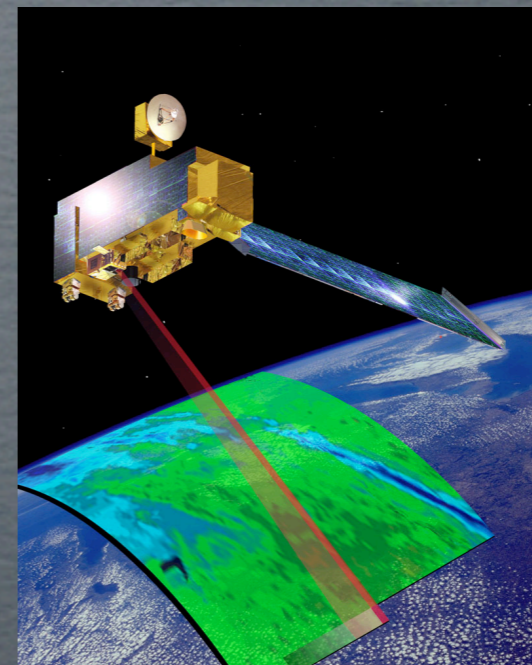


CO EMISSION ESTIMATES

STATIONS VS MOPITT



Pim Hooghiemstra & Maarten Krol
TM meeting May 30, 2011

WHY CO?

- ✱ CO is the main sink of OH
- ✱ CO IAV influences methane lifetime
- ✱ CO source strengths uncertain
- ✱ 4D-Var approach to optimize CO emission estimates

4D-VAR INGREDIENTS

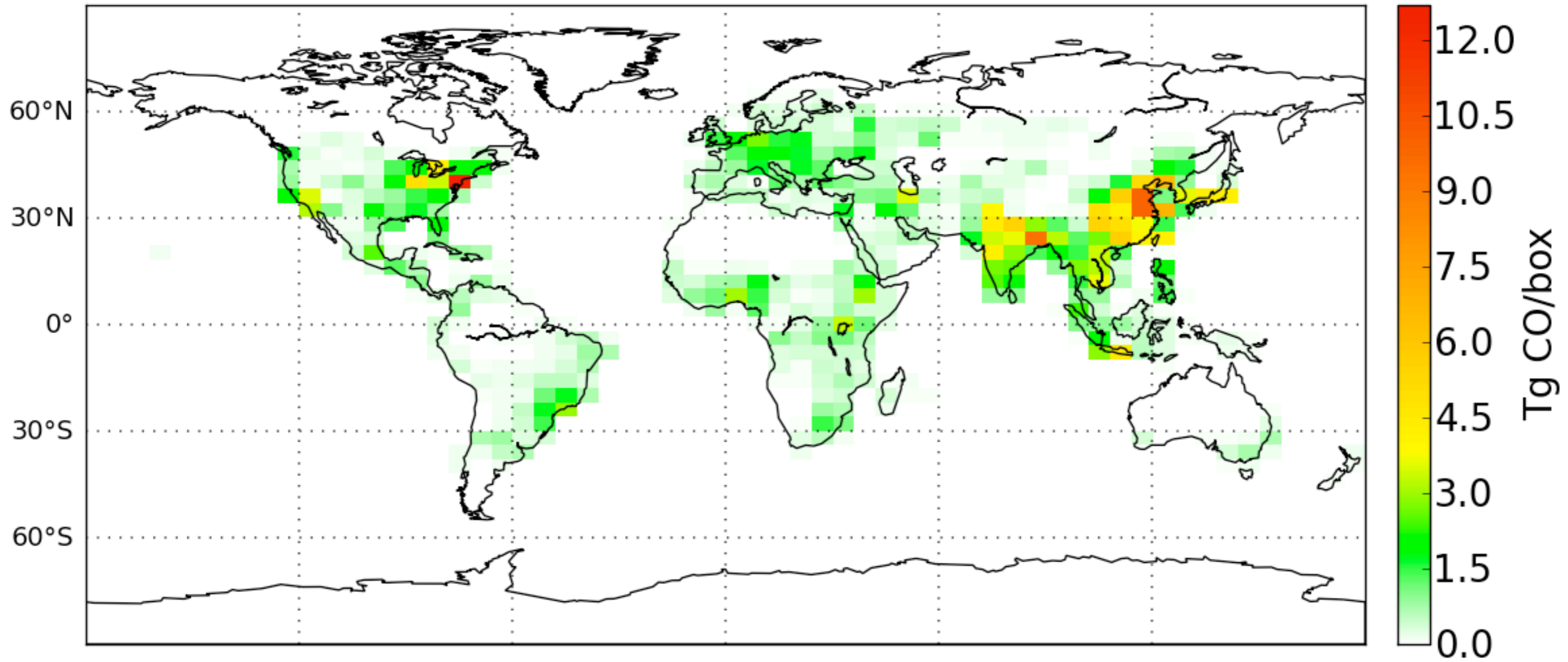
- ✻ Prior information from recent inventories
- ✻ Observations from NOAA surface network
- ✻ Satellite observations from MOPITT instrument
- ✻ TM5 model & adjoint

4D-VAR INGREDIENTS

- ✱ Prior information from recent inventories
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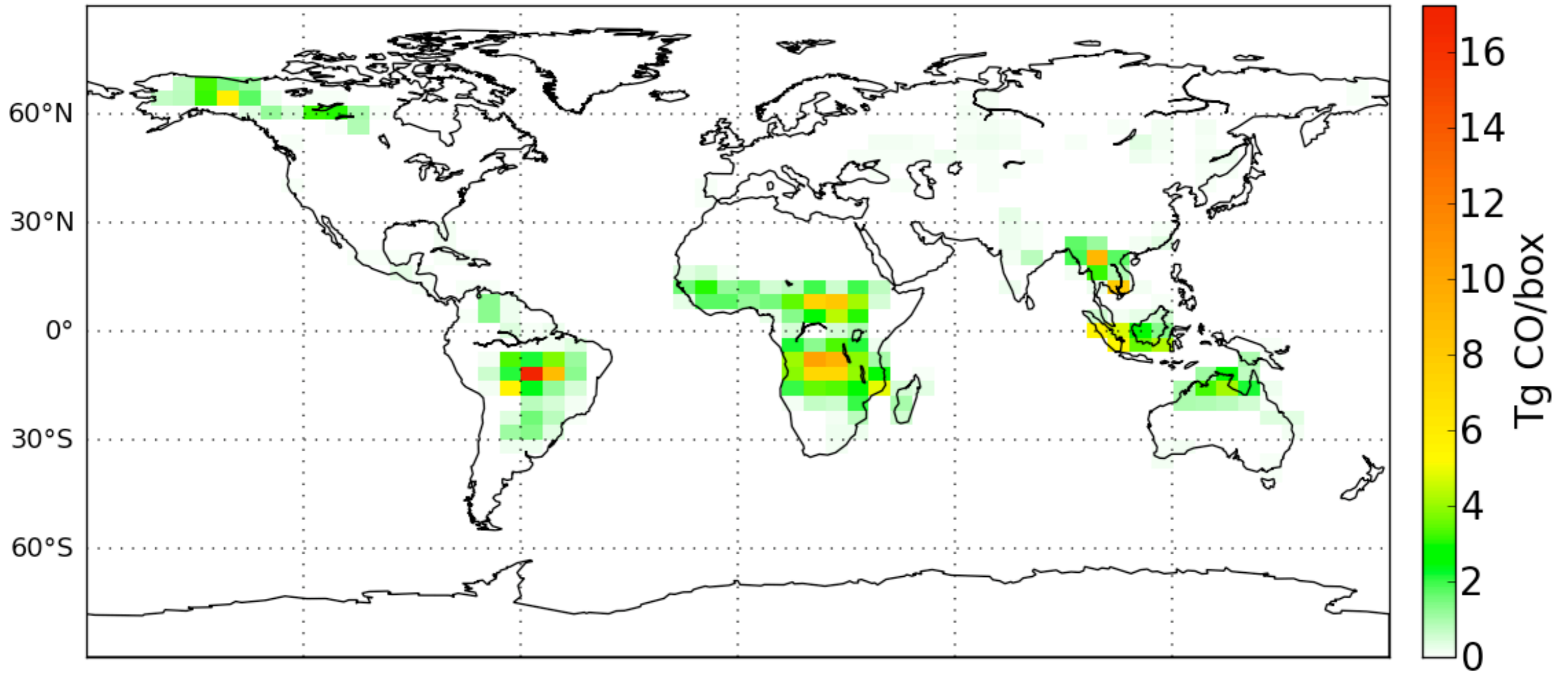
PRIOR EMISSIONS

