The OCO-2 Model Intercomparison Project Reveals Systematic Transport Model Effects on Inverse Model CO_2 Fluxes

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The NASA Orbiting Carbon Observatory-2 (OCO-2) program has organized an atmospheric inverse model intercomparison activity, in which modeling groups have performed experiments assimilating OCO-2 retrievals and traditional *in situ* carbon dioxide (CO_2) measurements. This collection of inverse models is dominated by atmospheric transport simulated by two models: three use the Tracer Model, Version 5 (TM5) and four use Goddard Earth Observing System-Chem (GEOS-Chem). Forward simulations of CO_2 and sulfur hexafluoride (SF_6) in these two models reveal systematic differences in vertical-meridional transport, suggesting that GEOS-Chem moves tracer mass out of northern midlatitudes more quickly than TM5. In an inverse model framework, the ensemble of GEOS-Chem models retrieves a larger annual cycle of surface CO_2 fluxes in the large zonal band from the equator to 45°N. Since inverse models frequently simulate a net land sink by amplifying the annual cycle of prior models, one might expect that GEOS-Chem would have a larger net sink in this latitude range, but we find the opposite. The differences between the two models in seasonality and long-term mean fluxes are reversed north of 45°N. We provide potential explanations for these flux differences, and link them to transport processes using SF_6 constraints.

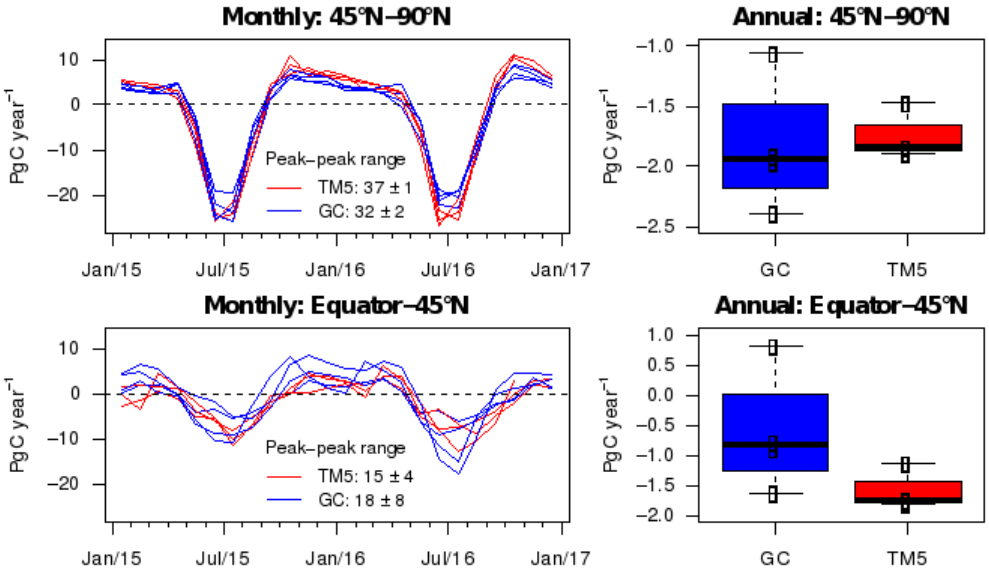

Figure 1. OCO-2 MIP fluxes estimated by GEOS-Chem ("GC", blue) and TM5 (red) transport in the latitude bands from the equator-45°N (bottom row) and from 45°N-90°N (top row). These optimized fluxes are derived by assimilation of traditional *in situ* measurements. Seasonality is revealed by monthly fluxes (left column) and the annual means are portrayed in the right column.