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METEOROLOGISKA INSTITUTET
FINNISH METEOROLOGICAL INSTITUTE

TM5 CH4 experiments

Prior temporal resolution, freshwater
emissions, and vertical resolution

03-11-25 36th International TM5 meeting

Rebecca Ward



Introduction

- Using TM5 for methane for various projects.
- Freshwater methane emissions.
- Different prior emissions temporal resolutions (daily vs monthly).
- Vertical resolution (25 to 34 levels).
- Currently only using TM5. Having some issue with the CTDAS inversion with TM5-MP.

TM5 for various projects

- Multiple CH₄ inversions with CTE-CH₄
 - Northern high latitude intercomparison project
 - EYECLIMA Russia inversions
 - Long-term trends (2000-2023)
 - Satellite inversions with TROPOMI (2018-)
- CH₄DAS (TM5-MP)
 - Using Community Inversion Framework (CIF)

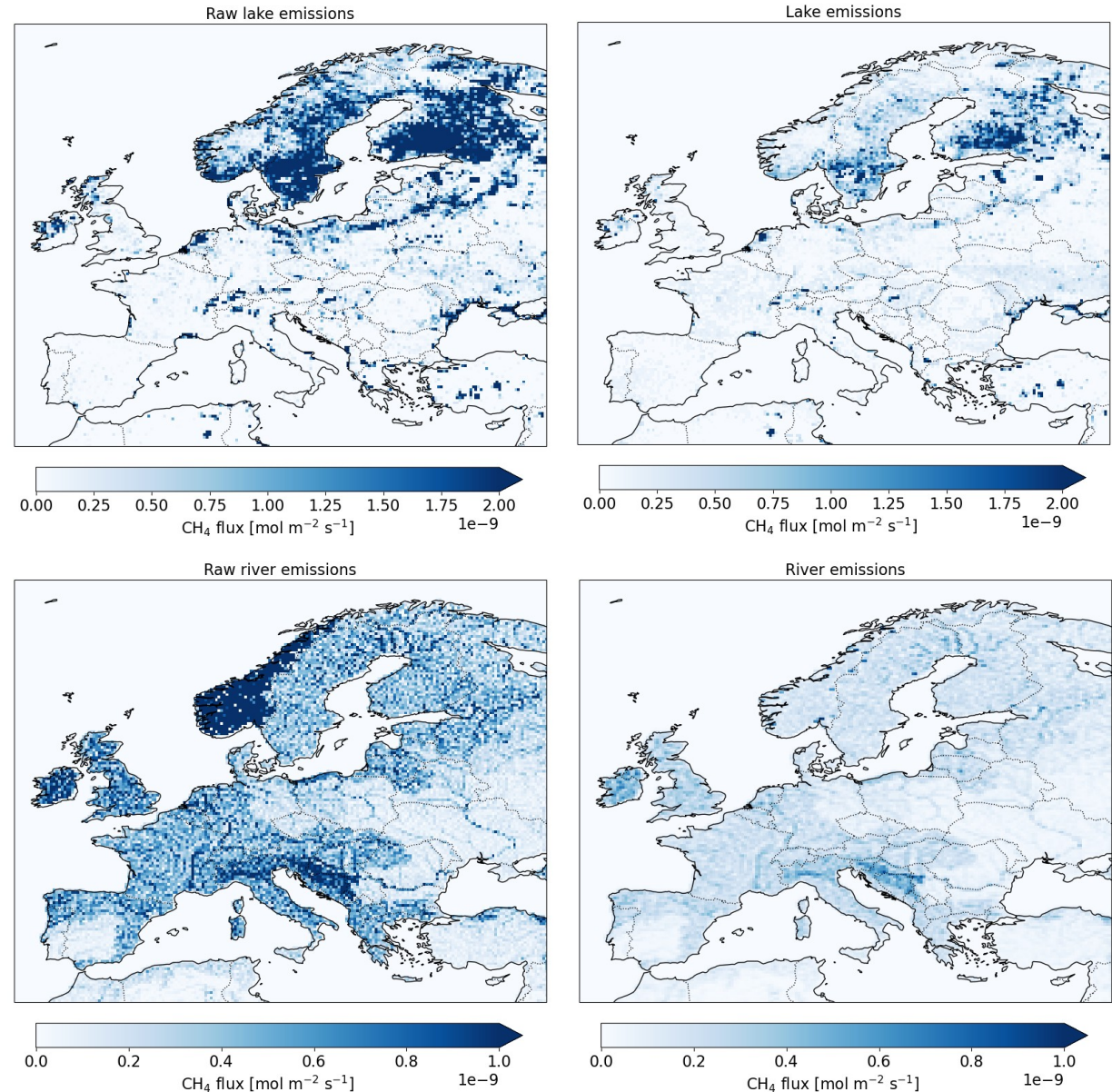
TM5 inputs

Resolution	Global 3x2, 25 or 34 vertical layers No zoom region
Chemistry	OH-T: Spivakovsky 2000 (60 levels) OH-S: Bruehl 2000 (60 levels) Cl: Bruehl ECHAM loss rate CH4+Cl (90 levels) O1D: Bruehl ECHAM loss rate CH4+OD (90 levels)
Emissions	Anthropogenic: EDGAR2024 Biospheric: JSBACH-HIMMELI (w or w/o freshwater emissions) Fires: GFAS v1.2 Others: Weber et al. 2019 for oceans, scaled Etiope et al. 2019 for geological and Saunois et al. 2020 for termites.
Meteo	ERA5, already coarsened to 3x2
Initial fields	From CTE-CH4 inversion posteriors.



