

Using satellite-derived CH₄ / CO₂ columns in CH₄ flux inversion

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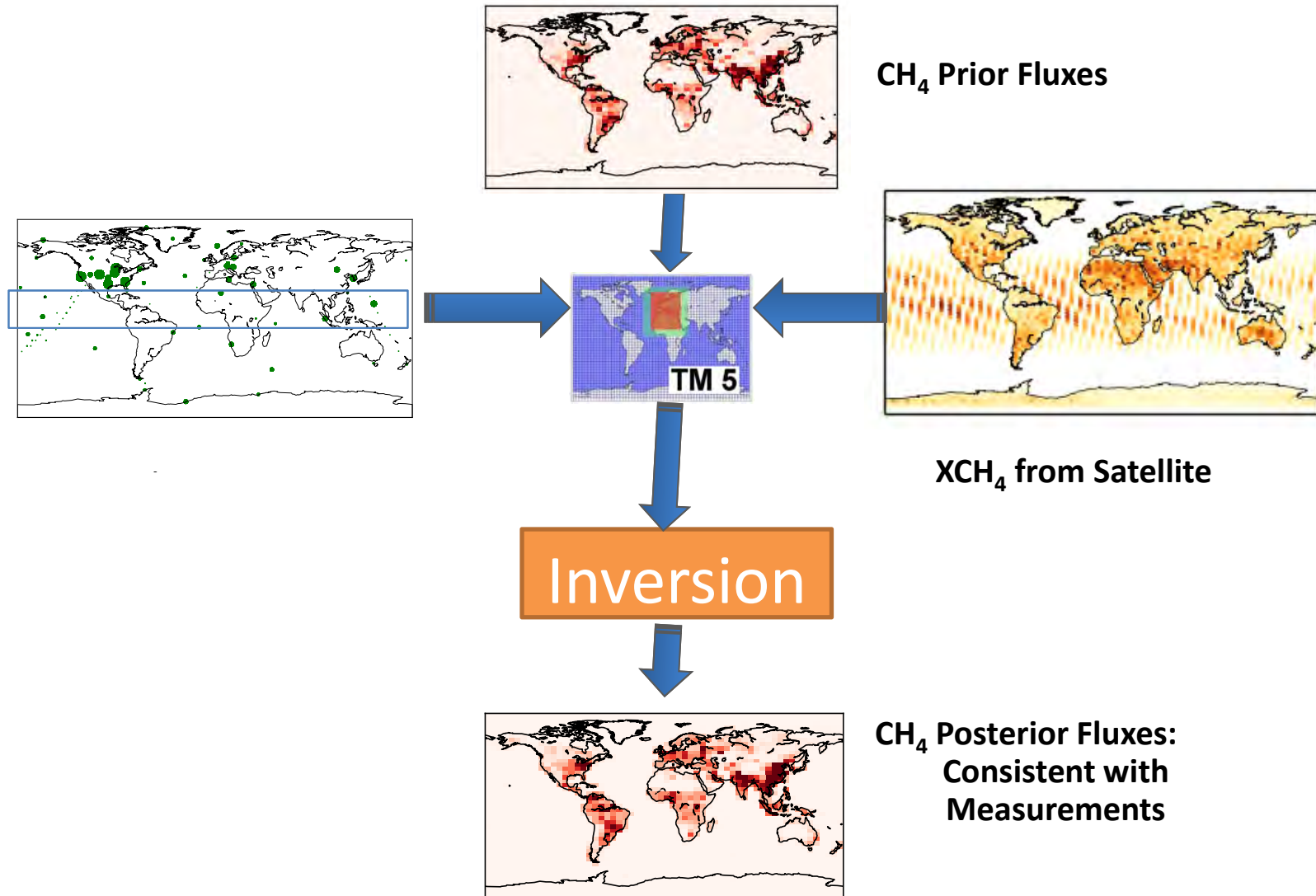


