



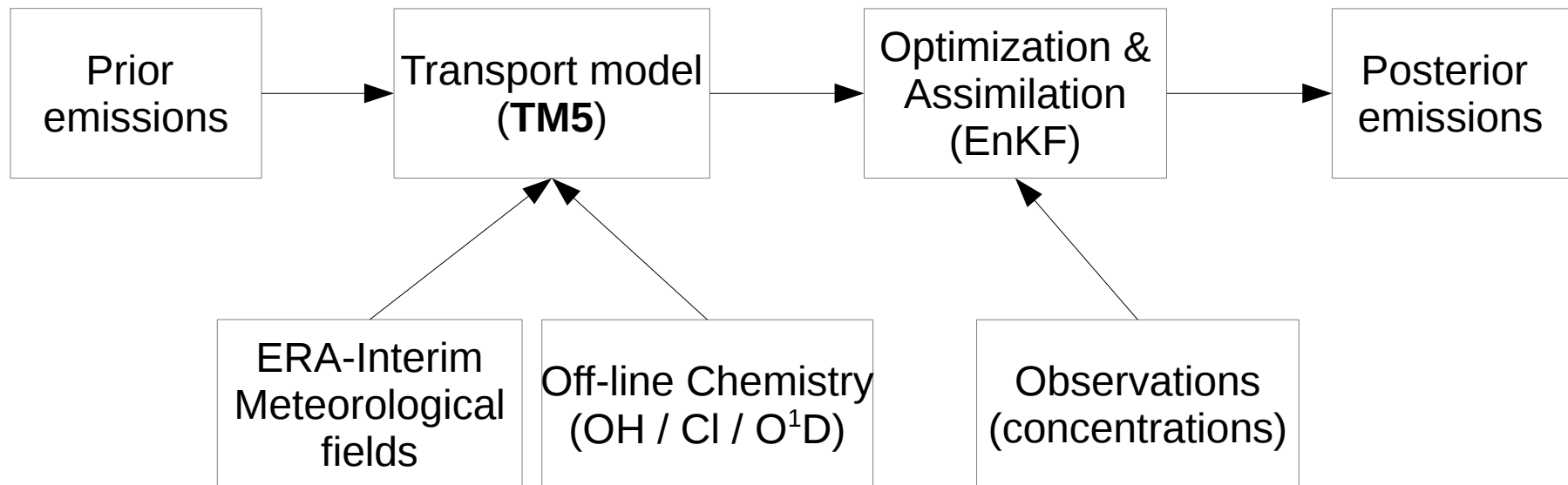
Development of CTE-methane at FMI and some comparisons from two TM5 convection schemes

Aki Tsuruta, Tuula Aalto, Leif Backman, Janne Hakkarainen



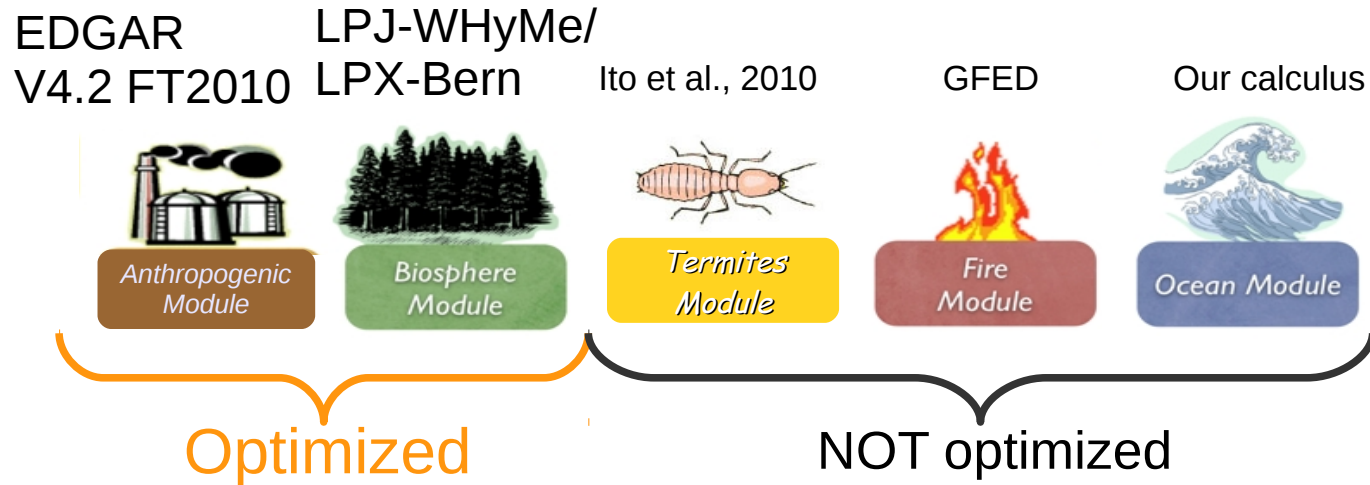
CarbonTracker Europe-CH₄ (CTE-CH₄)

- **CarbonTracker** model: inverse model based on ensemble Kalman filter (EnKF)
- Focus on **Europe**
- Optimizes **methane** surface fluxes





