Recent changes in global CH_4 emissions constrained by TROPOMI and IASI data

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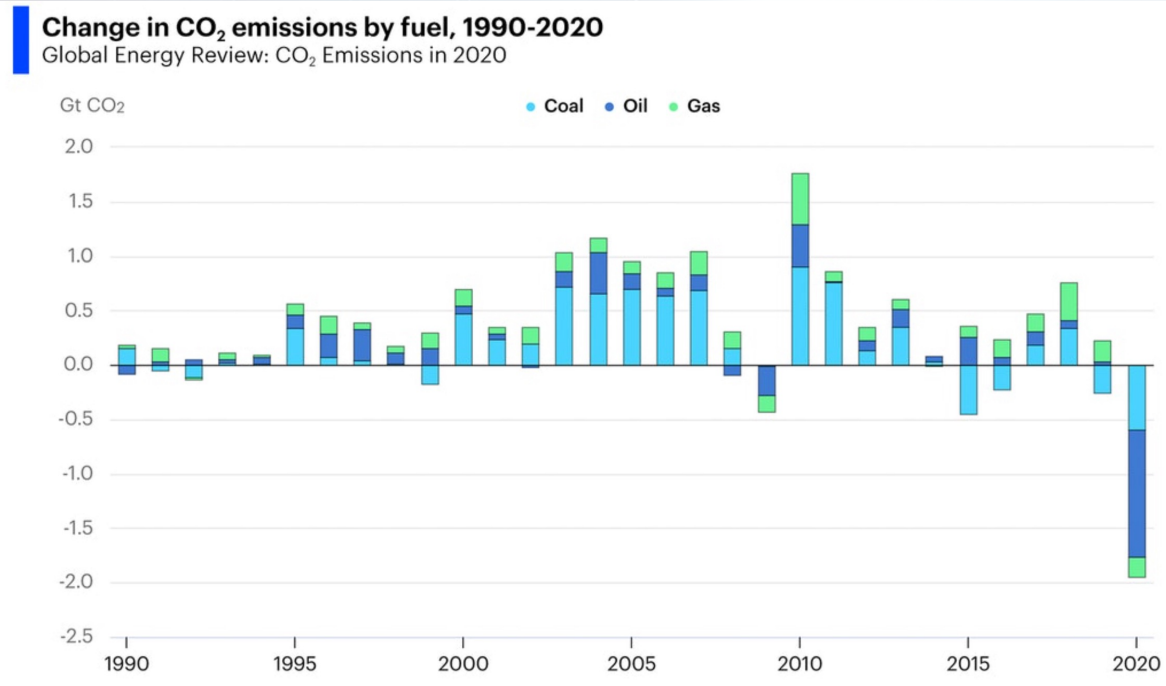
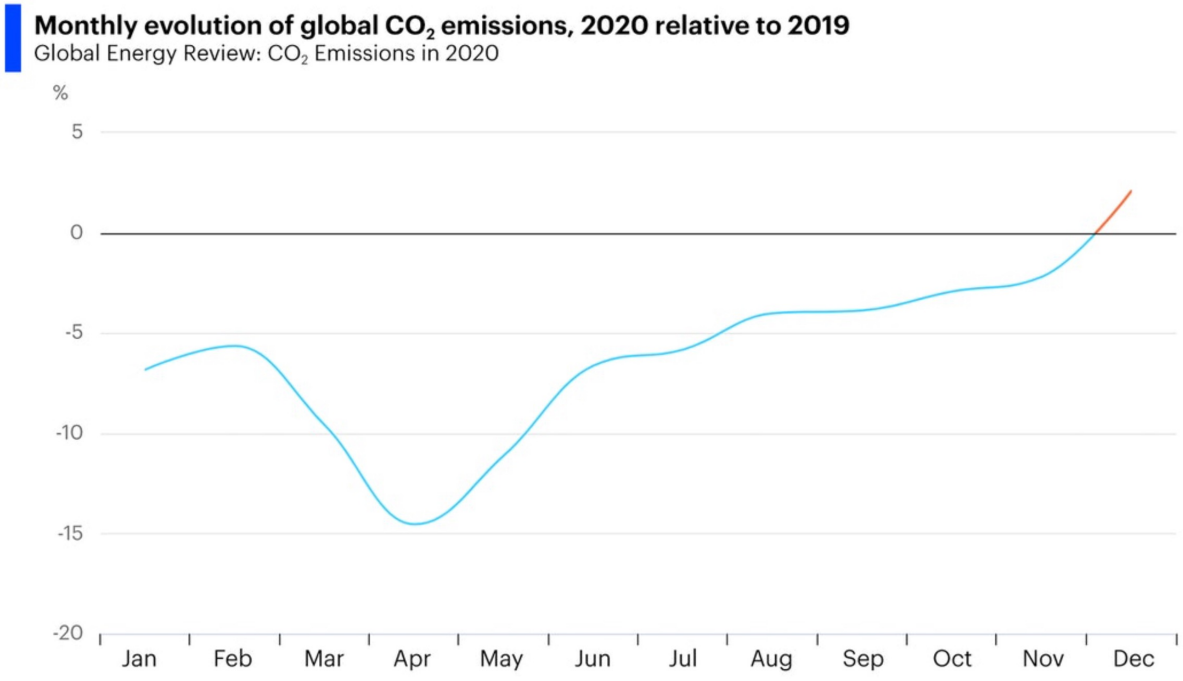
The COVID pandemic & global GHG emissions

