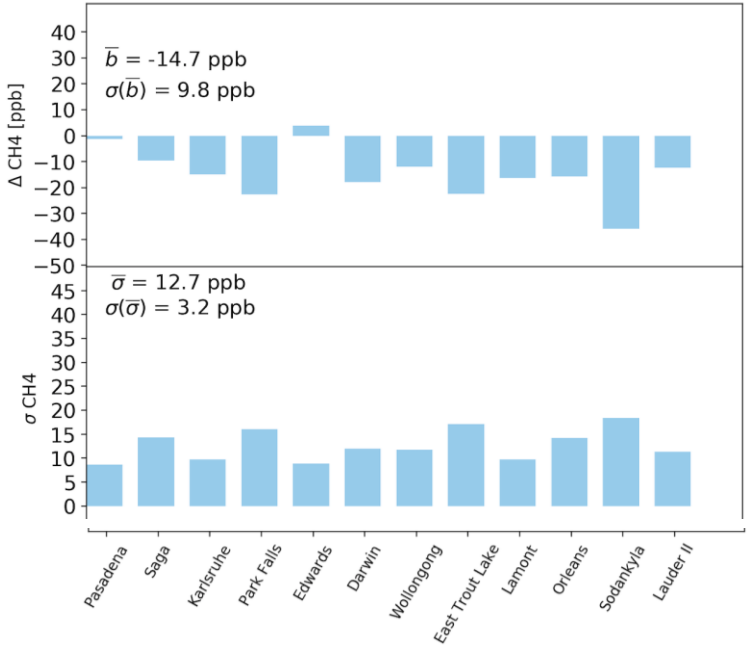
ΔCHI^2

What do TCCON and GOSAT say?

2nd order



3rd order



Validation with TCCON Improvement of ~ 4 ppb

GOSAT TROPOMI comparison: Improvement of ~ 2 ppb

SRON

Lessons learned and future work

The Sentinel 5 Precursor XCH_4 data product is overall compliant with mission requirements and triggered already a lot of scientific studies.

Validation

- For a GHG mission, we need at least a year of data to do a proper validation
- TCCON and NDACC provide essential measurements for validation.
- The validation strategy should include data over source-free small areas

Open issues

- The upper edge problem is not solved yet
- An explanation for the surface-dependent bias not found

Future work

- Test CAMS prior data stream for CH_4 prior information
- High latitude performance

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