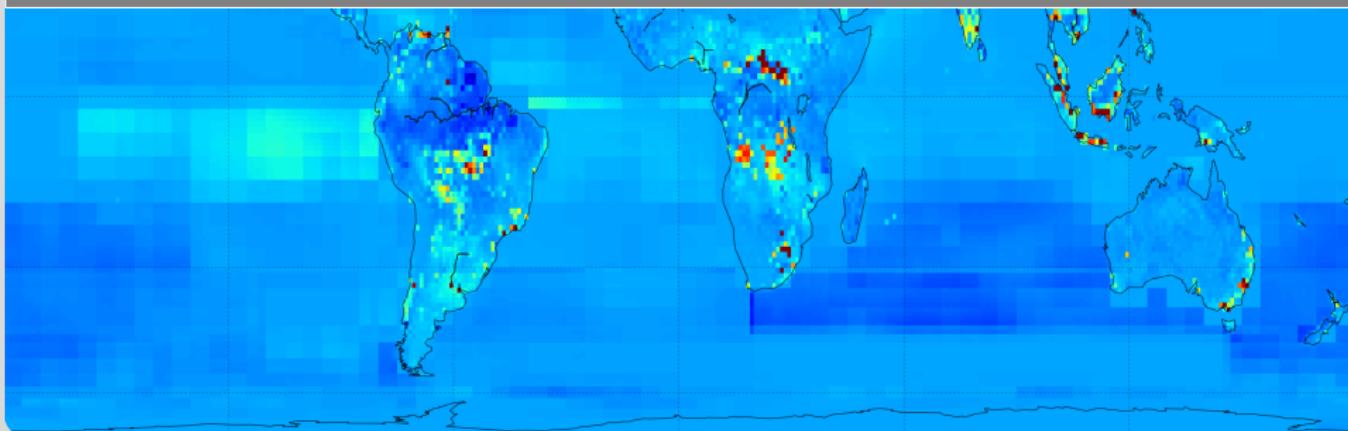


Carbontracker vs. TM5-4DVar, preliminary results

Arne Babenhauserheide | 9. Mai 2014

IMK-ASF, REMOTEC GHG-GROUP, VIA ANDRÉ BUTZ



Surface Flux Modelling

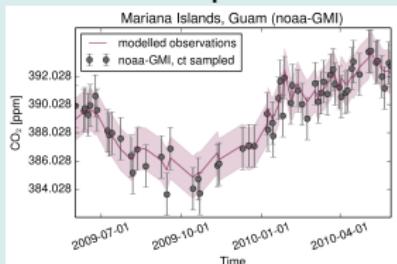
Why?

- quantify sources and sinks of greenhouse gases: drivers of climate change.



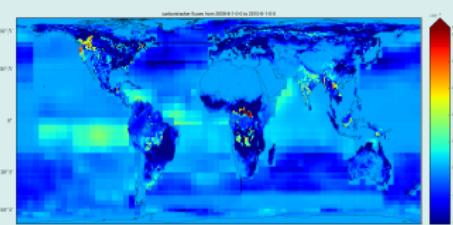
Have

- Gas Measurements
- Flux Models
- Tracer Transport



Need

- Surface Fluxes
- Solid Uncertainties



Goals of this Project

- Compare general model performance
- Estimate effects from the structure of observations
- Estimate flux uncertainties due to the inverse method

Carbontracker

Linear assumptions in the ensemble-run:

$$H(x') = H(\bar{x} + x') - H(\bar{x})$$

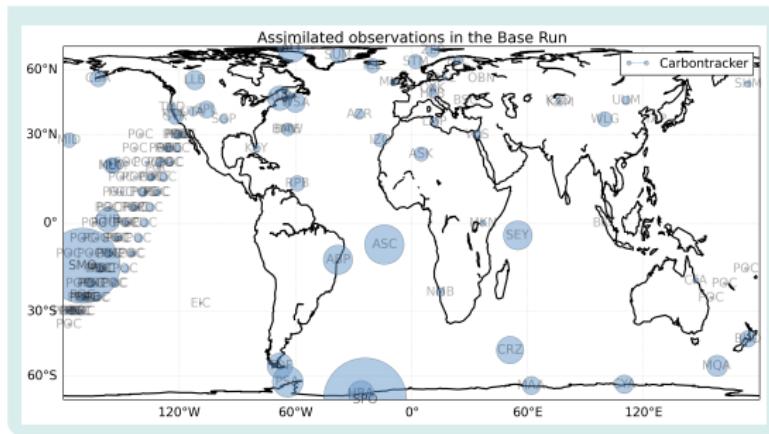
$$H(\bar{x}) = \frac{1}{N} \sum_N H(\bar{x} + x'_n)$$

