Overview and analysis of ACOS B3.4 XCO2

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B3.4 Features

- Spans ~ 4 years (June 2009 – May 2013)
  - *Uses Uniform Level-1B dataset as input (GOSAT v150)*
- Includes retrievals in Land gain H, Land gain M, ocean glint.
- Fits explicitly for chlorophyll fluorescence in land gain H.
- ~500k soundings over 4 years:
  - 49% Ocean
  - 34% land gain H
  - 17% land gain M

Post-processing

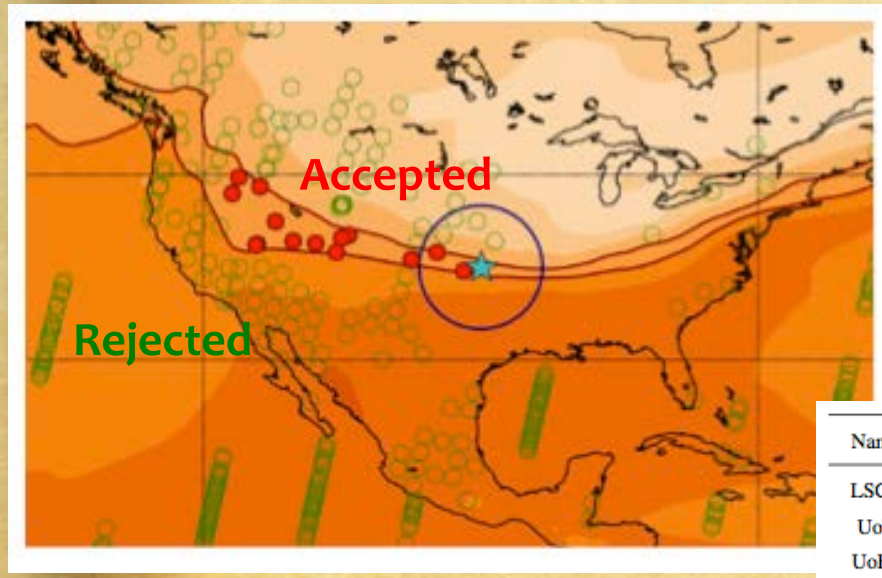
- Filters & Bias-correction developed for all modes (land gain H, land gain M, glint)
- Filters use several retrieved quantities
- Bias correction uses 2 parameters for land gain H and ocean-glint; 1 parameter for land gain M.
- Now providing rough uncertainties on bias-correction coefficients and overall mean bias.