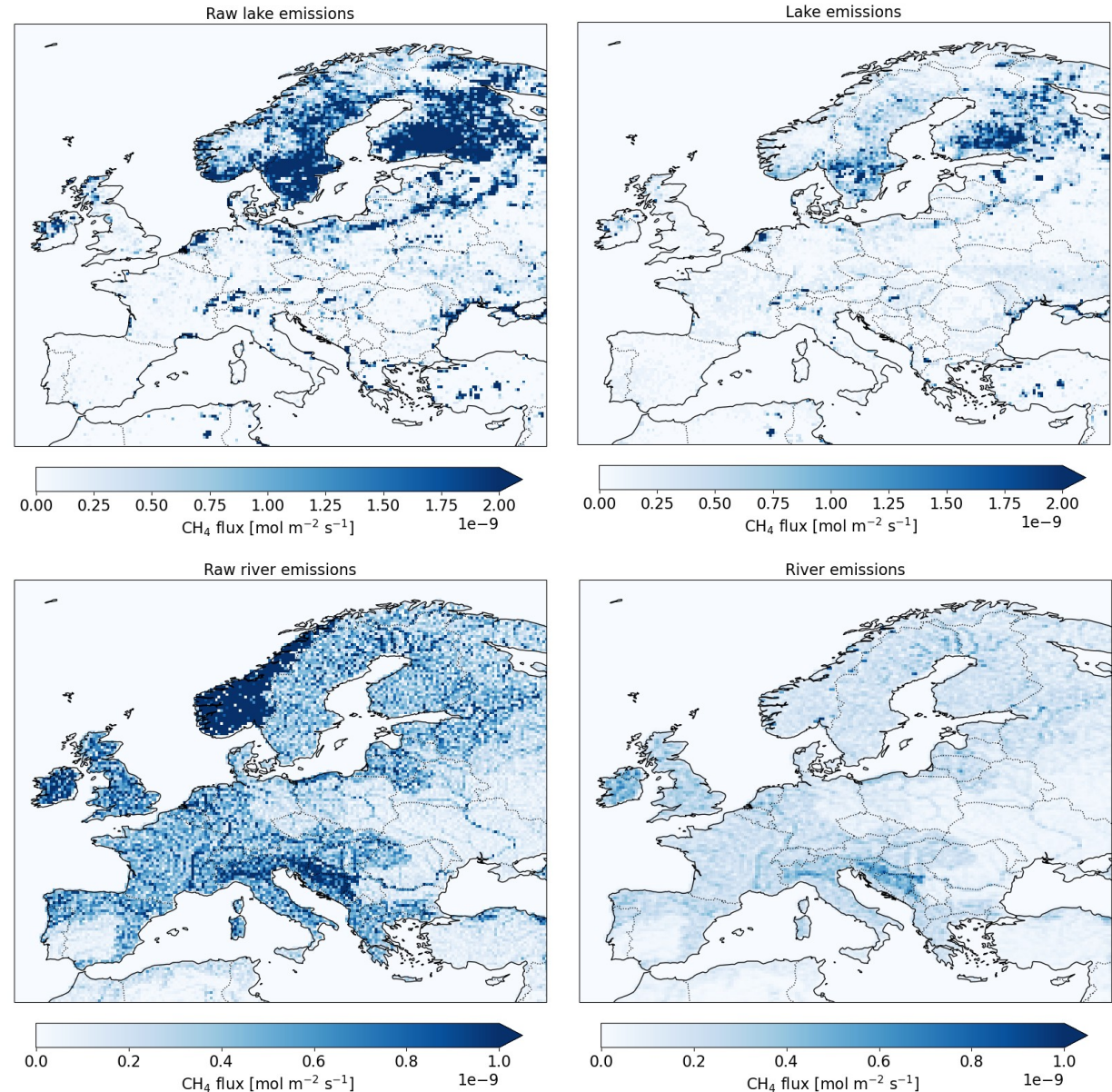
Using freshwater methane emissions

- Combining lake emissions from Johnson et al., 2022 and river emissions from Rocher-Ros et al., 2023.