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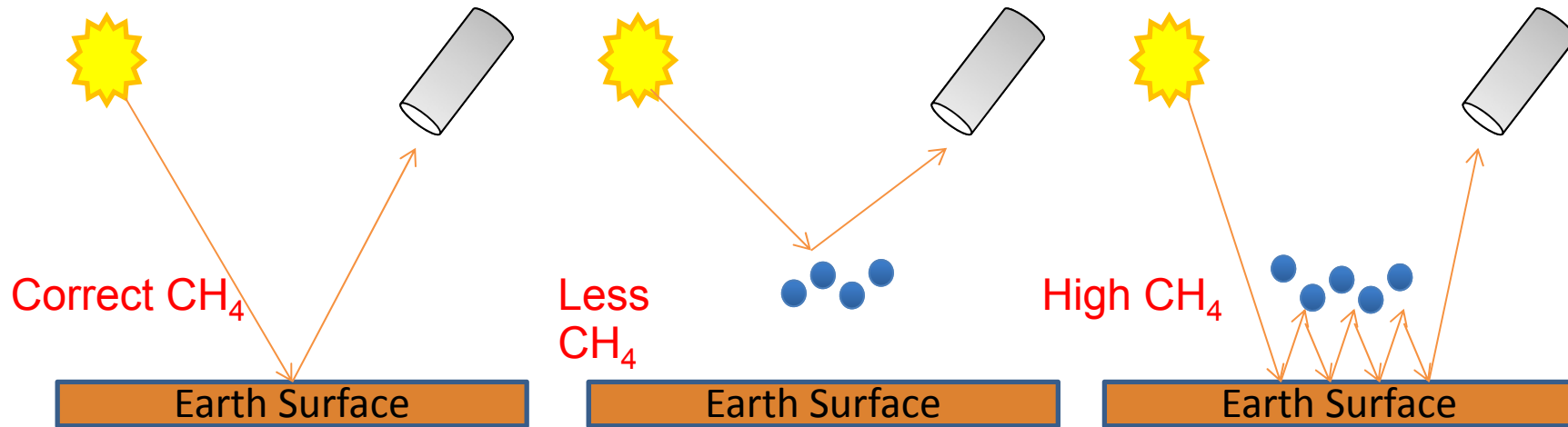
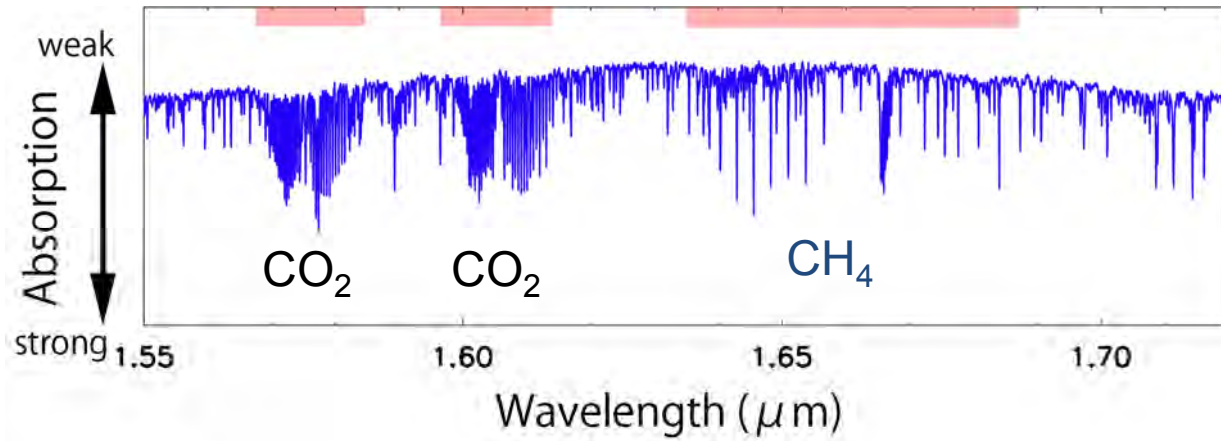
Outline

- Introduction
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 - Atmospheric scattering
- Method
 - Proxy method
 - Ratio method
 - Experiment
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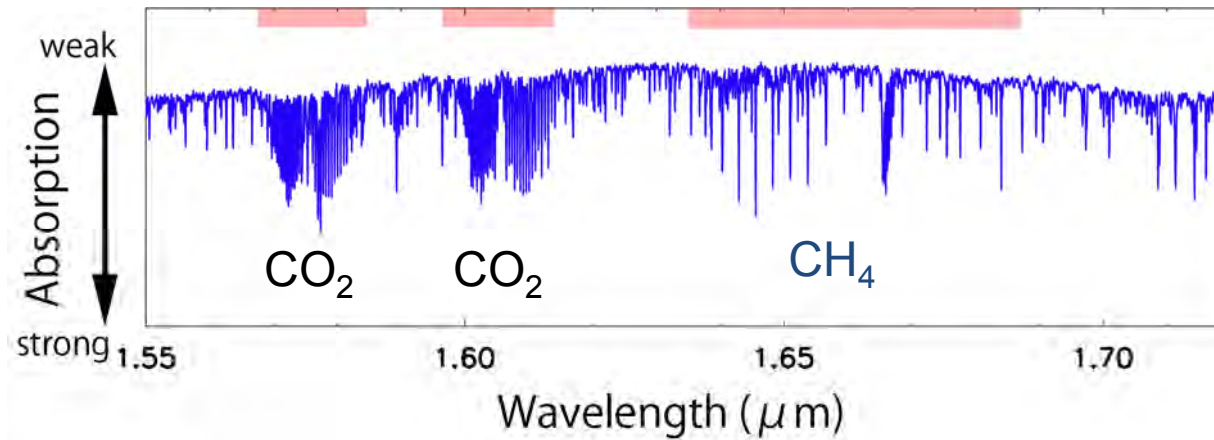
Inversion