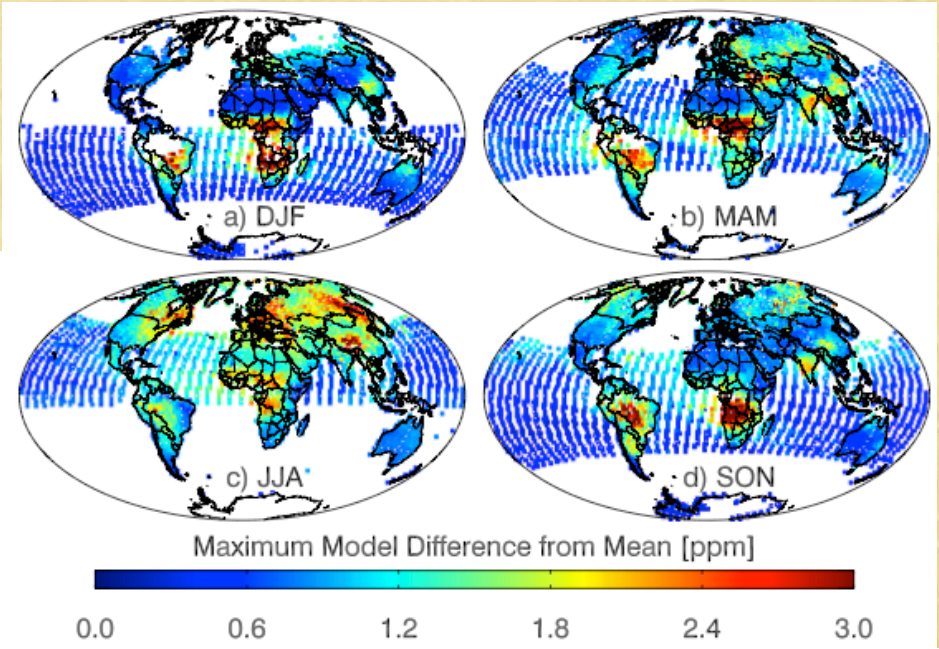
Two Truth Proxies: TCCON & Models

Models: Match to ACOS soundings
All agree to within ~1 ppm
Take model mean

TCCON: SRON/KIT/BASU Colocation

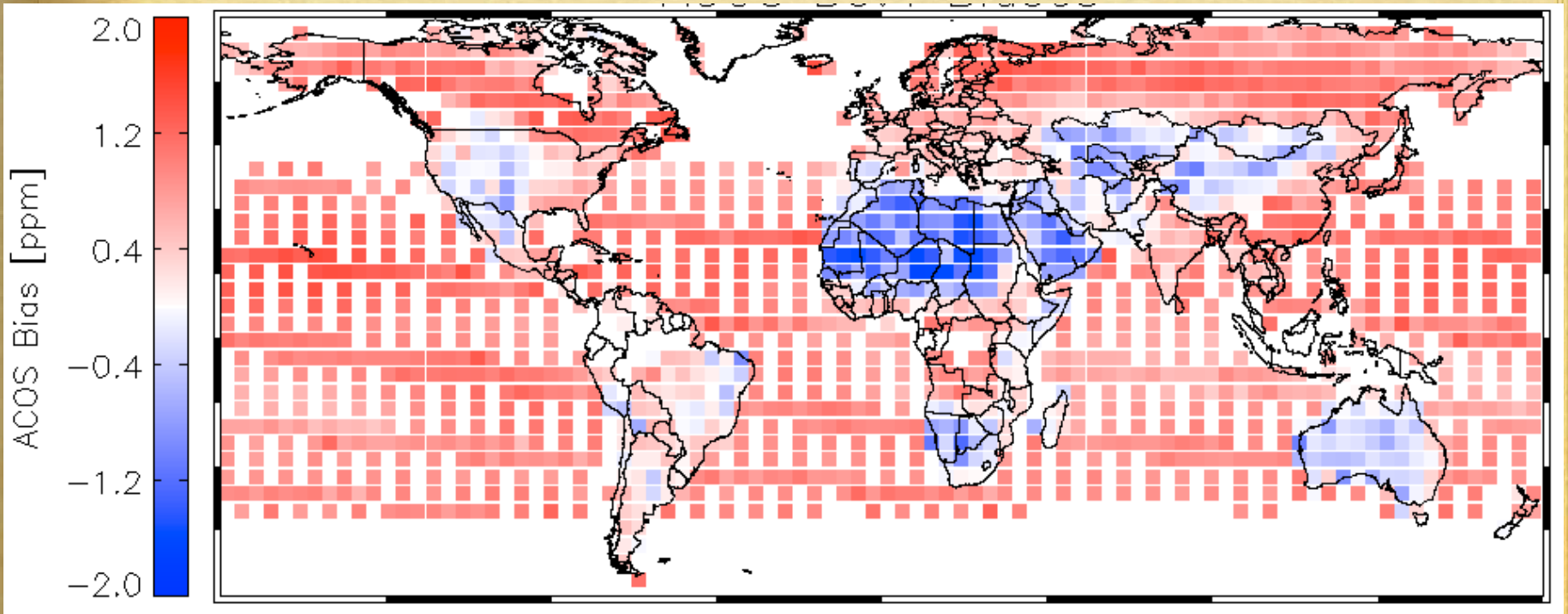
- Described in Guerlet et al., 2013
- Yields larger number of accurate colocations





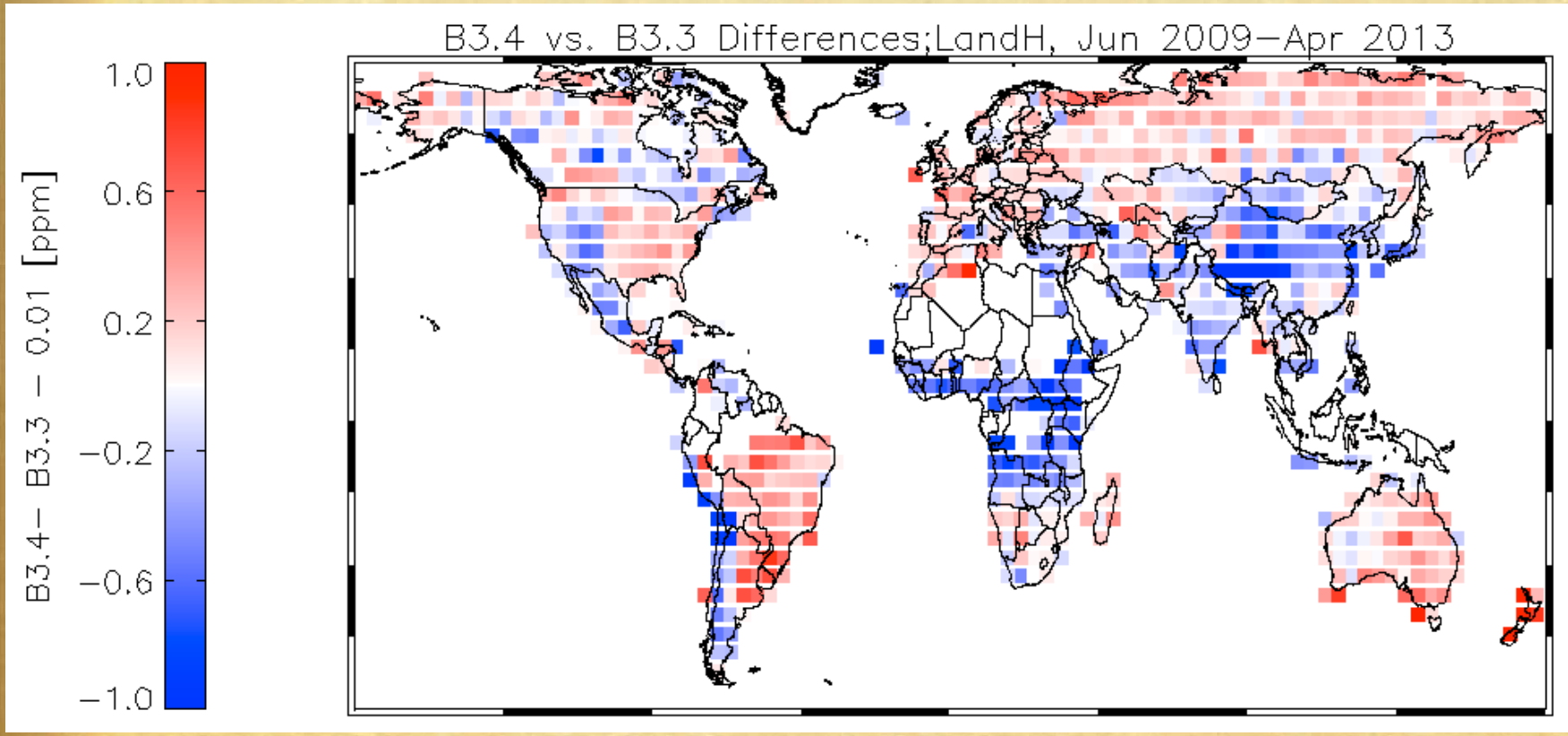
Name	Priors	Inv Method	In-situ	Winds	Transport	Mean X_{CO_2} [ppm]
LSCE	Chevallier et al. (a)	4D-Var	Multiple	ERA-Interm	LMDZ	387.43
UoE	?	EnKF	GLOBALVIEW	GEOS-5	GEOS-Chem	387.37
UoE*	as *LSCE*	as *LSCE*	as *LSCE*	GEOS-5	GEOS-Chem	387.16
NIES	?	4D-Var	?	JMA	NIES TM	387.13
NIES*	as *LSCE*	as *LSCE*	as *LSCE*	JMA	NIES TM	386.53
CT2011	CT website	EnKF	NOAA	ECMWF	TM5	387.65
Baker	CT2010	EnKF	NOAA	GEOS-5	PCTM	387.72