TM5-4DVar

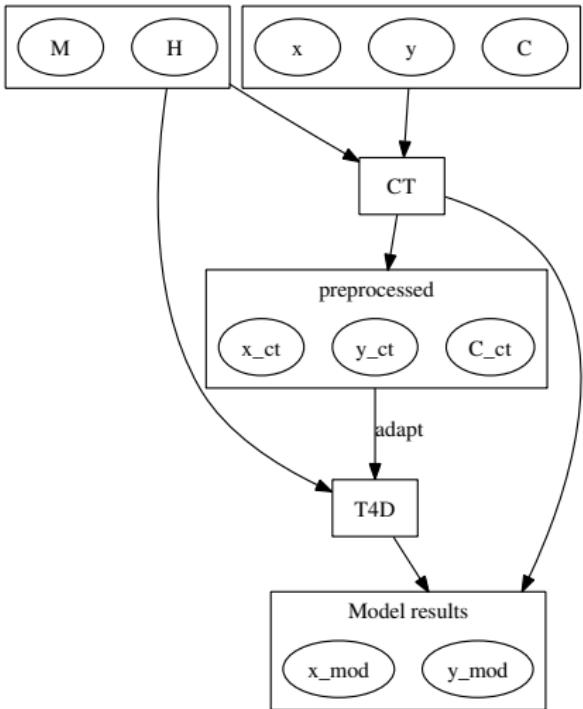
Linear Approximation of the Adjoint.

Harmonized Inputs

- NOAA obspack co2 1 PROTOTYPE v1.0.2 2013-01-28
- prior fluxes compiled using CASA, GFED2 (MODIS) and others
- prior flux uncertainties harmonized between Carbontracker with monthly cycle and TM5-4DVar.
- TM5



Process

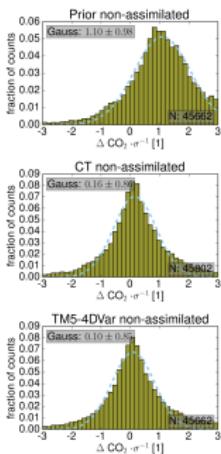
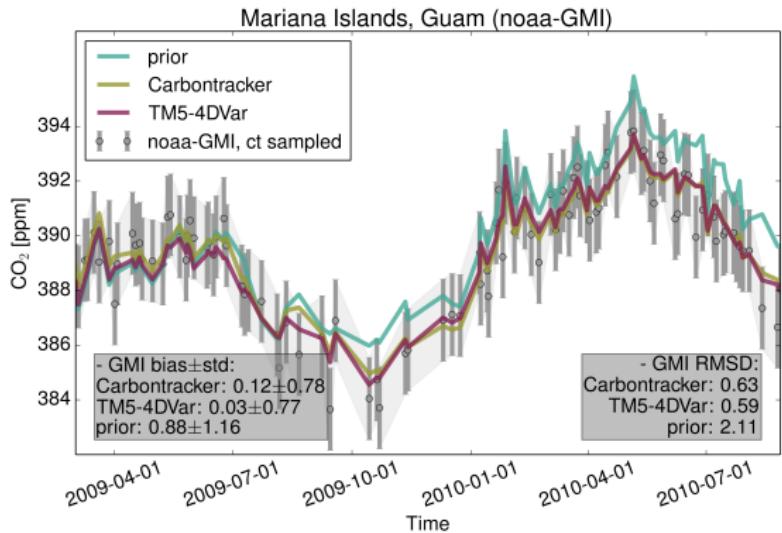


[... details]

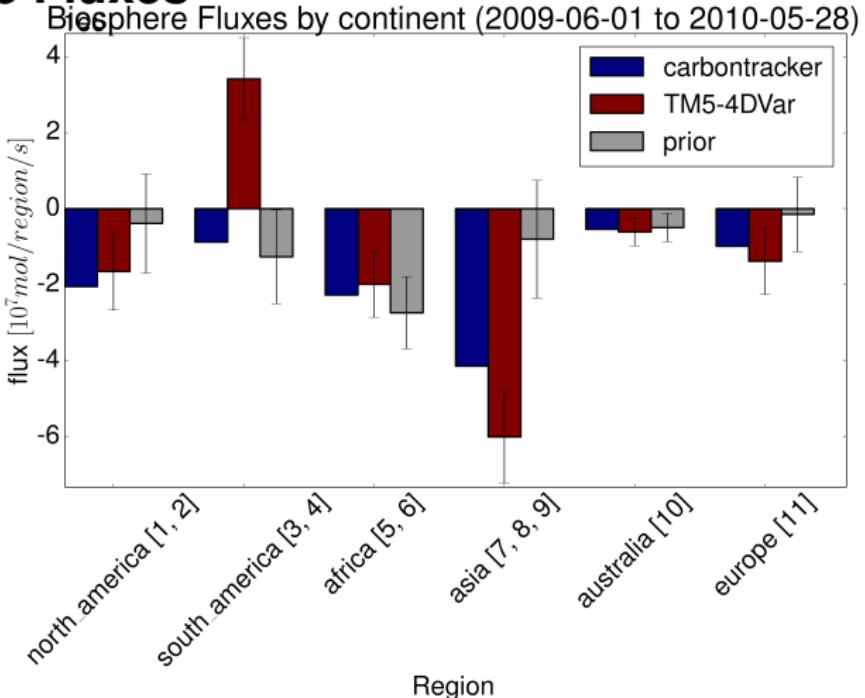
Summary

- big goal: Understand the carbon-cycle
- project: compare the methods of CT and T4D.
4DVar+grid vs. Kalman+Ecoregion
- method: harmonized inputs