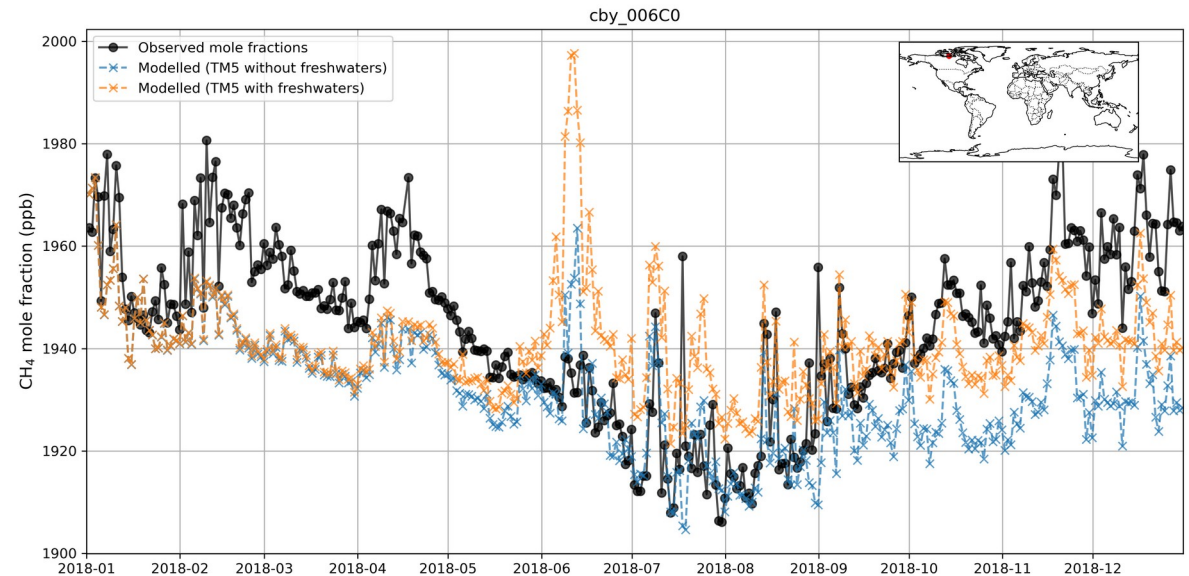
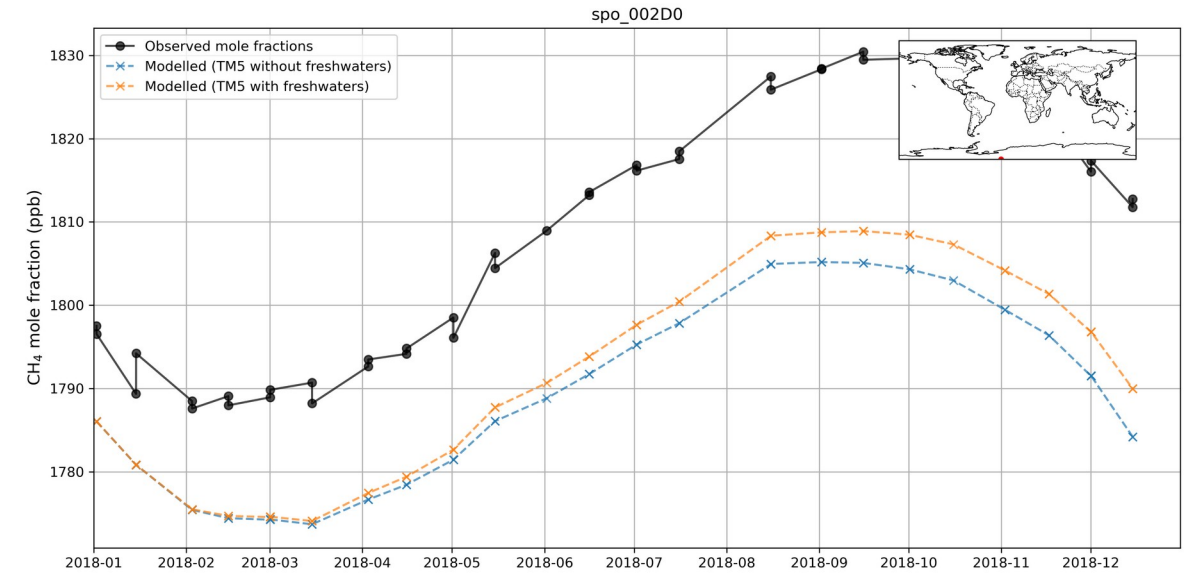
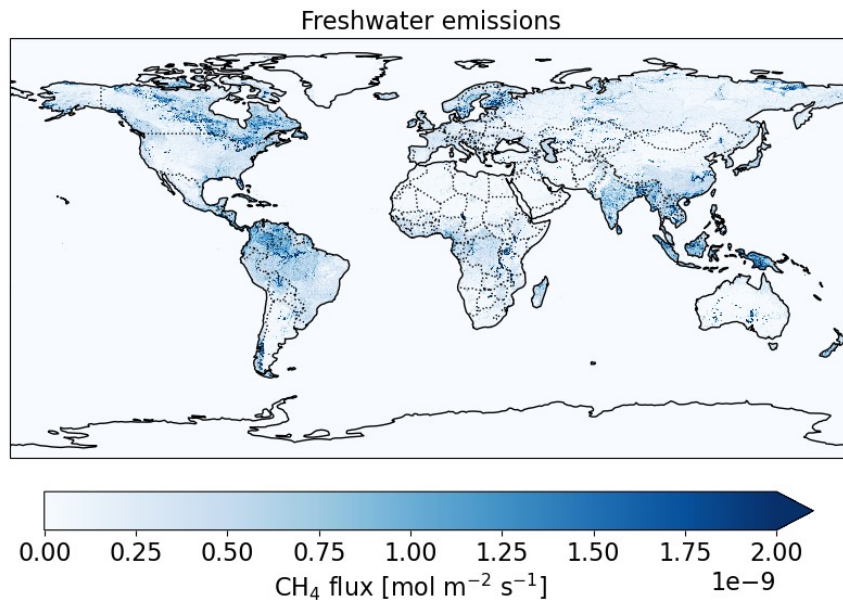
Using freshwater methane emissions

- Combining lake emissions from Johnson et al., 2022 and river emissions from Rocher-Ros et al., 2023.
- Lake scaling: Small high emitting lakes (<0.1 km²) unscaled, large lakes (>5000 km²) are scaled down to 10%. Remaining lakes are scaled to global total of 13 Tg, the lower limit in GMB.
- River scaling: Anomalously high flux regions (e.g. Norway) are scaled down using wetland proportion. Global total scaled down to 12 Tg, the lower limit in GMB.