Atmospheric Scattering



Proxy Method



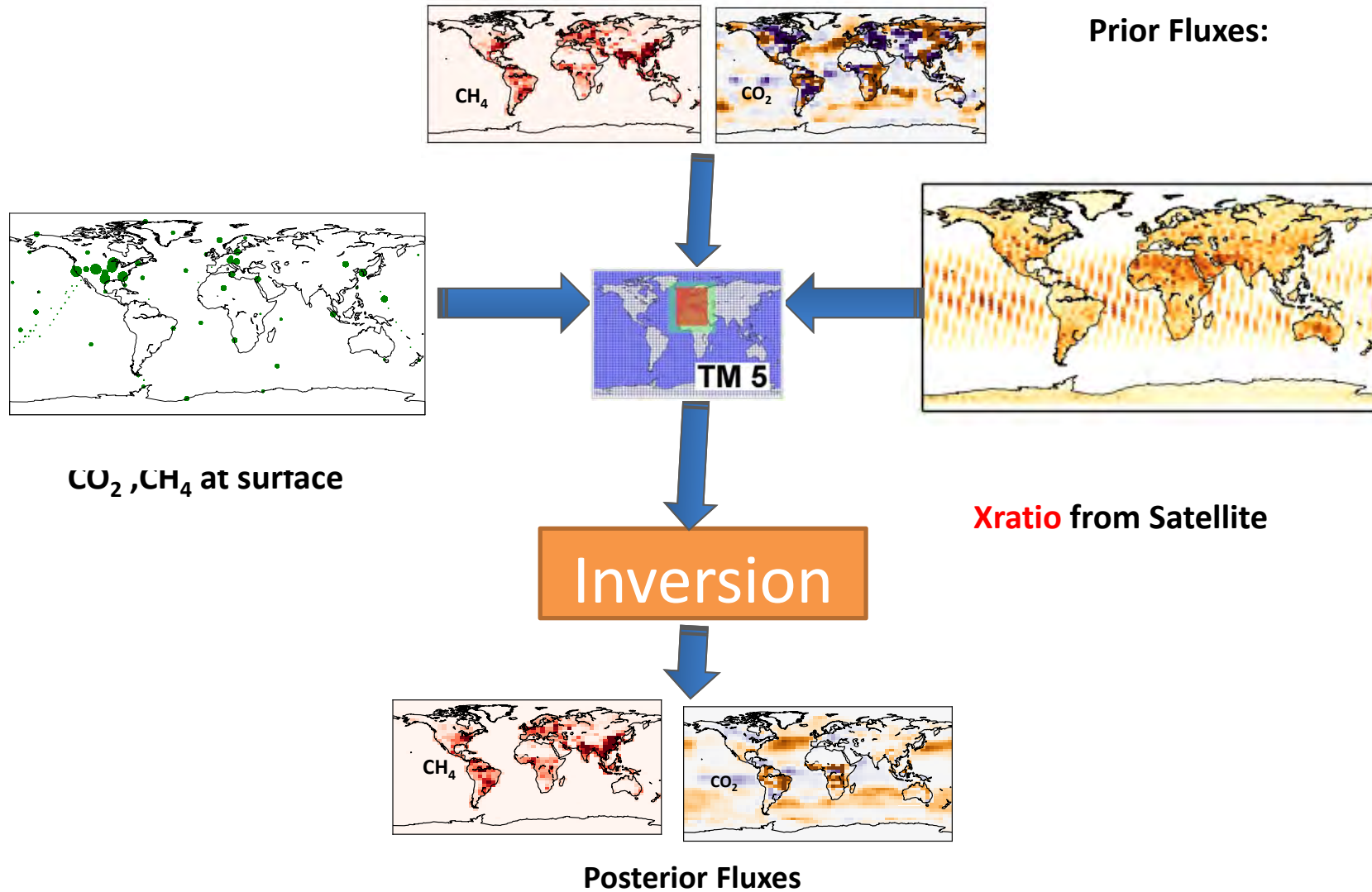
$$X_{CH_4}^{proxy} = \frac{X_{CH_4}^{obs}}{X_{CO_2}^{obs}} \times X_{CO_2}^{model}$$

Ratio Method

$$X_{ratio} = \frac{X_{CH_4}^{obs}}{X_{CO_2}^{obs}}$$

- The posterior fluxes of CH₄ and CO₂ are made consistent with satellite-measured Xratio in the atmosphere (Pandey et al., 2015).