Bias Correction B3.4 (land gain H)



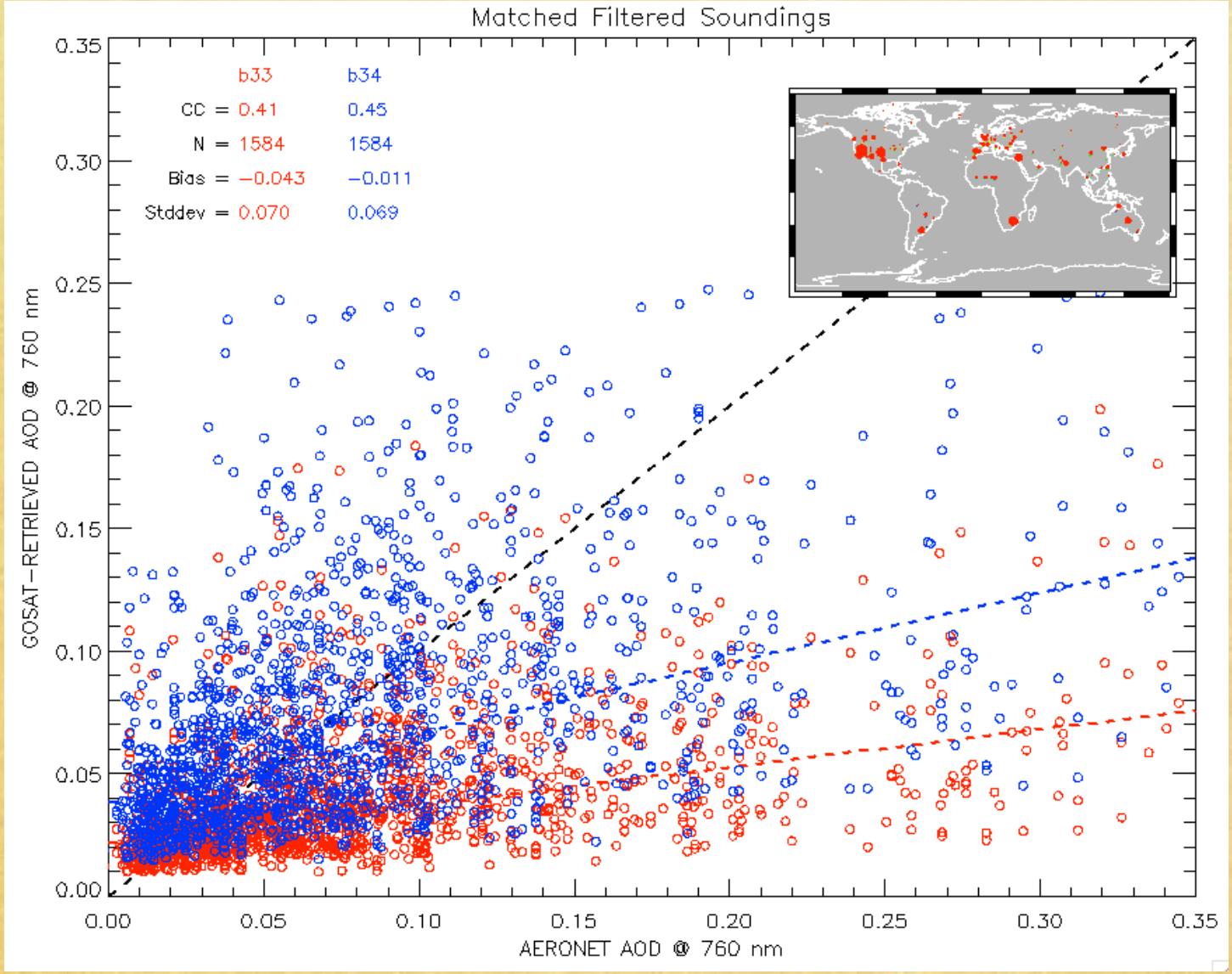
- Large positive bias (~1ppm) for high latitudes & oceans.
- Large negative bias for tropical deserts (gain M)
- East-west U.S. gradient
- Are often seasonal components to the bias.

