

Recent changes in global CH₄ emissions constrained by TROPOMI and IASI data

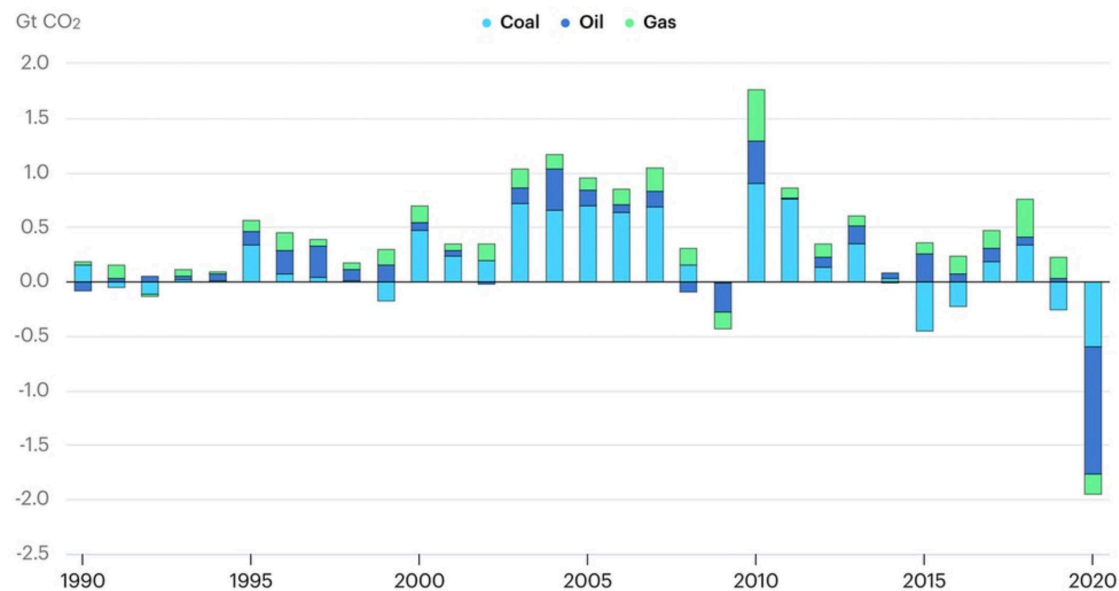
Sander Houweling (VUA/SRON), Jacob van Peet (VUA), Tonatiuh Nunez Ramirez (MPI-BGC), Julia Marshall (DLR), Ilse Aben (SRON), Michael Buchwitz (iUP), Cyril Crevoisier (LMD), Tobias Borsdorff (SRON), Alba Lorente Delgado (SRON), Richard van Hees (SRON), Brian Kerridge (RAL), Diane Knappett (RAL), Nicolas Meilhac (LMD), Christian Retscher (ESA), Oliver Schneising (iUP), Richard Siddans (RAL), Steffen Vanselow (iUP), Lucy Ventress (RAL)

The COVID pandemic & global GHG emissions

Example 1: CO₂

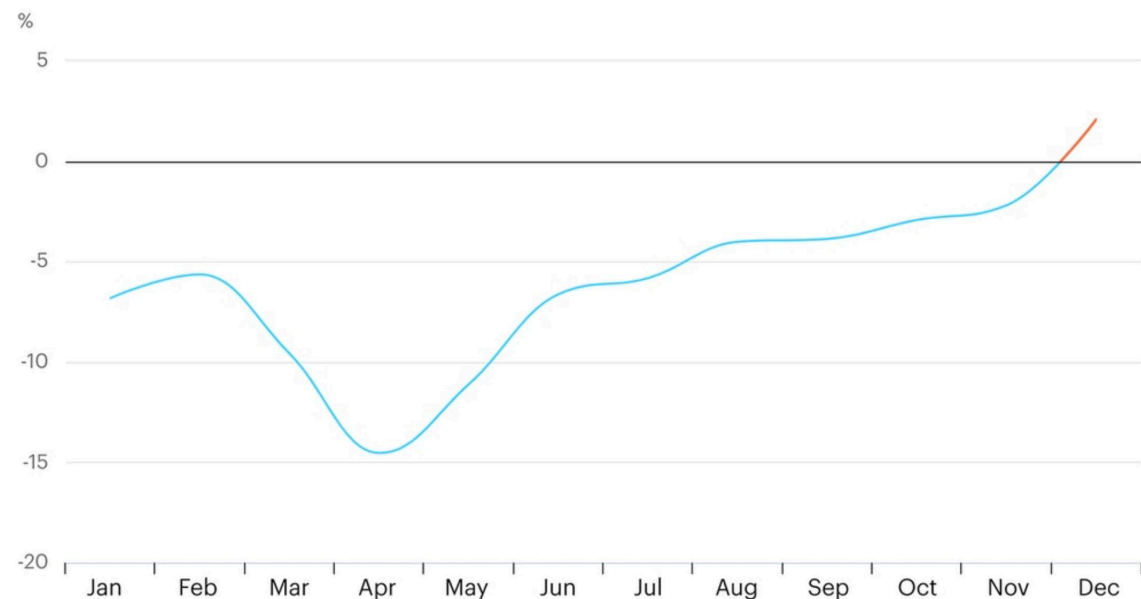
Change in CO₂ emissions by fuel, 1990-2020

