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.