Example 1: CO_2





IEA: In 2020 global CO_2 emissions dropped by ~5% compared to 2019

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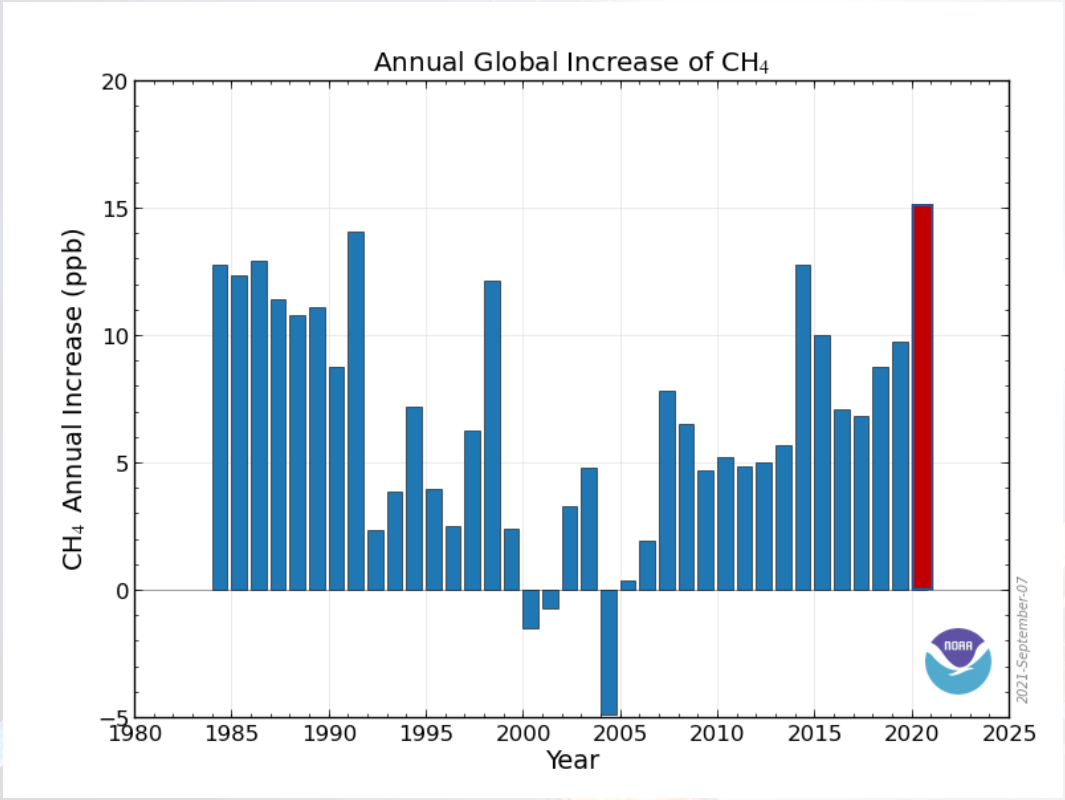
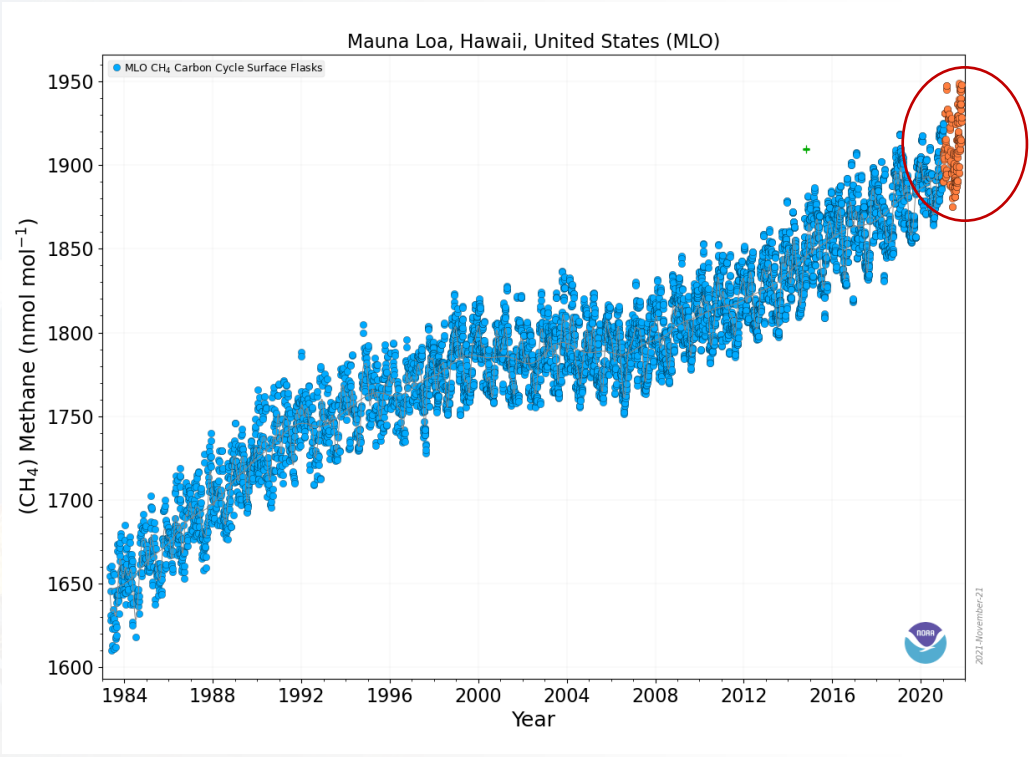
How about CH_4?

→ Stevensen et al (ACPD, 2021): NOx reductions (and impact on OH) sufficient to explain the rise in CH_4





= 2021

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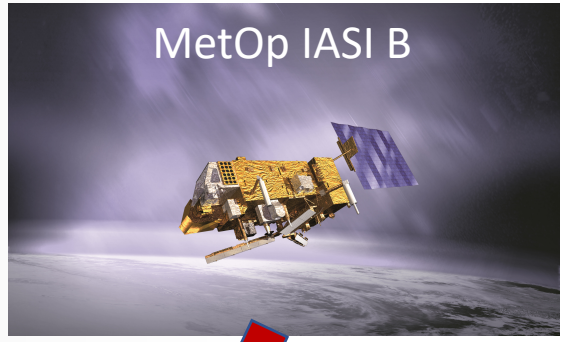
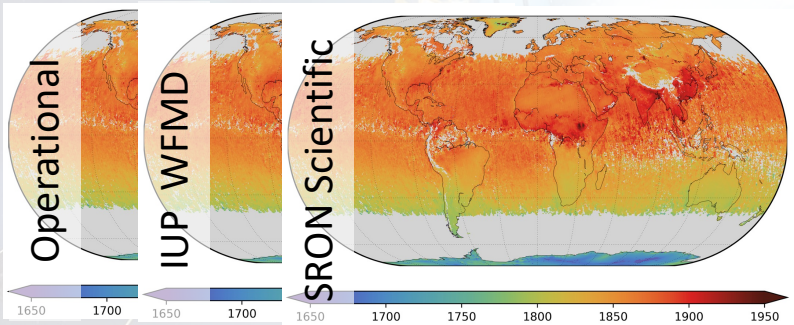
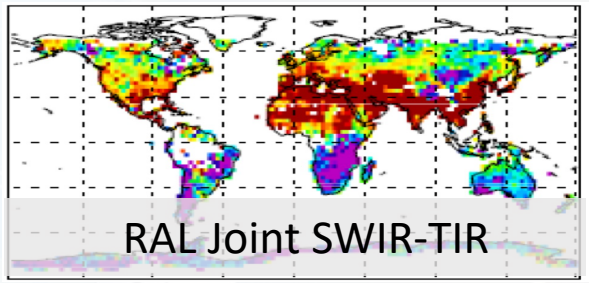
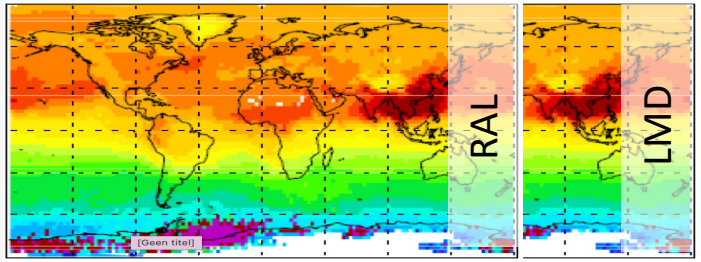


L2







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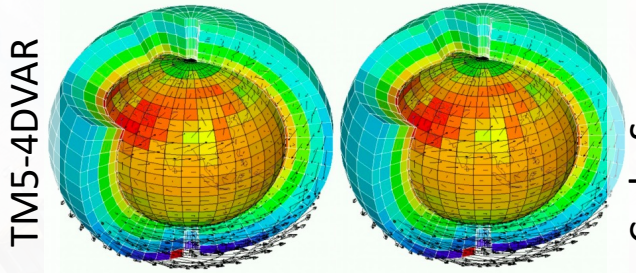
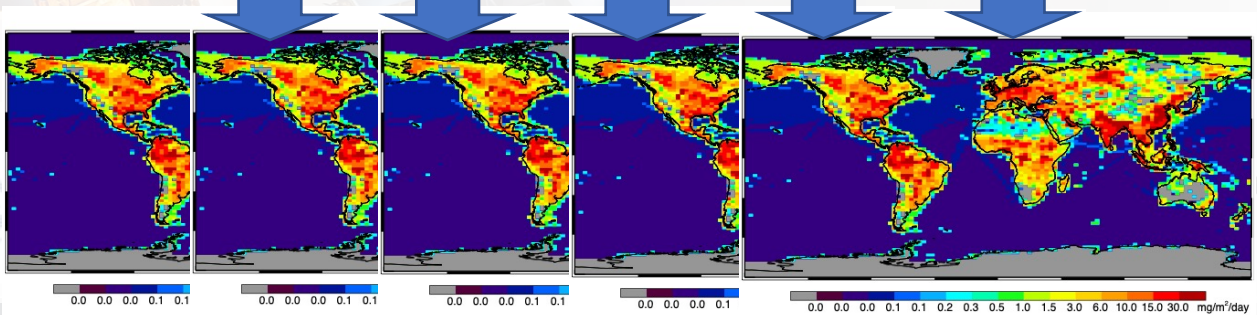