Global Energy Review: CO₂ Emissions in 2020



Monthly evolution of global CO₂ emissions, 2020 relative to 2019

Global Energy Review: CO₂ Emissions in 2020

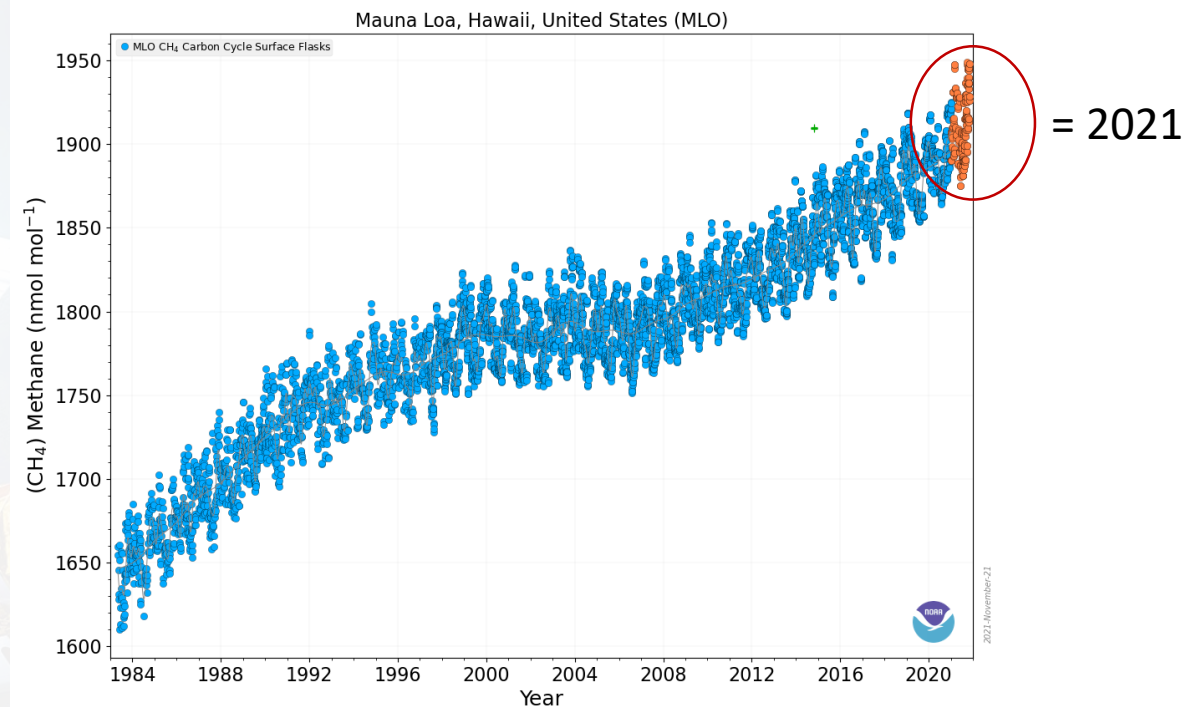
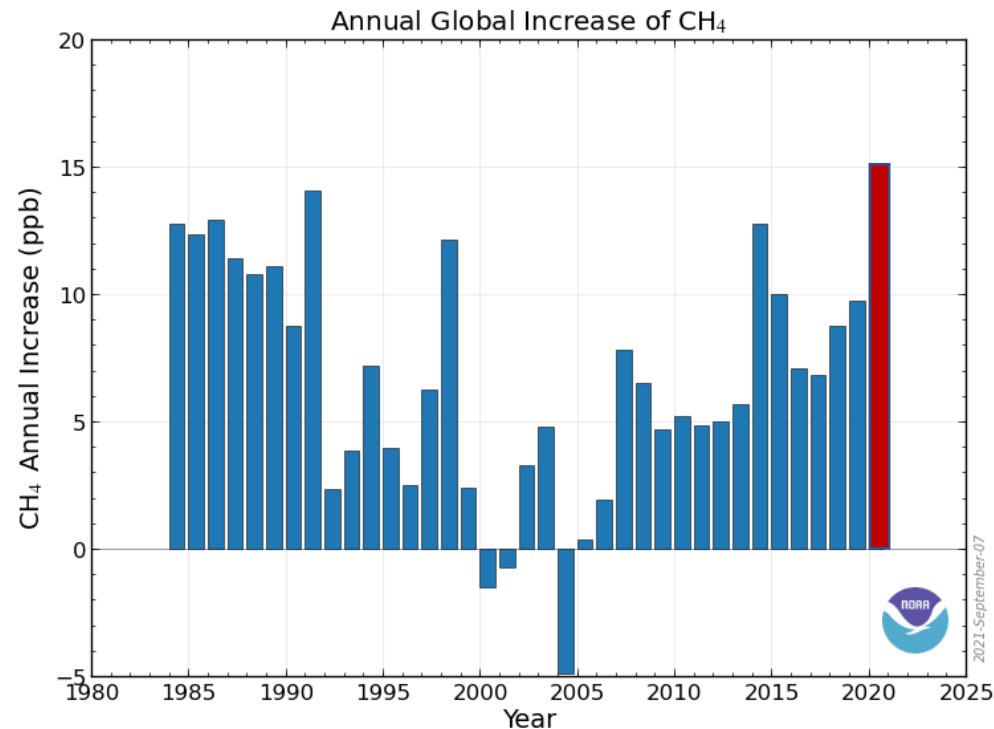


IEA: In 2020 global CO₂ emissions dropped by ~5% compared to 2019

The COVID pandemic & global GHG emissions

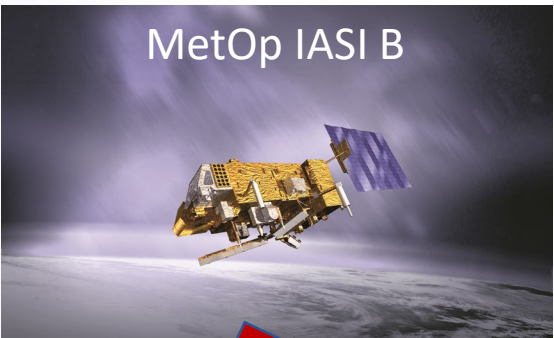
How about CH₄?

➡ Stevensen et al (ACPD, 2021): NO_x reductions (and impact on OH) sufficient to explain the rise in CH₄

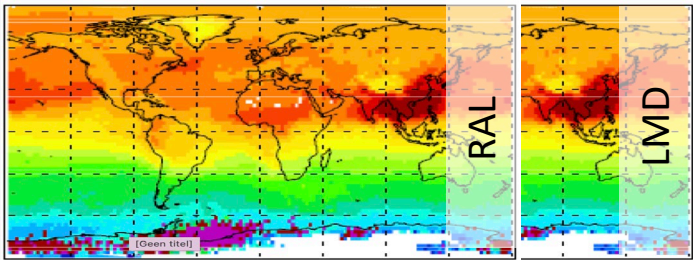
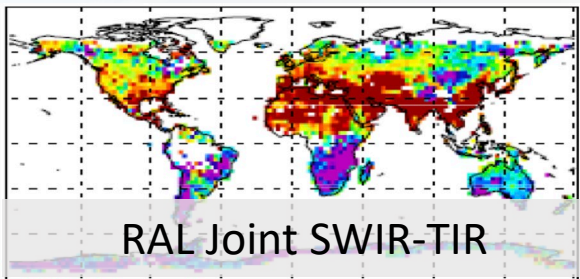
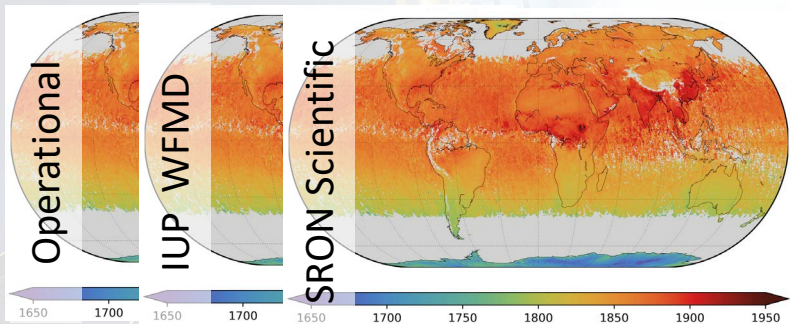




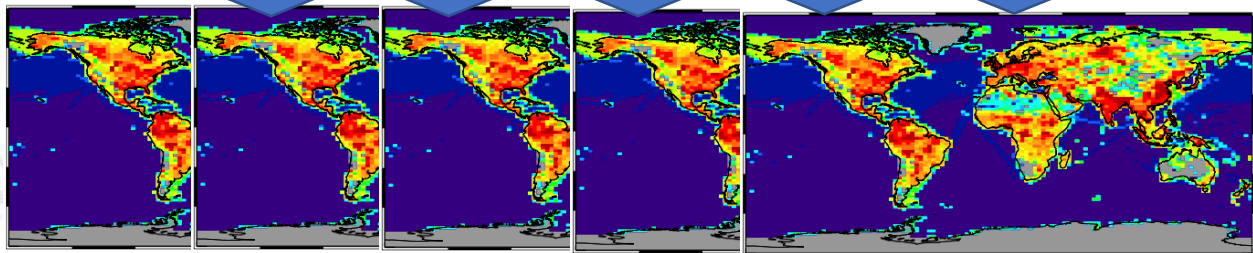
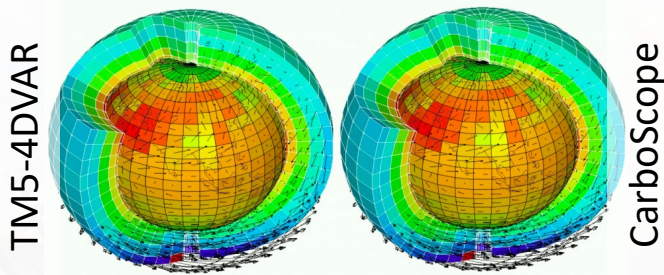
ESA Methane+



