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Calculation of XCH_4 for CTE-CH_4 inversion

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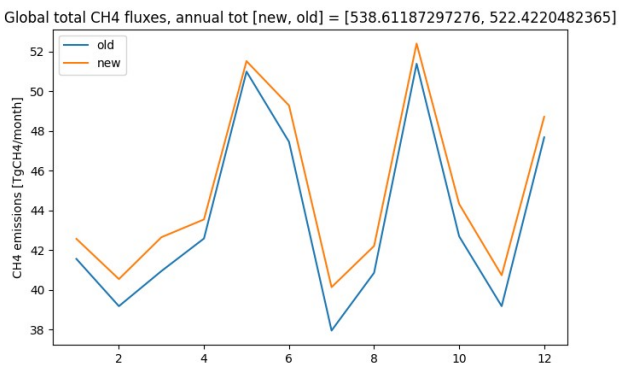
Background

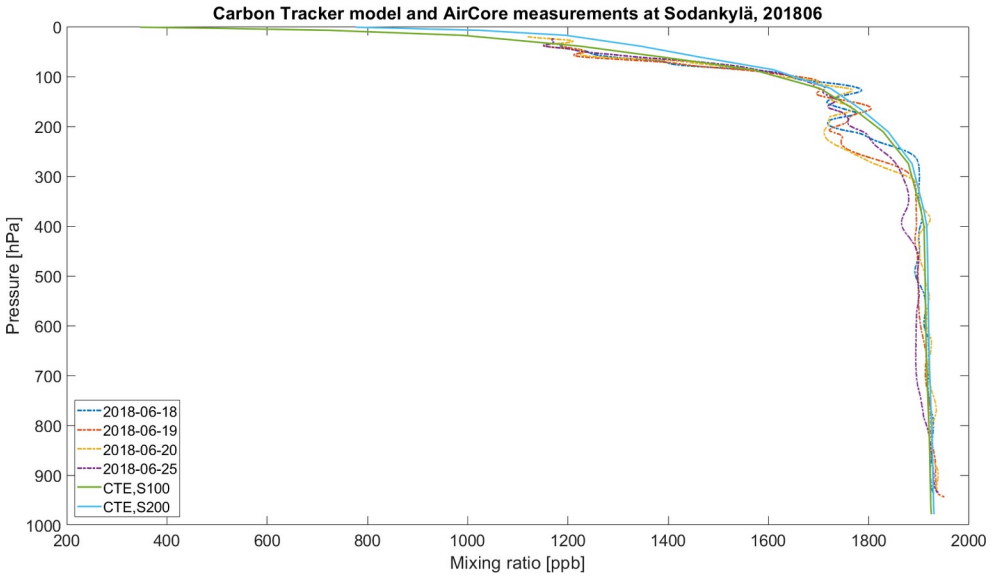
- Methane inversion using TROPOMI XCH_4 data for understanding of seasonality & spatial distribution at NHL.
- We use CTE-CH_4: EnKF based atm. inverse model.
- It can calculate XCH_4 in two ways

1) Inside CTDAS (Python): Class Observations
   - TM5 outputs mixing ratio and pressure profiles for all ensemble members
   - Loop through members for AK and vertical interpolation etc. (very slow)
2) Inside TM5
   - AK, interpolation etc will be done in TM5 (based on Liesbeth's XCO_2 code)
   - TM5 outputs XCH_4 for all ensemble members

→ Results in different XCH_4 values...

Some other updates…

- Meteorological fields: ERA-Interm → ERA5
- Stratospheric chemistry: TRANSCOM → ECHAM
  - Updates includes e.g. separation of sink reaction to Cl and O(^{1}D)
  - Affects seasonality
- Prior fluxes
  - EDGAR v6.0 (GCP2021) anthropogenic
  - GCP 2021 geological
  - LPX-Bern with latest version
- 