Baseline Concentration Comparison

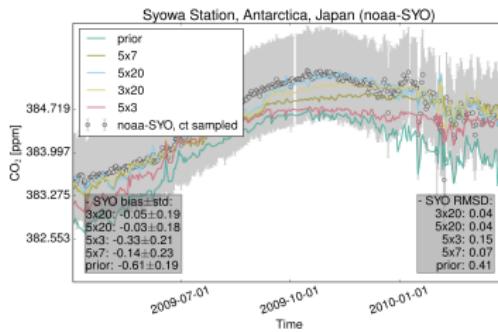
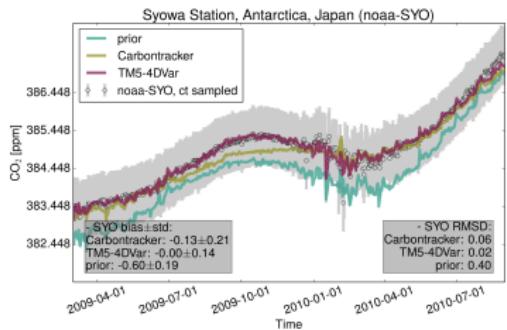


Baseline Fluxes



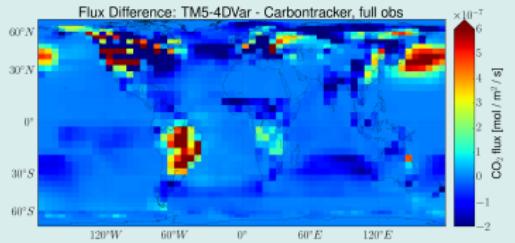
yes, there was a bug on the poster which led to too big errors.

Antarctica Concentration: CT Cycle

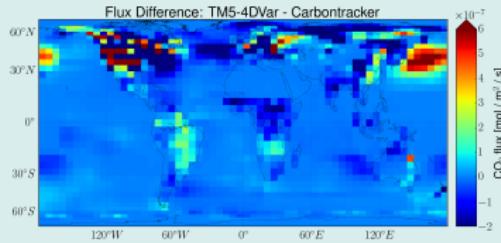


Southern America Fluxes: Sites?

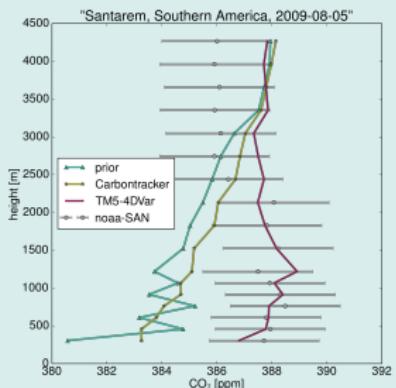
with abp



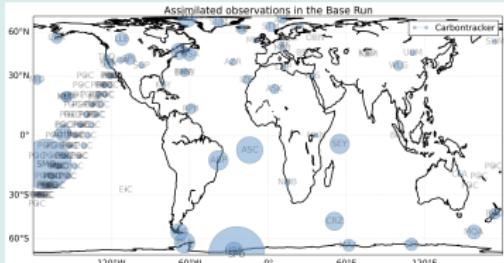
without abp



Santarem

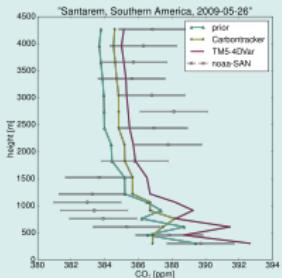


Obs

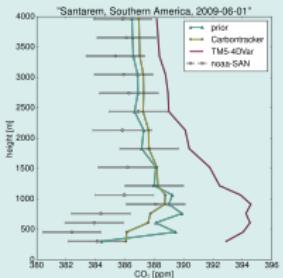


Santarem summer

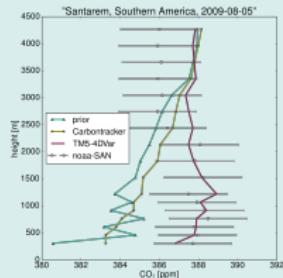
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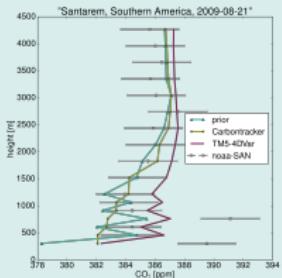
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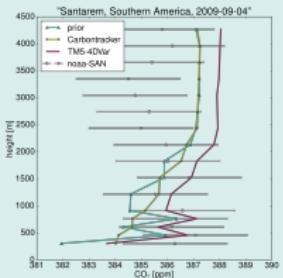
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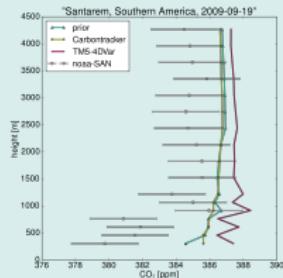
2009-08-21



