Using *In Situ* CO_2 Measurements to Help Understand GOSAT and OCO-2 Column CO_2 Retrievals

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In situ measurements of atmospheric carbon dioxide (CO_2) have provided much of our understanding of the workings of the global carbon cycle (GCC). However, we still do not understand which processes are most important in driving the observed interannual variability of the GCC; as a result, it is unlikely we will be able to predict accurately its response to climate change in the future. We lack insight into these processes because we lack information on fluxes at the regional scales at which they operate, because of the sparse coverage of *in situ* CO_2 measurements over much of the globe. Measurements of CO_2 from satellite are meant to provide the spatial and temporal coverage to surmount this problem.

Measuring CO_2 from space at the required sub-ppm accuracy is challenging: radiative transfer must be modeled, including scattering from clouds and aerosols, and systematic errors can occur. To help understand such errors, we compare retrievals of column CO_2 from the GOSAT and OCO-2 satellites to corresponding values from a suite of forward transport model runs forced to agree with *in situ* CO_2 data. We present the CO_2 fluxes obtained when the satellite CO_2 data are assimilated with global atmospheric transport models, show how they vary when errors in the satellite data are corrected, and compare them to fluxes implied by the surface CO_2 data.

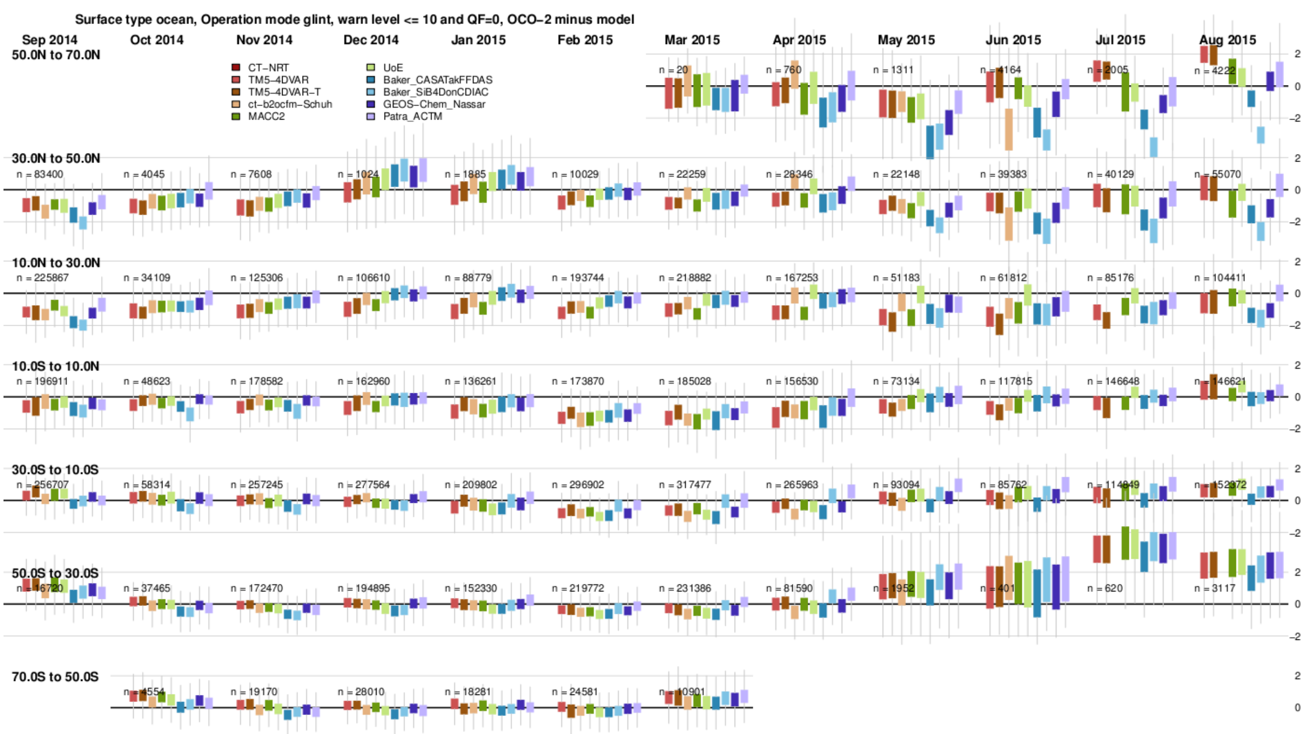

Figure 1. The difference [ppm] between column dry air mixing ratio of CO_2 (X_{CO2}) retrieved by the OCO-2 satellite in ocean glint viewing mode and corresponding values from a suite of atmospheric transport model runs forced to agree with *in situ* CO_2 data, averaged across months and latitude bands. Hints of a positive bias in the OCO-2 data at high solar zenith angles emerge.