Mean Spatial Differences vs. B3.3

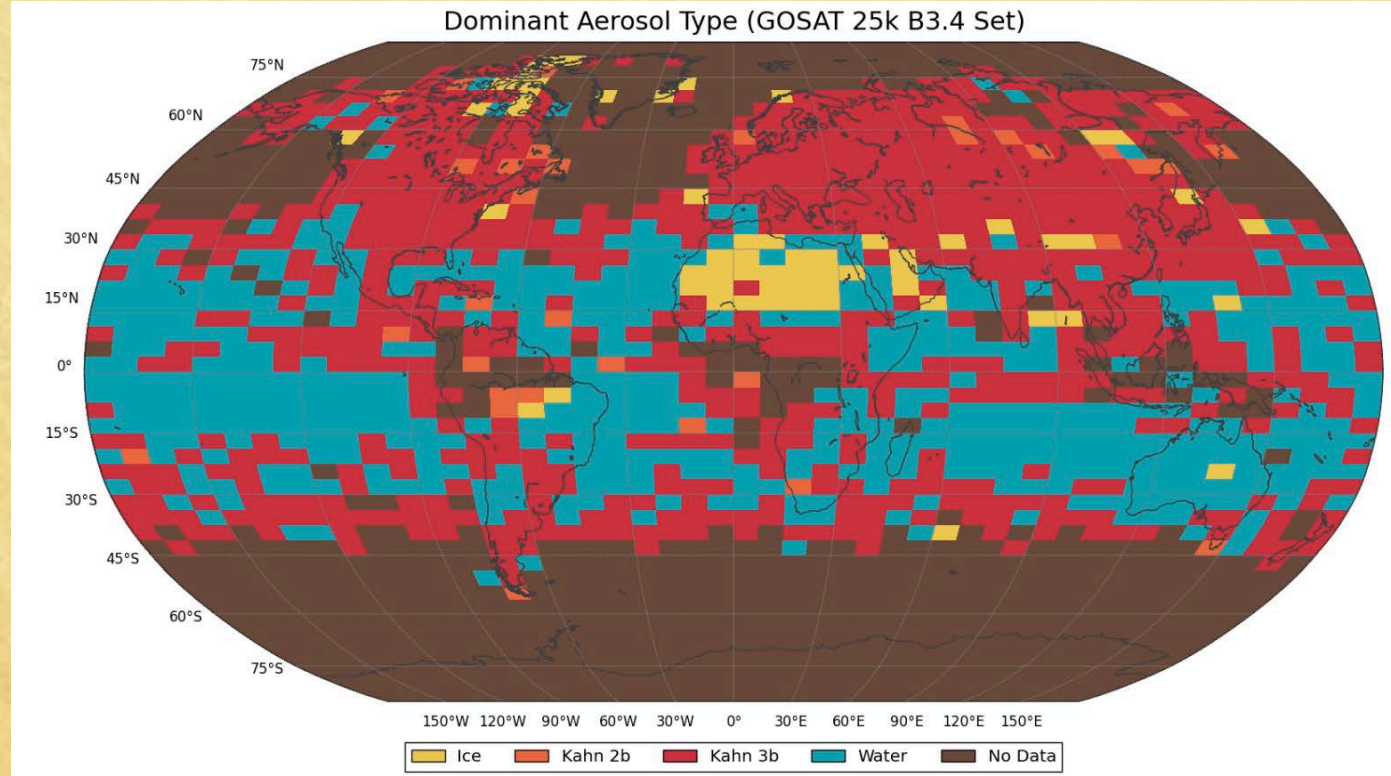


- Poor-man's estimate of bias-correction uncertainty
- Regional differences can approach 0.5-1 ppm
- Does this doom the use of ACOS/GOSAT data in global flux inversions?