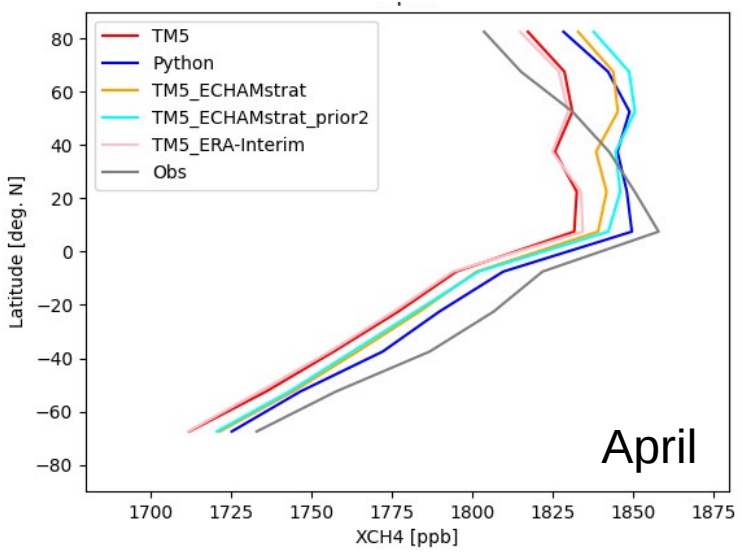


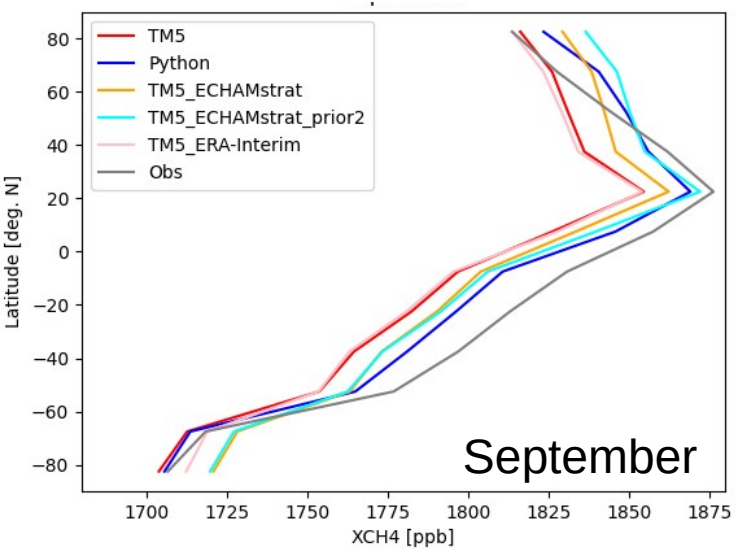
Results

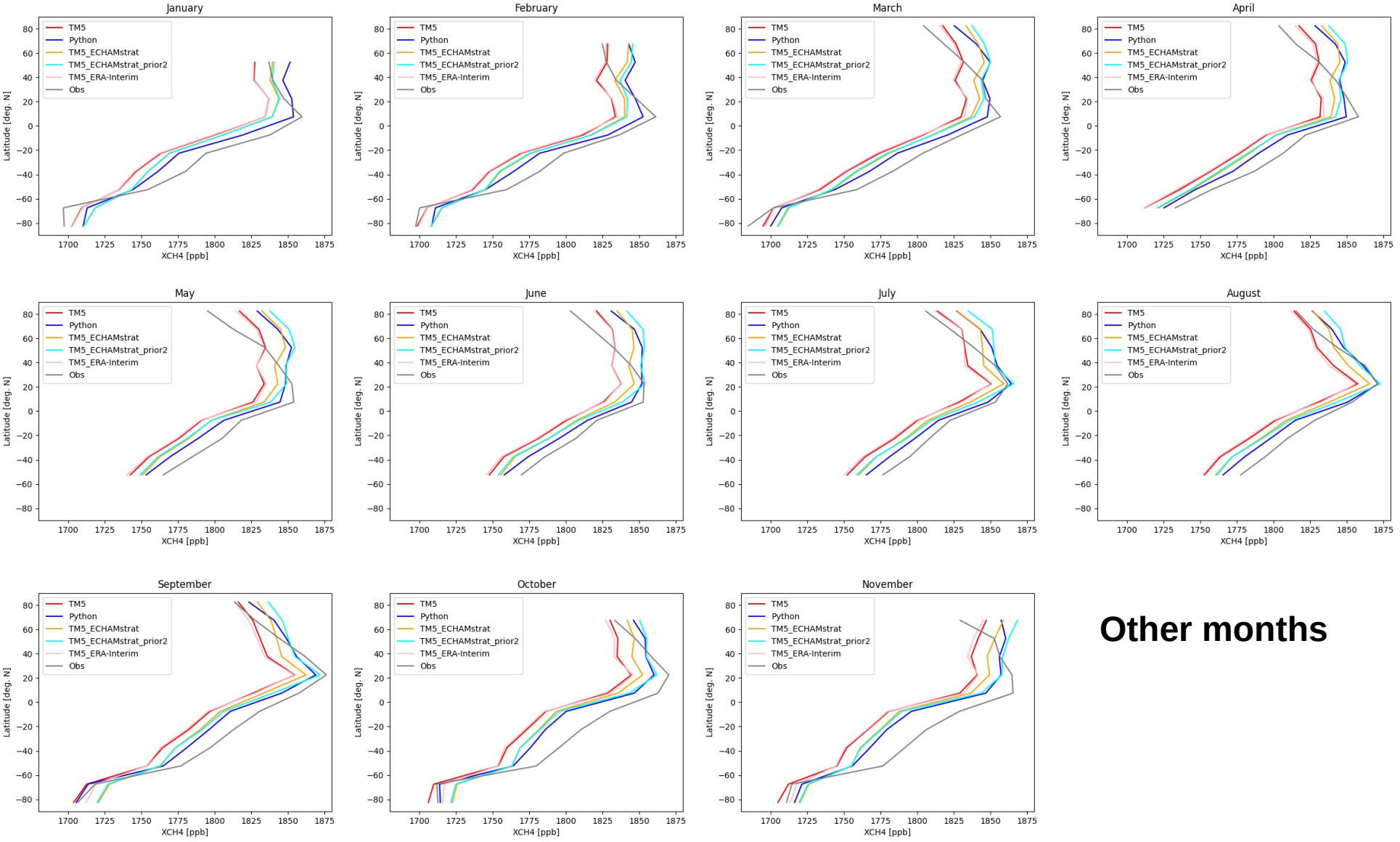
Prior concentrations vs TROPOMI (WFMD)