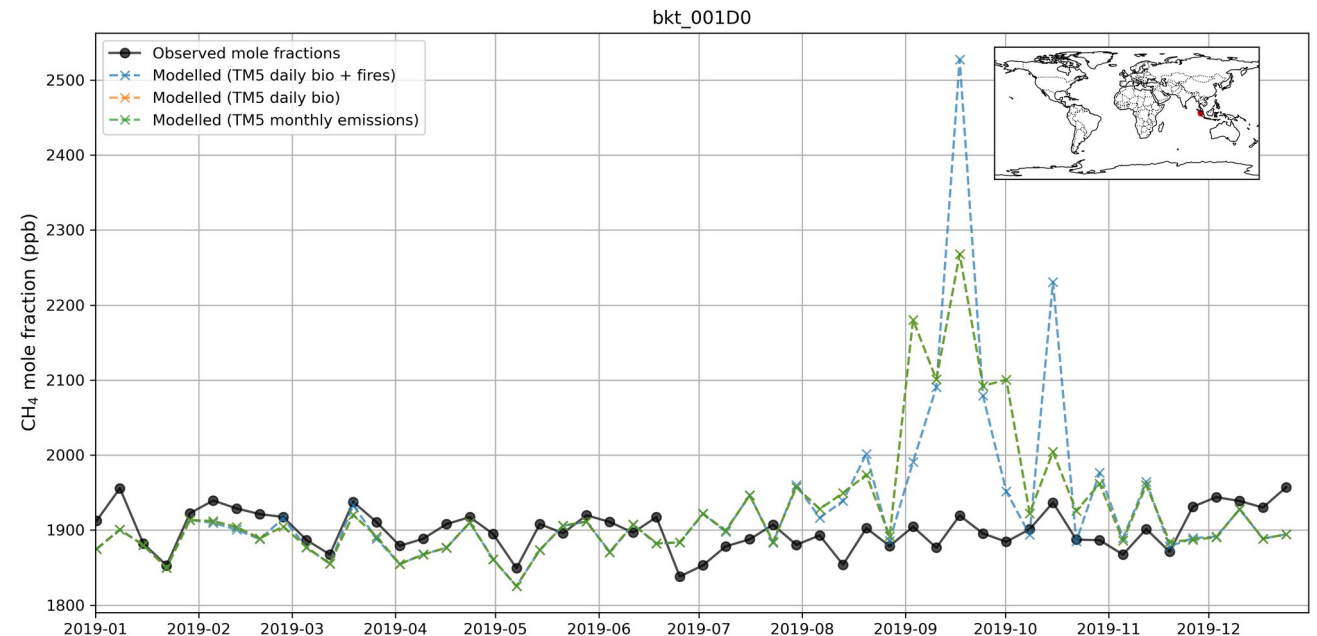
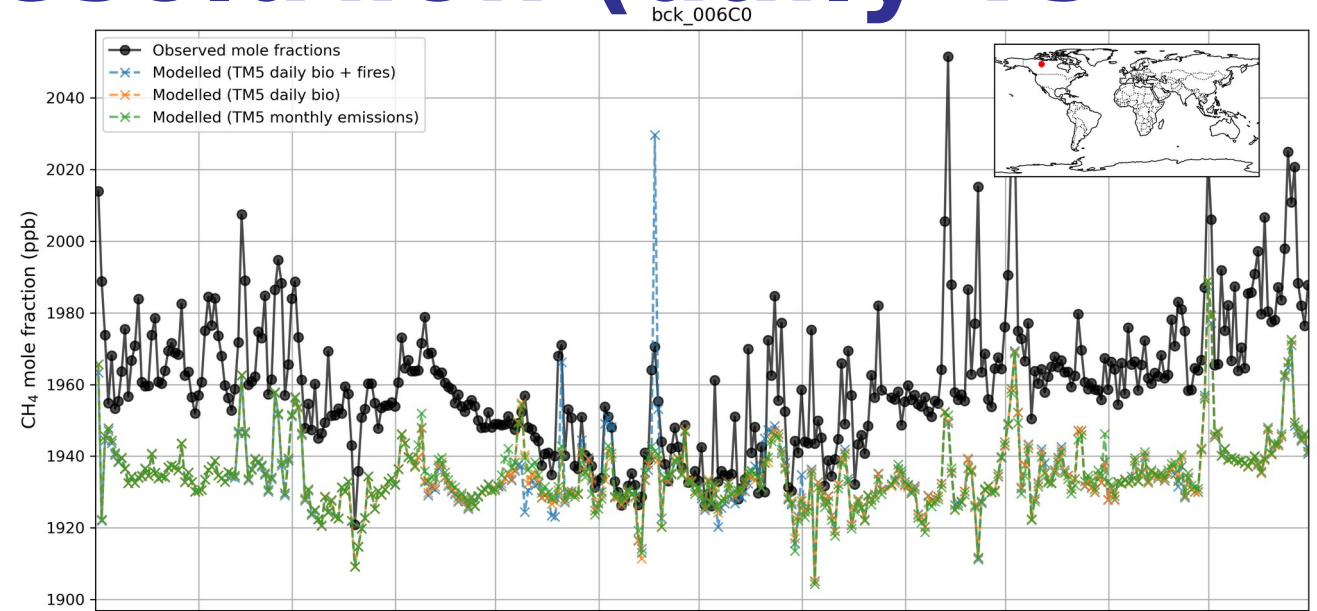
Using freshwater methane emissions