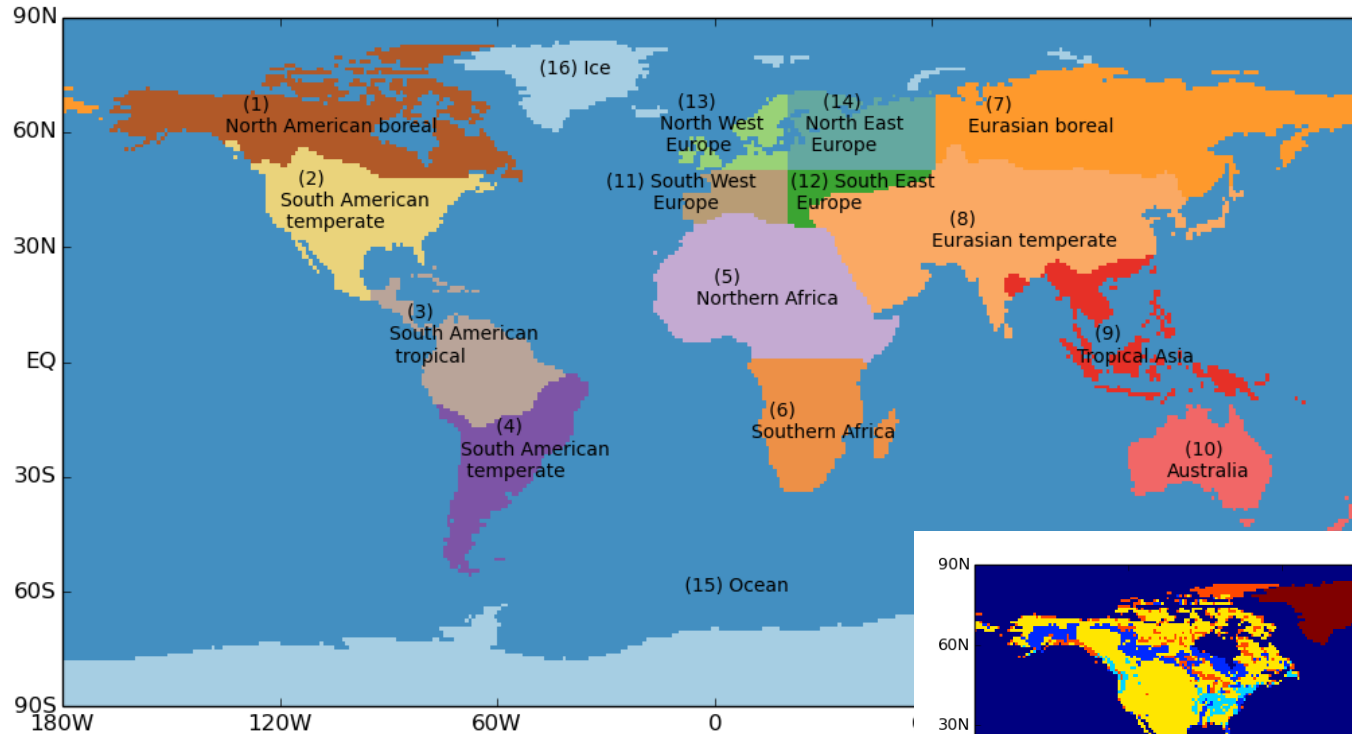
Prior emissions for CTE-CH4



$$F_{total} = \lambda_{ff}(F_{ff}) + \lambda_{bio}(F_{bio}) + F_{term} + F_{fire} + F_{oce}$$

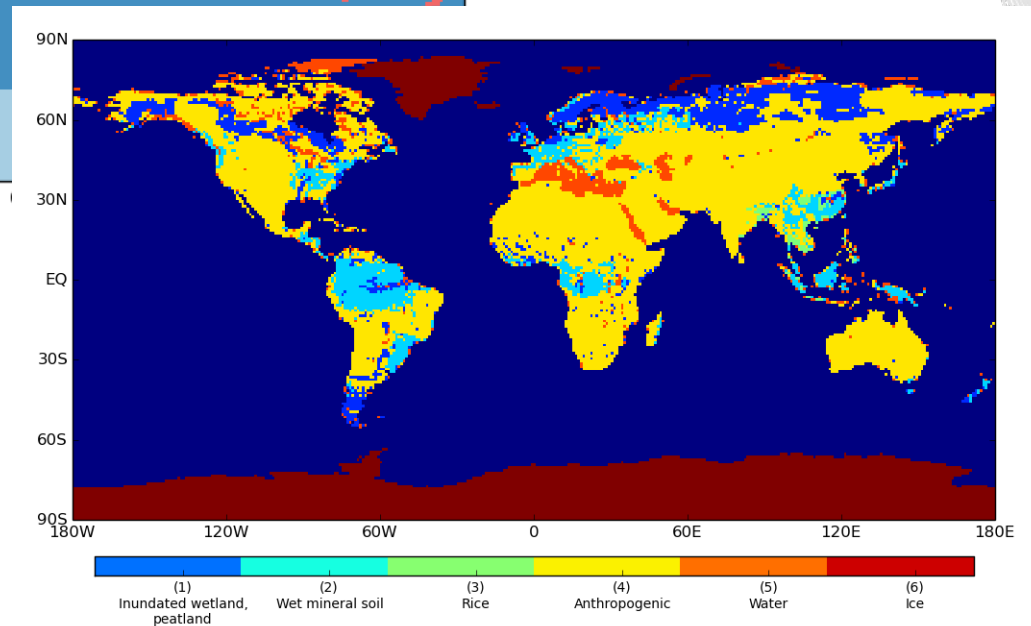


Regional definition in CTE-CH4



16 TransCom regions

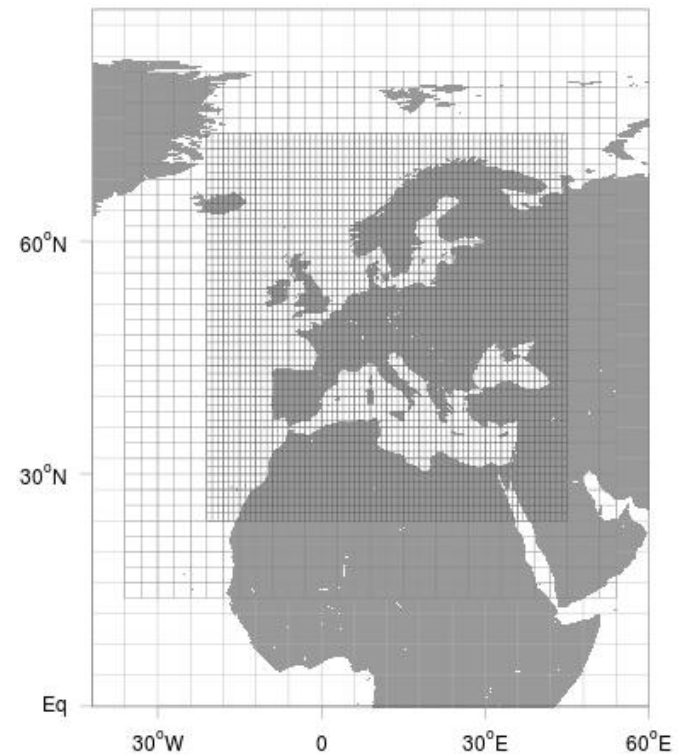
5 land-ecosystem regions





TM5 for CTE-CH4

- Driven by ECMWF ERA-Interim data
- European domain model grid:
 - 1°x1° Europe (up to 74°N)**
 - 3°x2° Outer-Europe**
 - 6°x4° Global**
- Time step: 3 hours
- Vertical resolution: **25 levels**
- Off-line chemistry: **OH, Cl, O(¹D)**





Observations for CTE-CH4

- Concentration measurements collected from WDCGG
- Flask (weekly) + some continuous (hourly) data
- Arbitrary model-data-mismatch (criteria for rejection) per site, similarly to Bruhwiler et al. (2014).