Aeronet AOD comparisons

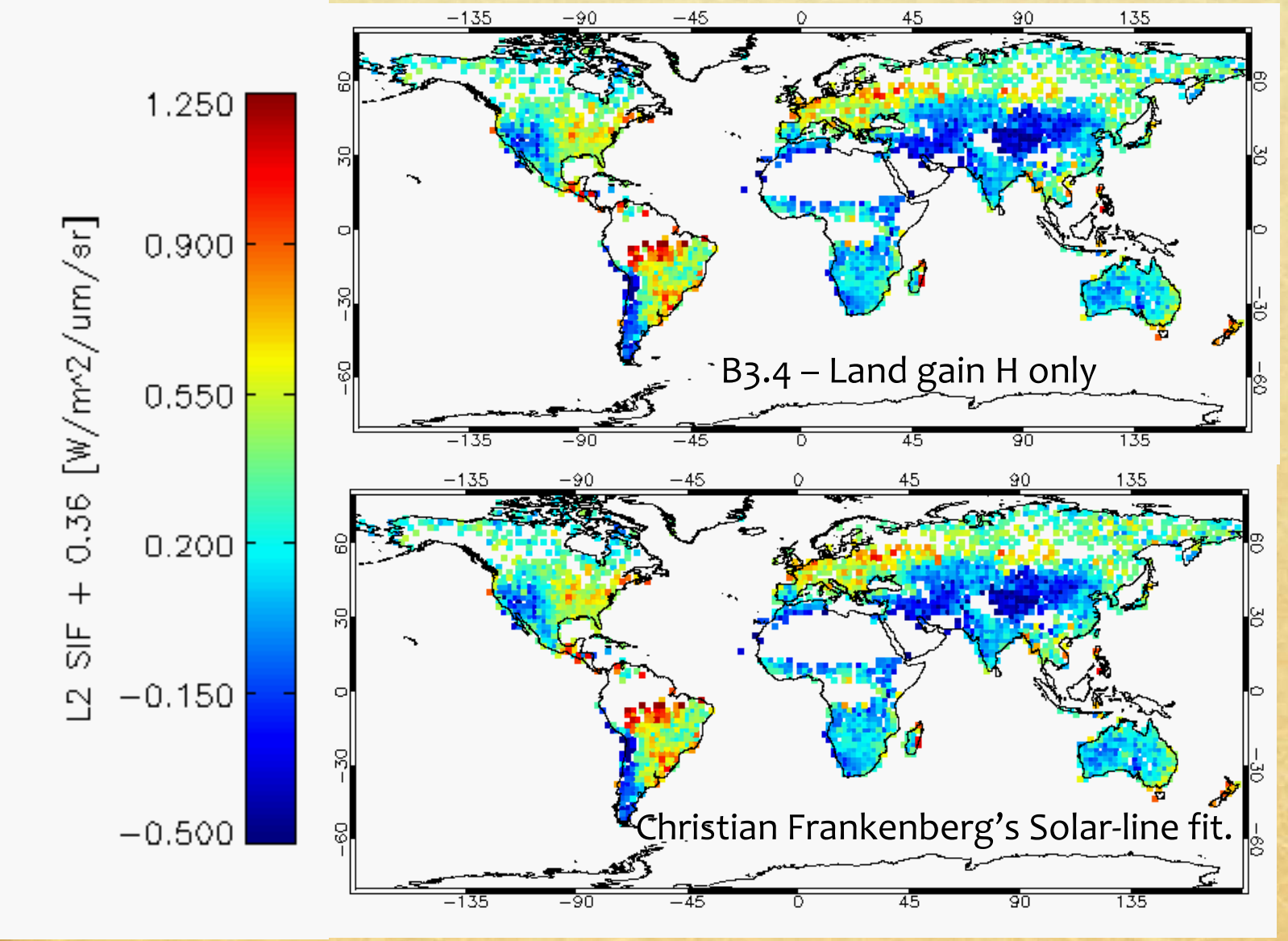


Retrieved Aerosol Types

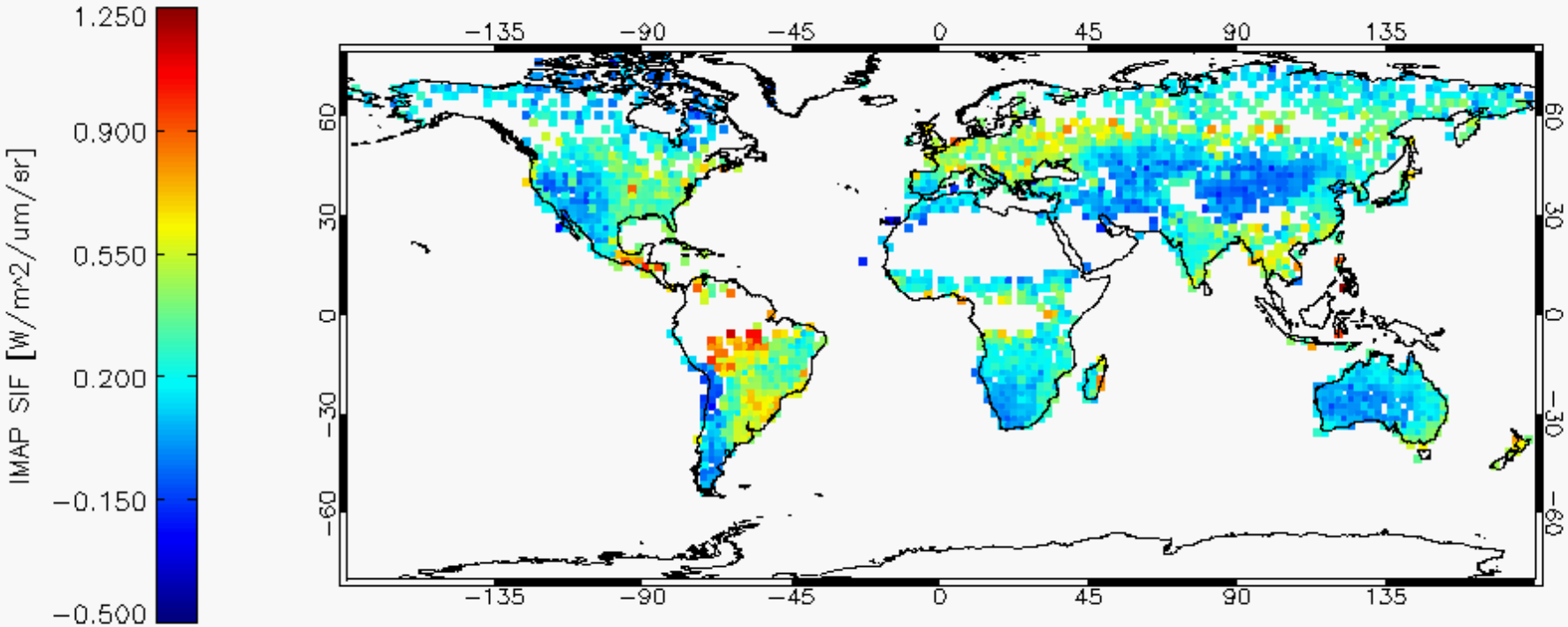


- **Kahn 2b** – Fine mode, dominates northern hemisphere, surrogate for sulfate/pollution aerosol
- **Water cloud** – dominates oceans, surrogate for (large) sea salt aerosol?
- **Ice cloud** – dominates over Tropical deserts; surrogate for dust, perhaps lofted?