EDGARv4 emissions 2004



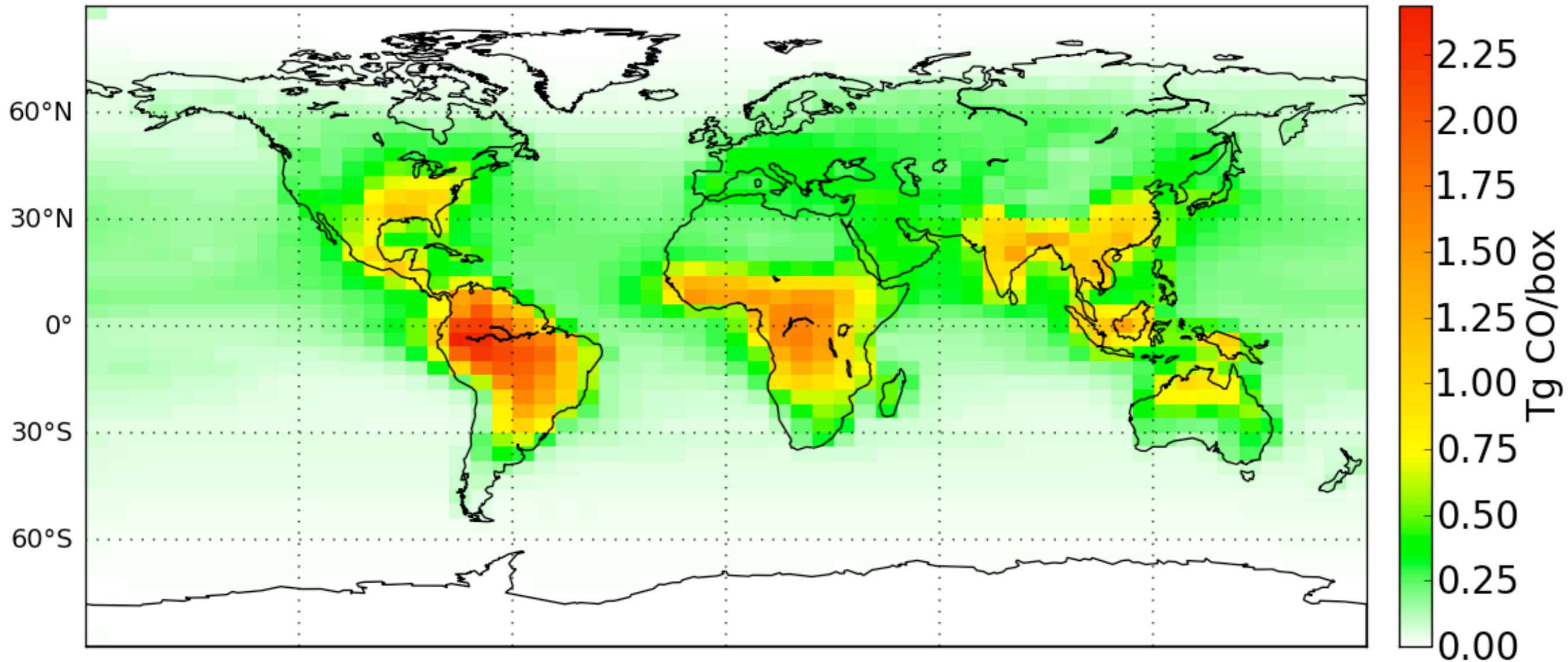
PRIOR EMISSIONS

GFEDv3 emissions 2004



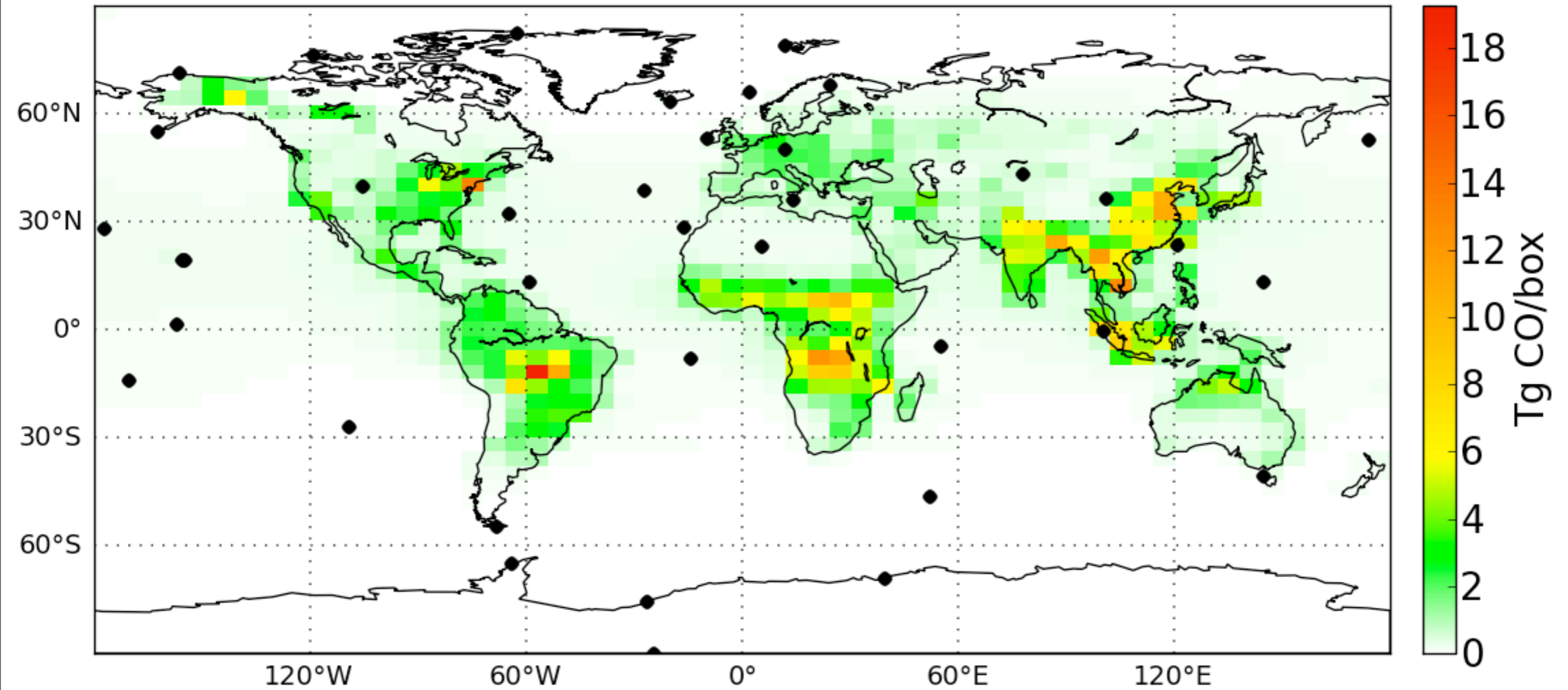
PRIOR EMISSIONS

natural+NMVOC emissions 2004



PRIOR EMISSIONS

Prior emissions 2004

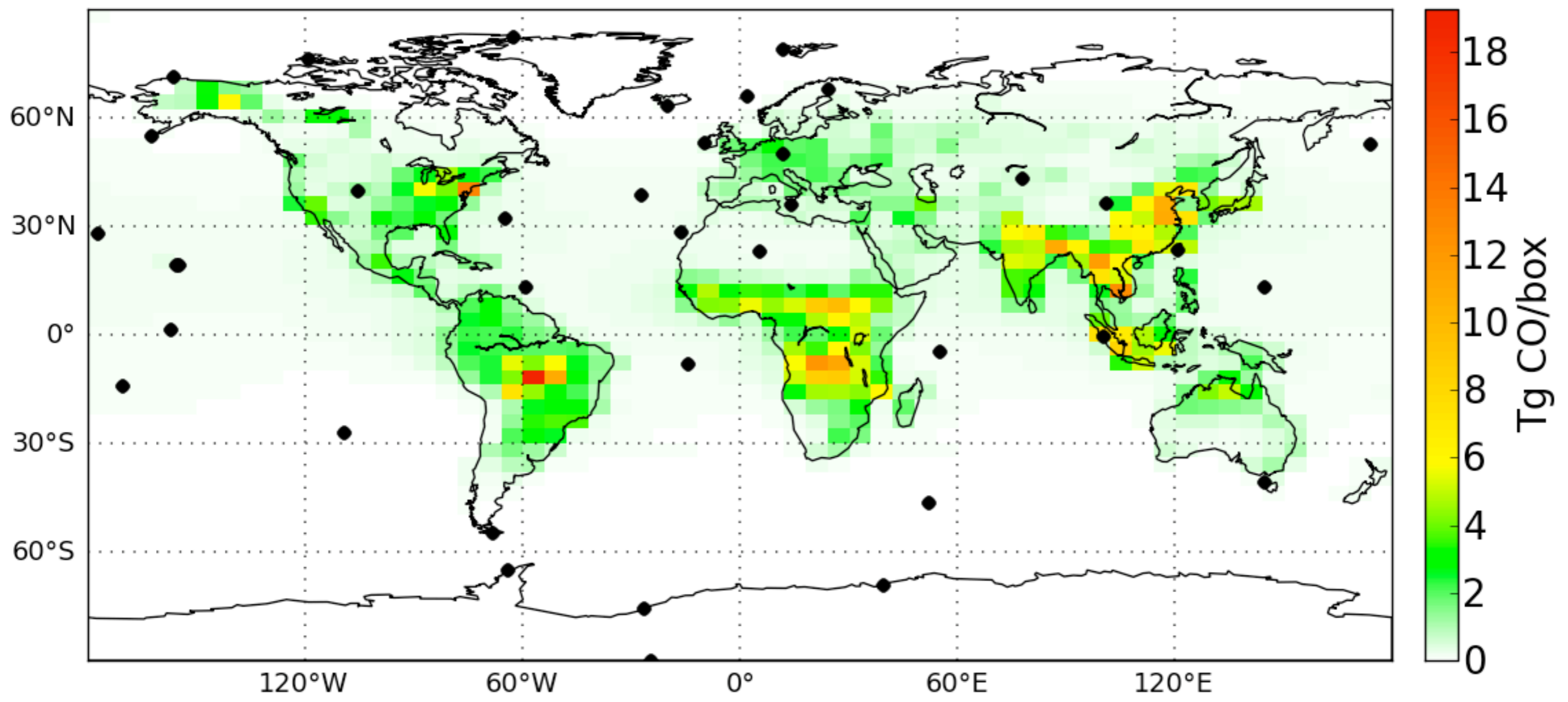


4D-VAR INGREDIENTS

- ✱ Prior information from recent inventories
- ✱ Observations from NOAA surface network
- ✱ Satellite observations from MOPITT instrument
- ✱ TM5 model & adjoint

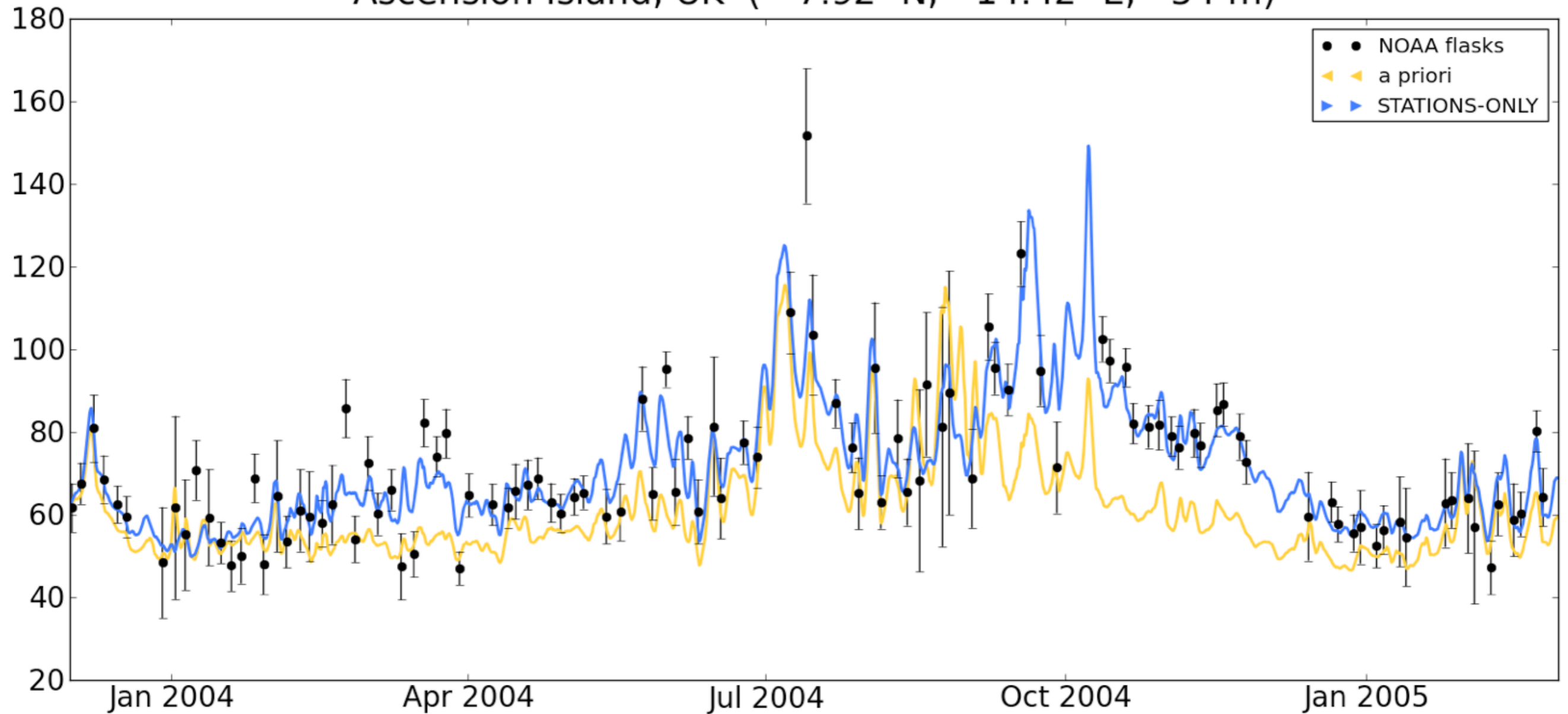
NOAA OBSERVATIONS

Prior emissions 2004



NOAA OBSERVATIONS

Ascension Island, UK (-7.92° N, -14.42° E, 54 m)