L2



L2



L4

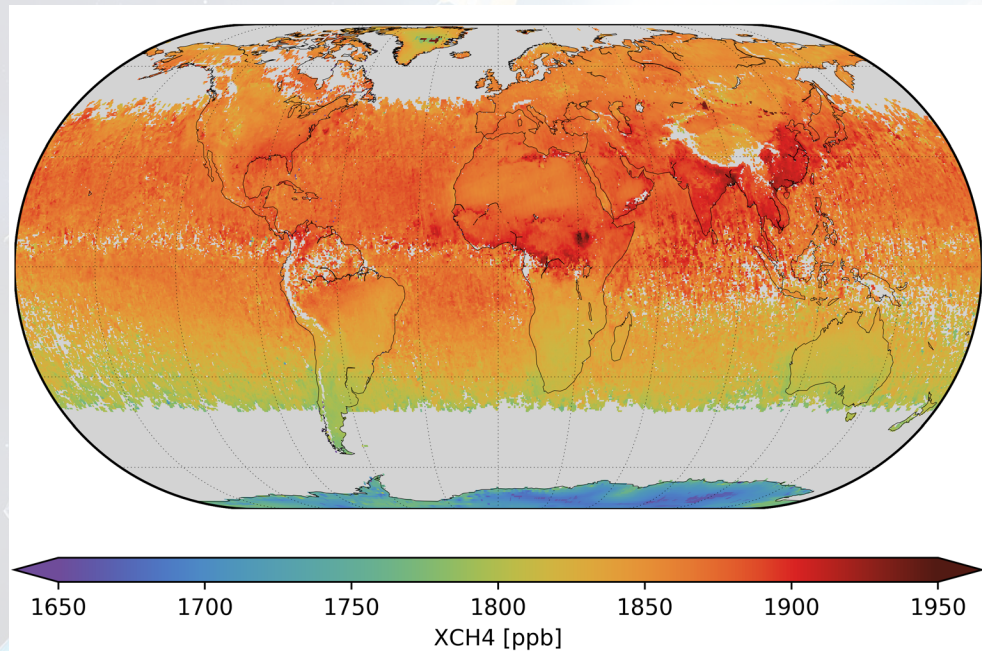
methaneplus.eu
METHANE+

L4

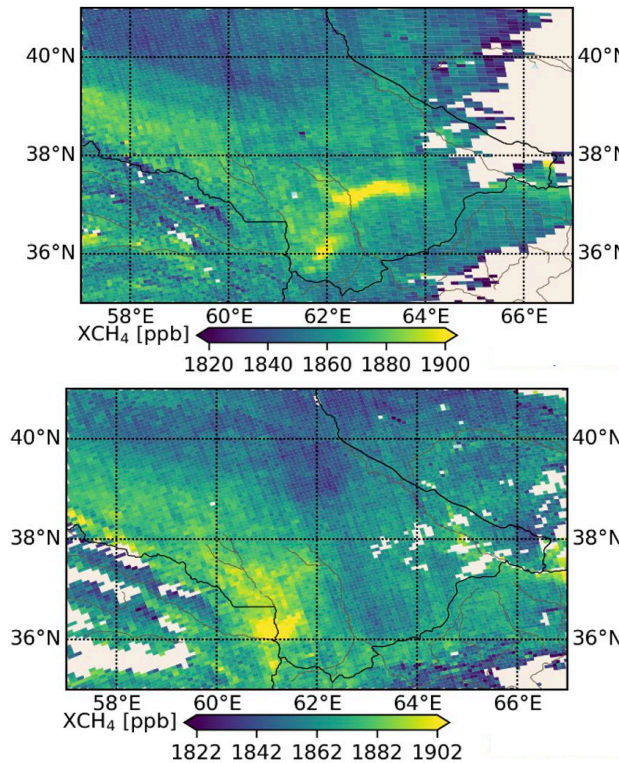
Methane+ retrieval: TROPOMI

- Improved accuracy + coverage

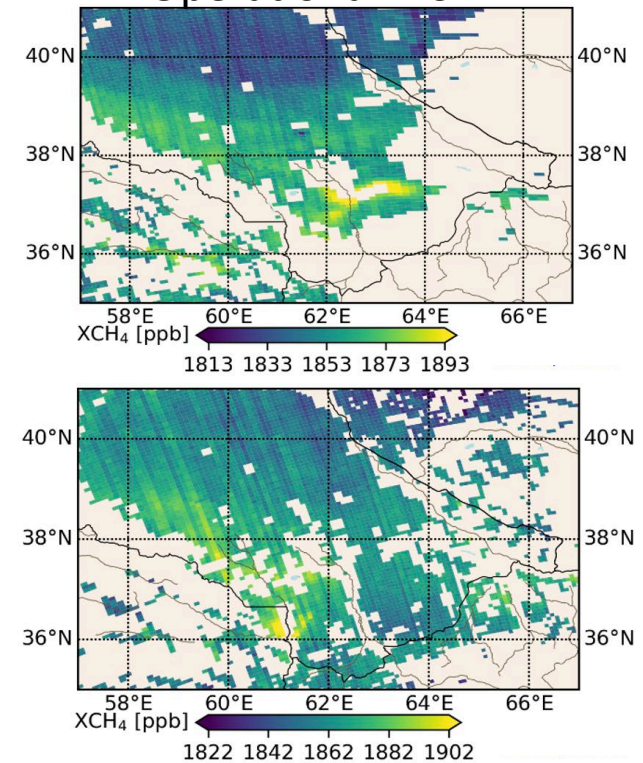
SRON retrieval: Land + Ocean



WFMD v1.2 XCH₄

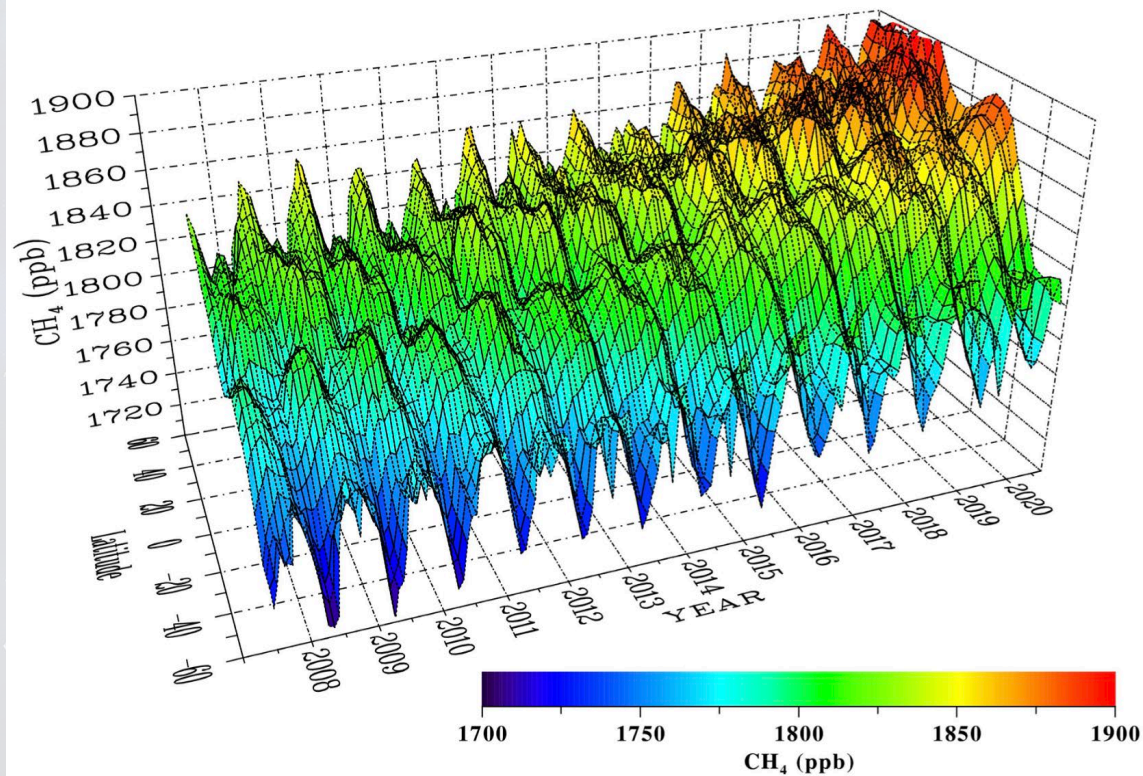