Recent development of CTE-CH4

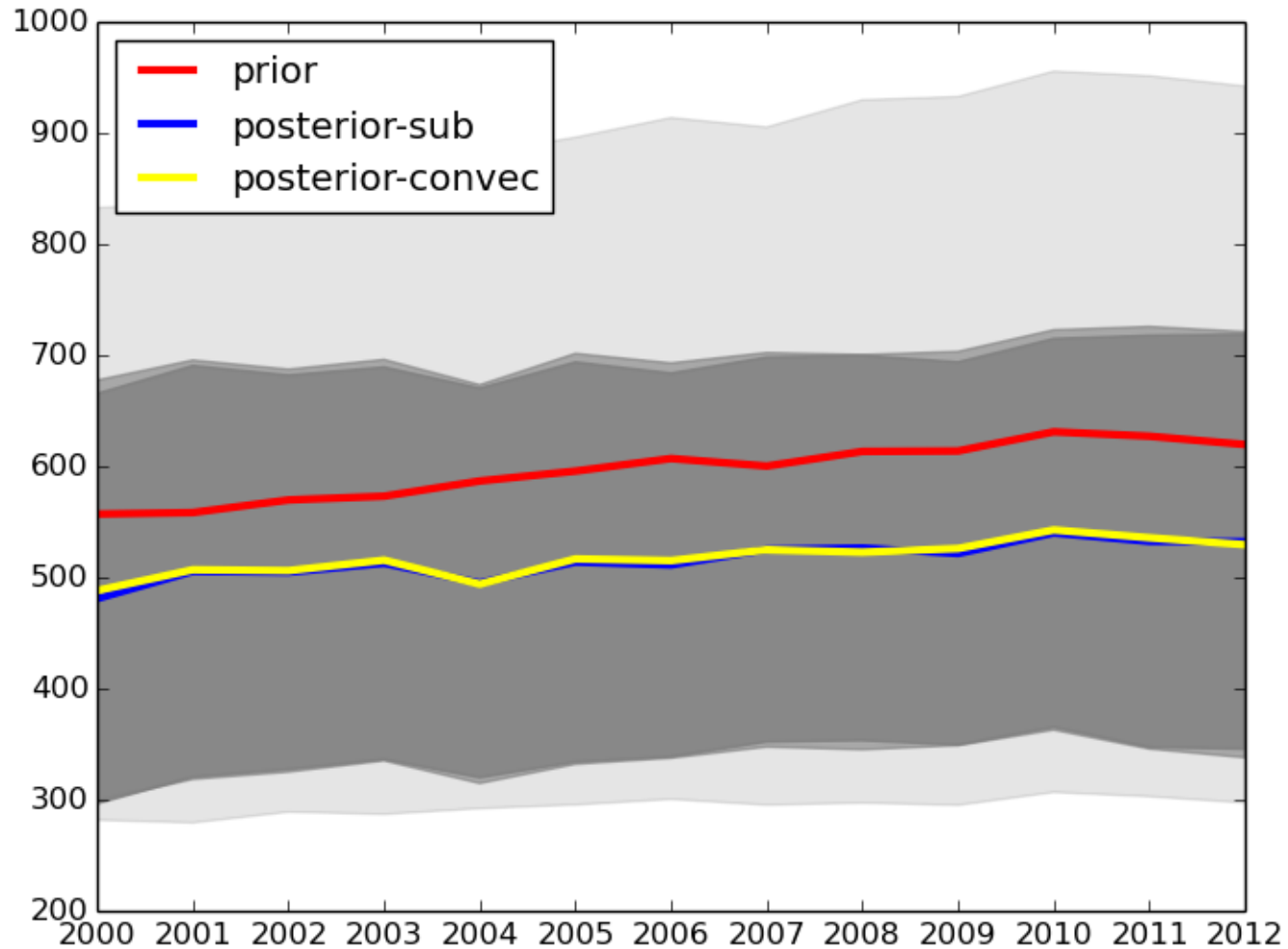
- Implemented 'convec' version (Thanks to Sander&Wouter)
- Long-term run 2000-2012 using 'sub' and 'convec'
- XCH4 comparison with GOSAT retrievals
- New version



'sub' and 'convec' comparison

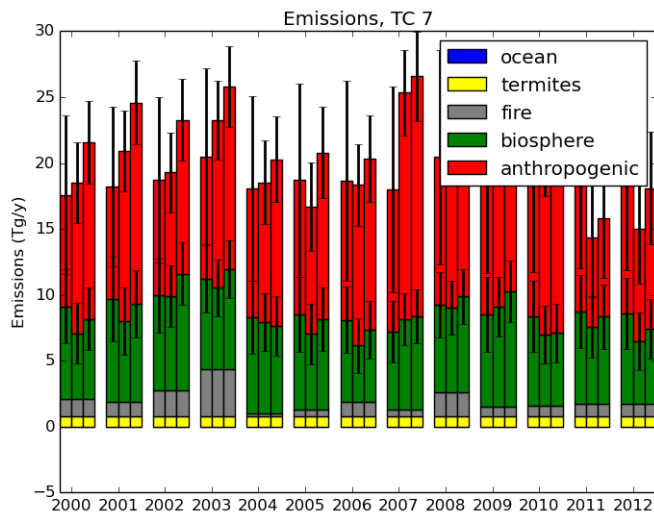
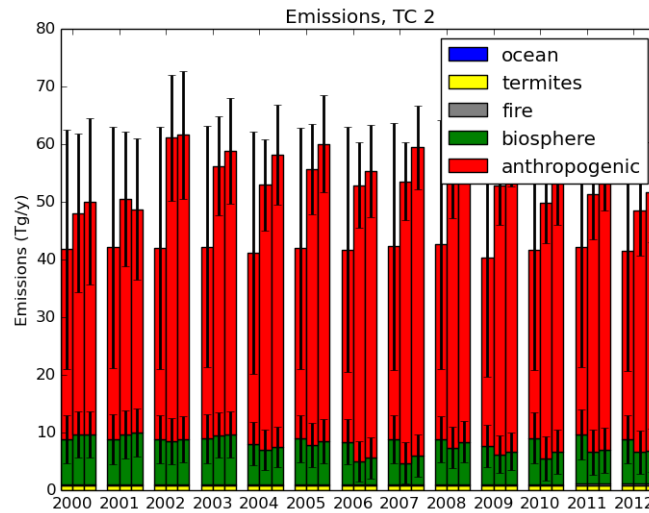
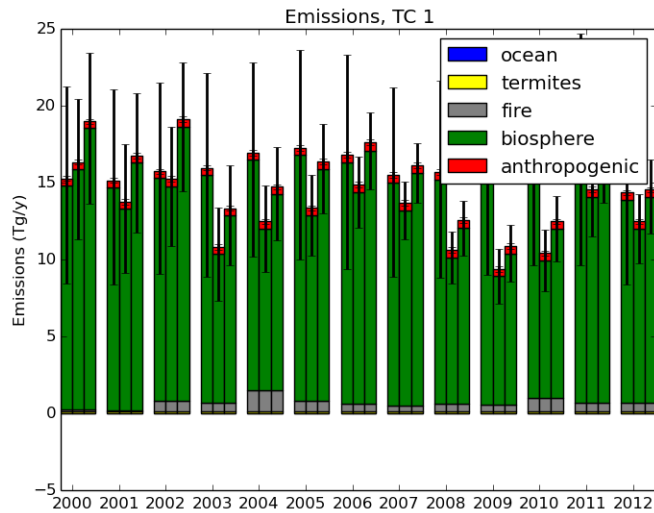
Global total emissions