L4



L4

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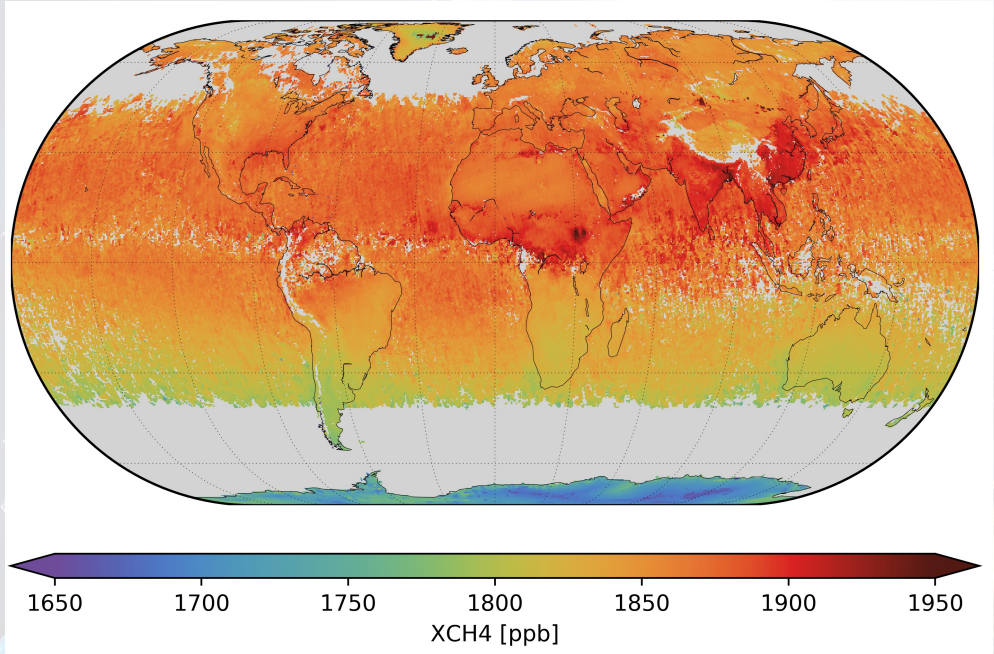
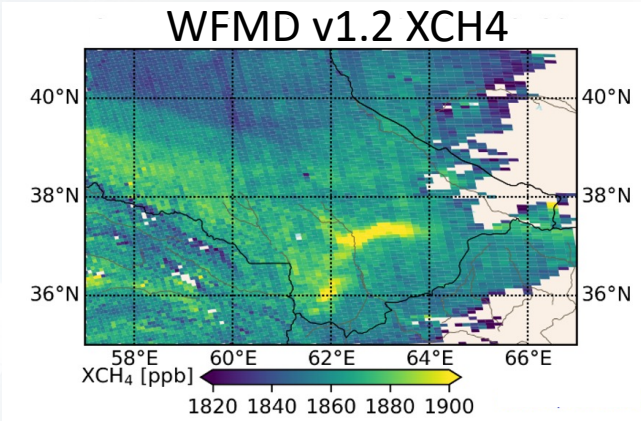
Methane+ retrieval: TROPOMI