Operational XCH₄

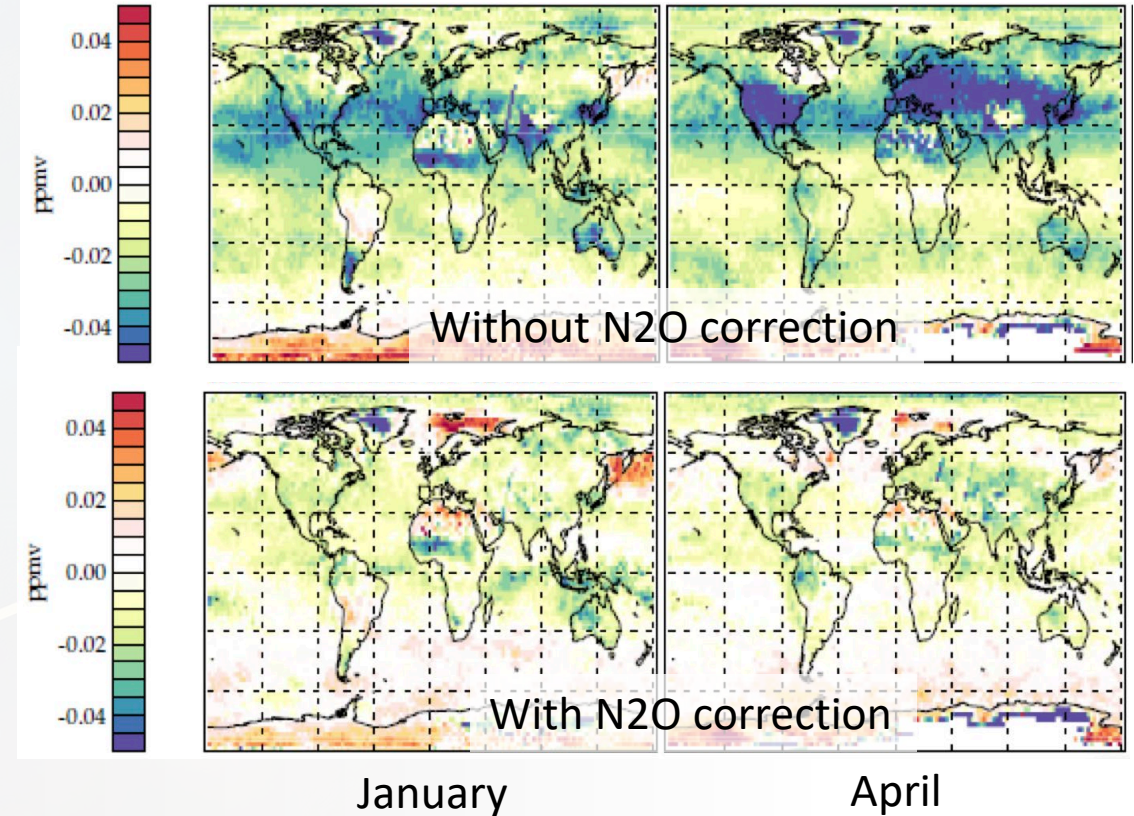


Methane+ retrieval: IASI

LMD IASI XCH₄ retrieval: full dataset



RAL XCH₄ – CAMS XCH₄

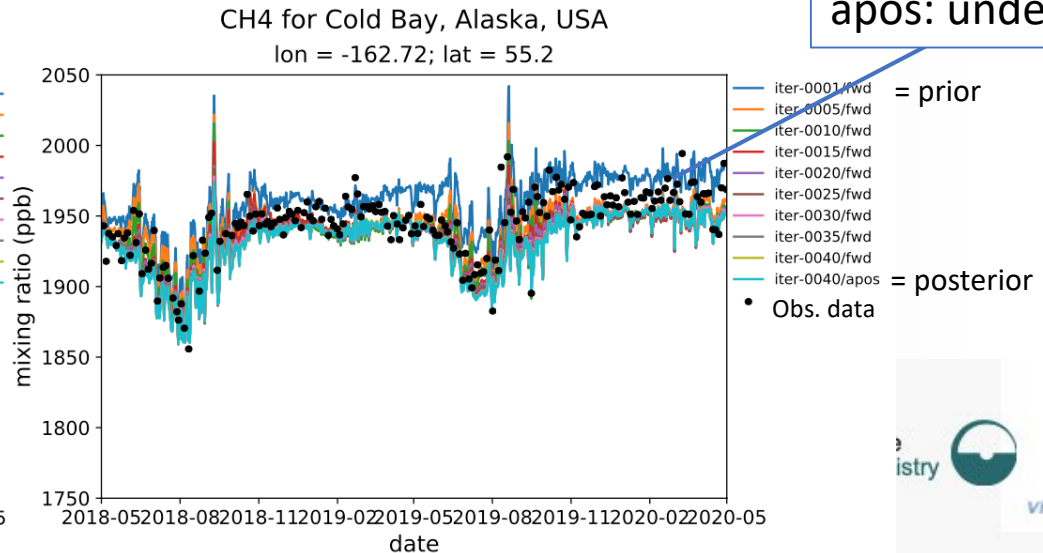
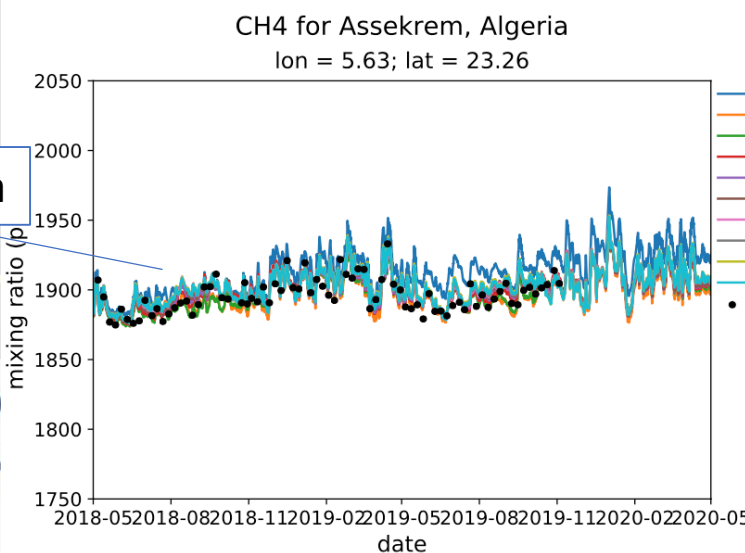
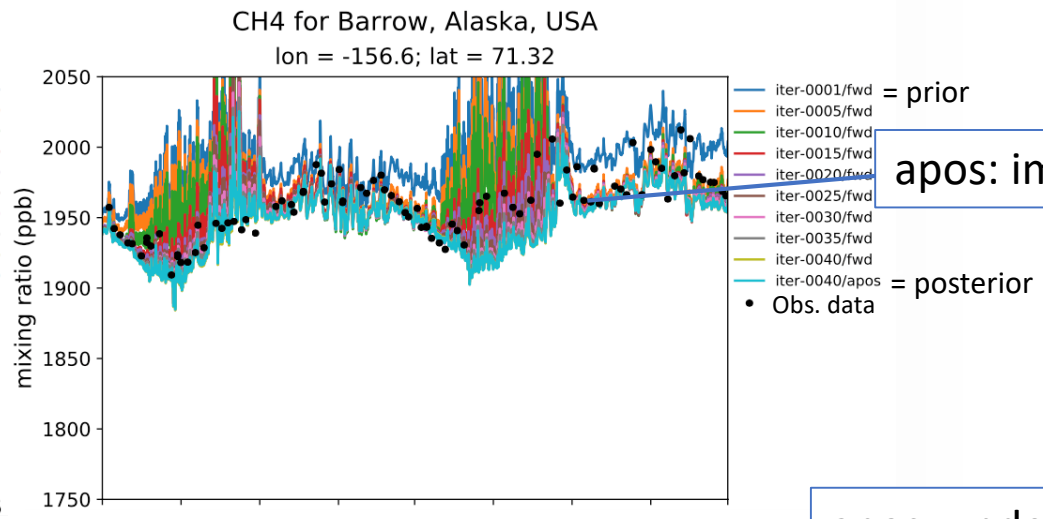
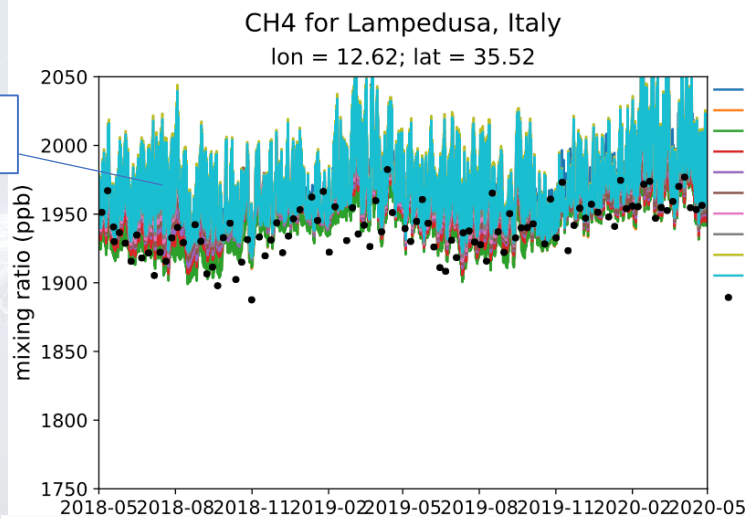