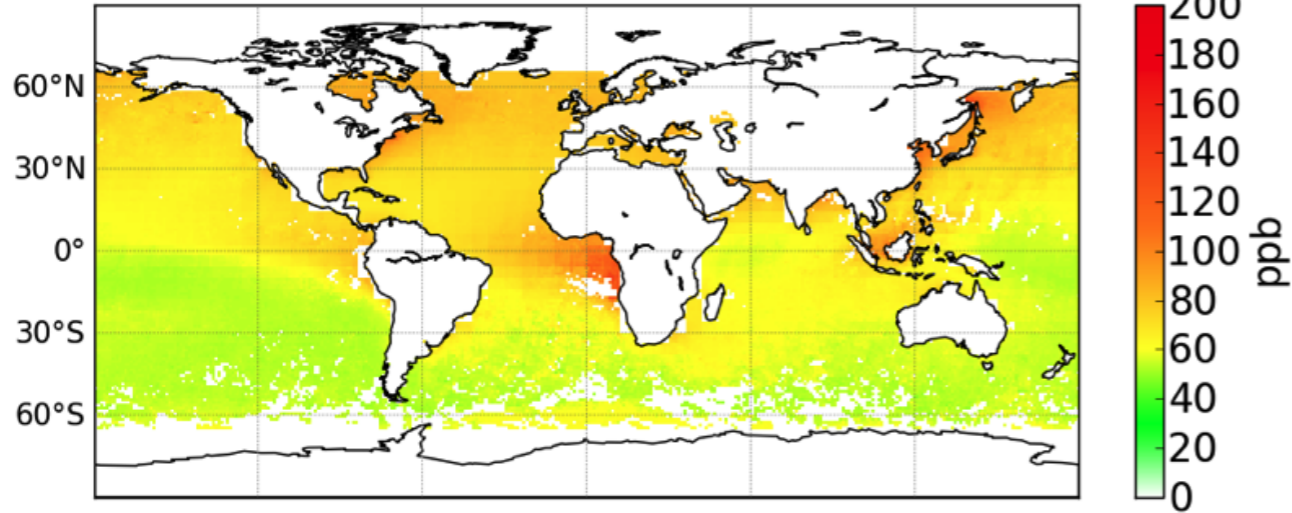


4D-VAR INGREDIENTS

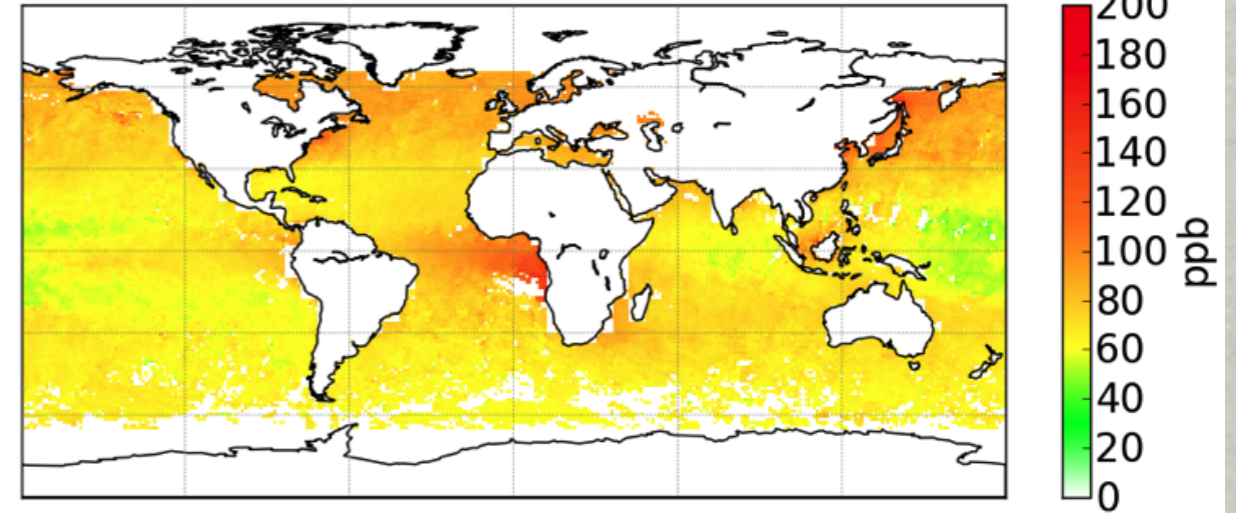
- ✻ Prior information from recent inventories
- ✻ Observations from NOAA surface network
- ✻ **Satellite observations from MOPITT
instrument**
- ✻ TM5 model & adjoint