- Improved accuracy + coverage

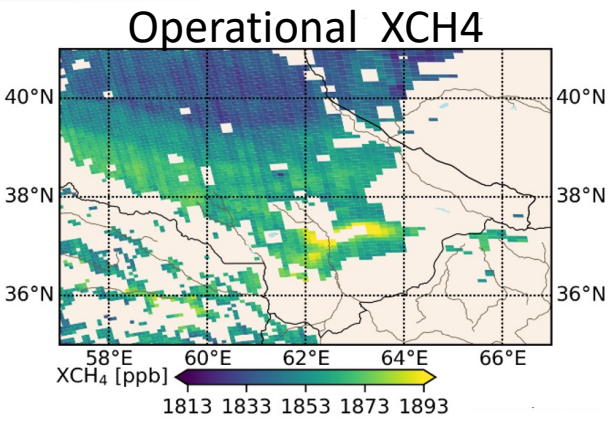
SRON retrieval: Land + Ocean

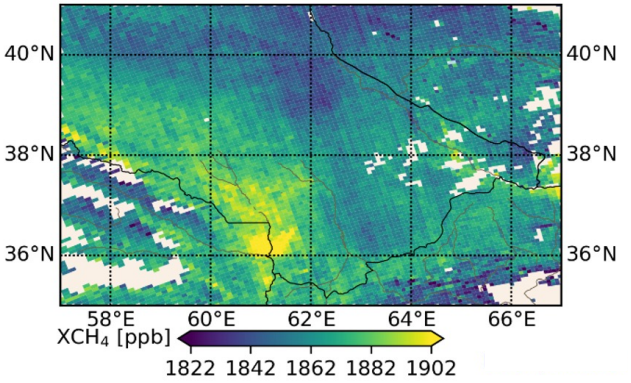


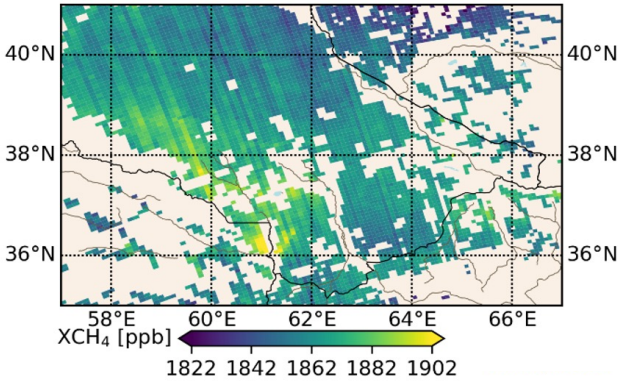
WFMD v1.2 XCH4



Operational XCH4







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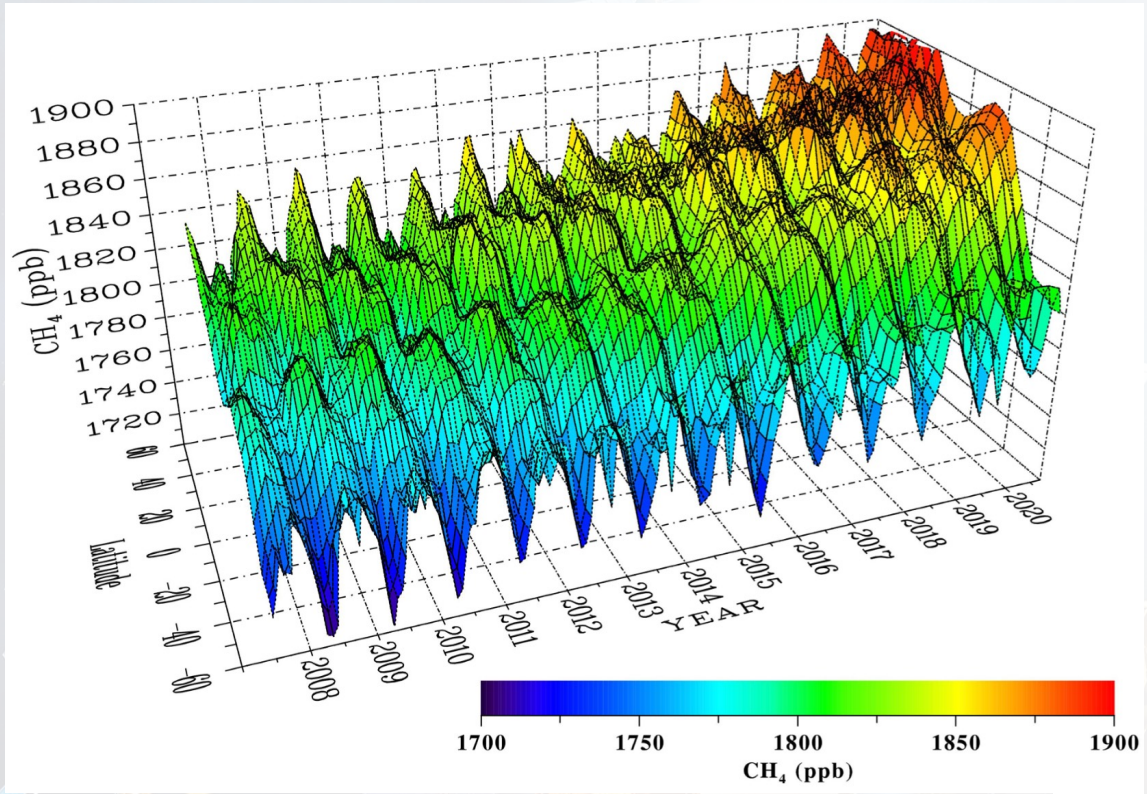
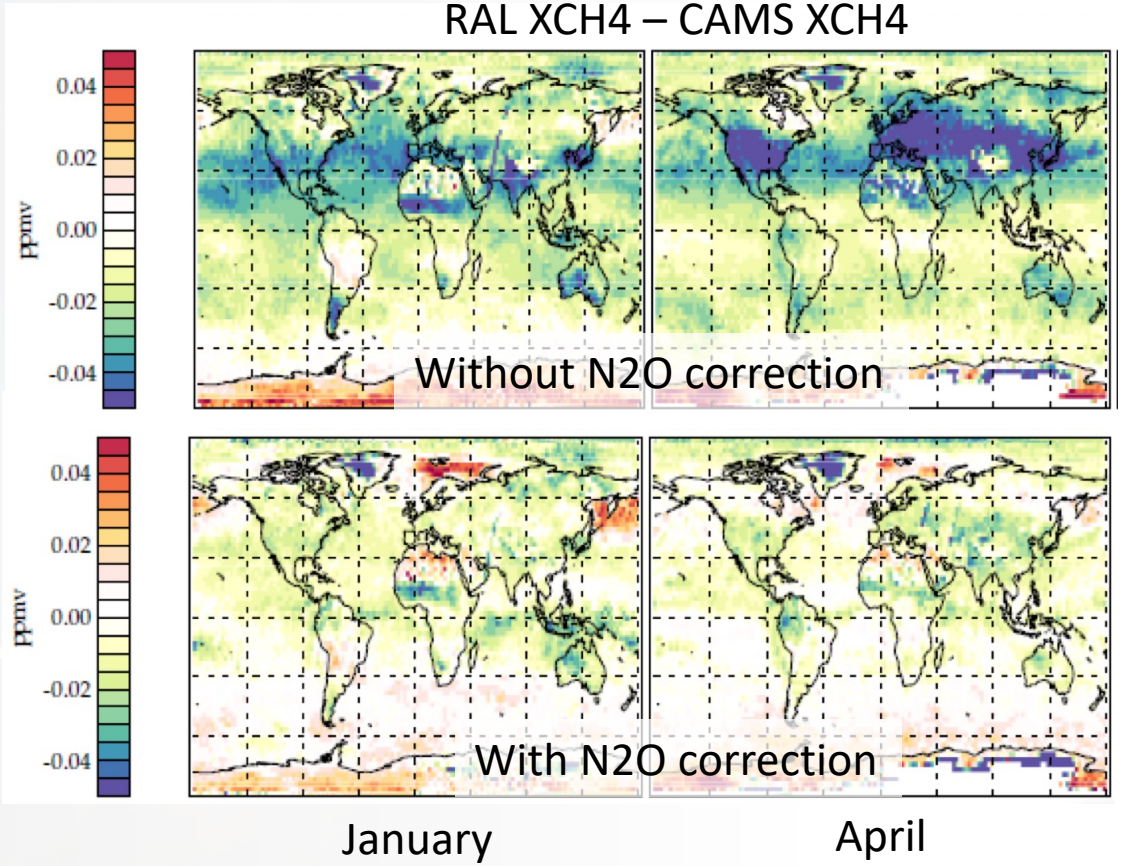
Methane+ retrieval: IASI

LMD IASI XCH4 retrieval: full dataset



RAL XCH4 – CAMS XCH4



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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)

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TM5-4DAR: Comparison with surface data

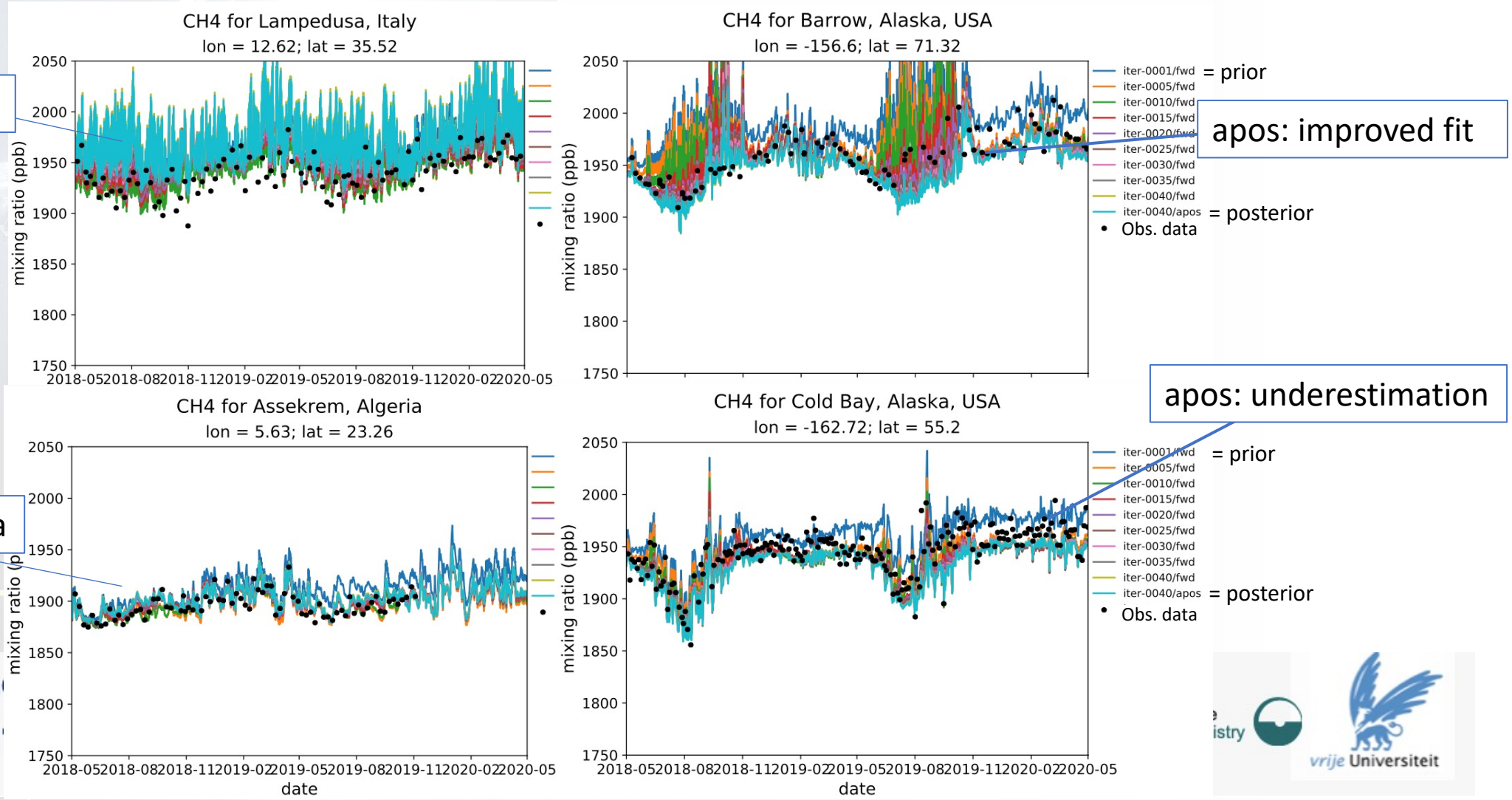
Inversion using TROPOMI SRON Scientific product, incl. bias correction