CH₄ Tg/year



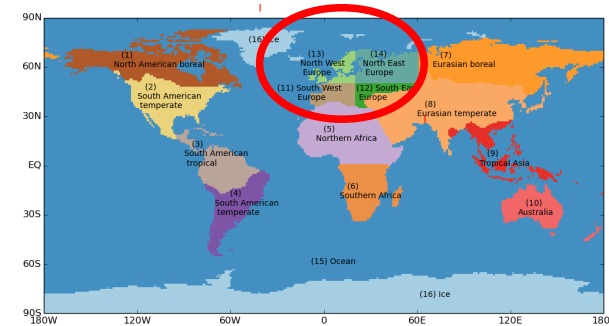
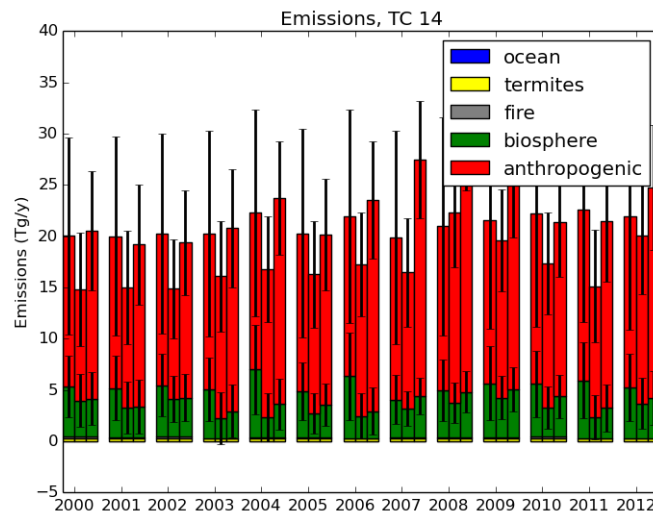
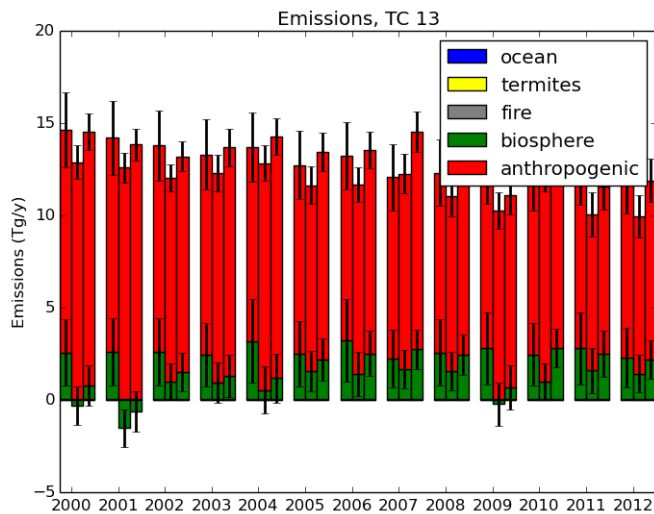
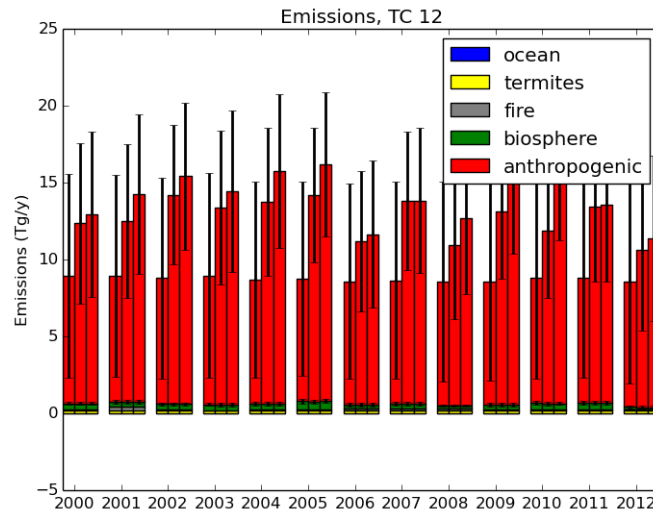
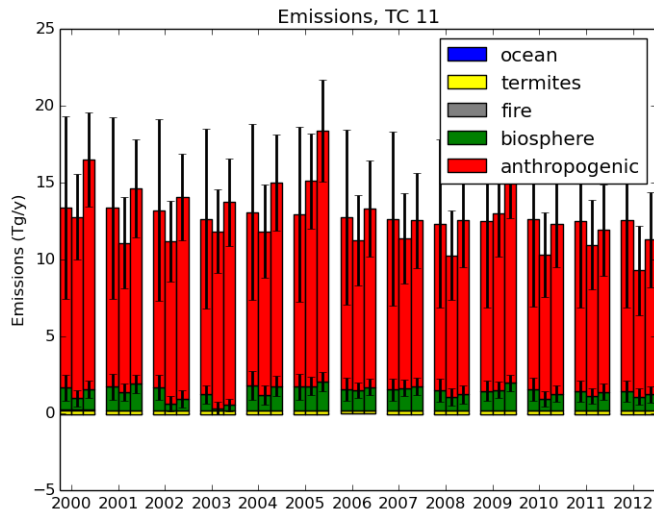