MOPITT OBSERVATIONS

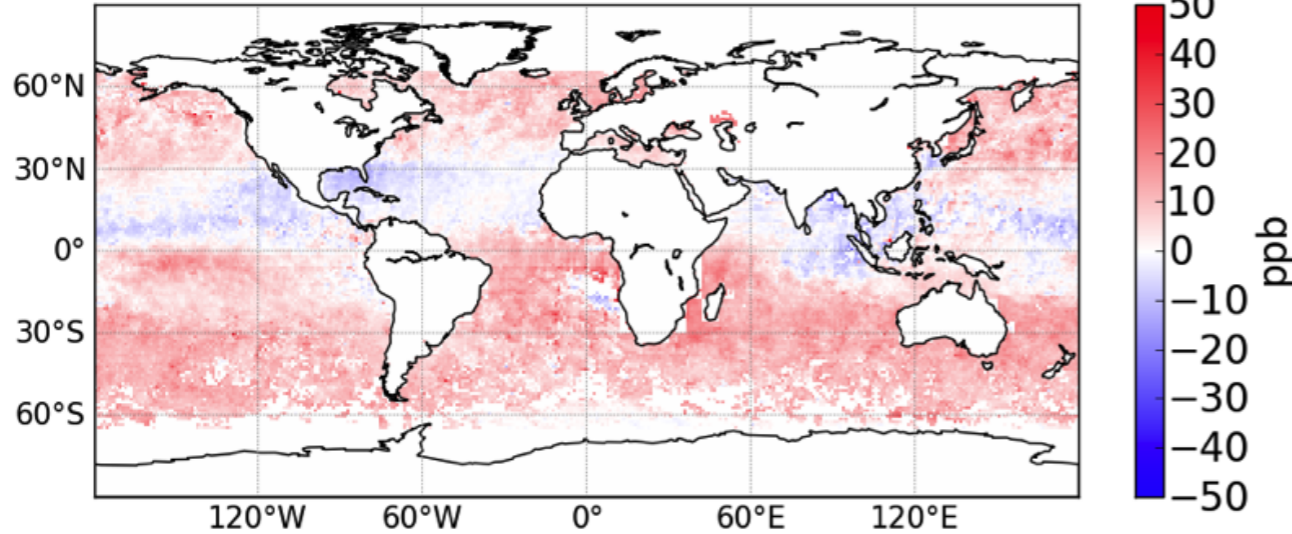
A priori modeled total column 200408



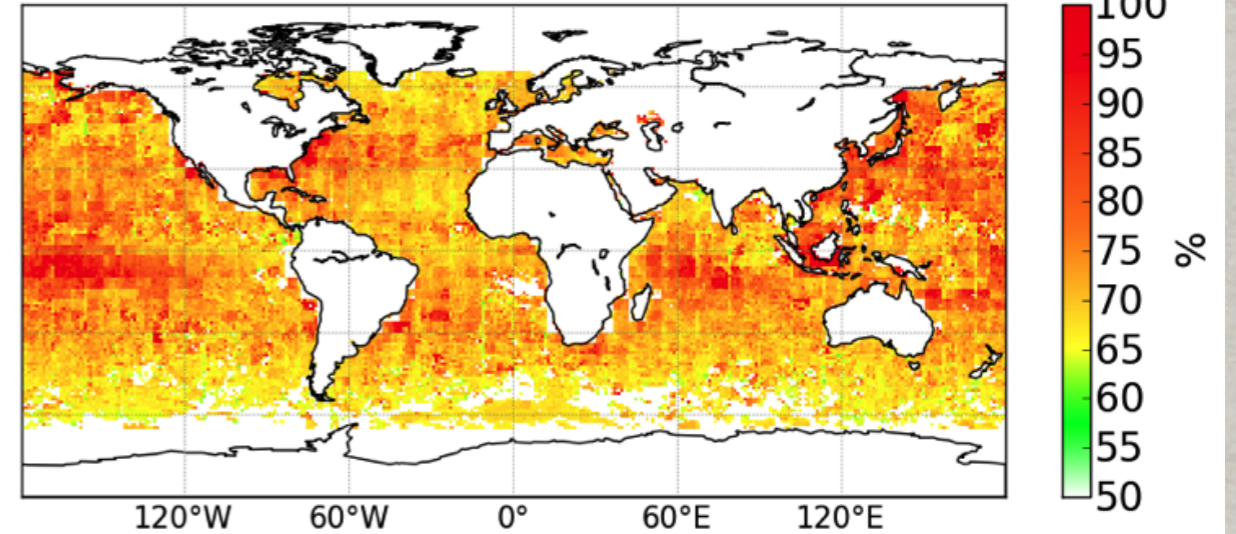
Observed modeled total column 200408



Observed - modeled total column 200408

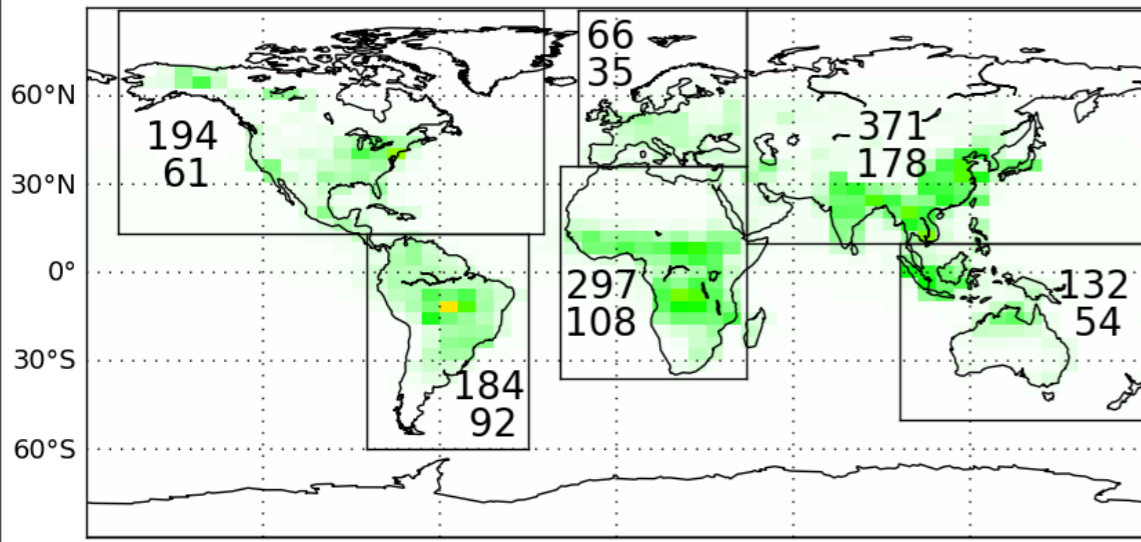


Error modeled total column 200408

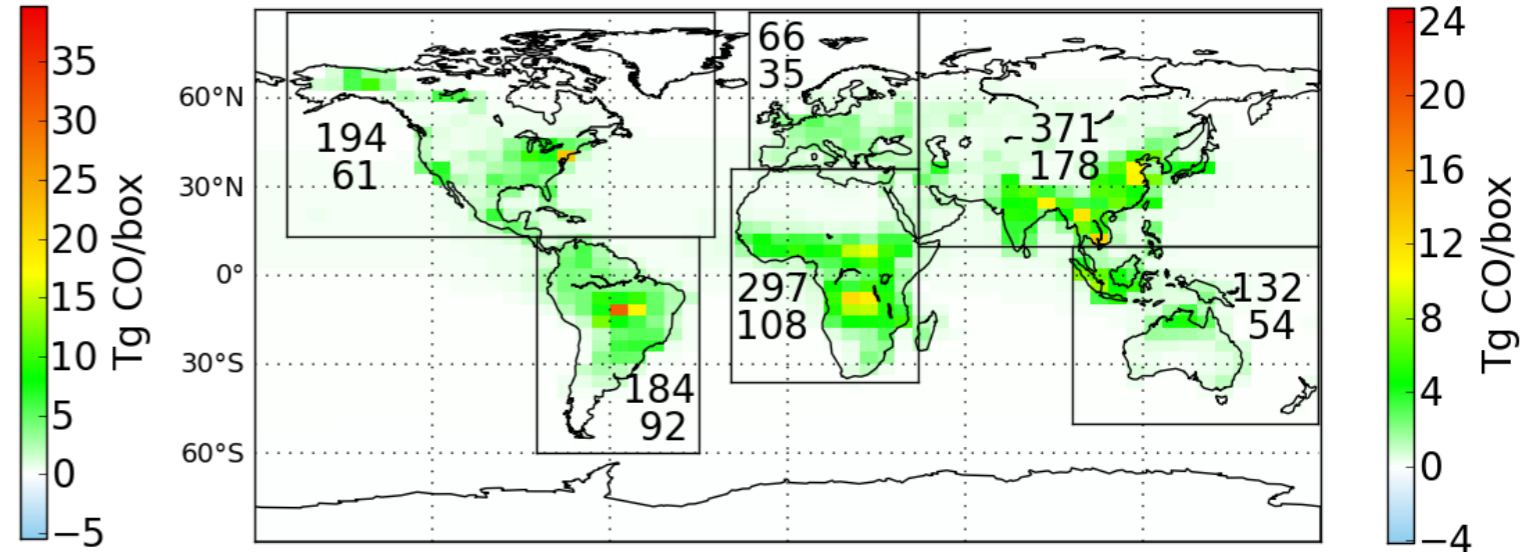


EMISSION INCREMENTS