apos: dust problem?

apos: OK over Sahara

apos: improved fit

apos: underestimation



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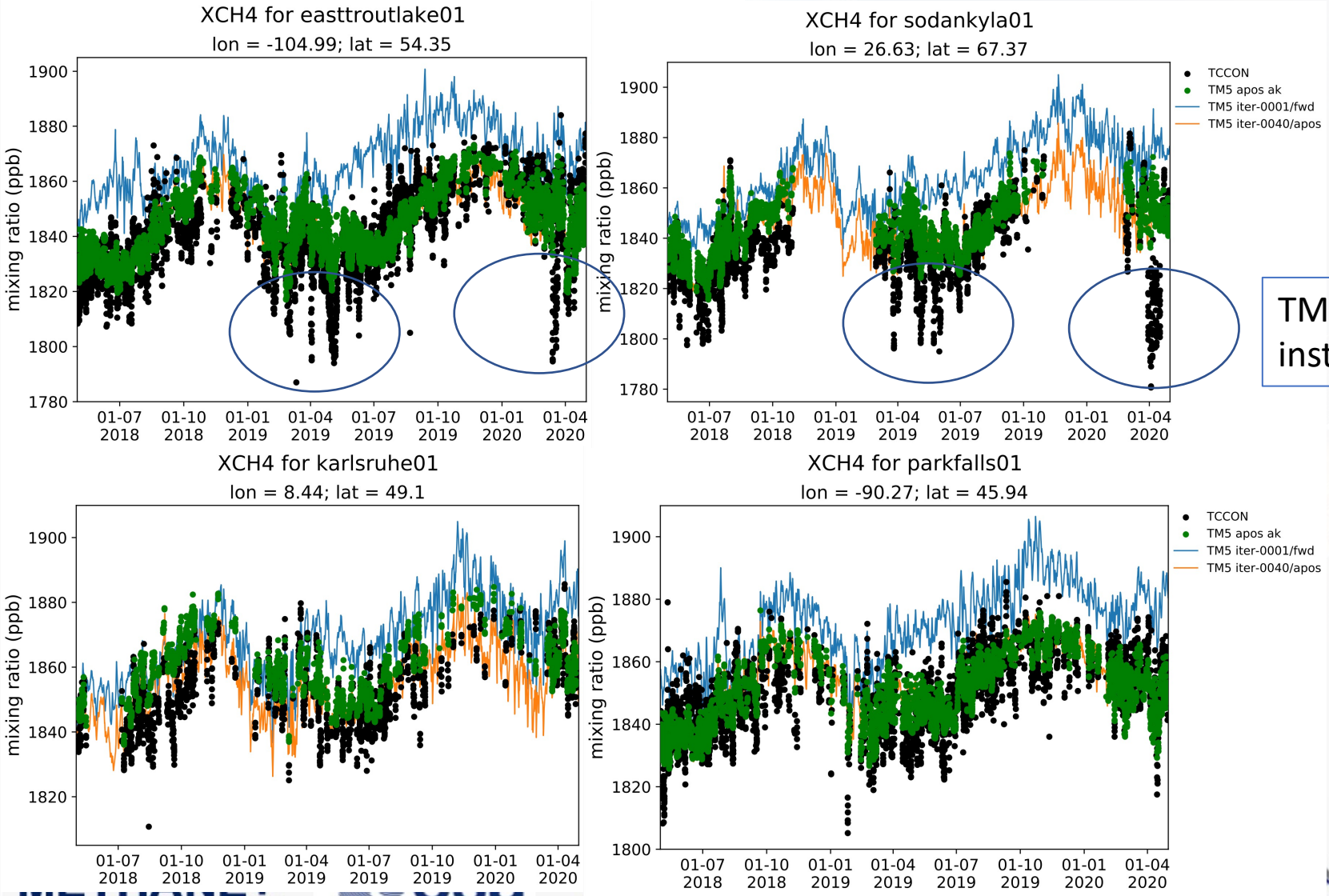
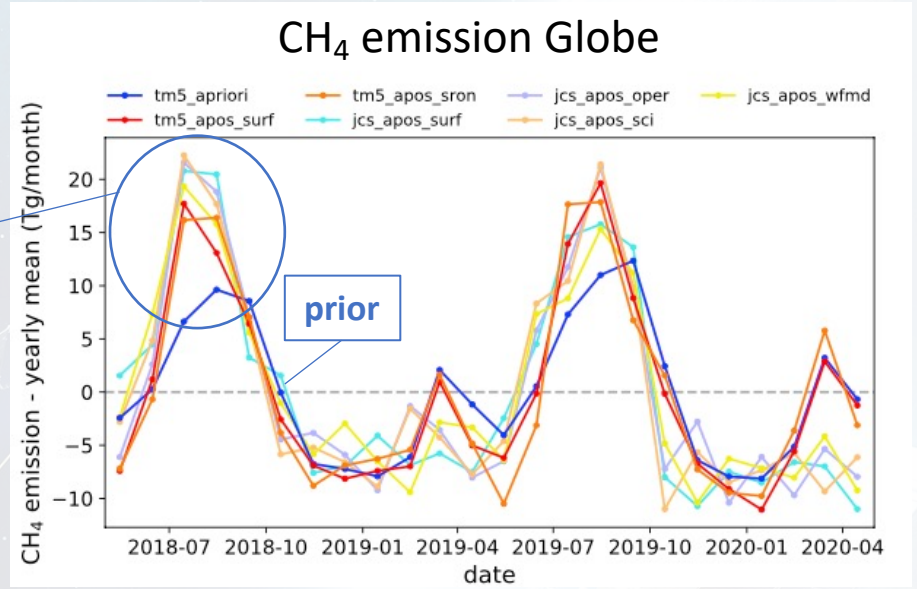
TM5-4DVAR: Comparison with total column data