2009-09-04



2009-09-19



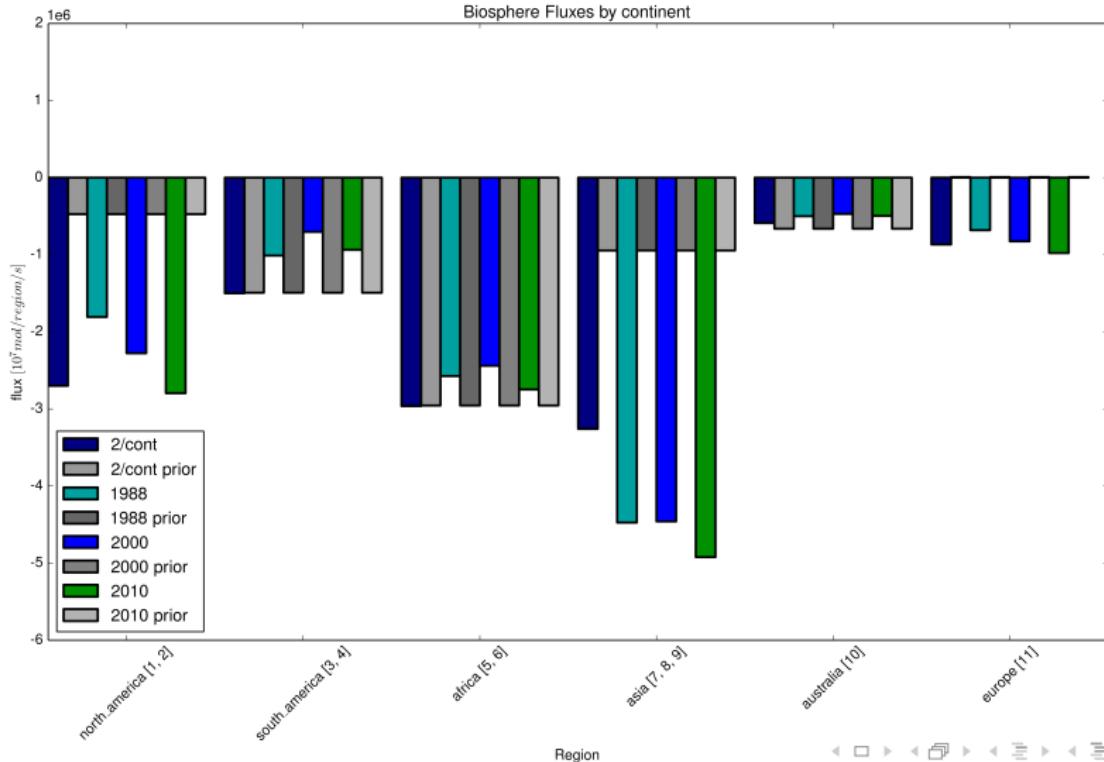
Sensitivity to Observation Density

selection of assimilated sites based on historical availability of data.

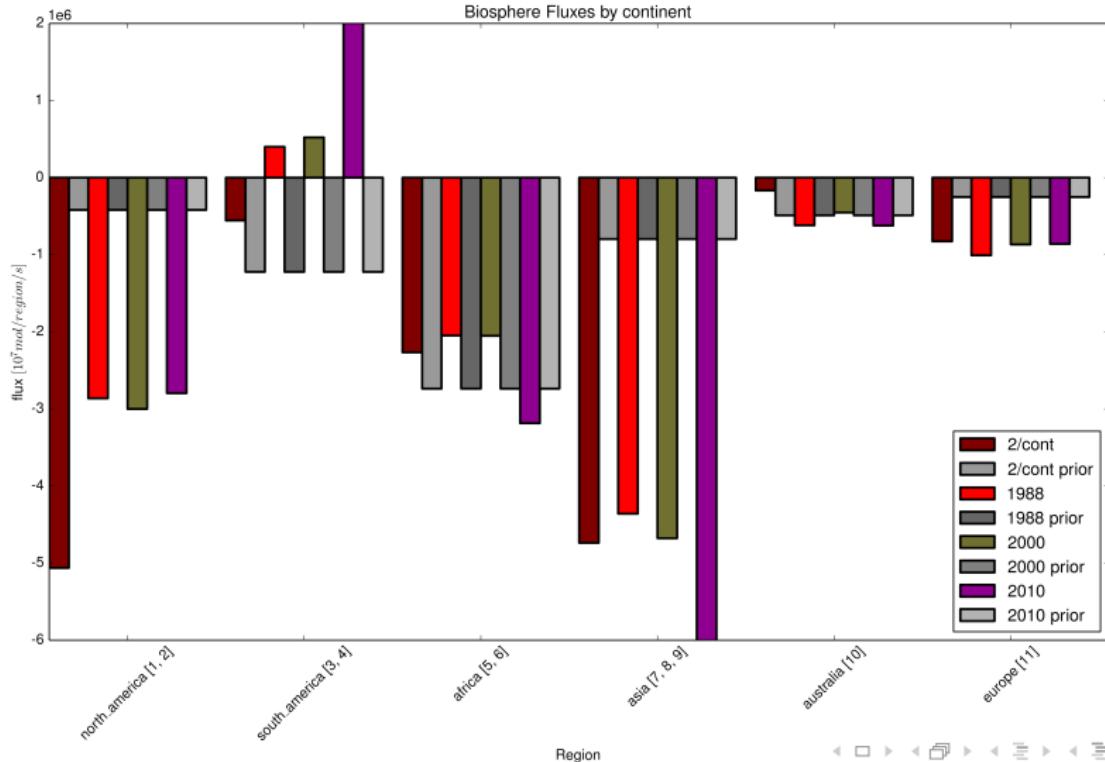
- 1988
- 2000
- 2000 + ABP (currently running)
- 2010