'sub' and 'convec' comparison



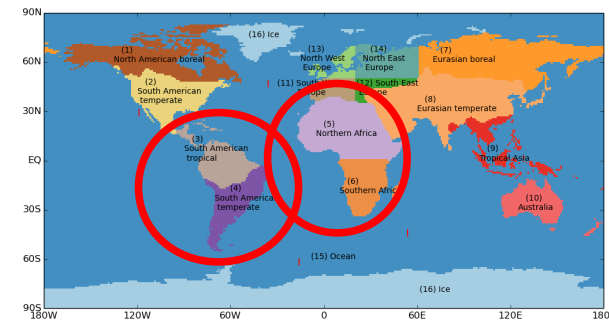
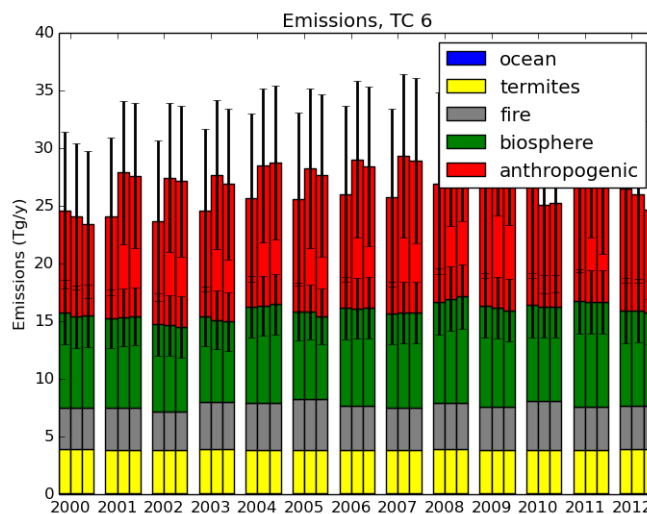
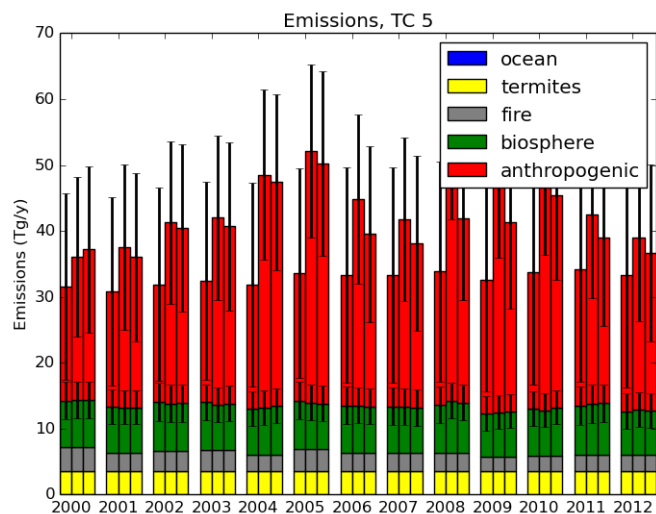
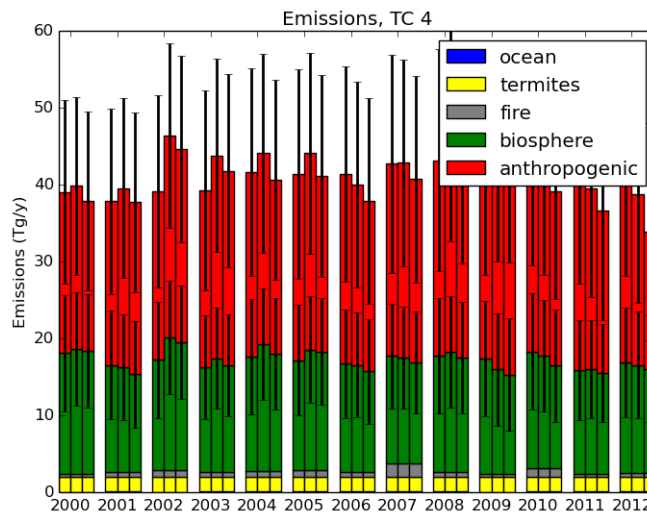
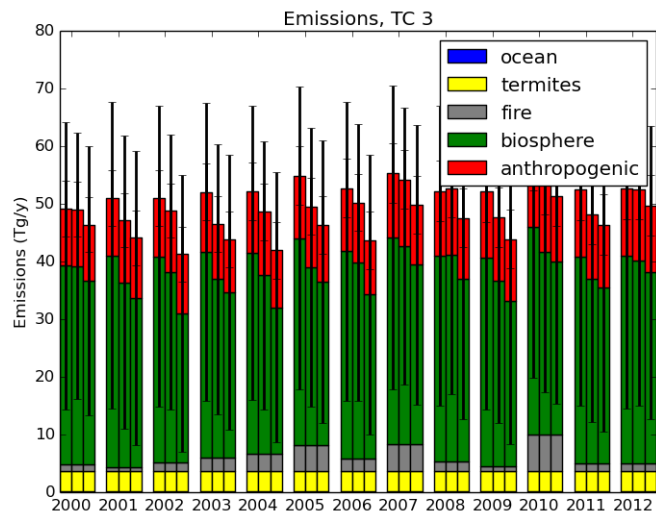


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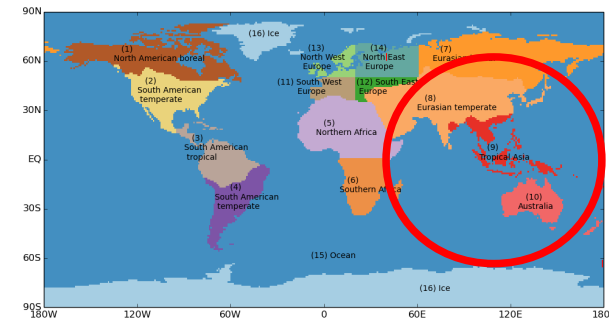
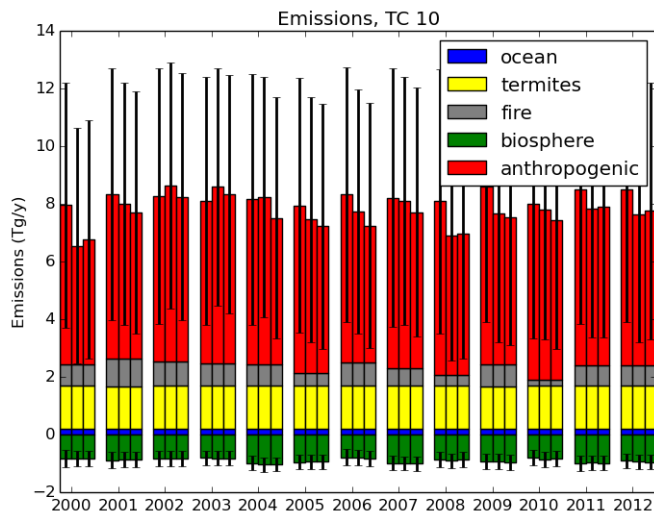
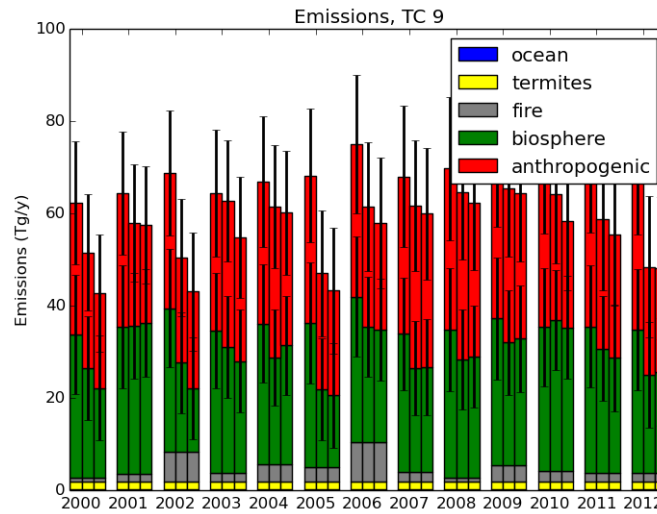
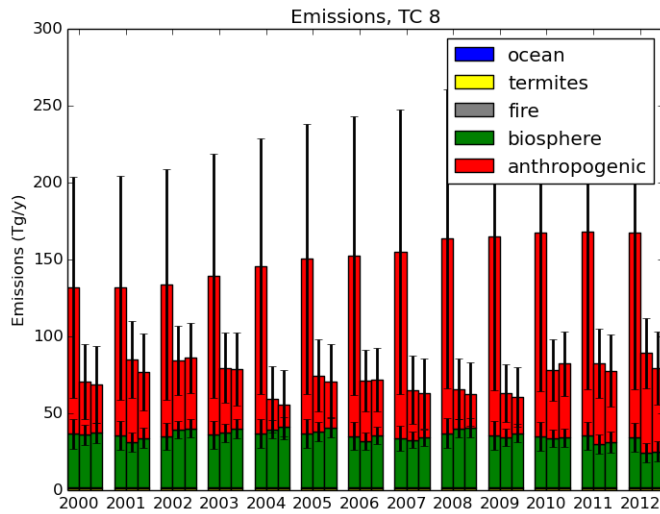