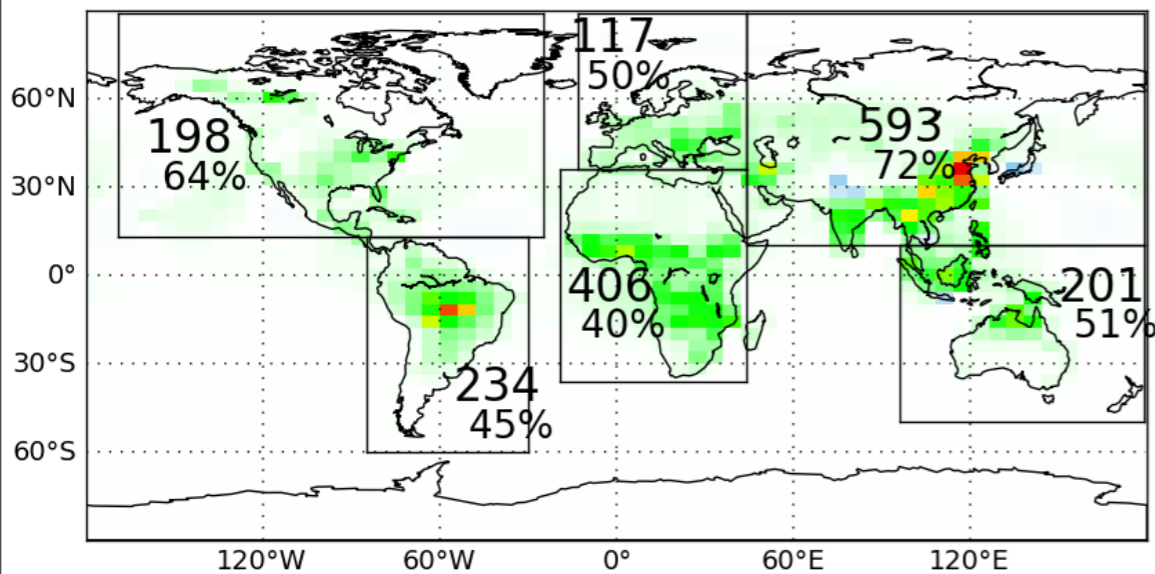
STATIONS-only
Starting emissions 2004



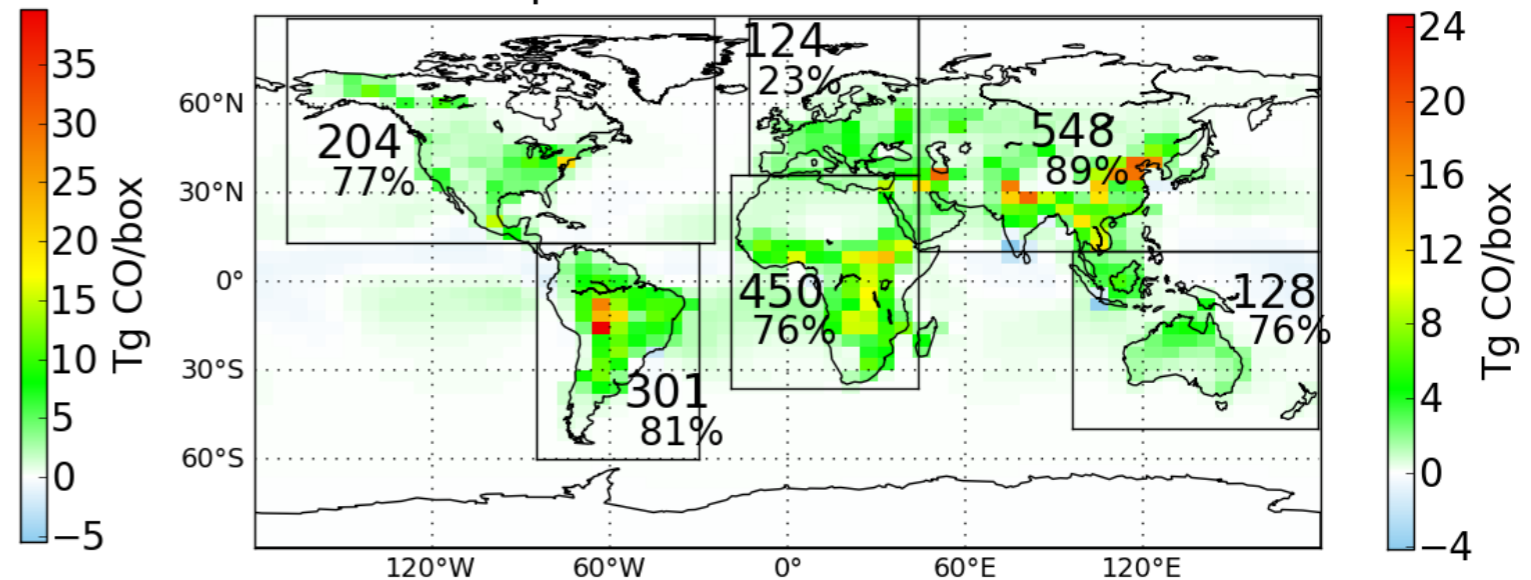
MOPITT-only
Starting emissions 2004



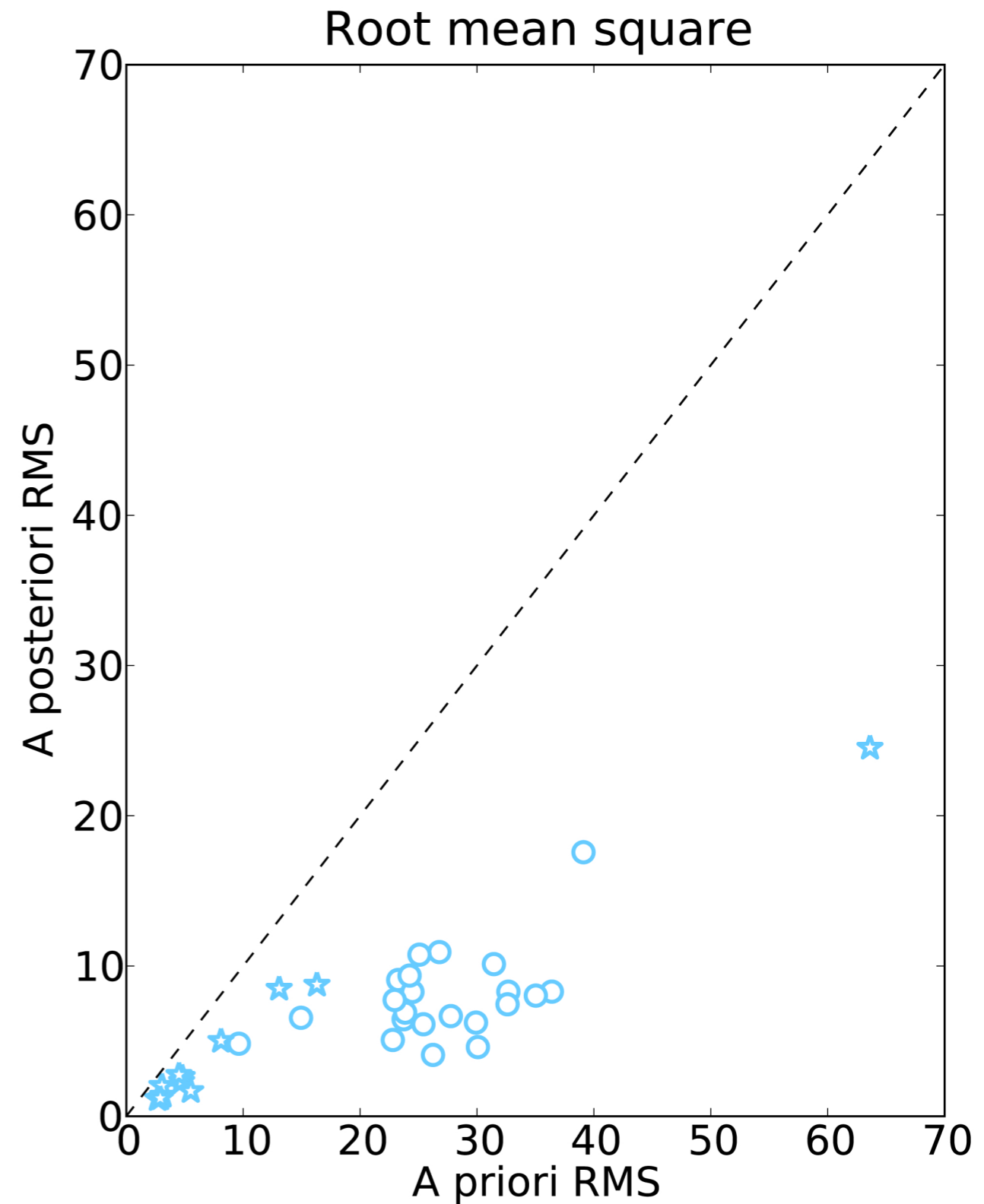
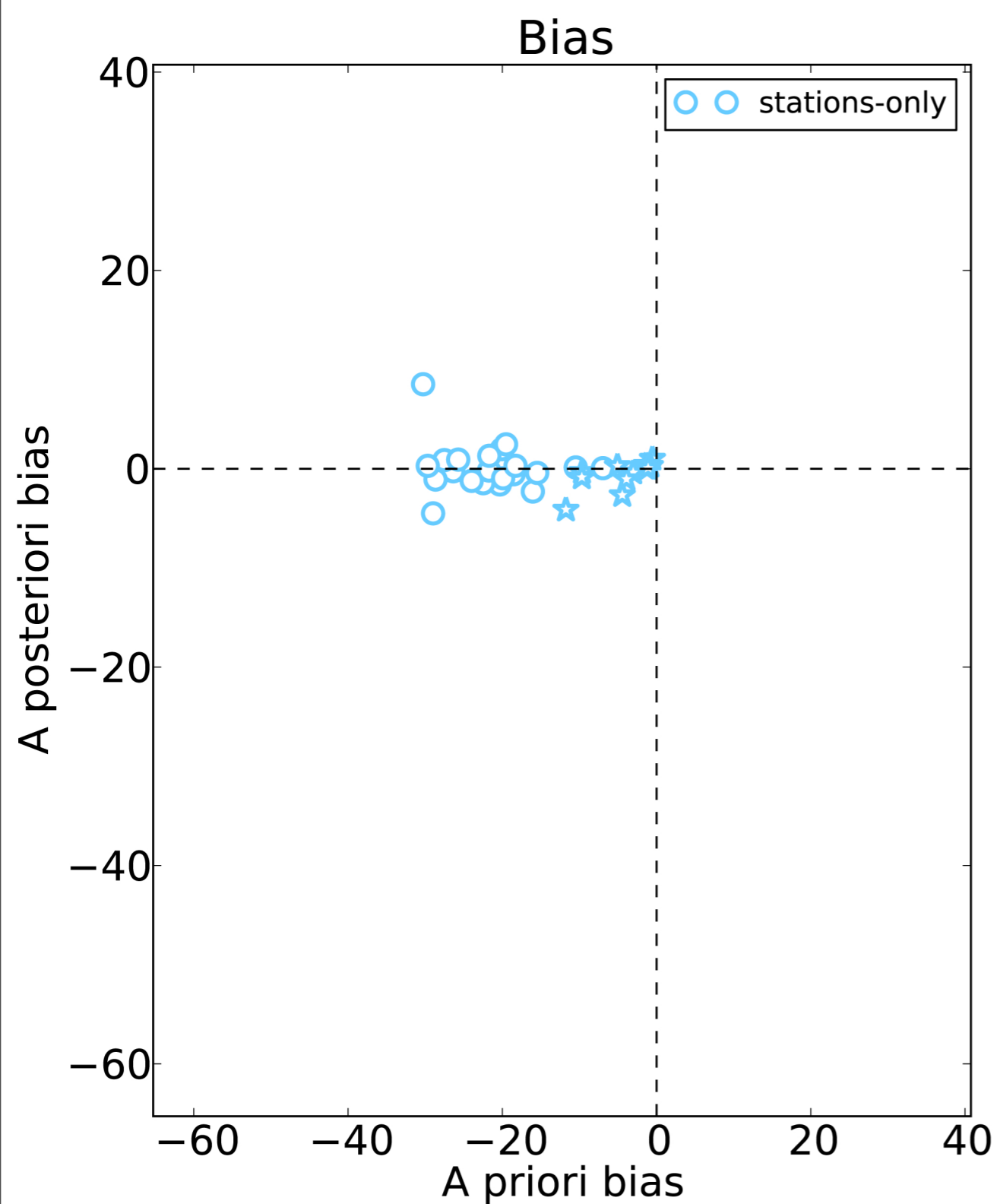
Optimized emissions 2004



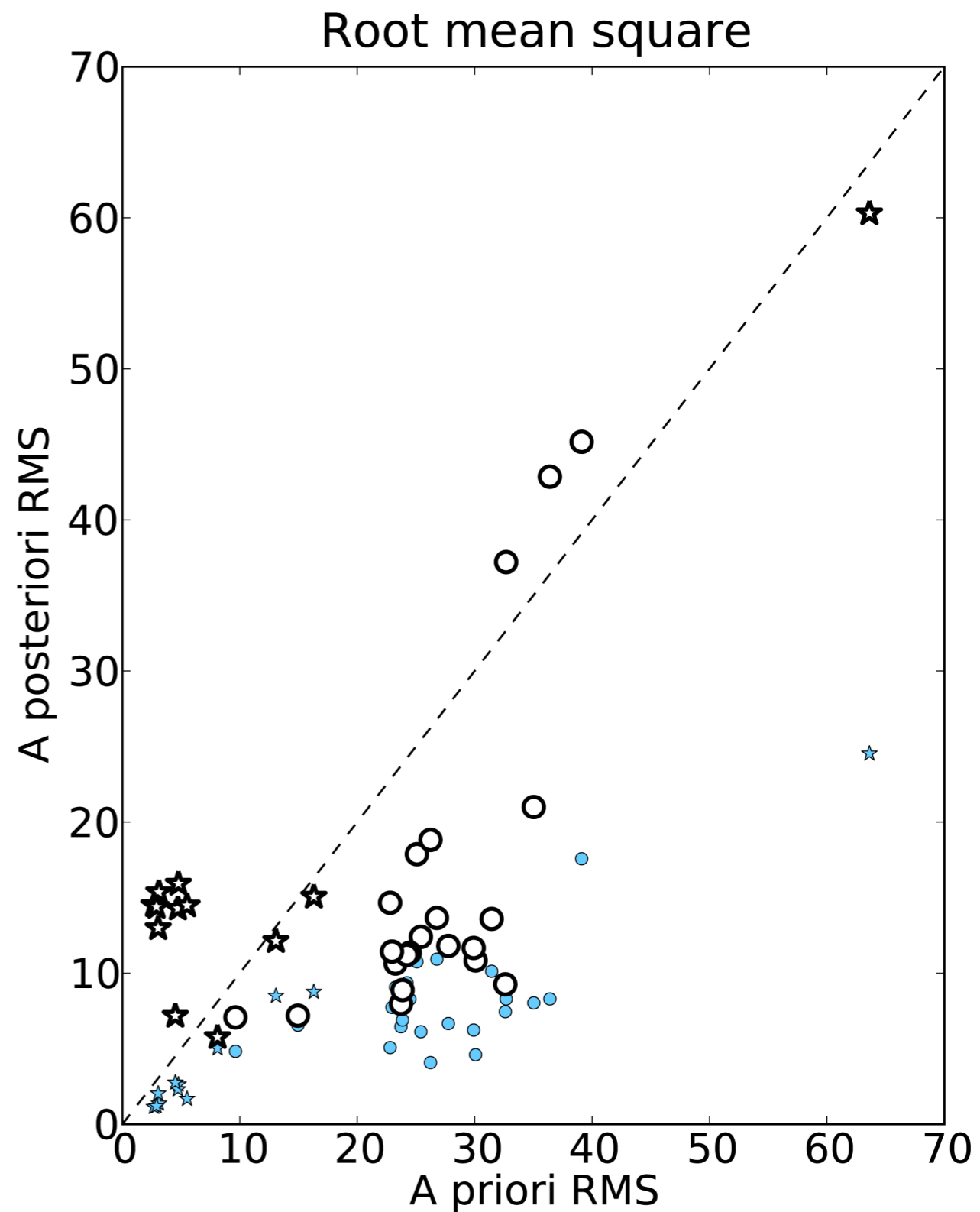
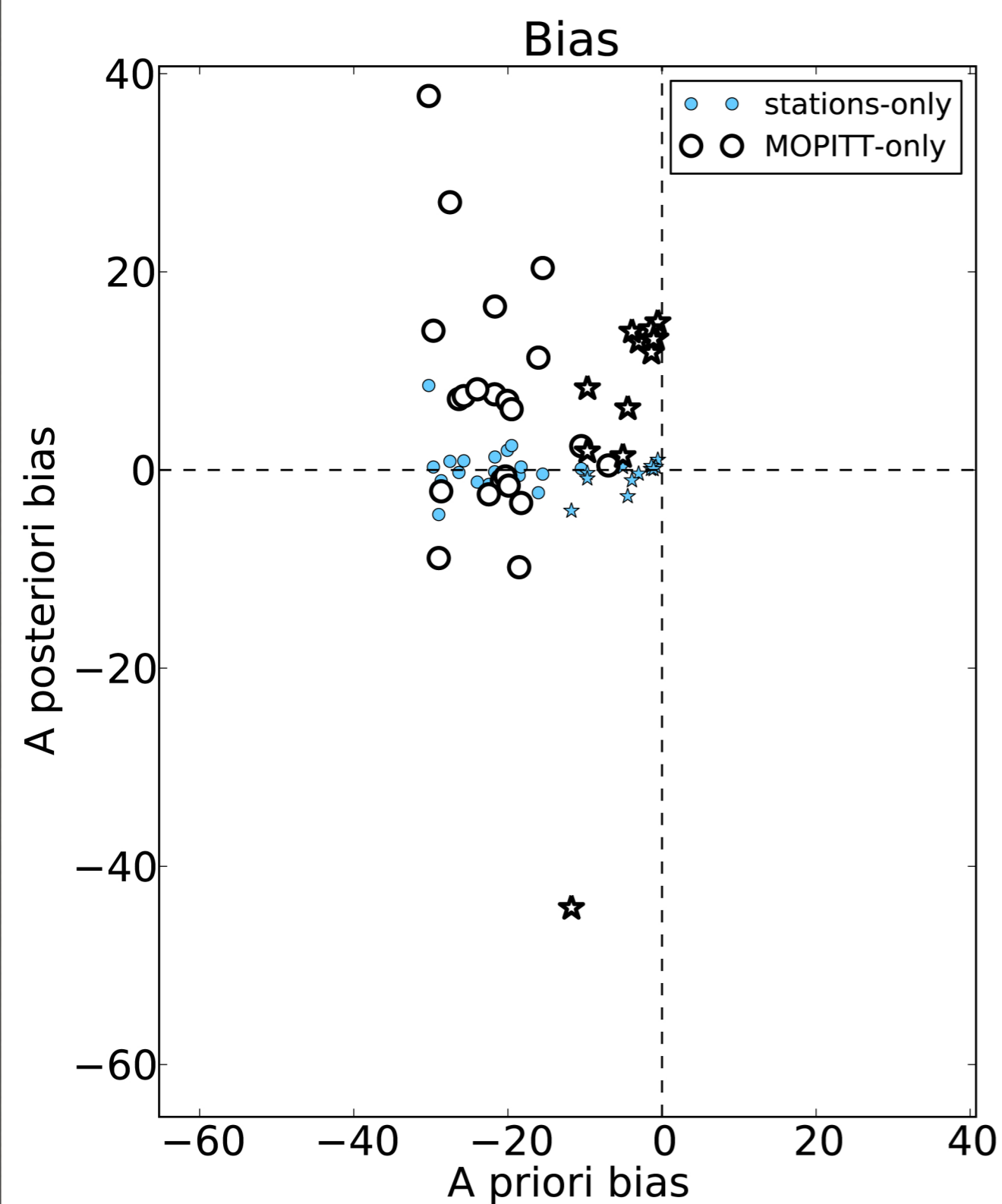
Optimized emissions 2004



FIT ON STATIONS...