Big thanks to Sourish!

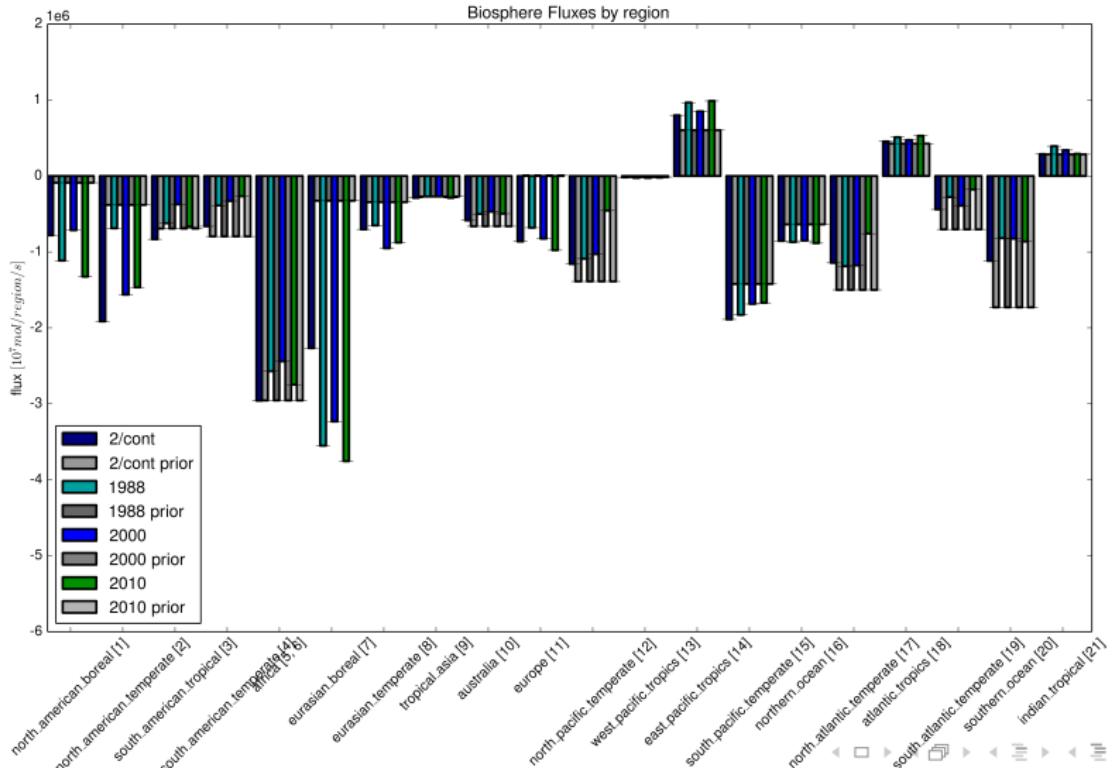
CT Observation Density continents (*very preliminary*)