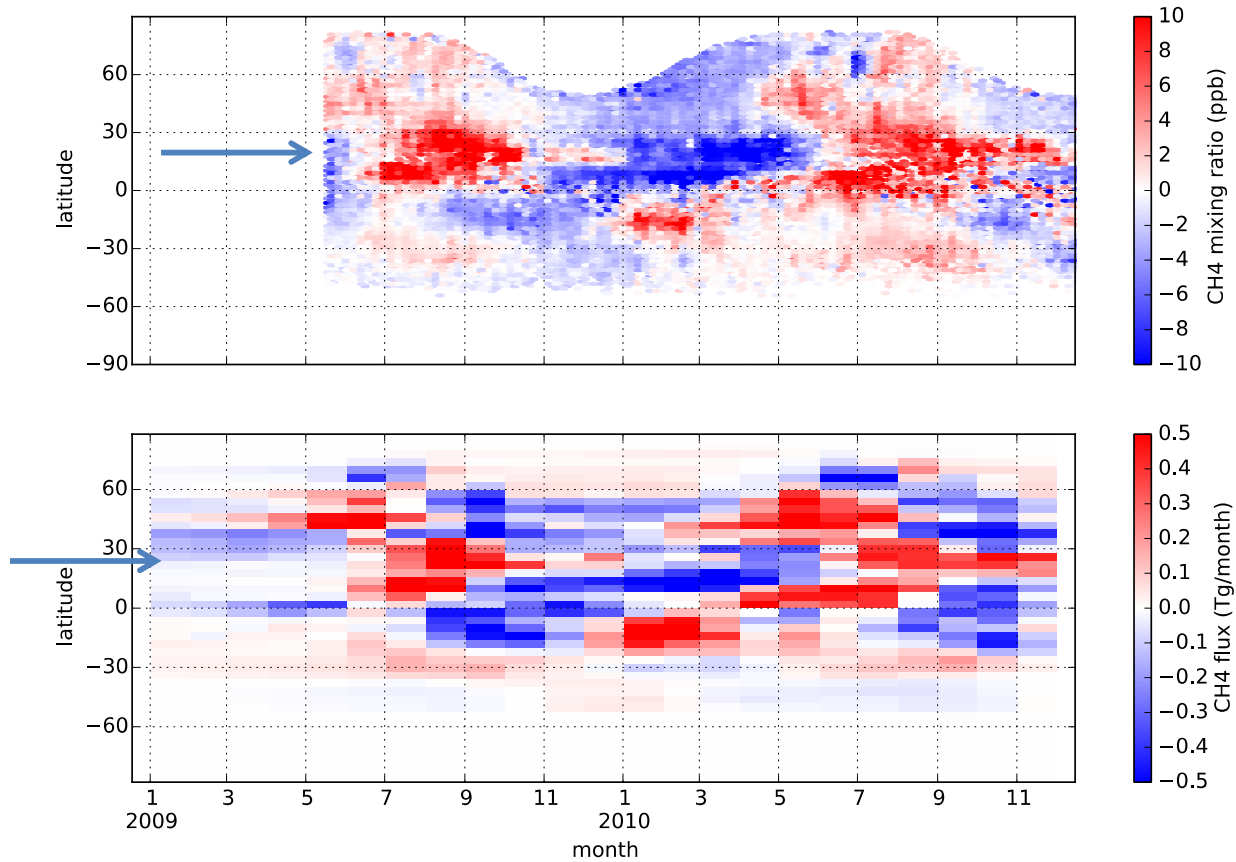
Ratio Method



Inversion Experiment

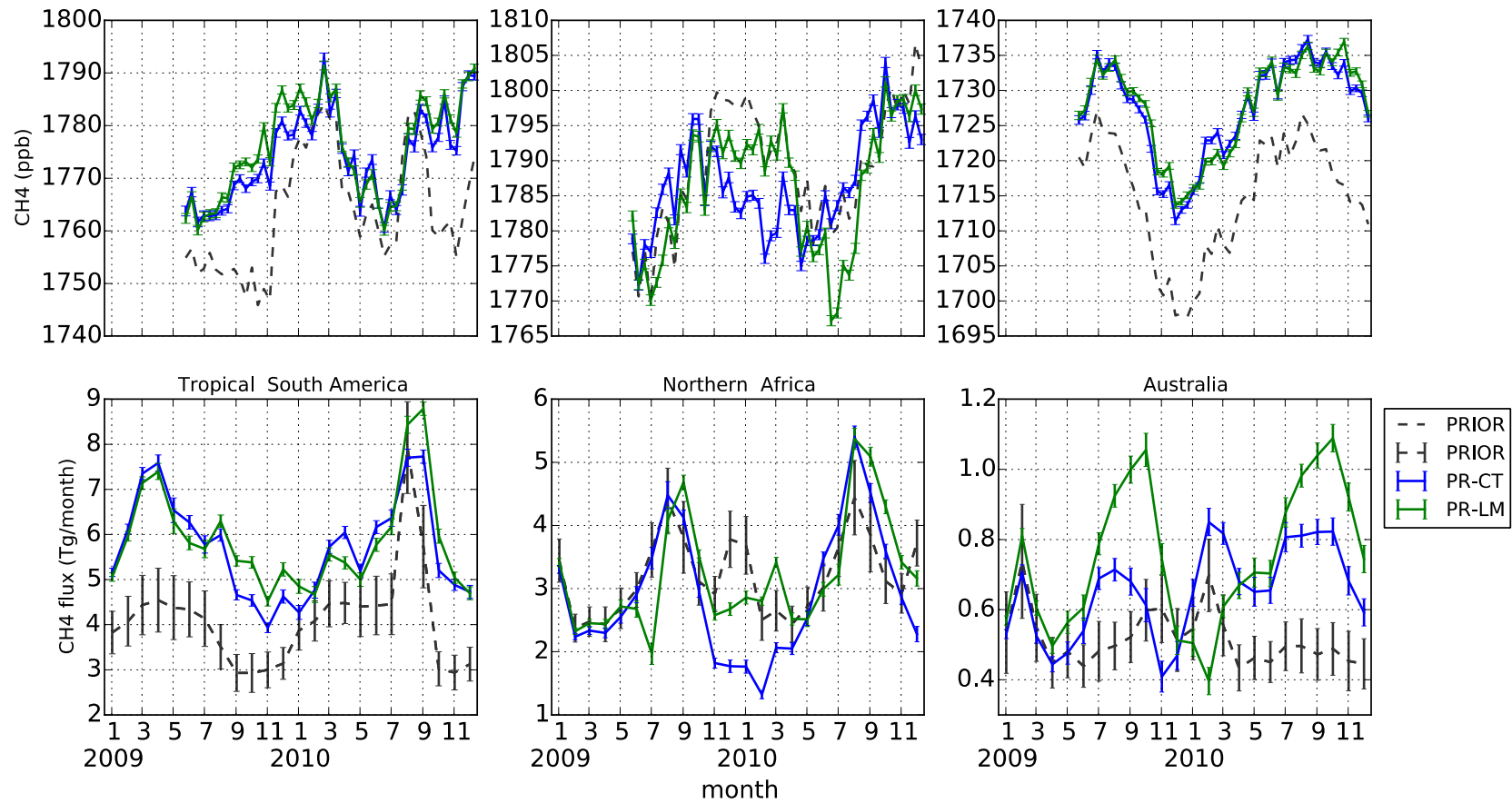
- Inversion time period: **Jan 2009 to Dec 2010**
- Surface measurements from **NOAA**
- Satellite measurements from **GOSAT**
- **TM5-4DVAR** inversion setup
- Two proxy inversions to :
 - PR-CT: model CO2 from CarbonTracker.
 - PR-LM: model CO2 from LMDZ.
- One ratio inversion (RATIO).

