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EUROPEAN CH_4 EMISSIONS FROM CTE-CH_4 ATMOSPHERIC INVERSE MODEL

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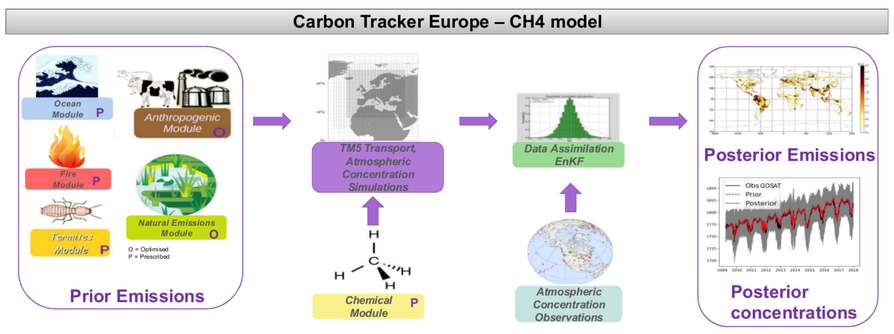
INTRODUCTION

- European CH_4 emissions from national reports and estimated from inventories and top-down estimates have discrepancies.
- There could be missing sources in reported emissions
- Estimates from process-based biospheric models vary much due to e.g. employed peatland distribution map
- We examined European CH_4 emissions using an atmospheric inverse model, CarbonTracker Europe-CH_4 (CTE-CH_4[3]).
  - Test sensitivity of the inversion to prior fluxes
  - Test sensitivity of the inversion to observations

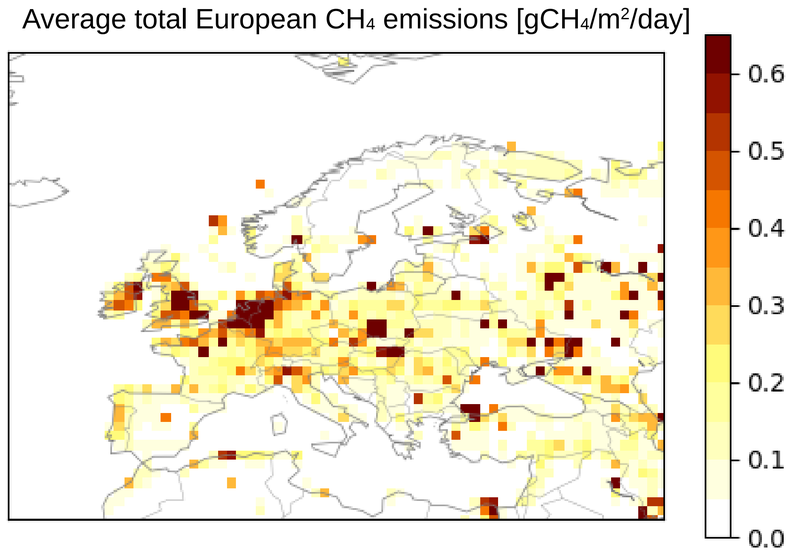
• MODELLING



- Grid-based optimization over Europe
  - 1°x1° horizontal resolution (correlation length = 100-500 km)
  - Weekly temporal resolution
- Anthropogenic priors:
  - **(P1)** EDGAR v4.2 FT2010[1]: annual means, but same values for 2012-2017
  - **(P2)** EDGAR-GCP: annual means, extended to 2017
- Biospheric priors
  - **(P1)** LPX-Bern DYPTOP ecosystem model[2]: monthly and interannually varying fluxes
  - **(P2)** Previous GCP-CH4 bottom-up estimates averaged over the models, climatological fluxes
- Other priors: GFED v4.2 (fire), termites & other microbial sources, geological sources (only in P2), ocean
- Assimilated observations
  - **(SURF)** High-precision observations from ground-based stations
  - **(GOSAT)** Dry air total column-averaged CH4 mole fractions, retrieval from GOSAT TANSO-FTS[4] (NIES v2.72 retrieval)

EUROPEAN CH_4 EMISSIONS

Average total European CH_4 emissions [$gCH_4/m^2/day$]

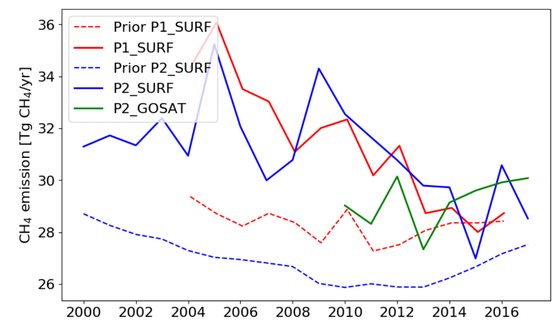


- European CH_4 emissions are high in cities due to anthropogenic emissions.
- Posterior total emissions are higher than prior.
  - Estimates from inversions agree well despite different inputs.
- Posterior European CH_4 emissions decrease since 2000.