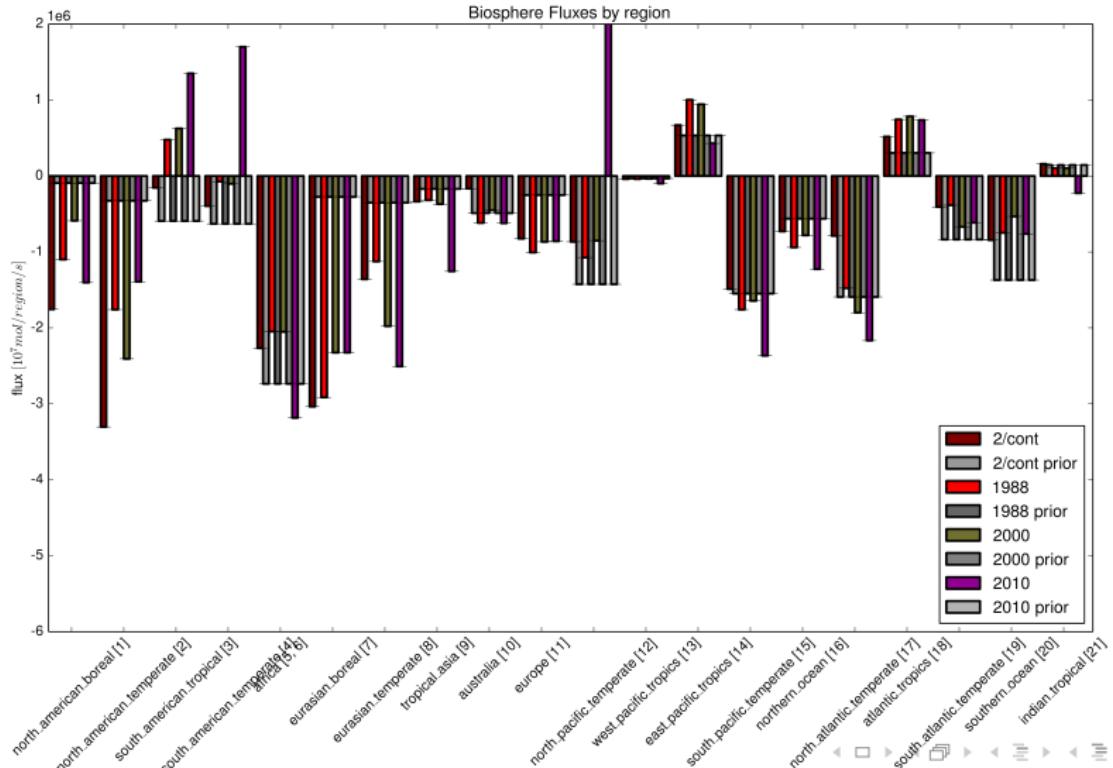
T4D Observation Density continents (very preliminary)



CT Observation Density regions (*very* preliminary)



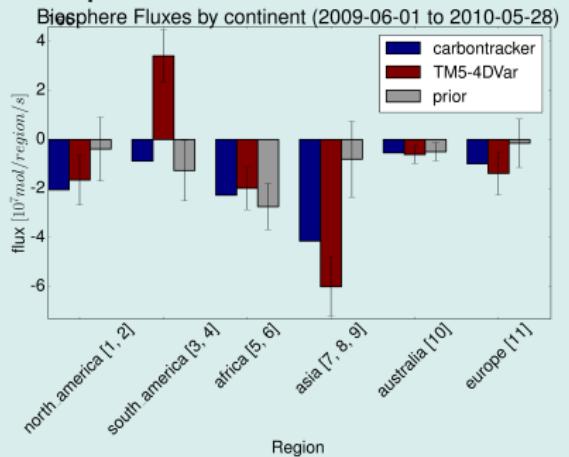
T4D Observation Density regions (*very* preliminary)



Conclusions

Base Runs

Comparable

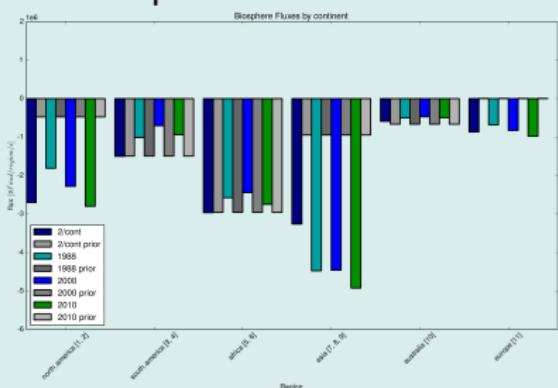


Uncertainties

Too Big?

Sensitivity

To be understood... Check
2000+abp.