Proxy Inversion

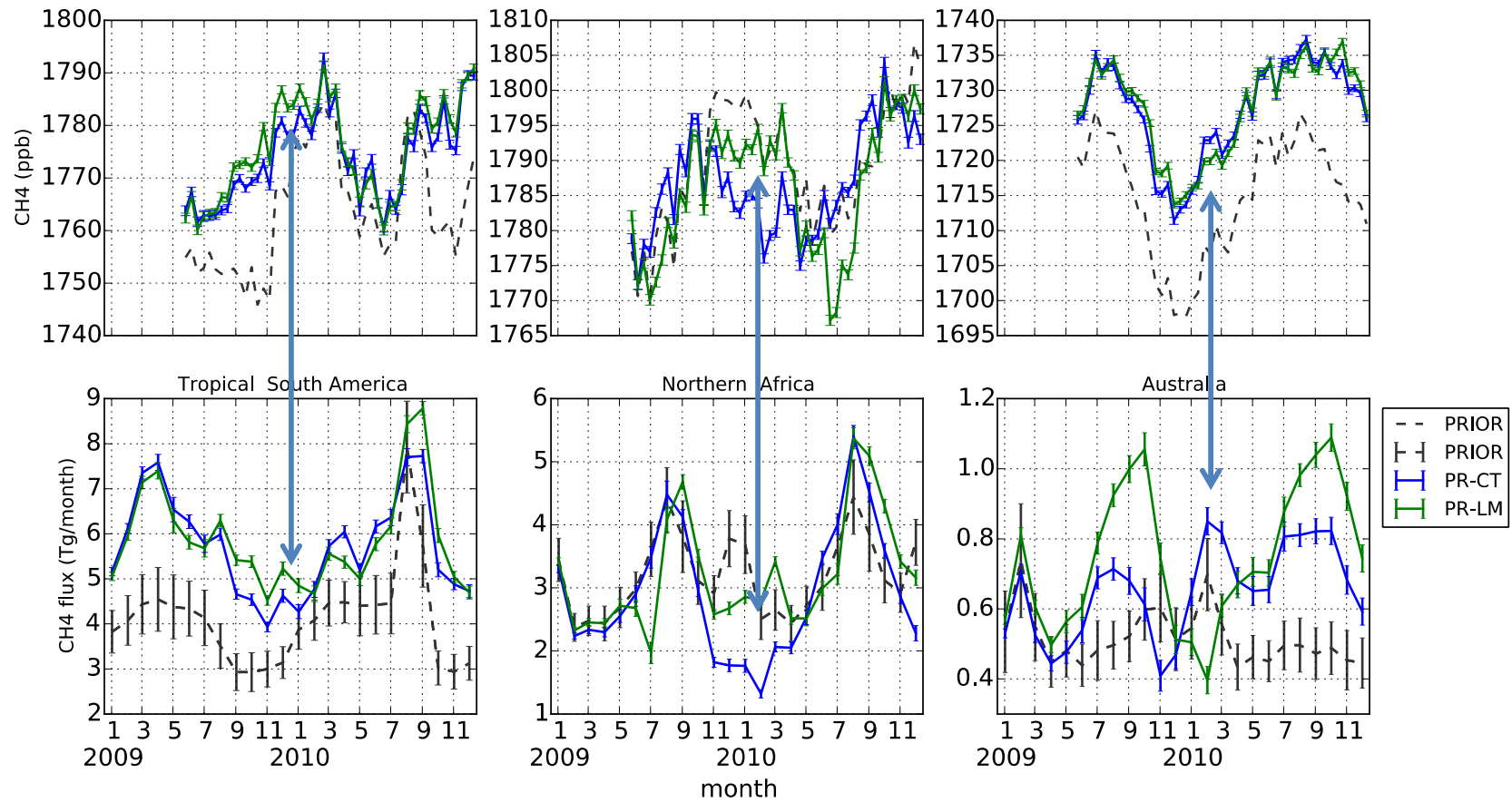


PR-CT – PR-LM

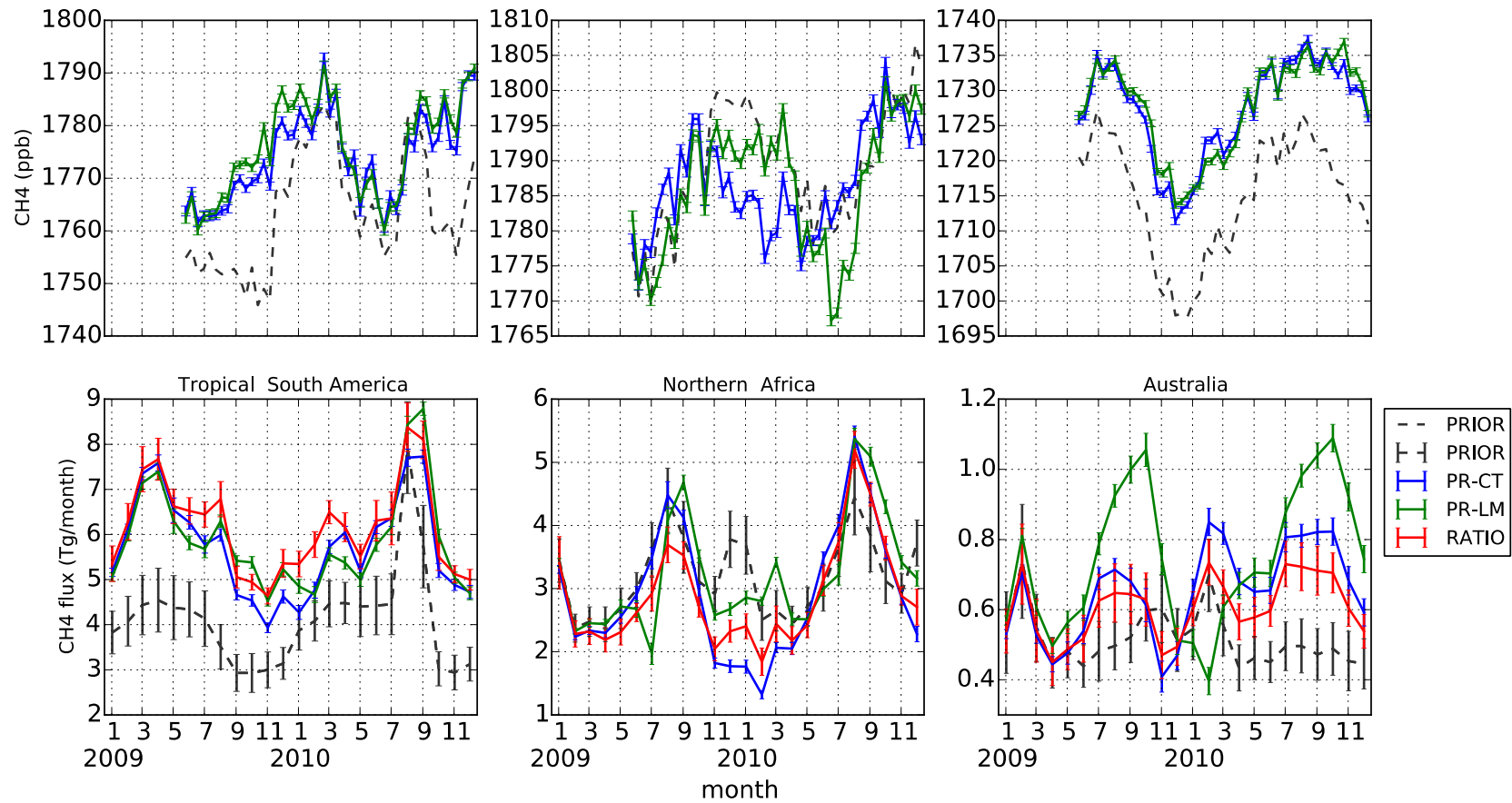
Monthly Fluxes



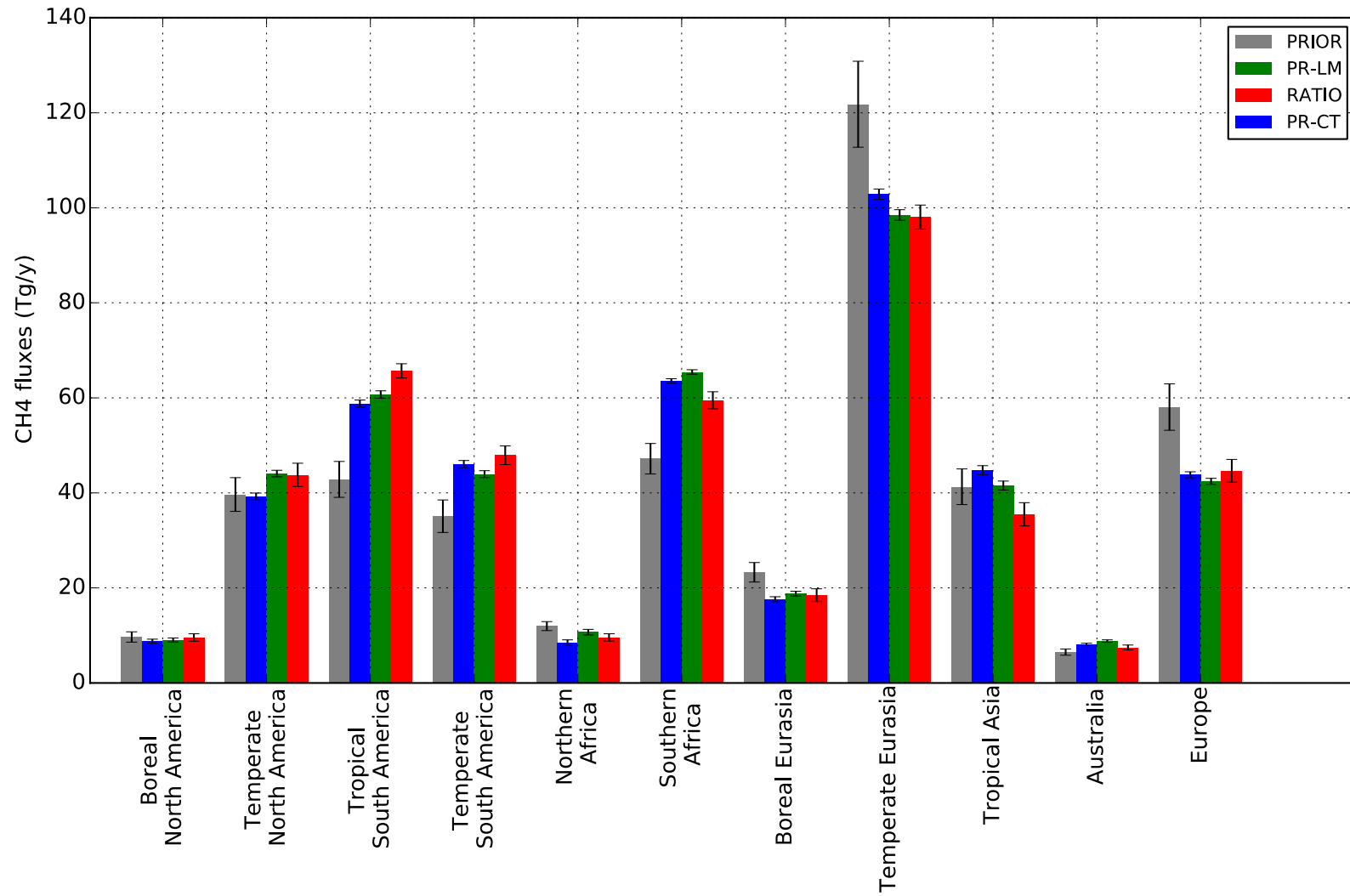
Monthly Fluxes



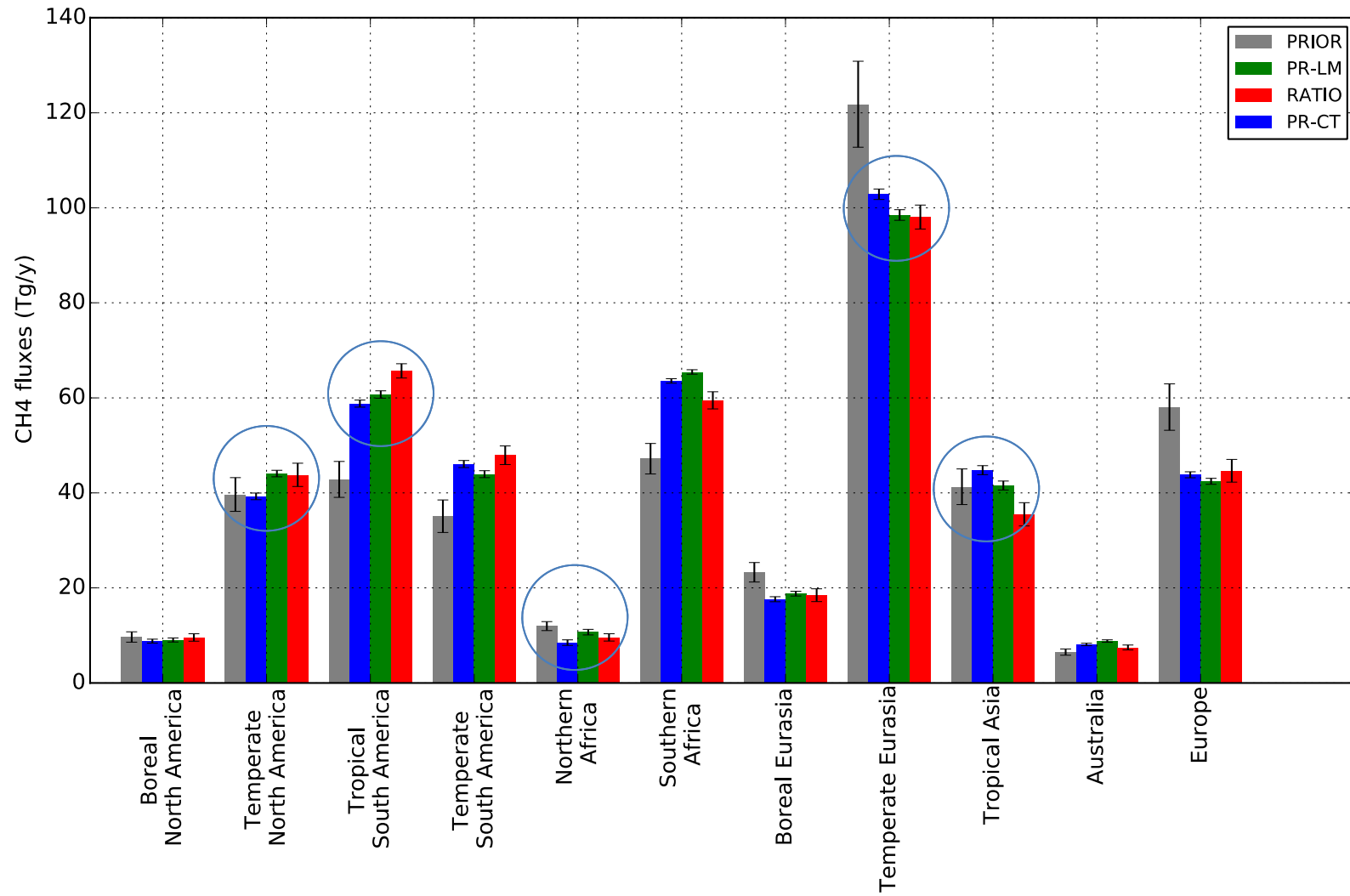