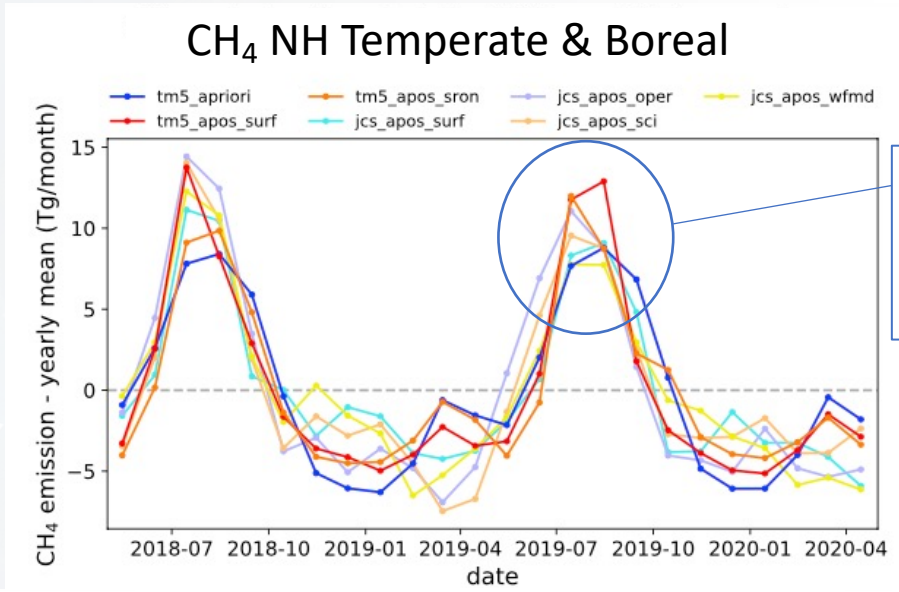


TM5 doesn't catch instances of low XCH4

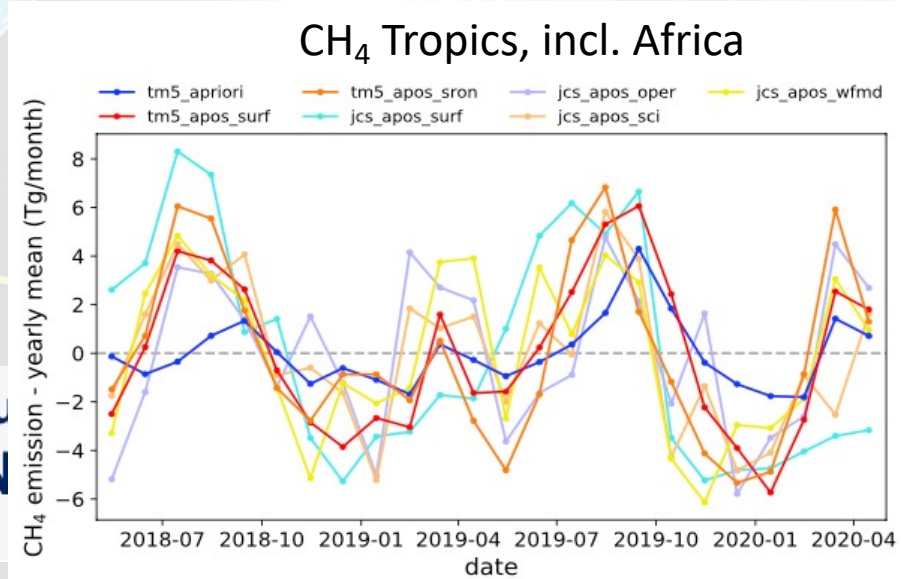
Comparing TM5-4DVAR & Carboscope

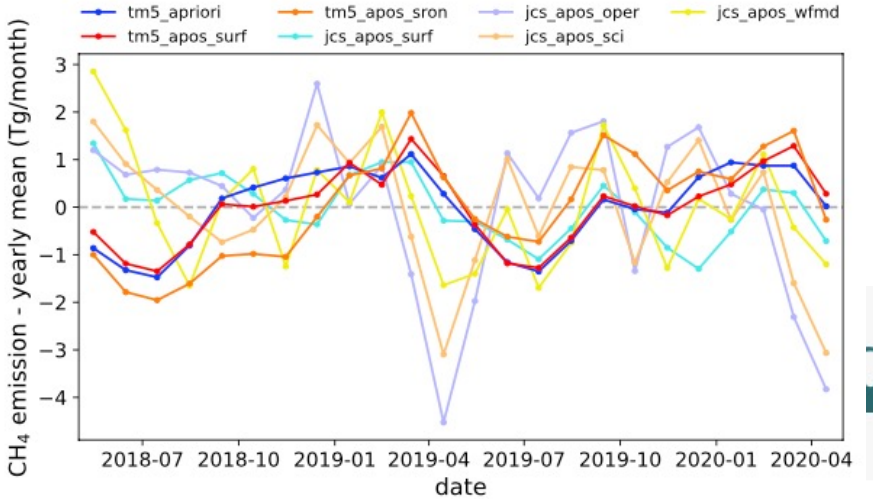
Upward correction NH summer





… driven by NH wetland emissions





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Comparison between the 2 years

- Results from TM5-4DVAR

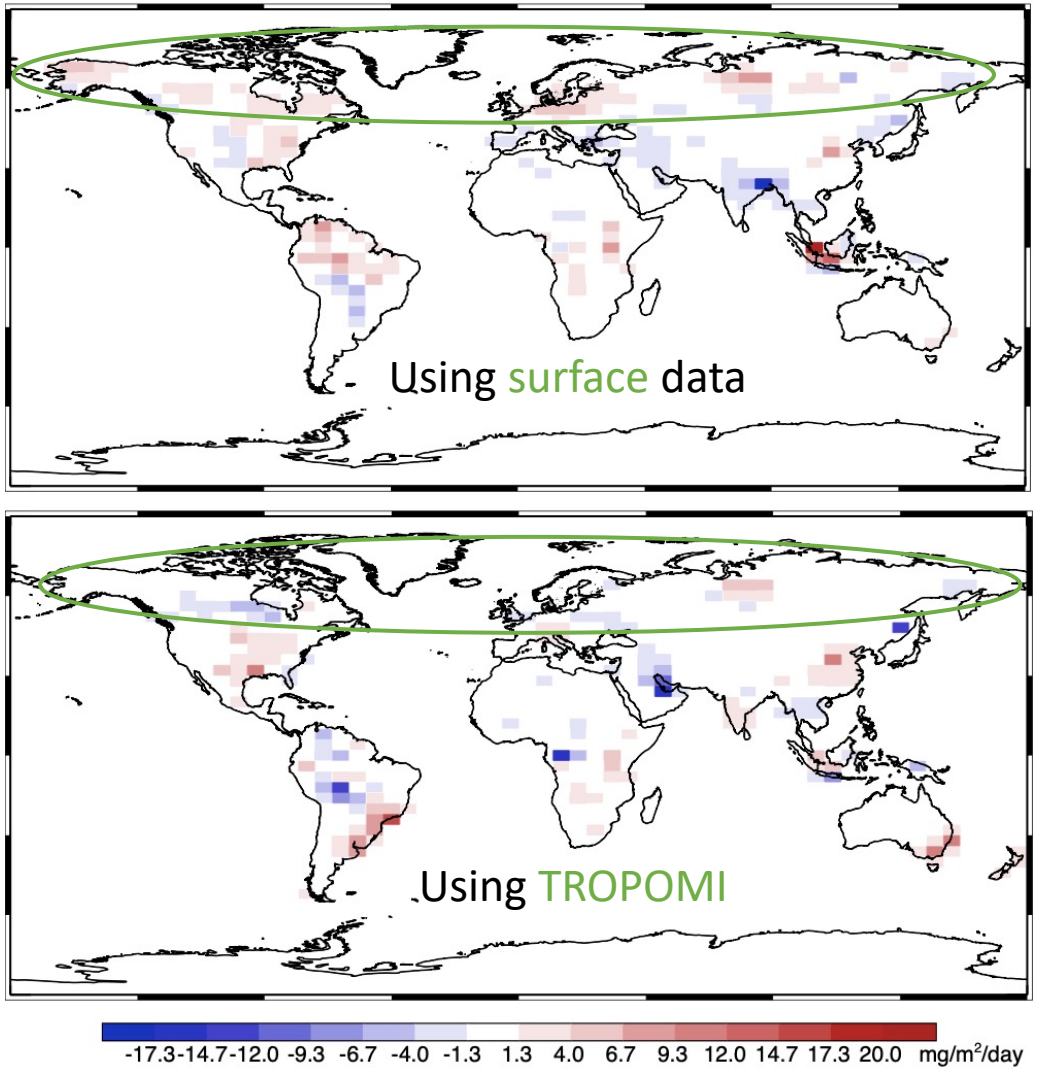
Emission increase:

Surface data: 10 $TgCH_4/yr$

TROPOMI: 5.5 $TgCH_4/yr$

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)



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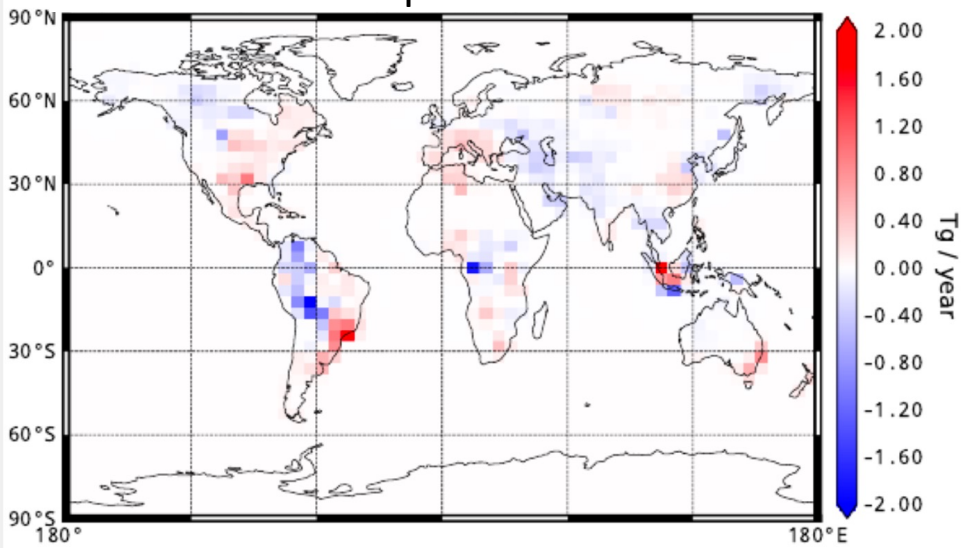
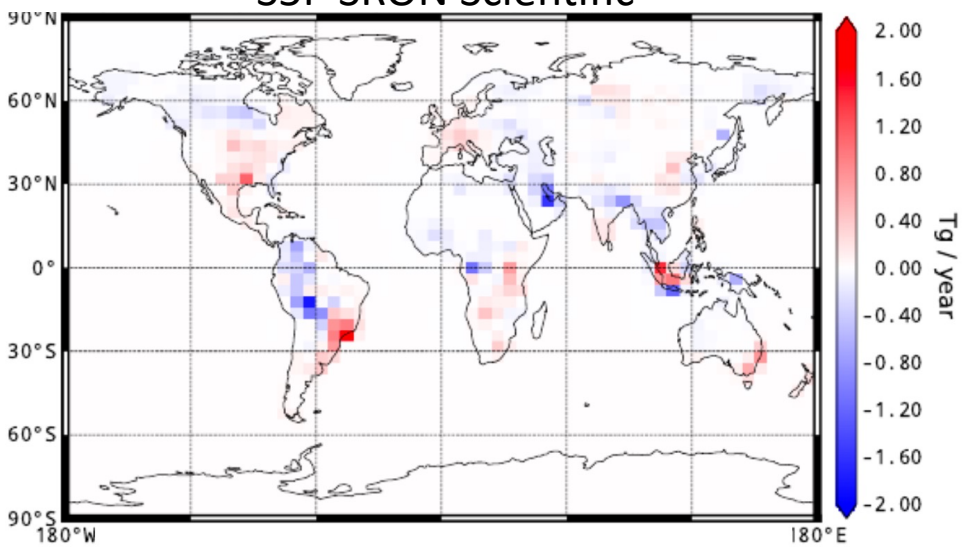
2-year difference using Methane+ satellite datasets