B3.4 Fluorescence



IMAP Fluorescence



Model Comparisons

CarbonTracker 2011

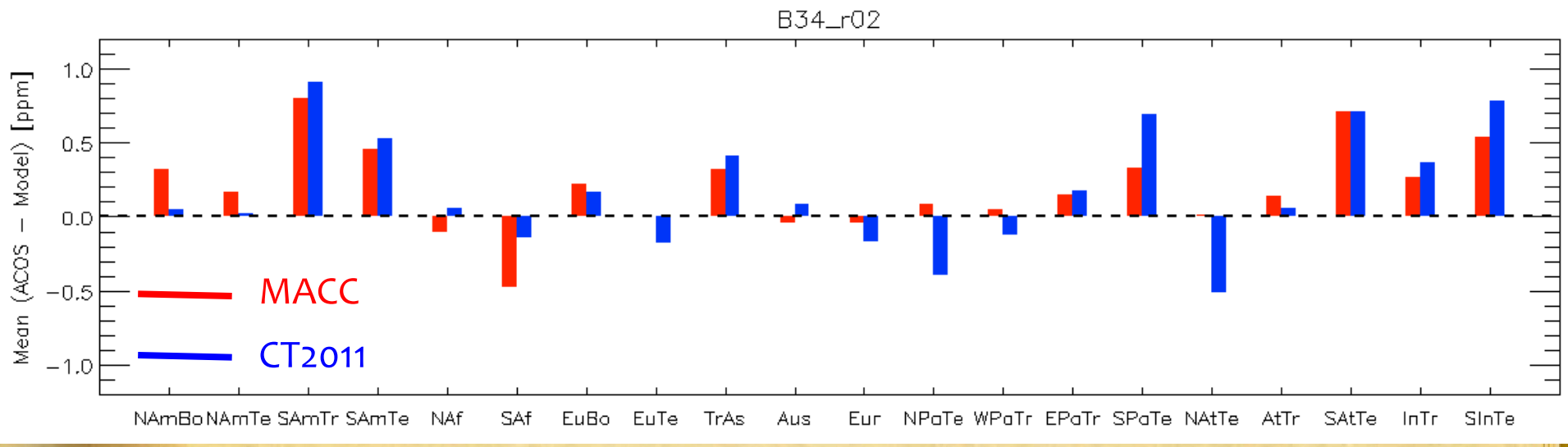
- June 2009 – Dec 2010
- Optimized against in situ CO2
- Ensemble-Kalman Filter
- NOAA-produced
- Removed 0.28 ppm bias

MACC

Monitoring Atmospheric Composition & Climate

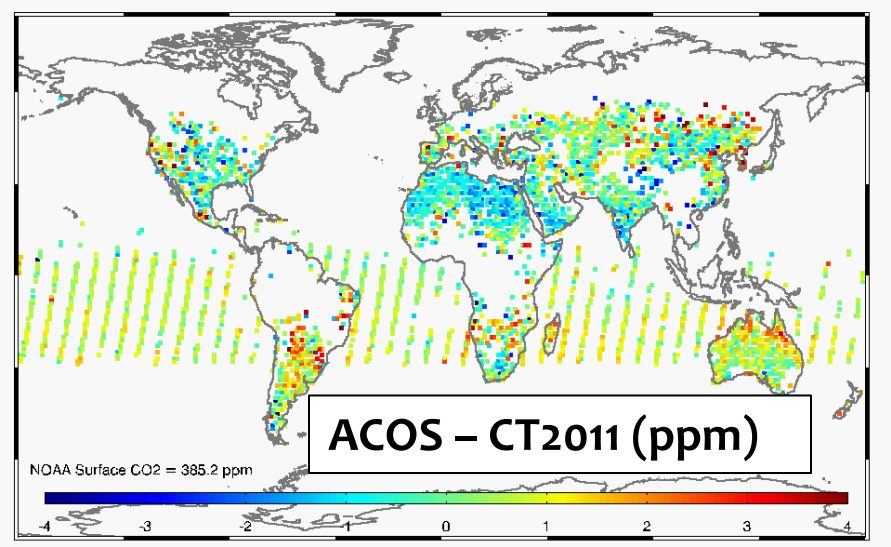
- June 2009 – Dec 2012
- Optimized against in-situ
- 4D-Var
- ECWWF + Partners

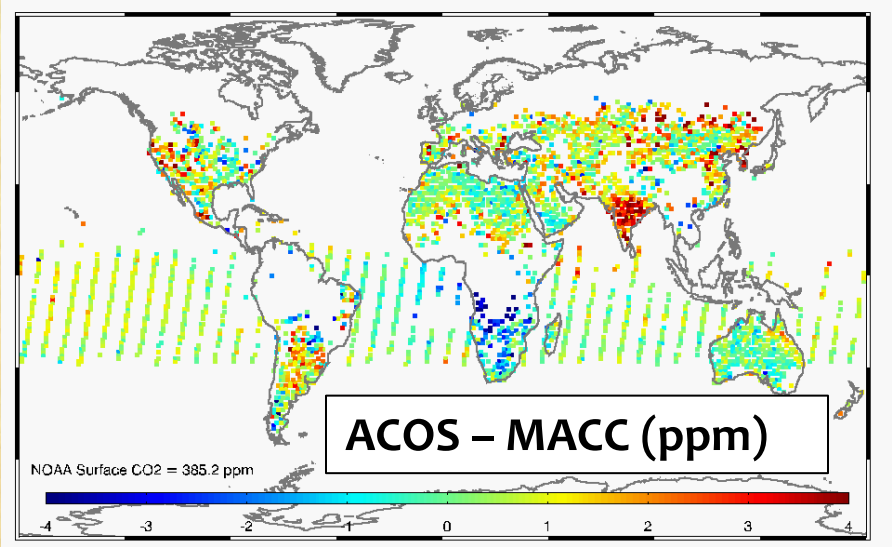
Mean Differences vs. Models Transcom-3 Regions, 2009-2010



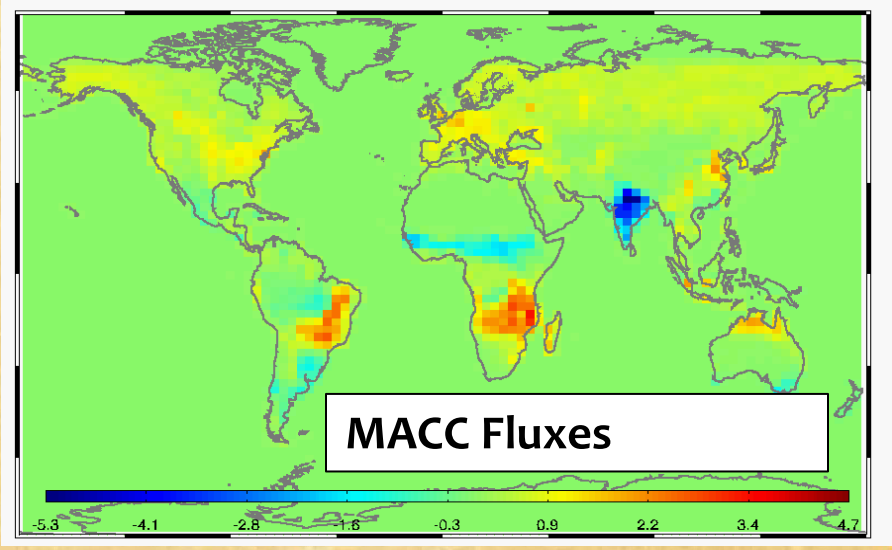
- Large regional mean difference between GOSAT & Models
- Large differences between the two Models!
- Largest Land differences over South America and Tropical Asia, where ACOS shows higher XCO2
- Large Ocean differences as well; ACOS exhibits positive anomaly for southern-hemisphere oceans.