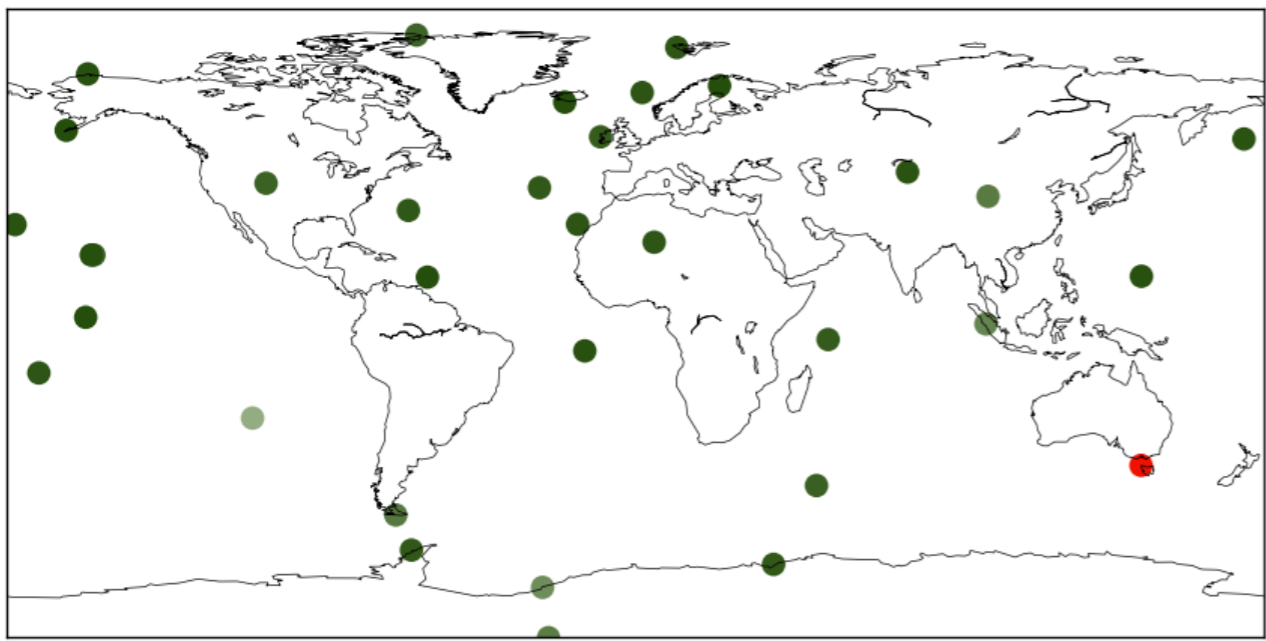
FIT ON STATIONS...