*average over 15 deg. zmean

- *Meteo:* differences are small
- *Chemistry:* difference of about <15 ppb.
- *Calc. methods:* differences can be ~20 ppb. NH is affected more than SH, and highest in the mid-latitudes – possibly due to extrapolation?
- *Prior fluxes:* Glb total emissions are approx. 15 Tg CH_4 (~3%) higher, and therefore XCH_4 increases







Other months

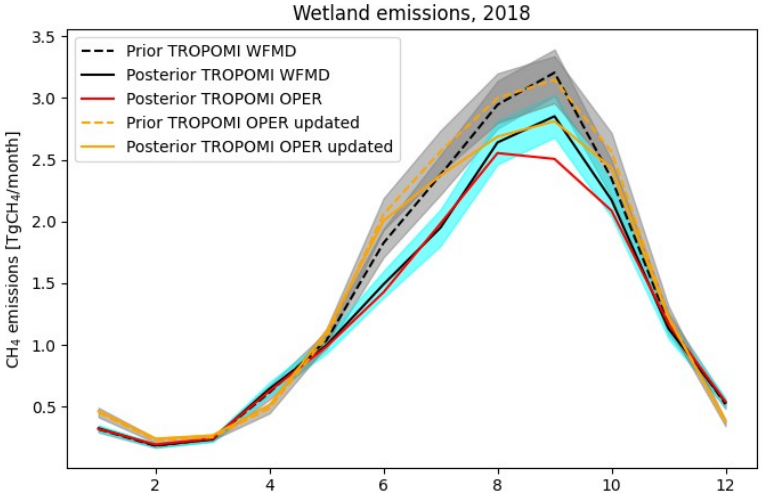
Results

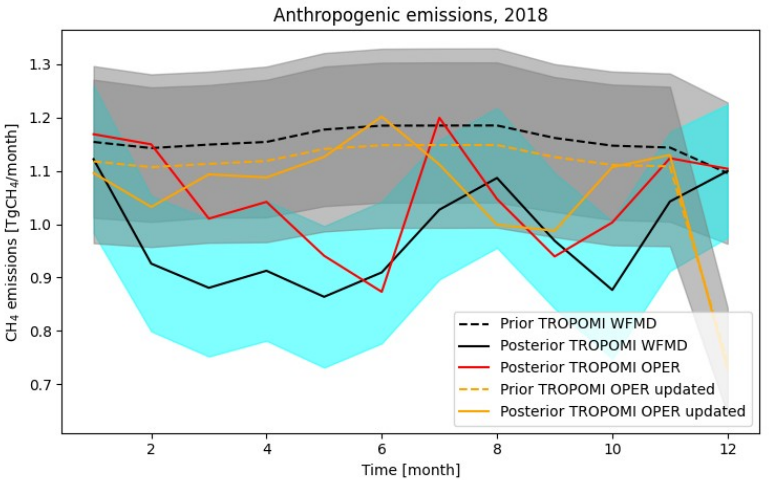
Northern high latitude* fluxes

*Canada, Northern Europe, Russia

	Prior		Posterior		
	Old	New	WFMD	OPER	OPER new
Wetlands	16.7	17.4	15.2	14.6	16.5
Anthropogenic	13.8	13.1	11.7	12.6	12.7

- Posterior annual totals are smaller than prior in both cases
- Spring wetland emissions are higher after updates, but still smaller than prior
- Anthropogenic emissions constantly smaller than prior





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Other news from FMI

Two papers are submitted :)

- Kangasaho et al., 2021, ACP: Role of emission sources and atmospheric sink on the seasonal cycle of CH_4 and δ^{13}-CH_4: analysis based on the atmospheric chemistry transport model TM5
  - Our code is based on “old” SVN version. Could we make them open to reviewers with e.g. “reviewer’s” login?
- Tenkanen et al., 2021, Remote Sensing: Utilizing Earth Observations of Soil Freeze/Thaw data and Atmospheric Concentrations to Estimate Cold Season Methane Emissions in the Northern Hemisphere