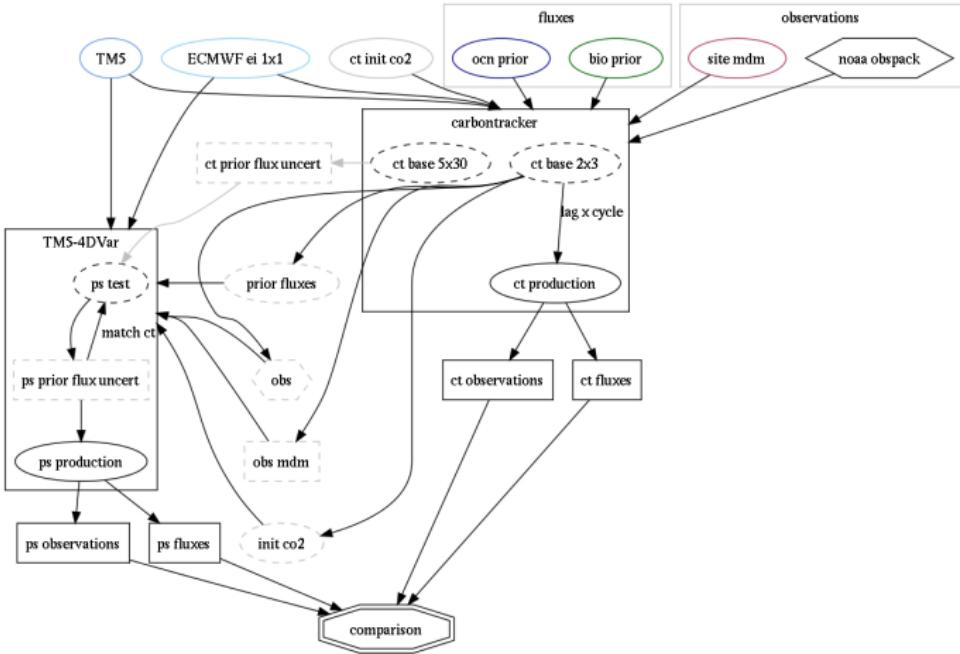
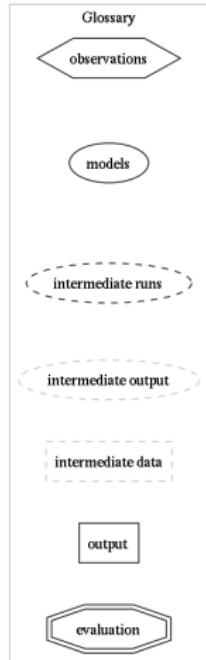
Vertical profiles

Summer - check other flights?

Thank you!



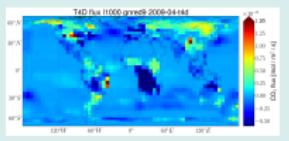
Comparison: Process details



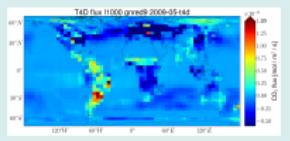
[... abstract process]