October 2009

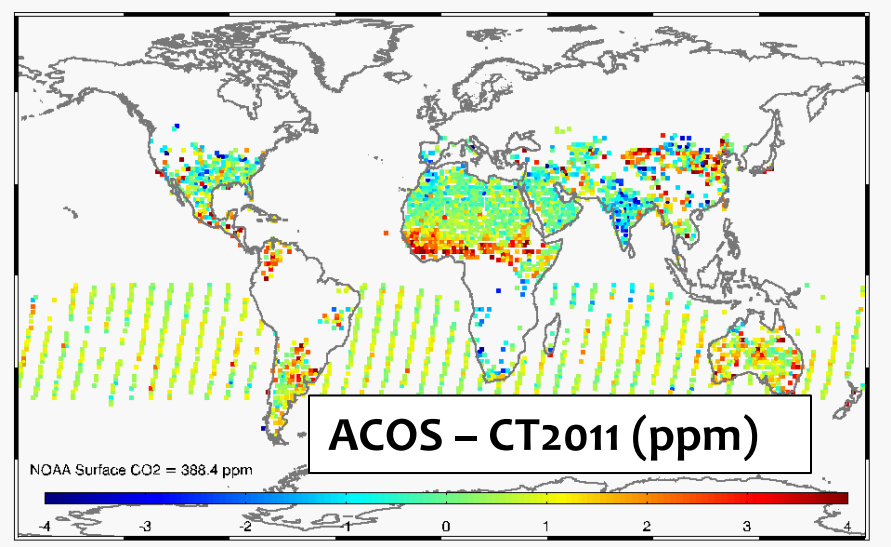


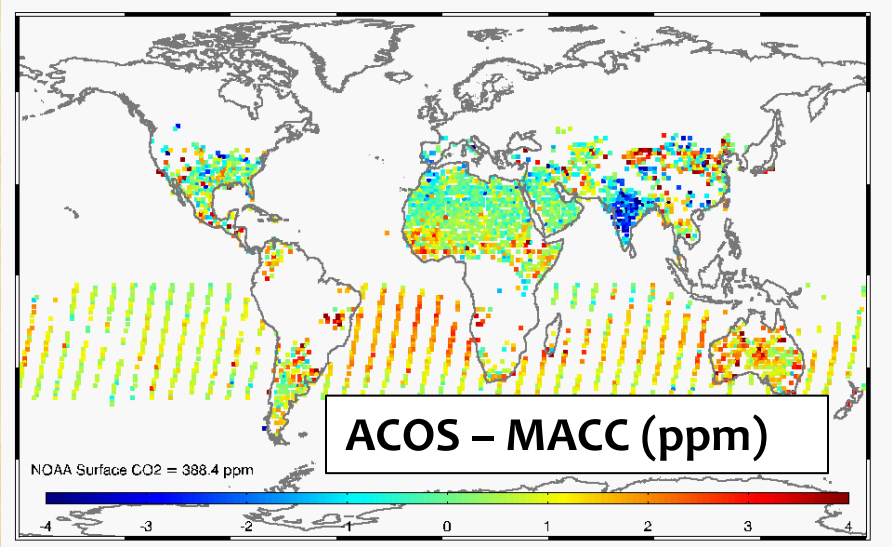


- MACC has large Indian sink (too large?)
- MACC biomass burning flux in S. Africa appears high.
- Both comparisons show slight east-west US Gradient