- Difference at some sites of with and without freshwaters
- Currently testing in inversions



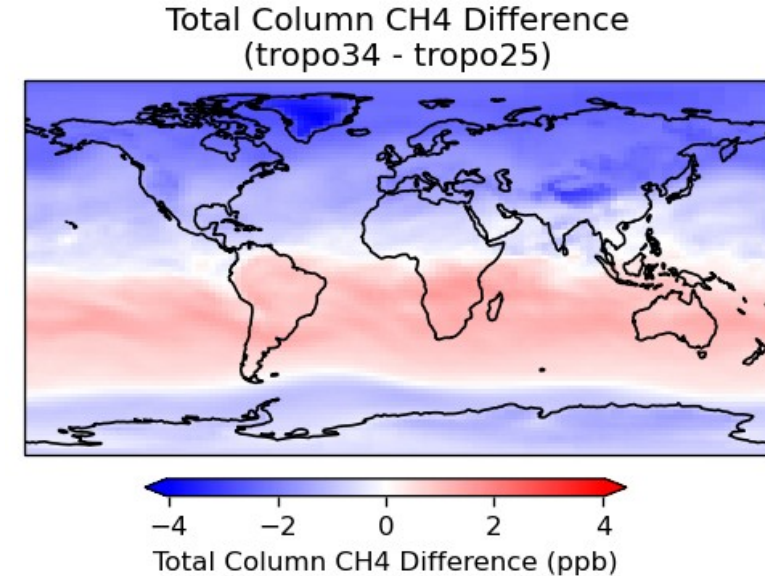
Prior temporal resolution (daily vs monthly)

- Updating TM5 to use daily emissions for wetlands and biomass burning.
- Fires: GFAS v1.2
- Bio: JSBACHH+Freshwaters
- Impact mostly at northern-high latitude sites and SE Asia.
- Largest changes from biomass burning emissions.