Monthly Fluxes T4D 2009

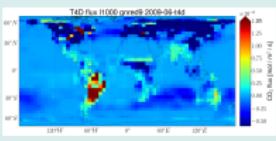
2009-04



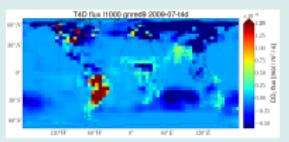
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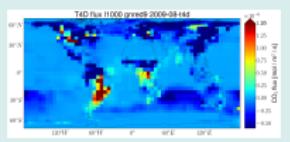
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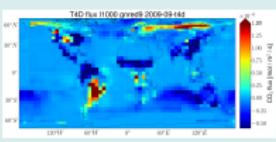
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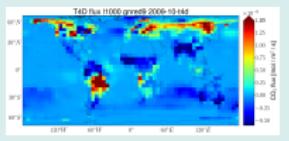
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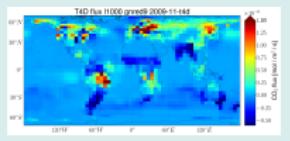
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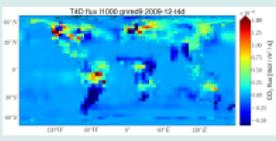
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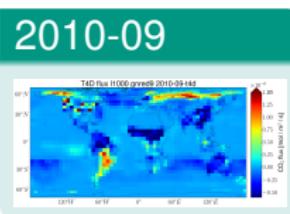
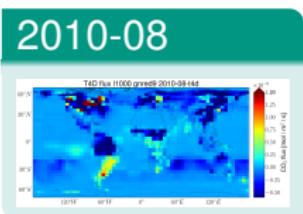
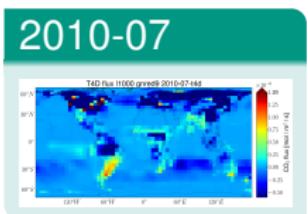
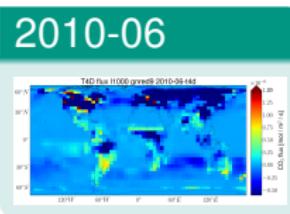
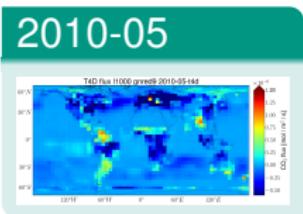
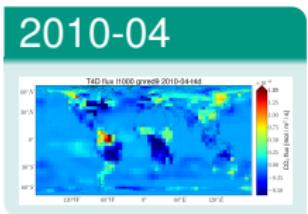
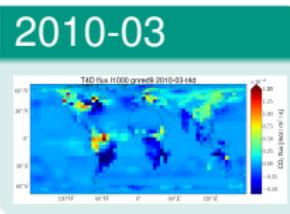
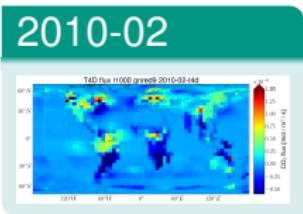
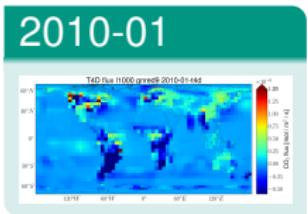
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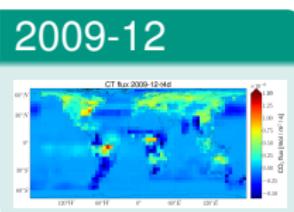
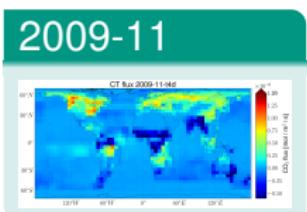
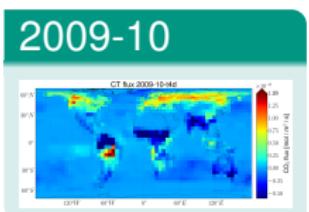
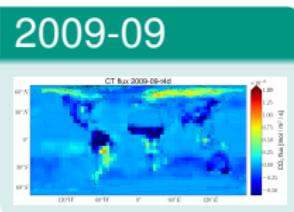
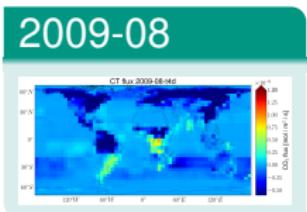
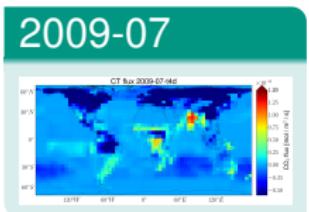
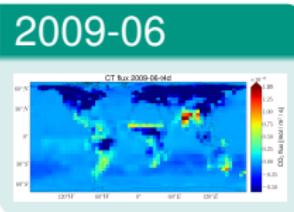
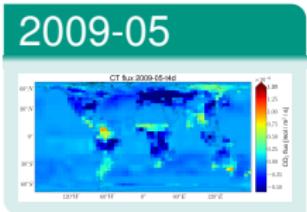
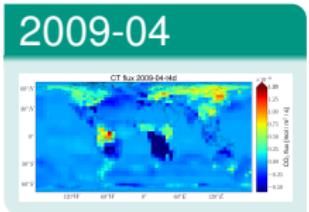
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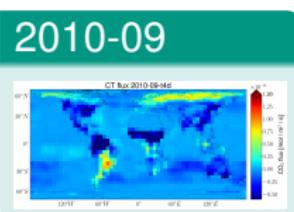
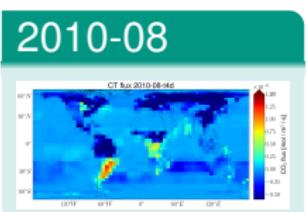
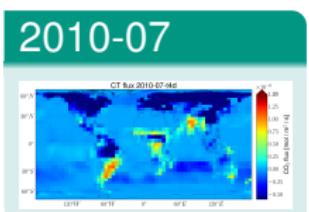
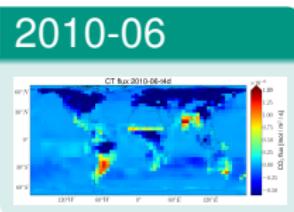
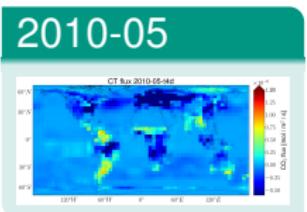
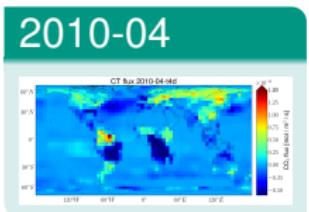
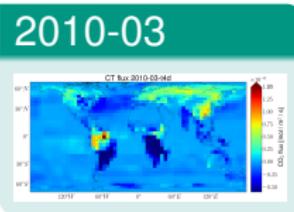
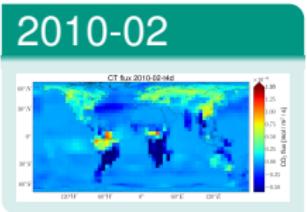
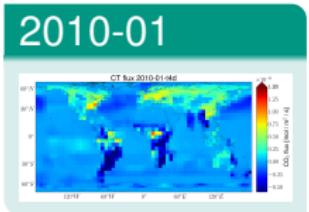
Monthly Fluxes T4D 2010



Monthly Fluxes CT 2009



Monthly Fluxes CT 2010



References

- obspack: Cooperative Global Atmospheric Data Integration Project. 2013, updated annually. Multi-laboratory compilation of atmospheric carbon dioxide data for the period 2000-2012
(obspack_{co21}PROTOTYPEv1.0.2₂₀₁₃₋₀₁₋₂₈). Compiled by NOAA Global Monitoring Division: Boulder, Colorado, U.S.A.
- prior fluxes: compiled using CASA, GFED2 (MODIS) and others as described on <http://esrl.noaa.gov/gmd/ccgg/carbontracker/documentation.html>
- [Stephen Jones]: Image Untitled licensed under cc-by:
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