Inverse modelling in ESA Methane+

- Inversion systems: TM5-4DVAR, Jena Carboscope
- Setup: following the CAMS reanalysis
- Datasets: TROPOMI (operational, SRON scientific, iUP)
IASI (LMD, RAL)
Combined SWIR-TIR (RAL)
- Time window: 2018/05 – 2020/04 (excluding spin-up/spin-down)

TM5-4DAR: Comparison with surface data

Inversion using TROPOMI SRON Scientific product, incl. bias correction



apos: dust problem?

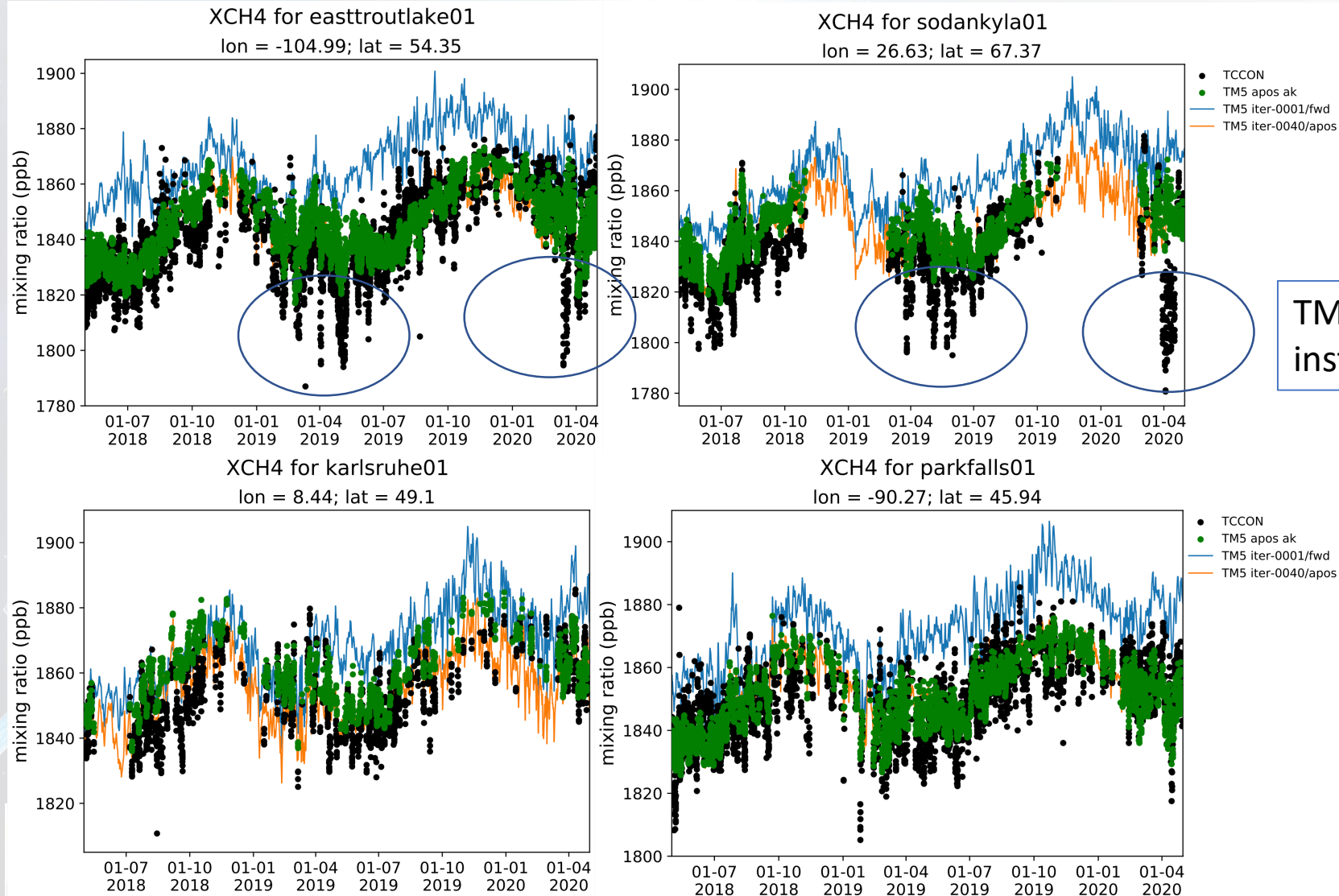
apos: improved fit

apos: OK over Sahara