Monthly Fluxes



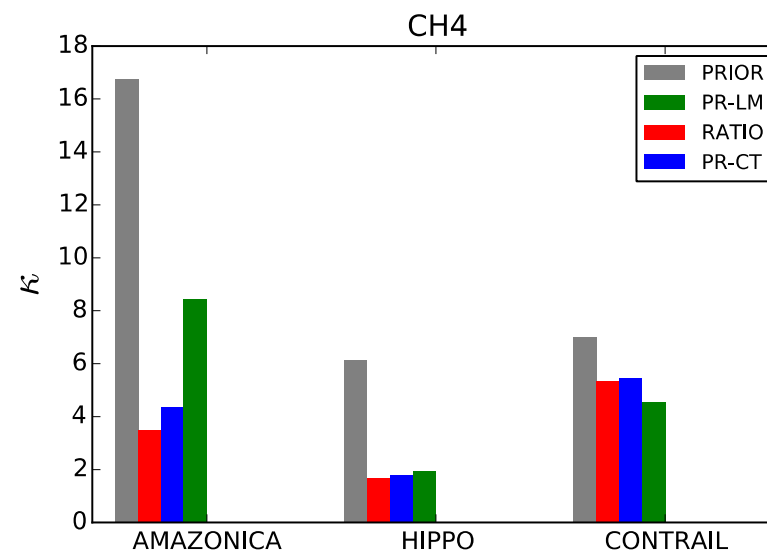
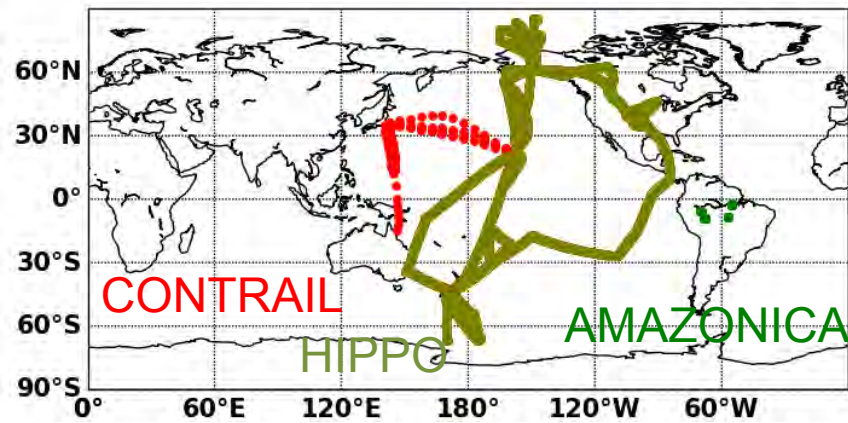
Annual Fluxes



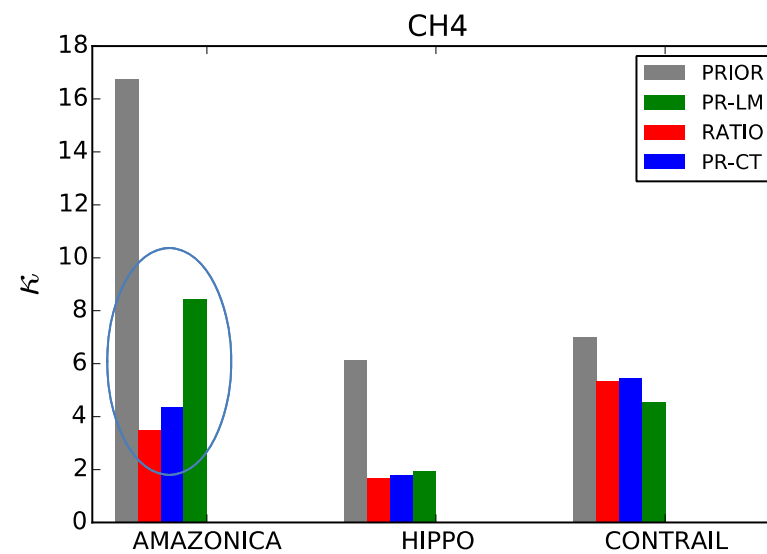
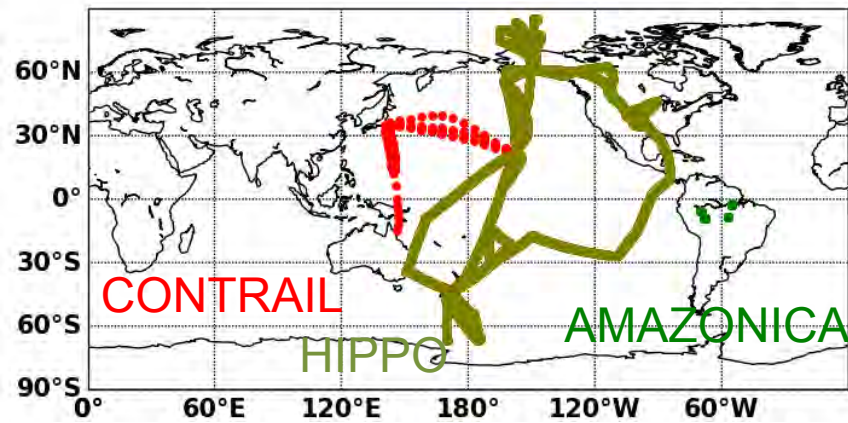
Annual Fluxes



Aircraft Validation



Aircraft Validation



Conclusions

- Model derived XCO₂ has systematic biases, which propagate to proxy XCH₄.
- We find a statistically significant impact of these biases on the inverted fluxes, especially in tropical regions.
- Ratio inversion method provides an alternative, where only the satellite measured information is used.
- Validation with aircraft measurements show that the ratio method performs better than the proxy method in Tropical South America.



Thank You