'sub' and 'convec' comparison





'sub' and 'convec' comparison



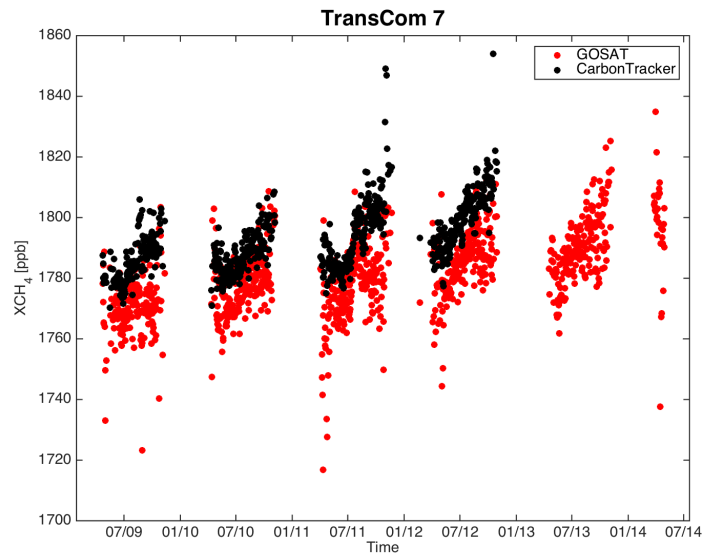
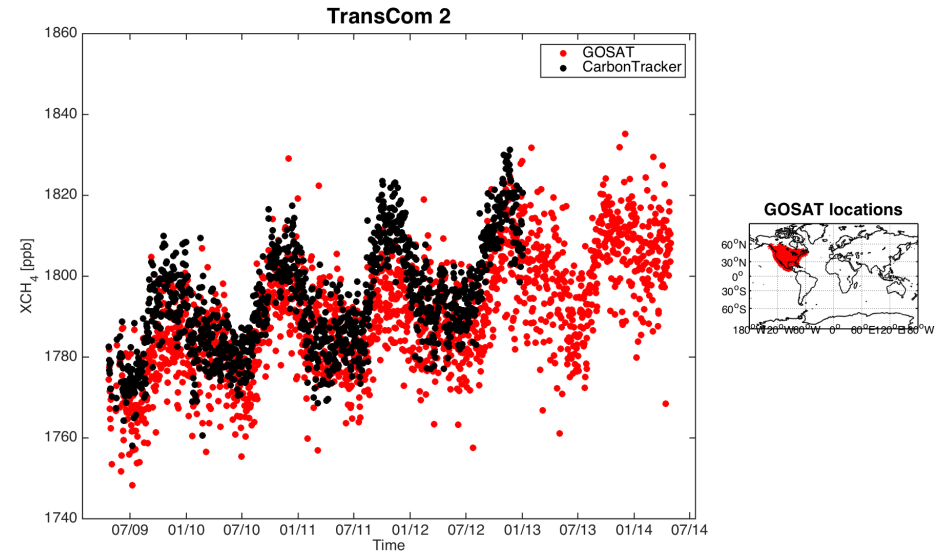
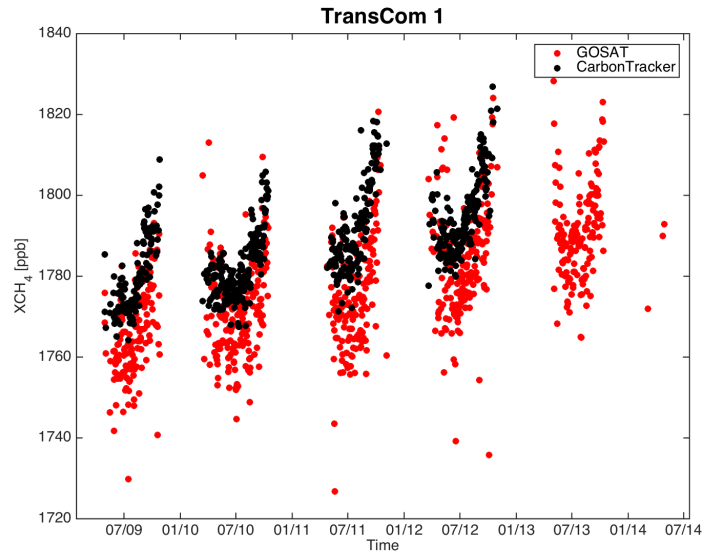


XCH₄ comparison with GOSAT

- TM5 mmix output, daily at 00:00:00.
- Posterior emissions from CTE-CH₄ (TM5-sub)
- GOSAT retrieval data (Yoshida *et al.*, 2013)
- Take daily average per TransCom region.