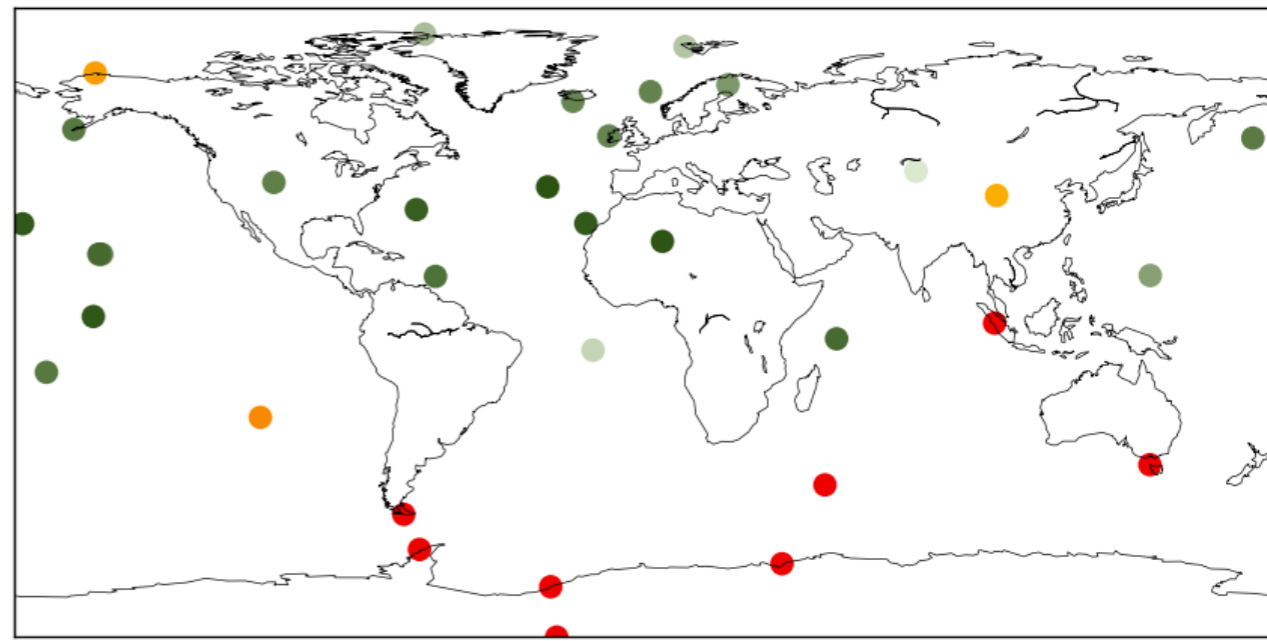
STATIONS

MOPITT

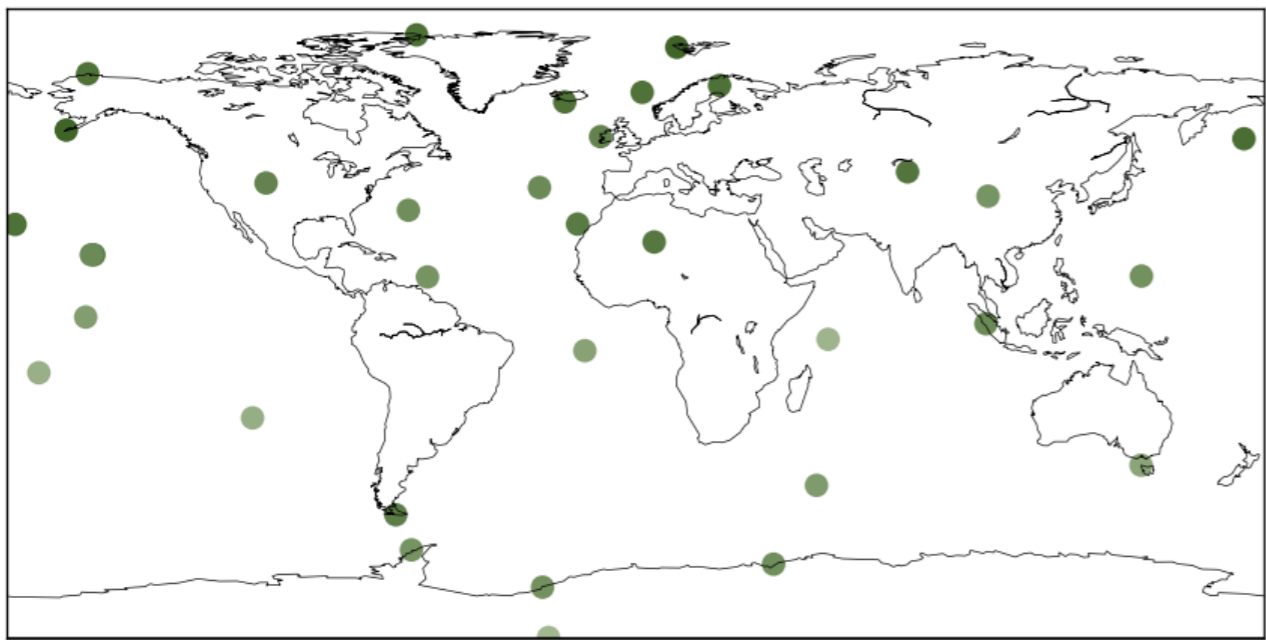
Ratio bias-apos/bias-apri



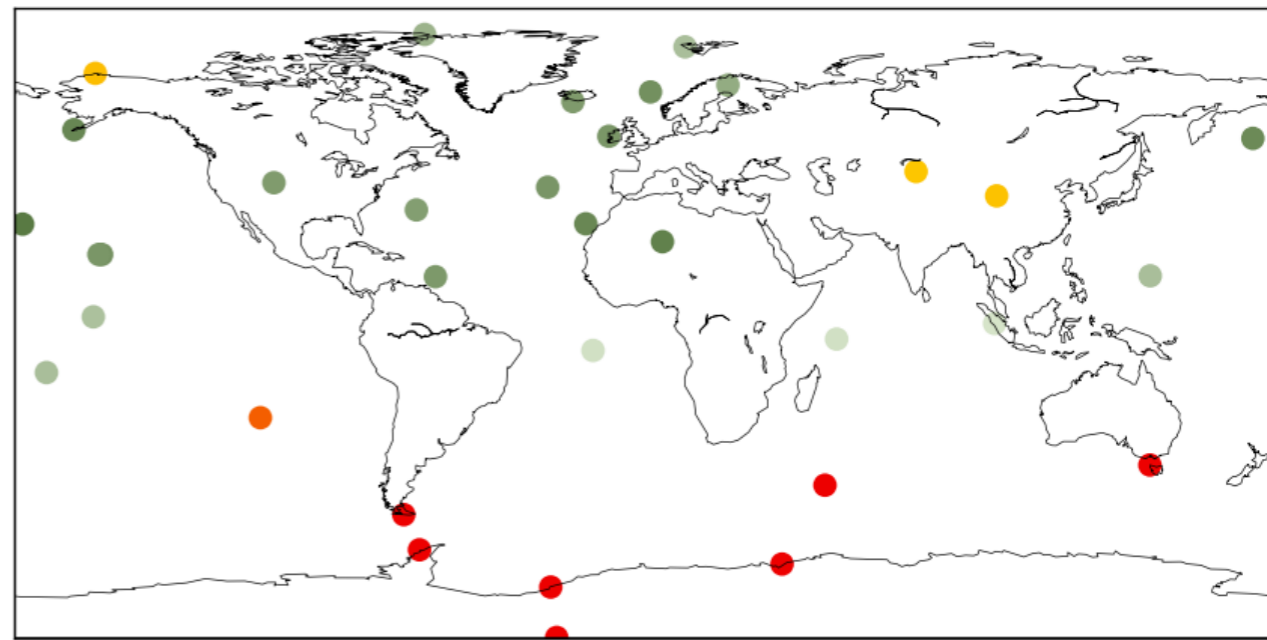
Ratio bias-apos/bias-apri



Ratio RMS-apos/RMS-apri



Ratio RMS-apos/RMS-apri



0.0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0

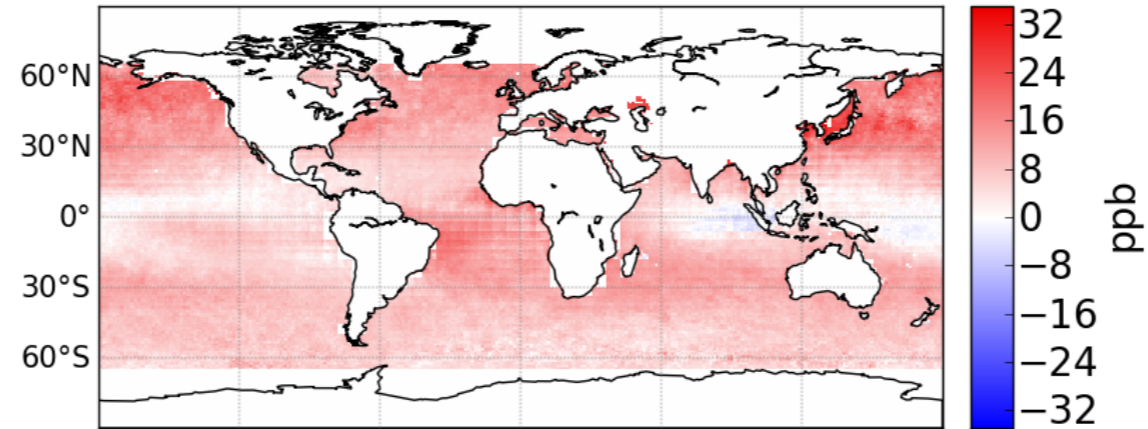
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0.0 0.2 0.4 0.6 0.8 1.0 1.2 1.4 1.6 1.8 2.0

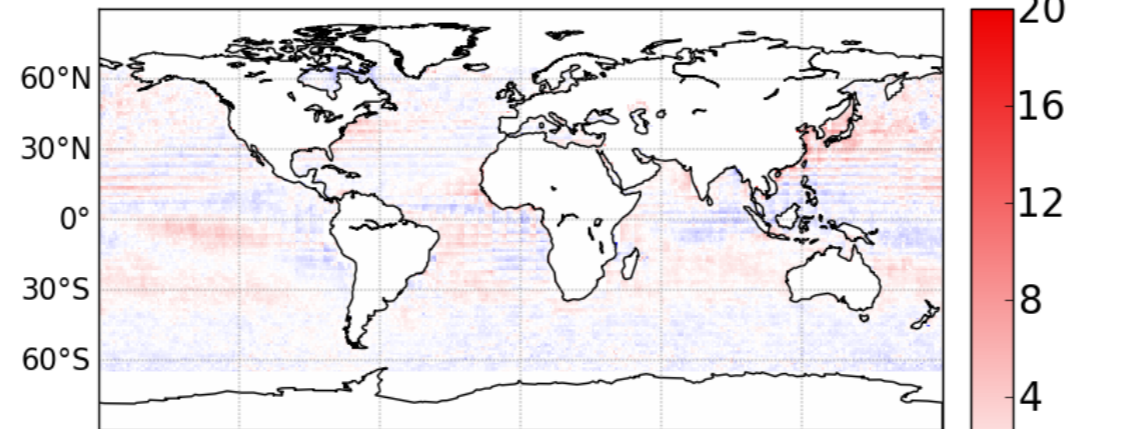
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FIT WITH MOPITT

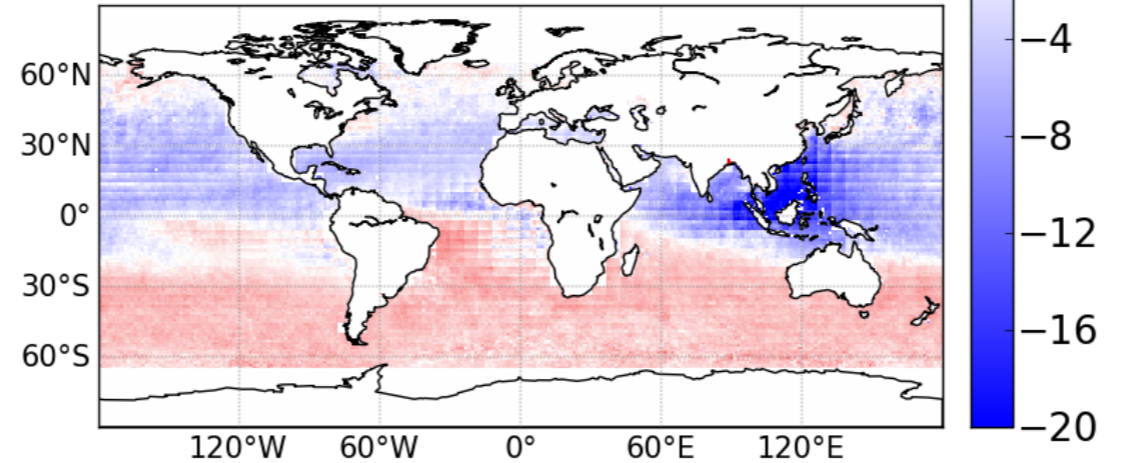
A priori: MOPITT - TM5



A posteriori: MOPITT - TM5(mopitt)

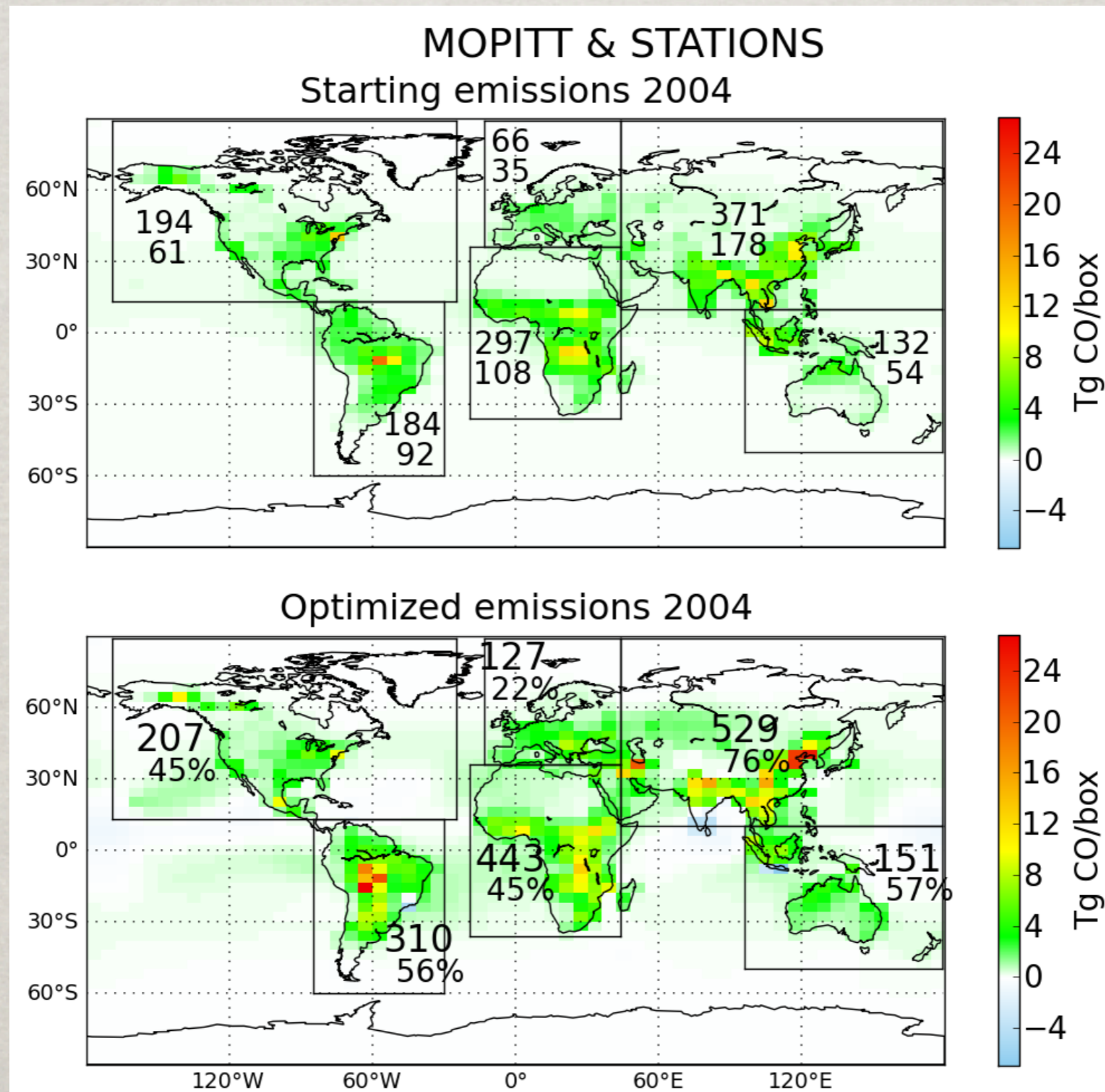


A Posteriori: MOPITT - TM5(stations)