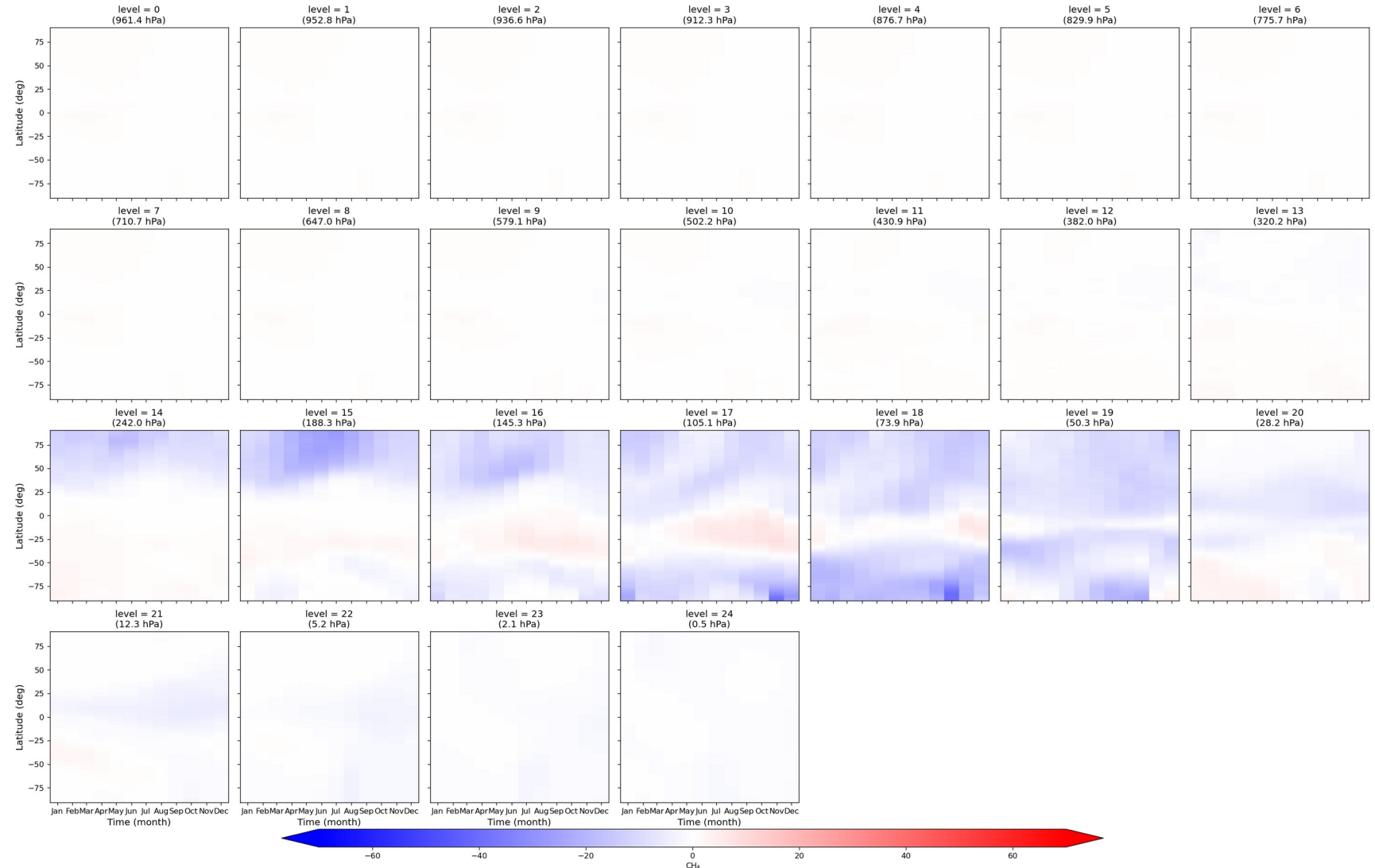
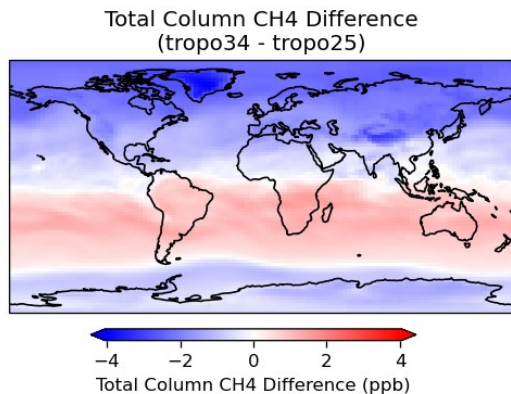
Moving from 25 to 34 levels

- Increasing the vertical resolution of our TM5 runs.
- Seeing a difference in column concentrations.