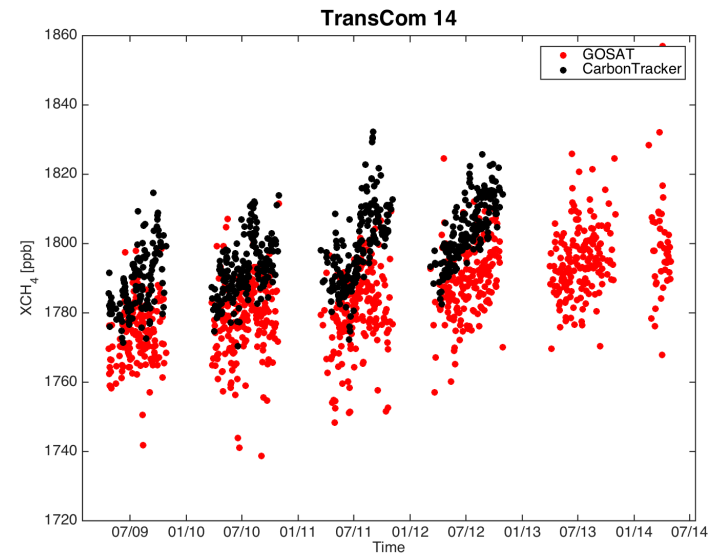
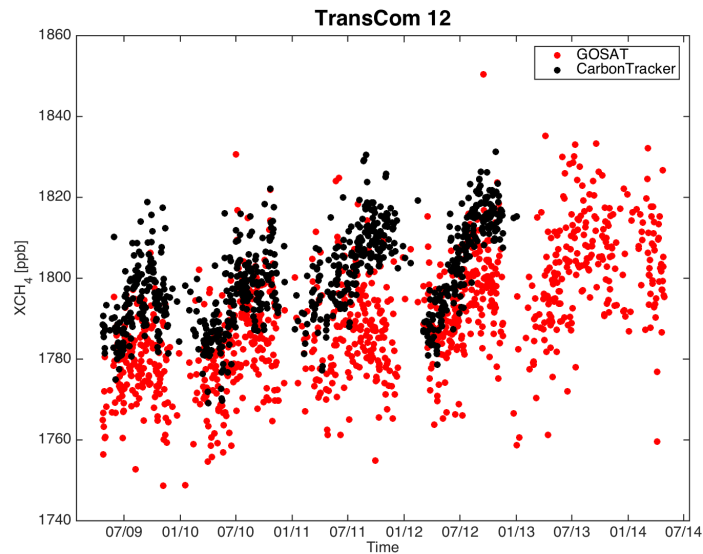
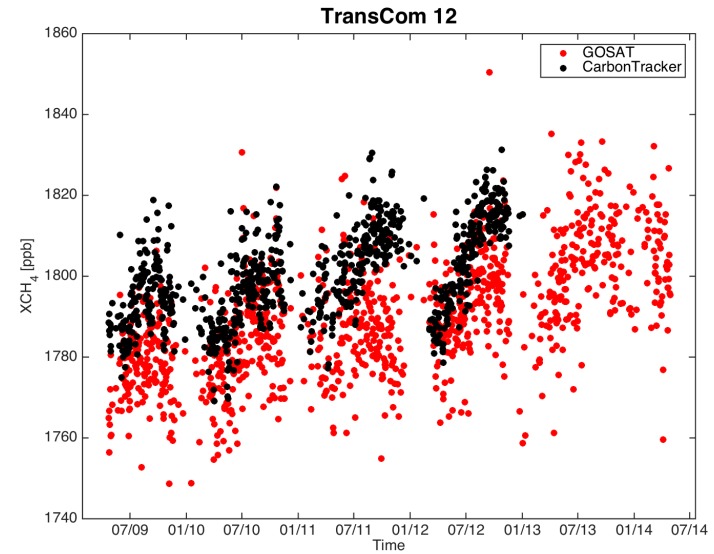
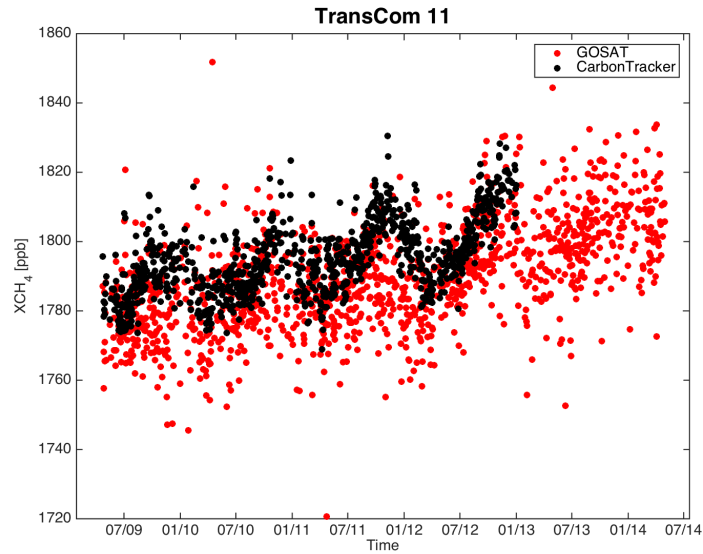


XCH₄ comparison with GOSAT



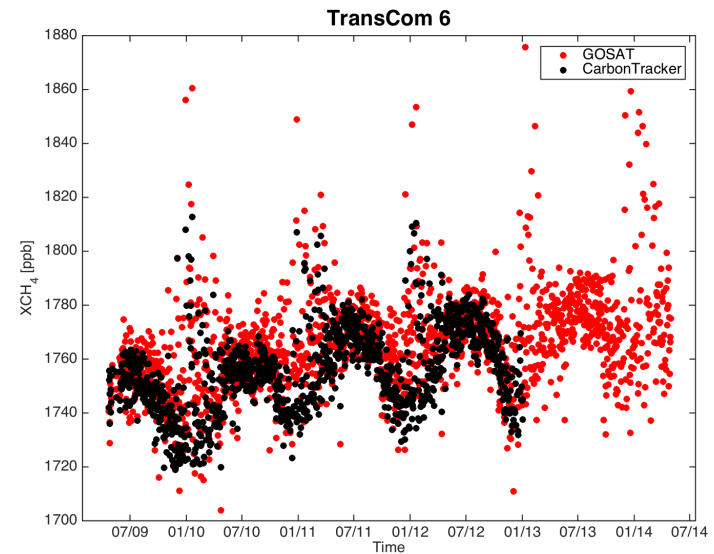
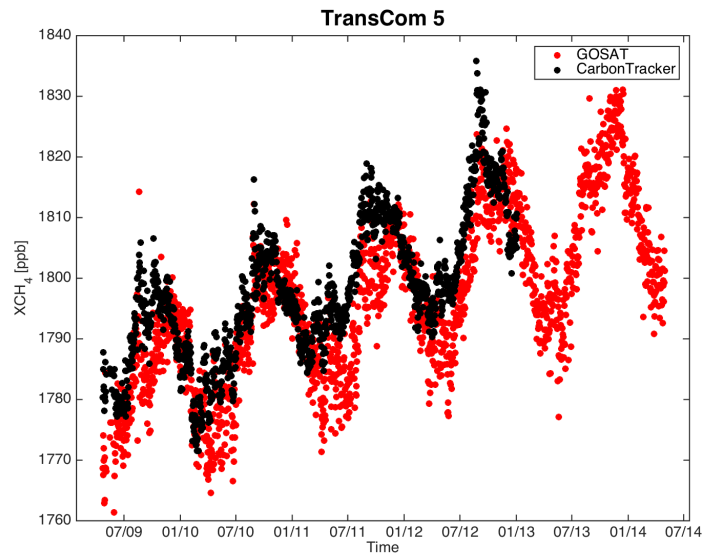
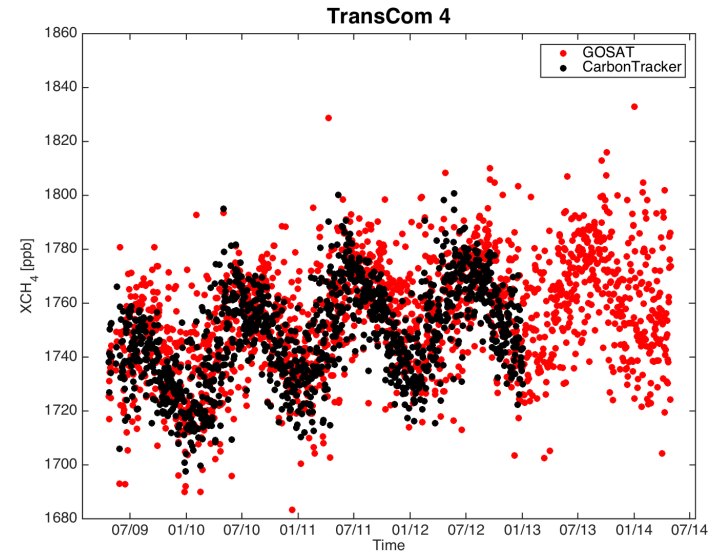
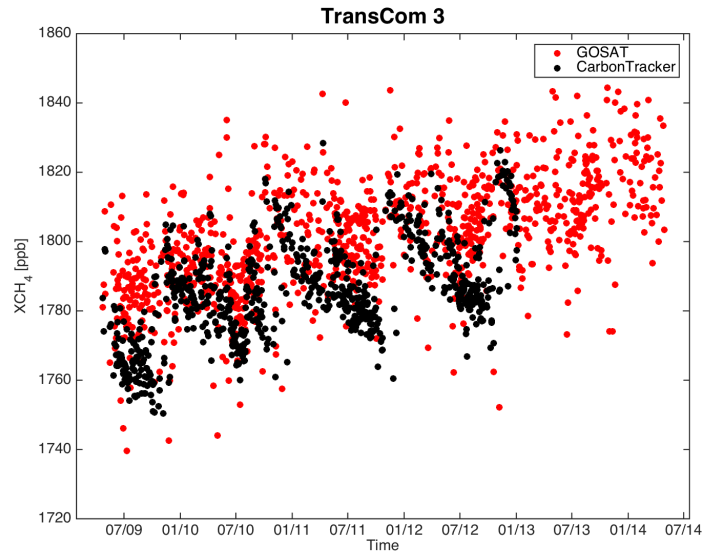