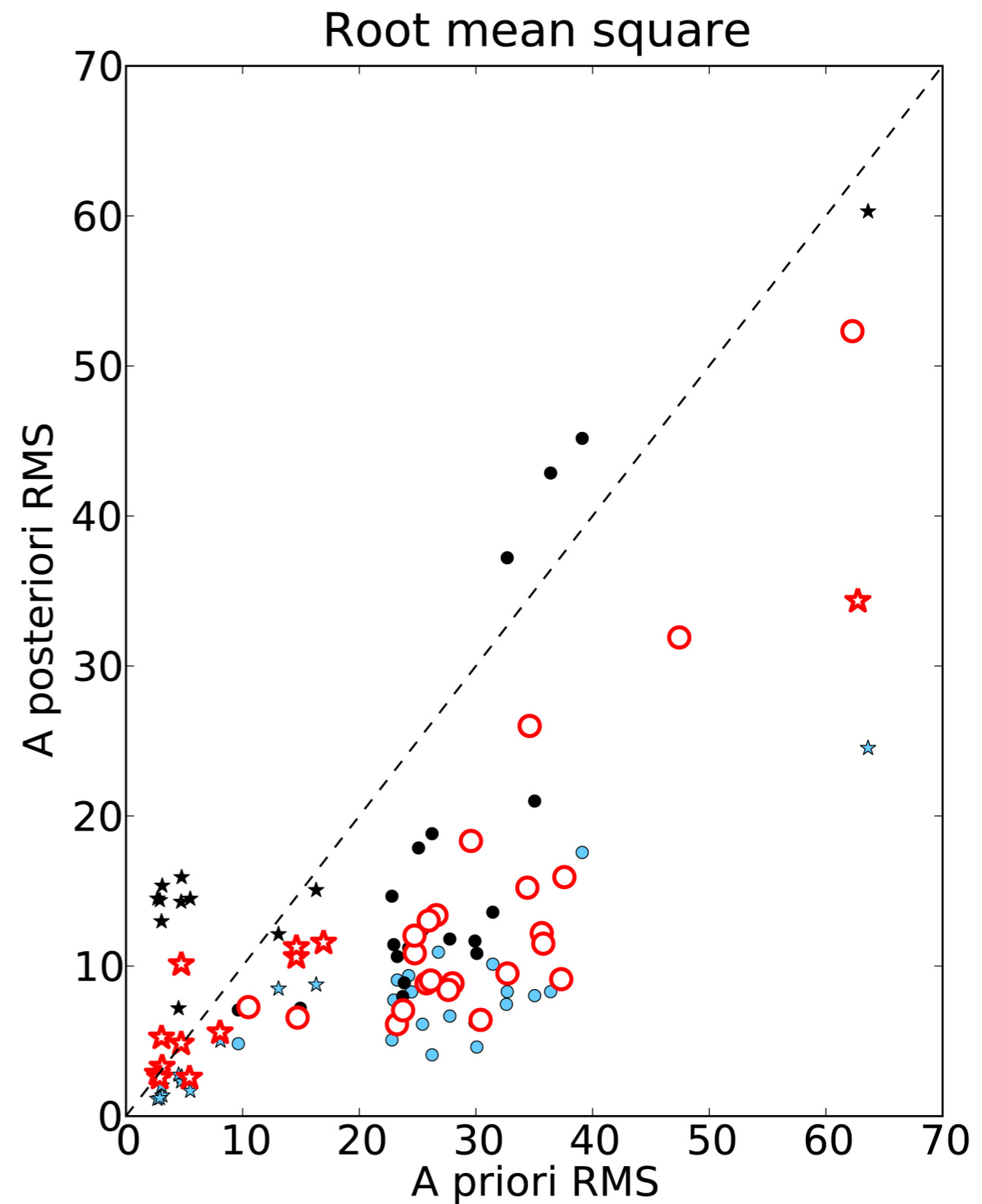
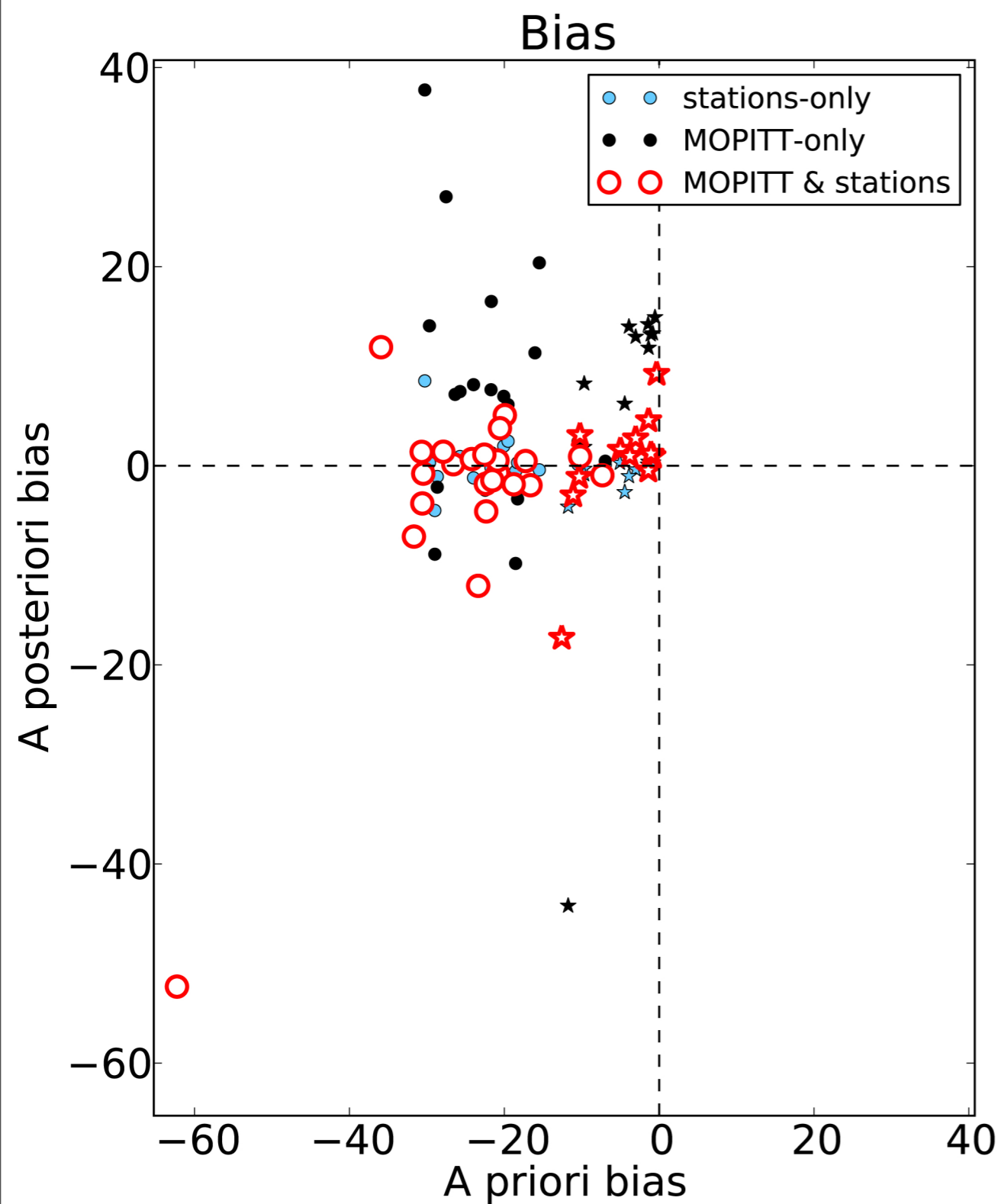


MOPITT & STATIONS

BEST OF BOTH WORLDS?

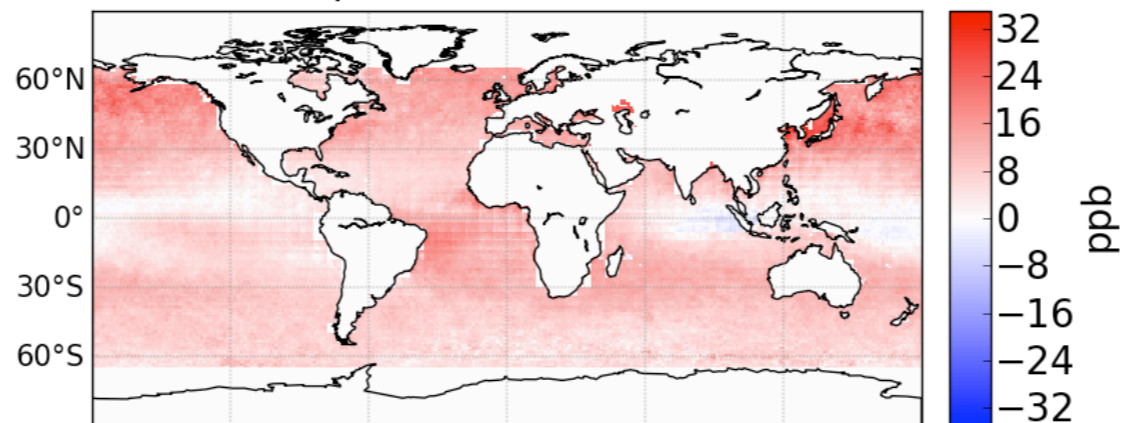


FIT ON STATIONS

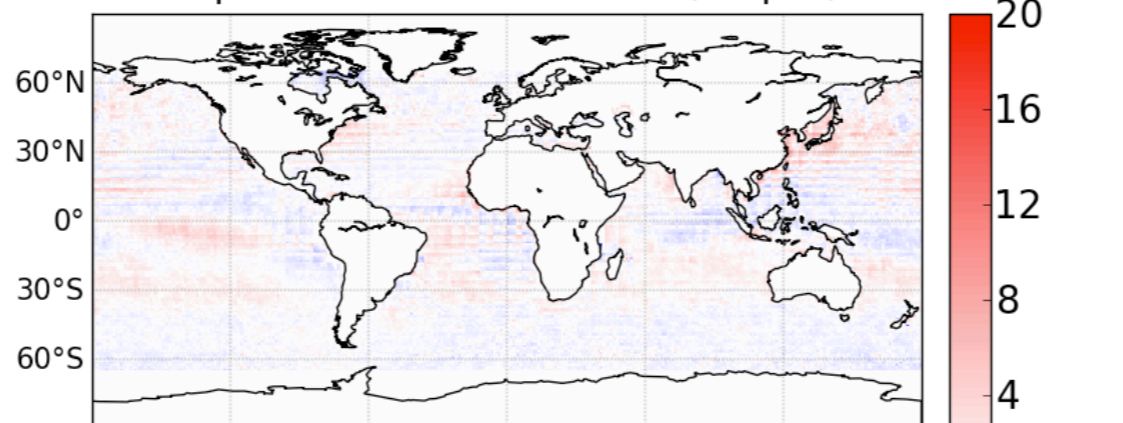


FIT WITH MOPITT

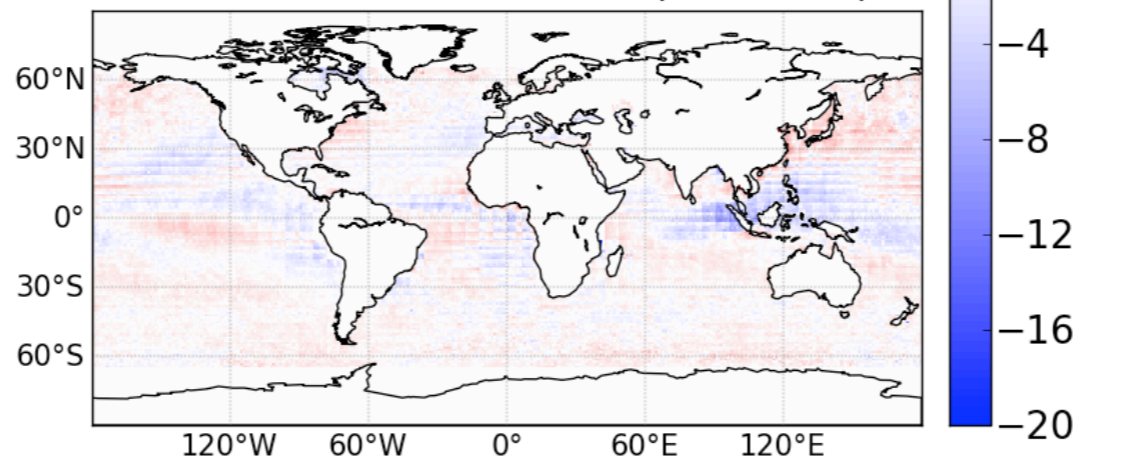
A priori: MOPITT - TM5



A posteriori: MOPITT - TM5(mopitt)



A Posteriori: MOPITT - TM5(combined)



CONCLUSIONS

- ✱ 4D-Var system ready for satellite observations
- ✱ Station inversion works well for NH, SH not well-constrained, but fit with MOPITT gets worse
- ✱ MOPITT inversion largely reduces emission uncertainties over SH, but fit with stations deteriorates
- ✱ Combined assimilation uses the best of both worlds

THANKS TO

☀ Sourish Basu

☀ NOAA team (P. Novelli)

☀ MOPITT team (M. Deeter)