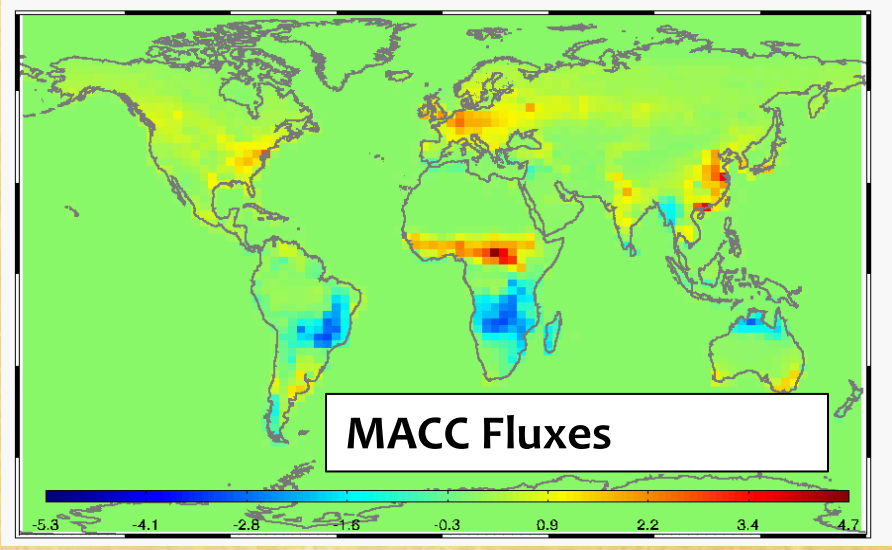


January 2010

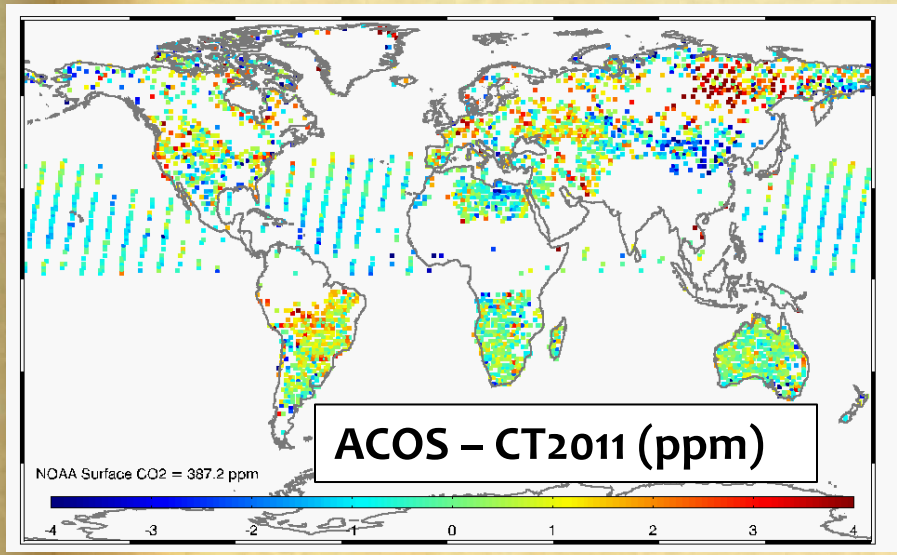


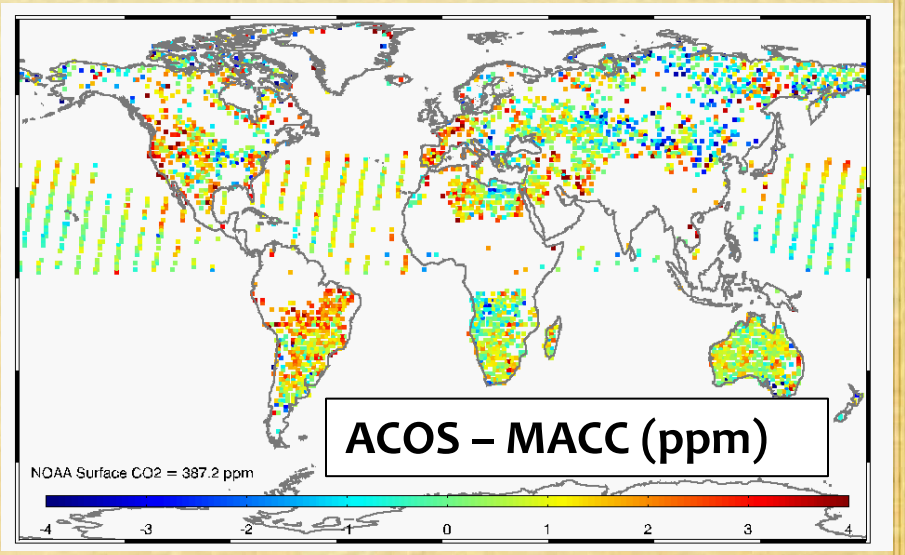


- CT2011 has too little biomass burning in Equatorial Africa
- MACC needs Indian Sink now!
- MACC has too strong S.H. sinks (seen via ocean data)

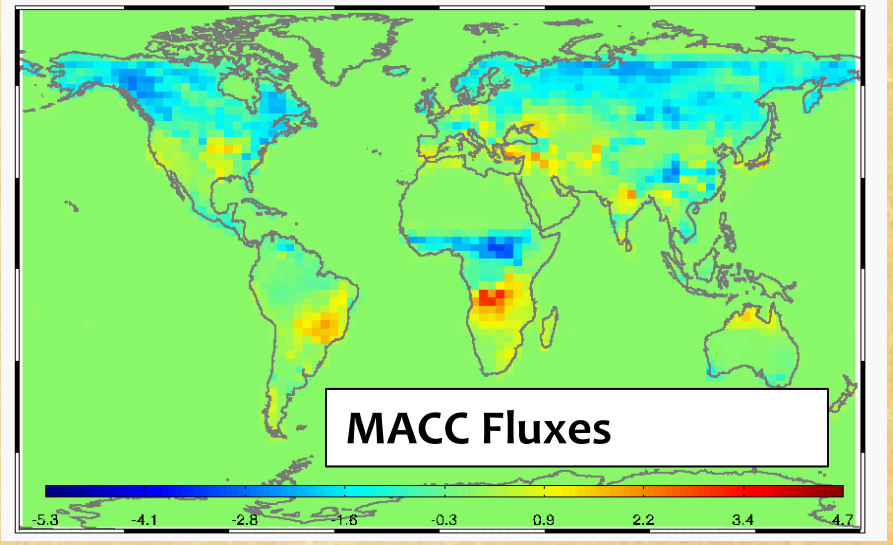


July 2010





- CT2011: too much Siberian uptake?
- MACC: Too little Siberian uptake?
  Large differences in Tropical SAm.
- Strong inter-model Ocean differences
- Can we see equatorial African uptake?



Summary

- B3.4 is out, we think it is the best yet
- Newly-retrieved fluorescence is realistic
- Retrieved aerosol is more realistic (but still needs work)
- Differing land (gain H vs M) and ocean biases imply that use of all 3 data types is a challenge in an inversion system.
- Model-ACOS differences in some regions and months are large, and offer a potentially robust way to improve flux estimates, even in the presence of residual retrieval biases.