Moving from 25 to 34 levels

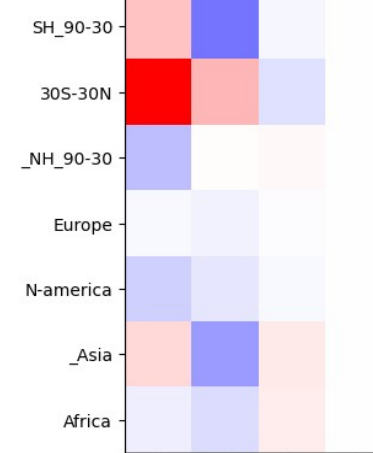
- Significant differences in concentrations start about 240hPa.



Moving from 25 to 34 levels

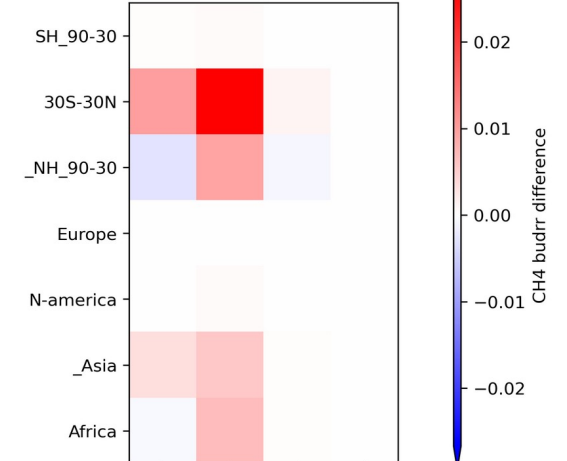
- Budgets – first month
 - Initial fields slightly different
 - 34 levels interpolated from 25 levels.
 - Cl and O1D sinks
 - Cl all zeros ??
 - O1D $1e-13$??
 - chemistry.F90

Initial conc. Difference: tropo34 - tropo25



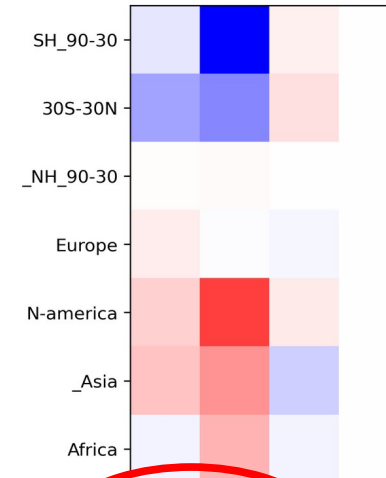
Total sink

Difference: tropo34 - tropo25



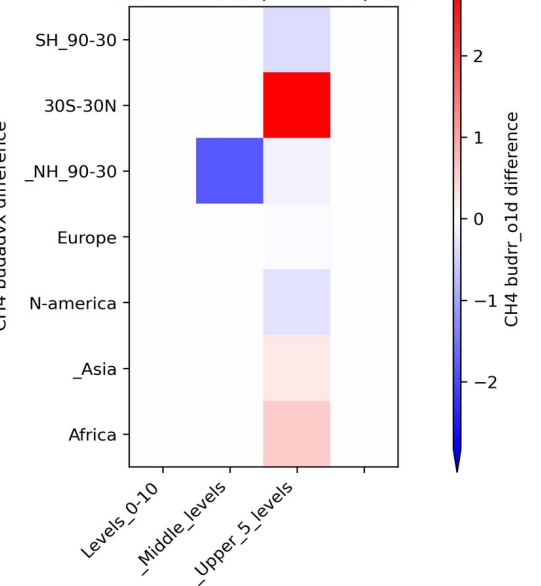
Advection in x

Difference: tropo34 - tropo25



O1D sink

Difference: tropo34 - tropo25





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Thanks! Any questions or advice?