XCH₄ comparison with GOSAT



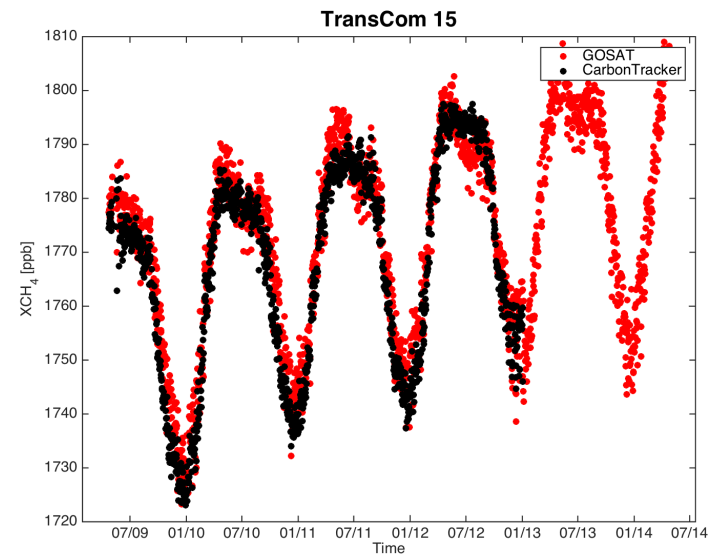
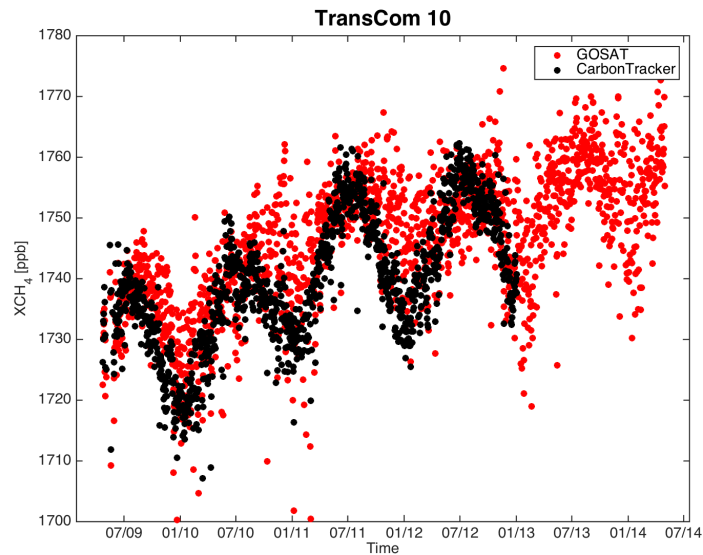
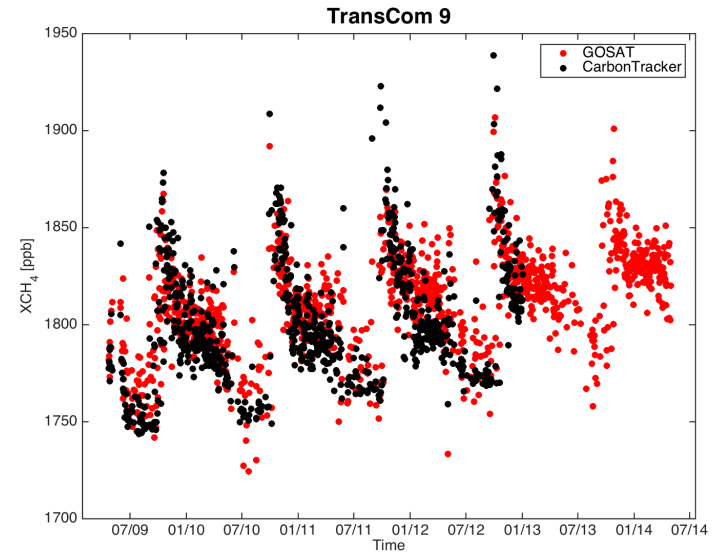
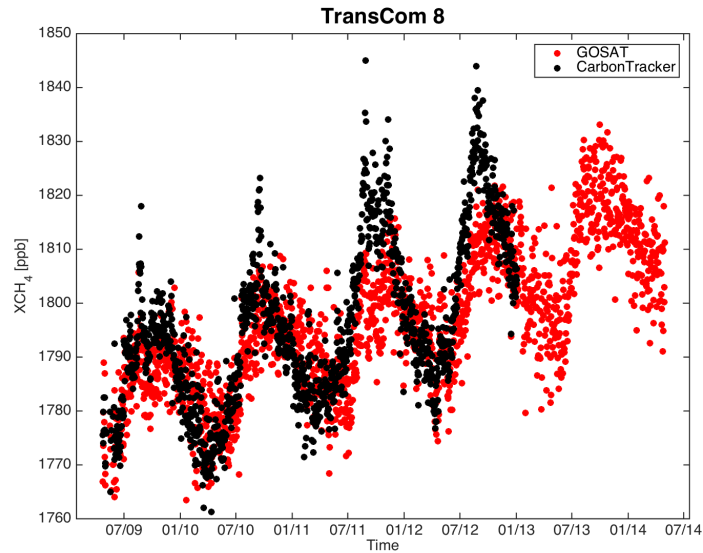


XCH₄ comparison with GOSAT





XCH₄ comparison with GOSAT





Conclusions

- 'sub' and 'convec' comparison:
 - Global total emission did not differ very much
 - Uncertainty range also did not differ much
 - High northern latitudes and America – 'convec' give more emission
 - Mid-latitudes, Tropics and Africa – 'convec' give less emission
- XCH₄ comparison:
 - Trend and seasonal cycles matches well
 - Some of the extremes were also captured
 - South American tropical region is difficult for both model and satellite
 - North African and Asian XCH₄ seems to be overestimated in the model, i.e. too much emission?



Future plans for CTE-CH4

- Assimilate satellite observations (GOSAT)
- Development for Russia
 - Assimilate more surface observations in Russia (eSTICC, Sasakawa et al., 2012)
 - Revise regional definition
 - Tiksi experiment