apos: underestimation

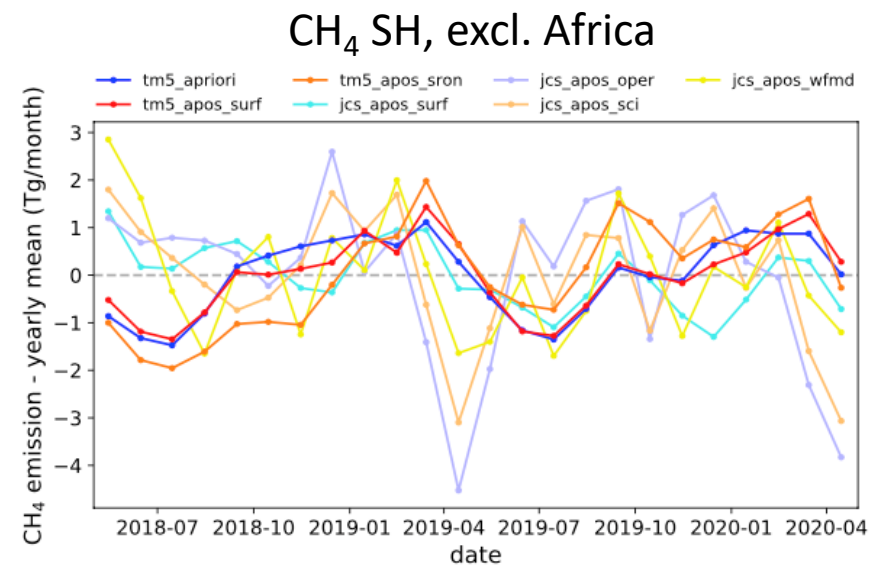
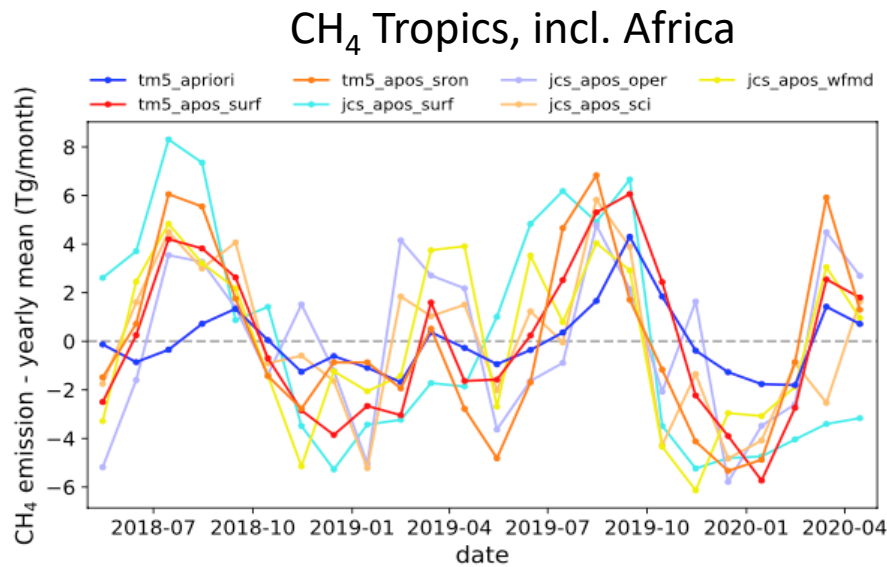
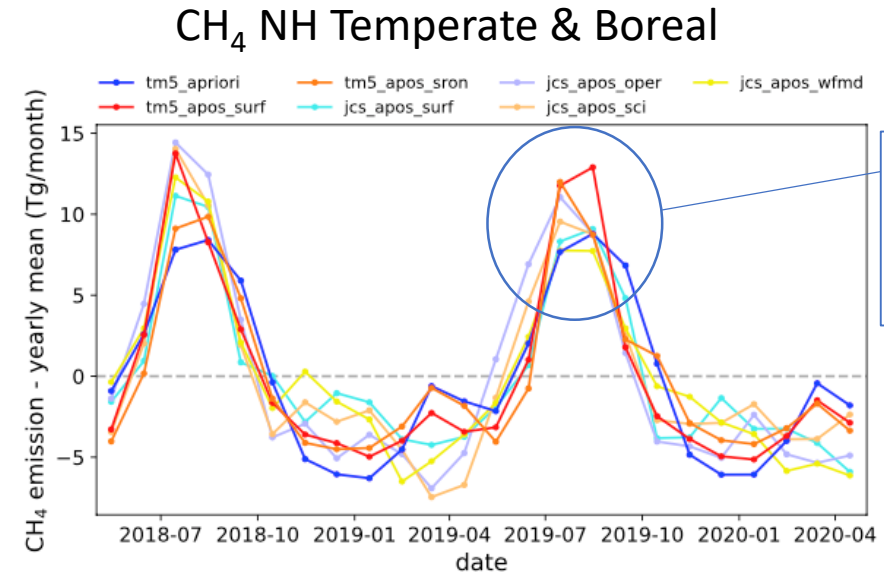
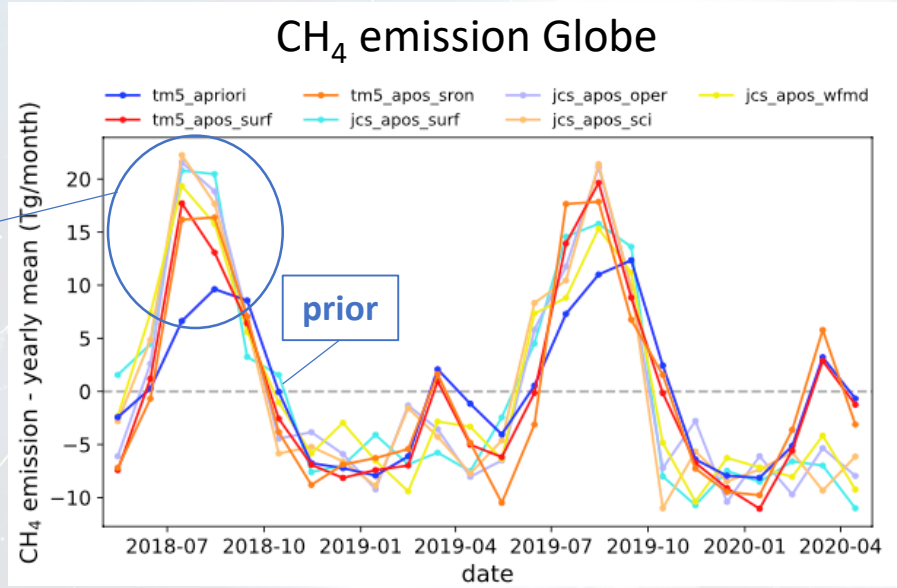
methaneplus.
METHANE

TM5-4DVAR: Comparison with total column data



TM5 doesn't catch instances of low XCH4

Comparing TM5-4DVAR & Carboscope



methaneplu
METHAN

Comparison between the 2 years

- Results from TM5-4DVAR

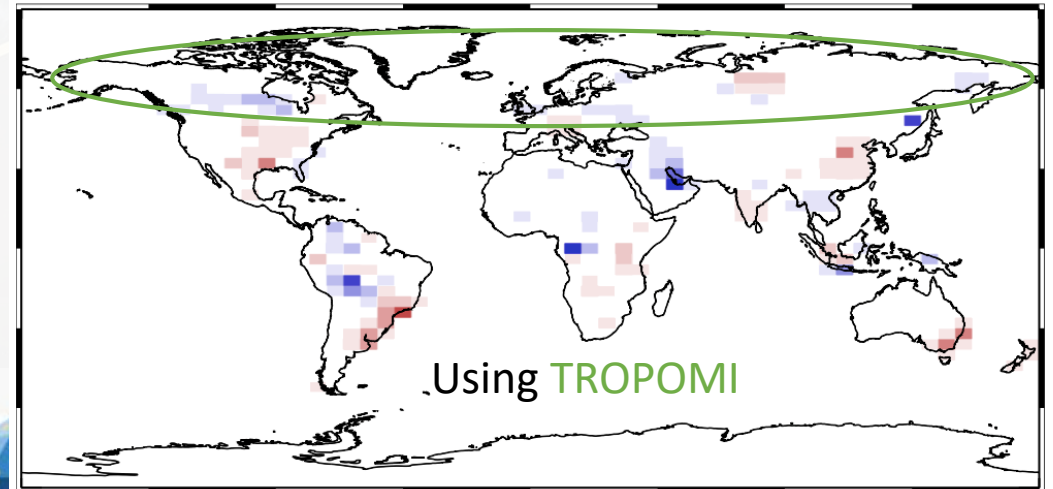
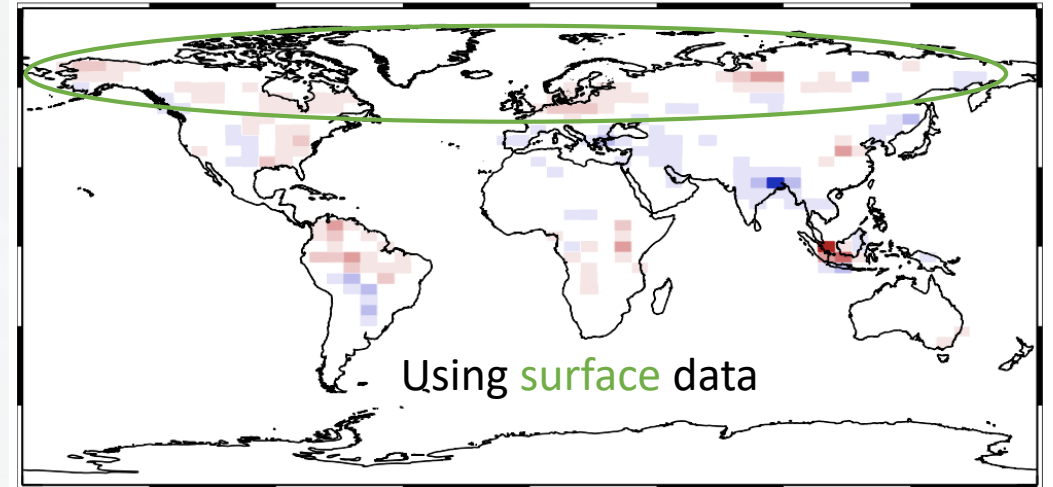
Emission increase:

Surface data: 10 TgCH₄/yr

TROPOMI: 5.5 TgCH₄/yr

Surface results show an increase in high northern latitudes, that is less clear using TROPOMI

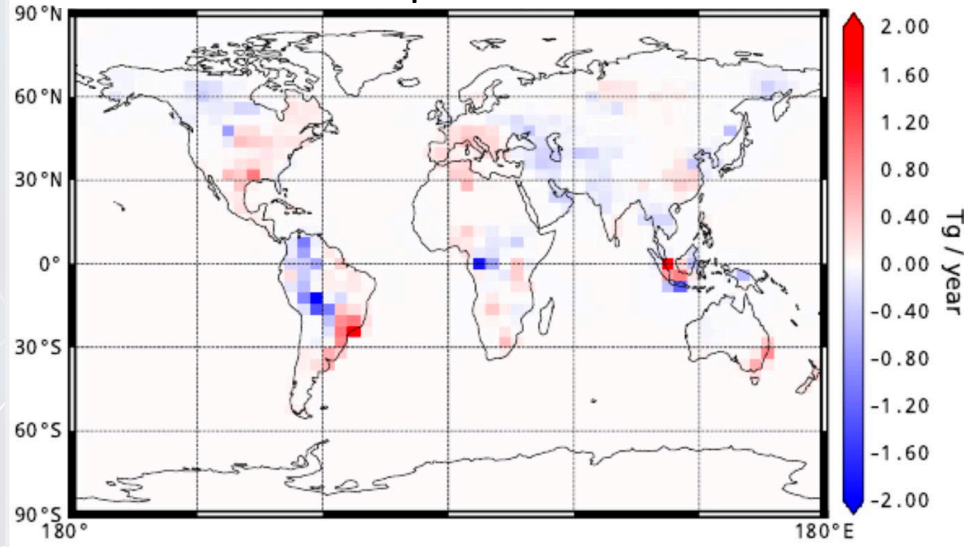
(May 2019 to May 2020) – (May 2019 to May 2018)



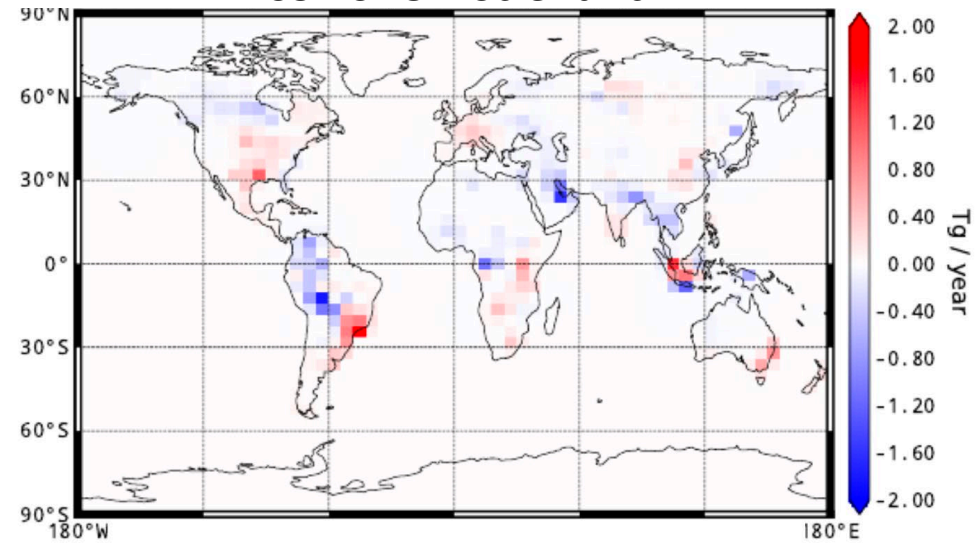
-17.3 -14.7 -12.0 -9.3 -6.7 -4.0 -1.3 1.3 4.0 6.7 9.3 12.0 14.7 17.3 20.0 mg/m²/day