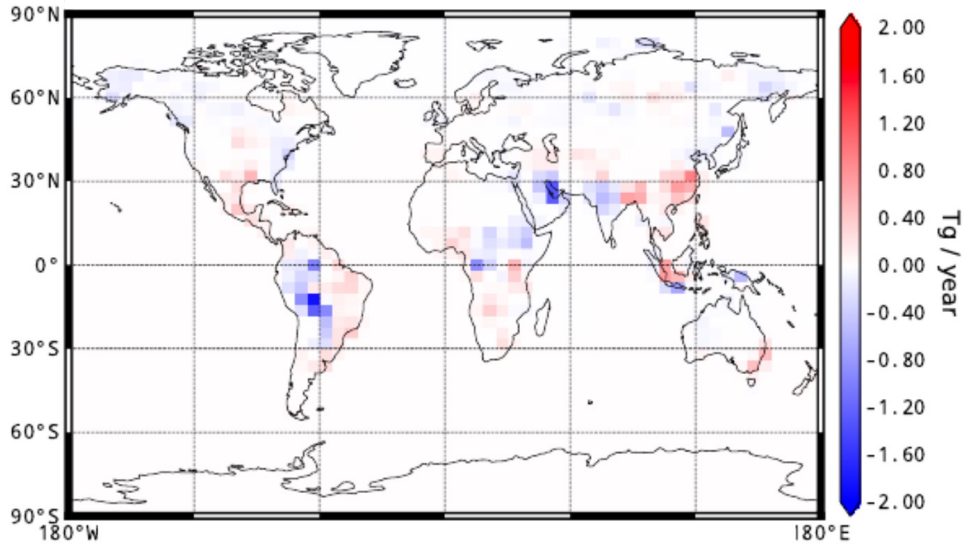
S5P Operational



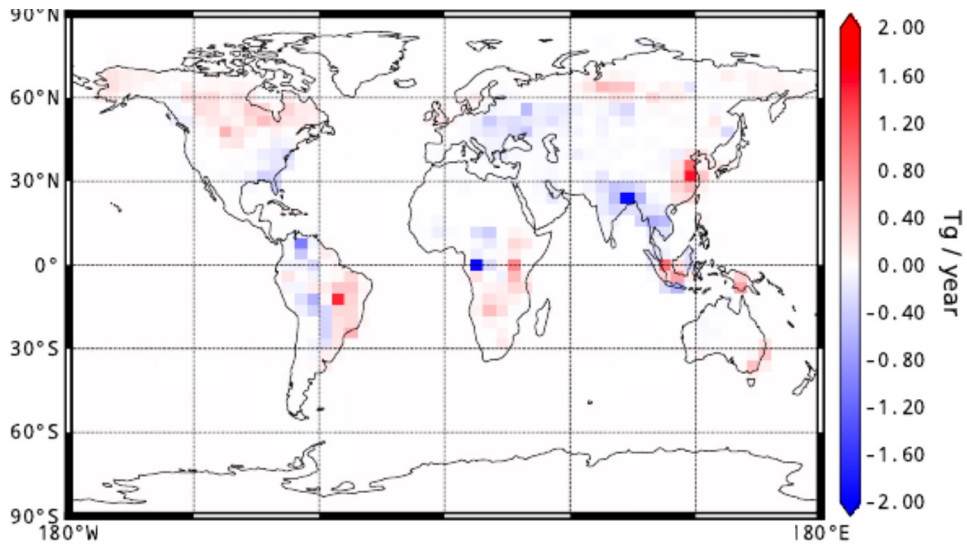
S5P SRON Scientific



S5P iUP WFMD

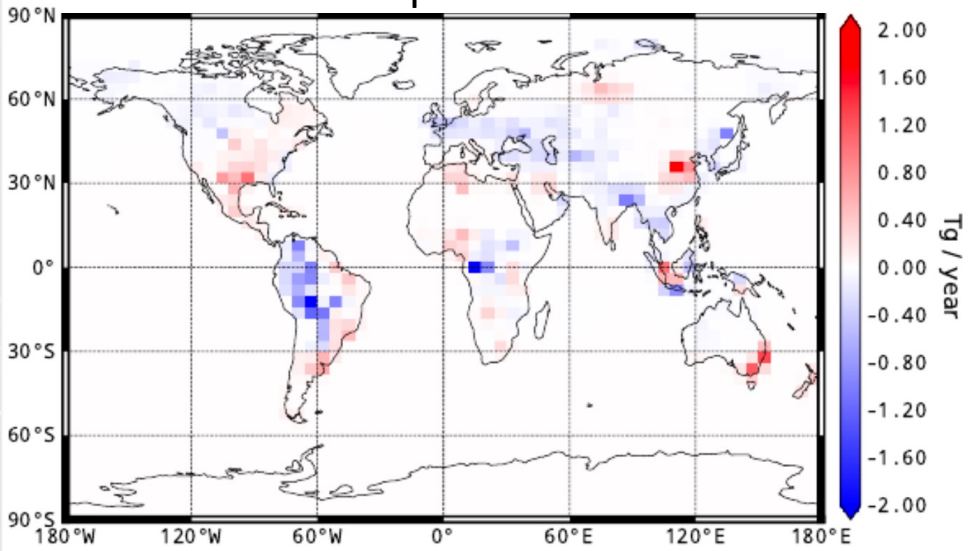


IASI RAL

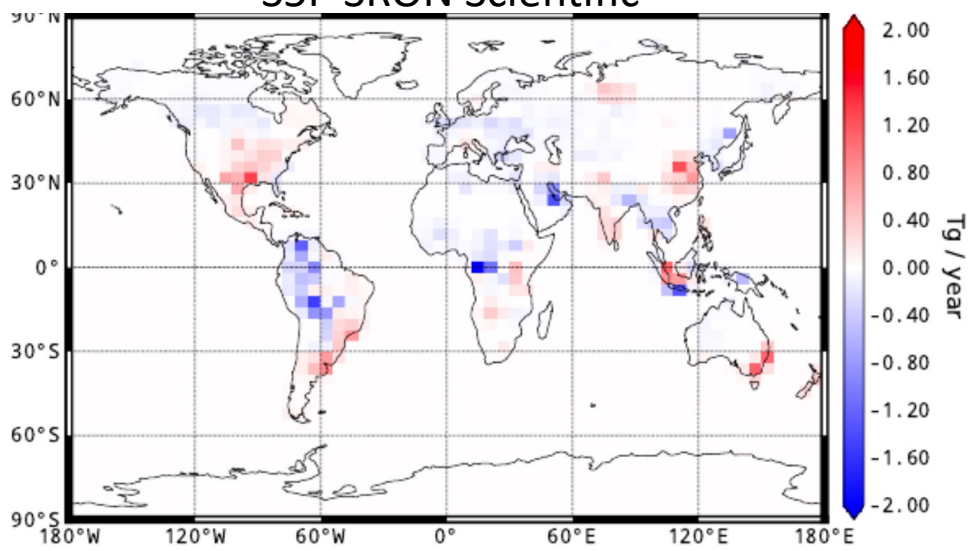


Same as previous, without bias correction

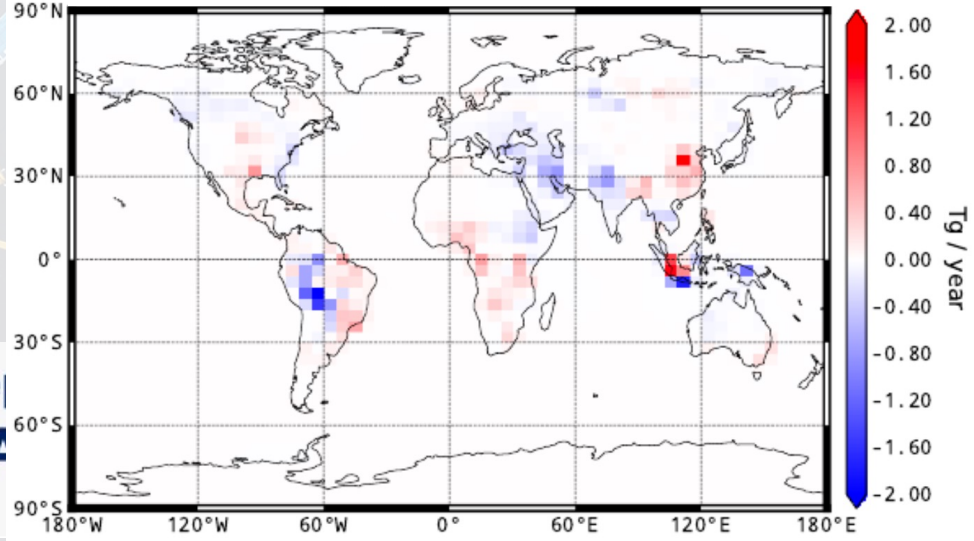
S5P Operational



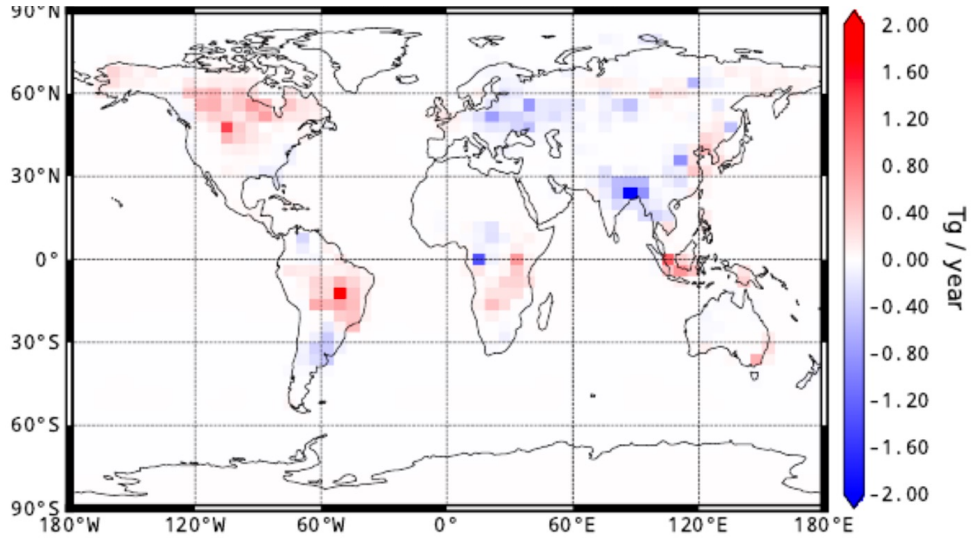
S5P SRON Scientific



S5P iUP WFMD



IASI RAL



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

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