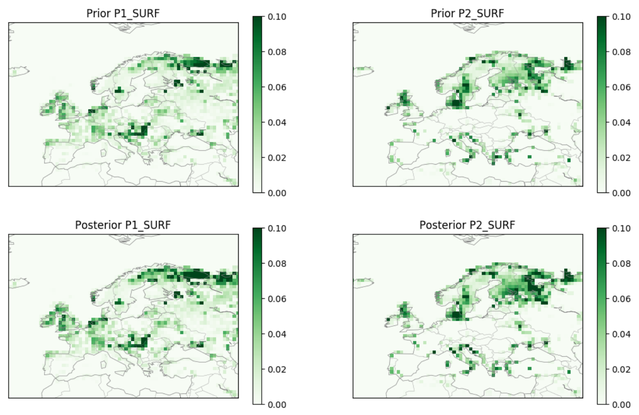
	Pior		Posterior		
	P1	P2	P1_SURF	P2_SURF	P2_GOSAT
Total	28.1	26.2	29.8	30.3	29.1
Anthropogenic	24.6	21.8	26.1	25.8	24.5
Wetlands + soil sink	3.0	1.8	3.2	1.9	2.0

Table 1: Average European total CH4 emissions for 2010-2016 [Tg CH4 yr]

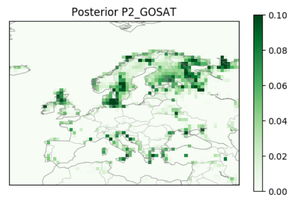
Annual total European CH_4 emissions [$gCH_4/m^2/day$]



- [Total and anthropogenic] Effect of observations are larger than the effect of prior
  - Differences in posteriors estimates are larger when using different observations (P2_SURF vs P2_GOSAT) than using different priors (P1_SURF vs P2_SURF).
- [Wetlands] Effect prior is larger than the effect of the observations in contrary to the anthropogenic case.



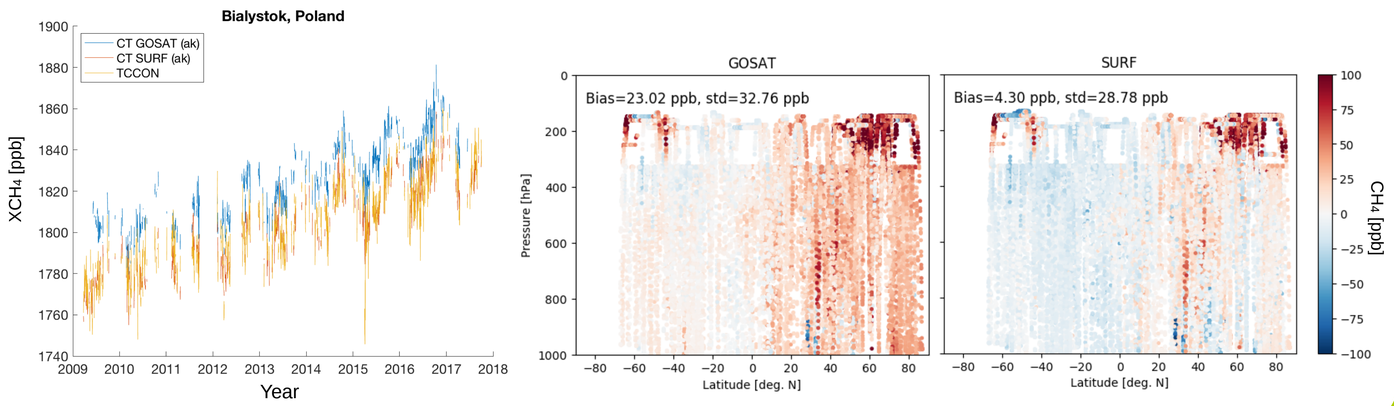
- Wetland estimates are still sensitive to prior fluxes, possibly more due to their location
  - Detecting location of wetland is crucial



  - Inversion could be further improved with help of atmospheric observations or optimizing parameters in process-based models at the same time.

MODEL EVALUATION

- Comparison with TCCON and HIPPO aircraft observations suggest overestimation of European CH_4 emissions when using GOSAT observations
  - Differences in emission estimates cannot alone explain the overestimation.
  - Long-range transport is likely to be the cause rather than e.g. effect of local emissions.



References:
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