2-year difference using Methane+ satellite datasets

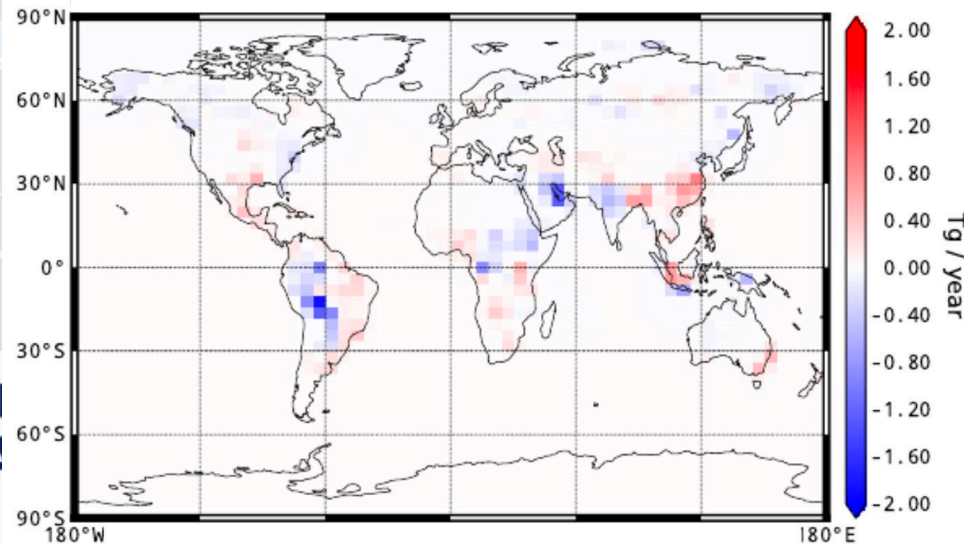
S5P Operational



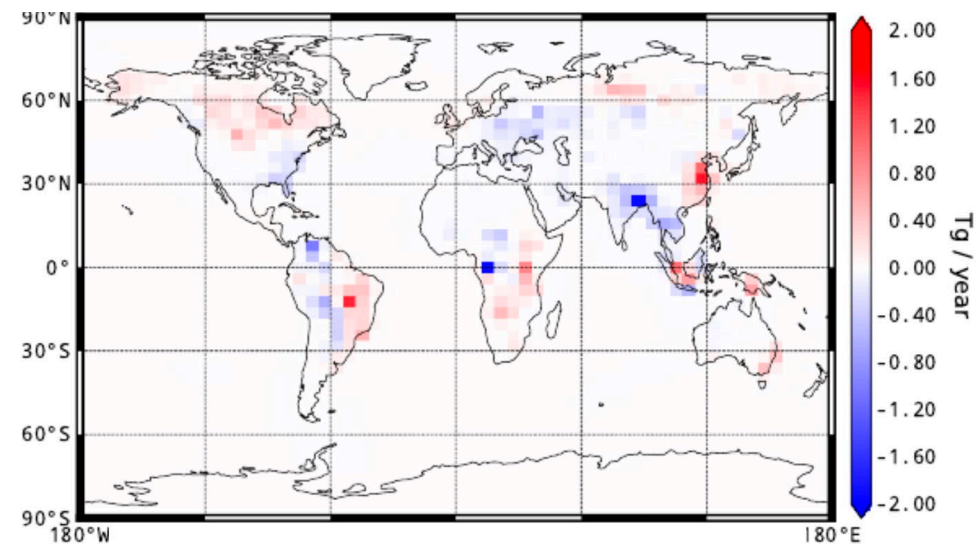
S5P SRON Scientific



S5P iUP WFMD



IASI RAL

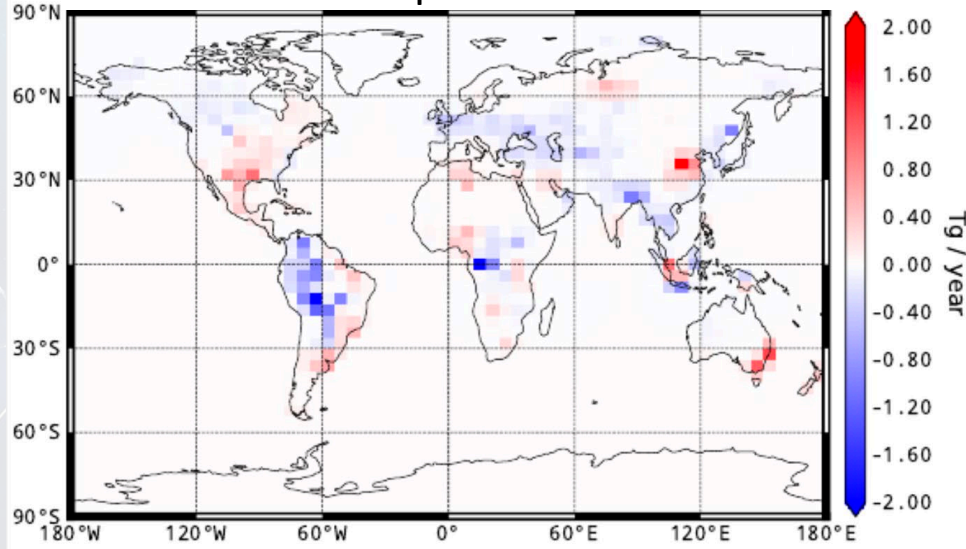


methane+
METHA

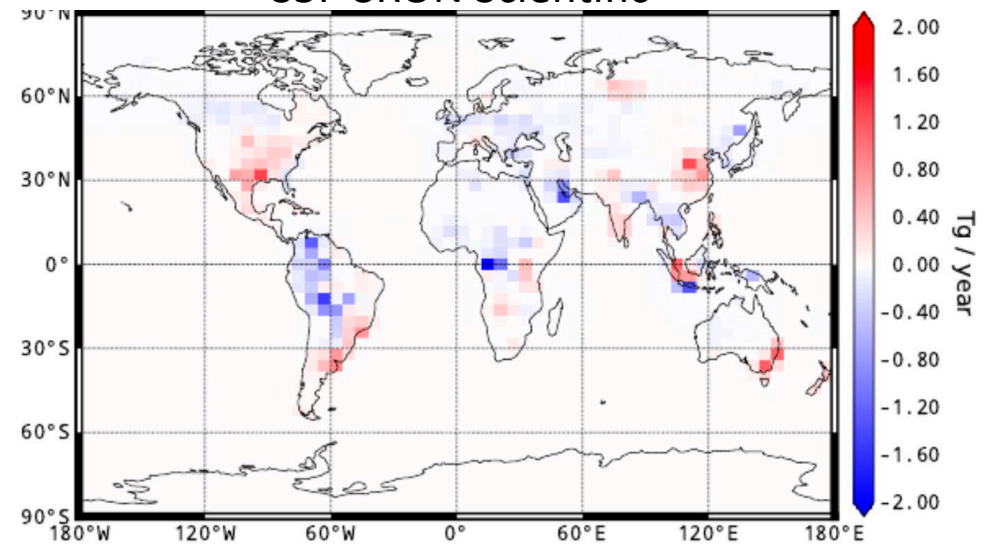


Same as previous, without bias correction

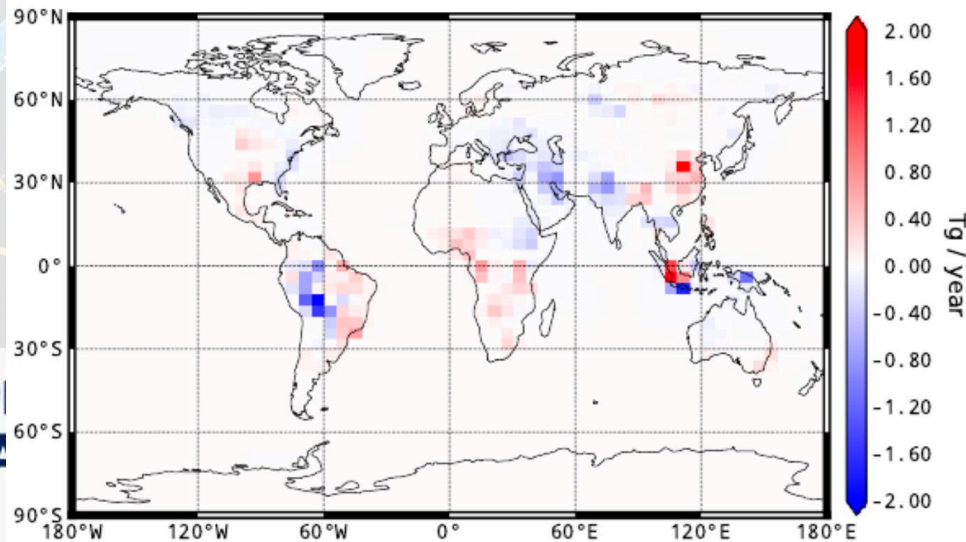
S5P Operational



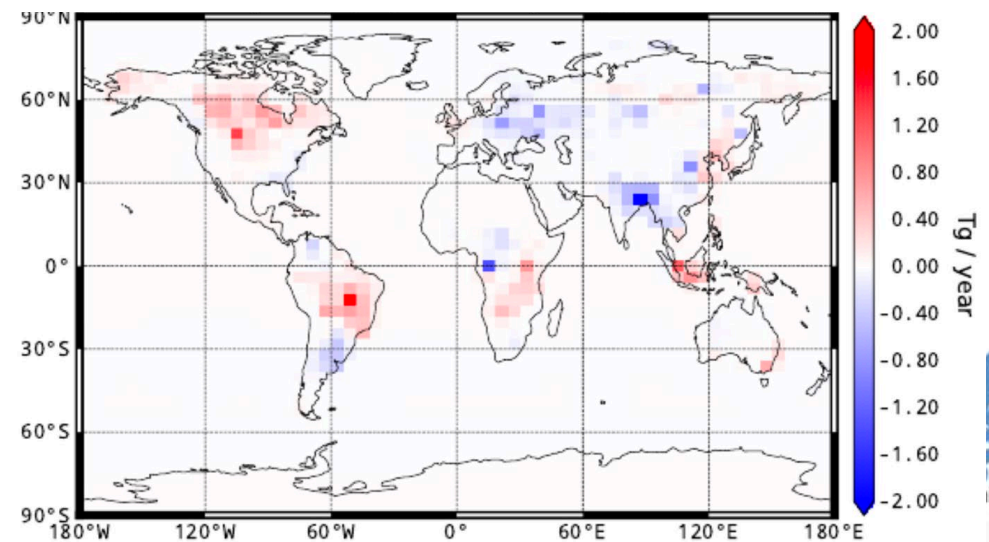
S5P SRON Scientific



S5P iUP WFMD



IASI RAL



methane
METHA

Summary

- Inversions using Methane+ TROPOMI and IASI datasets for 2018 - 2020
- Encouraging consistency between TM5-4DVAR and Carboscope seasonal flux adjustments in the Northern Hemisphere
- Robust emission changes between 2019 and 2020 using different satellite datasets
- Attribution of 2019-2020 growth rate change: Needs to account for the possible impact of changes in OH

