The Ability of Satellite-based CO_2 Measurements to Constrain Carbon Cycle Science: From Greenhouse Gases (GHG) Observing SATellite (GOSAT) to Orbiting Carbon Obervatory (OCO-2)

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Since the launch of GOSAT in 2009, the holy grail of the satellite-GHG community has been to constrain sources and sinks of CO_2 by direct assimilation of satellite-measured column-averaged dry air mole fraction of CO_2 (XCO_2) into carbon inversion systems. However, this effort has been hampered by a number of factors. On the GOSAT side, the observations have regional-scale biases of the order of 1 ppm which can differ for different surface types, solar zenith angles, and other factors, which can induce false fluxes in the inversion results. Models have their own shortcomings including uncertain transport, incorrect or unfairly-constrained prior fluxes, and issues related to the inversion scheme itself (such as temporal window length or poorly-estimated posterior uncertainty). Building on the latest Atmospheric CO_2 Observations from Space (ACOS)/GOSAT XCO_2 results, we give an overview of the errors of the satellite measurements, discuss data/model comparisons, and argue for a parallel research effort to complement the direct inversion approach. We finish with an overview of what OCO-2 (scheduled to launch on July 1, 2014) may bring to the table above and beyond GOSAT measurements.

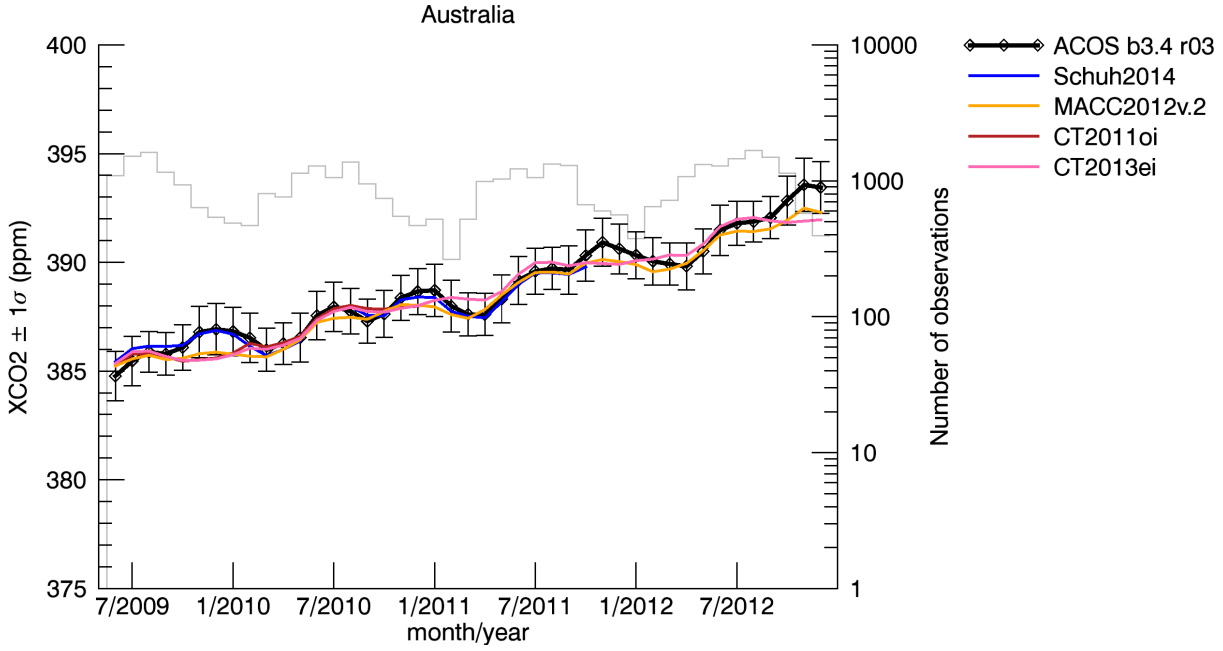

Figure 1. Monthly mean values of ACOS/GOSAT B3.4 XCO_2 values, averaged over the Australia Transcom-3 region (black). Corresponding values of model-averged XCO_2, matched to the data and similarly averaged, are also shown: CarbonTracker 2011oi (red), CarbonTracker 2013ei (pink), Monitoring Atmospheric Composition & Climate 2012v2 (yellow). These models all were optimized against surface *in situ* and aircraft data. A model optimized against an earlier version of ACOS/GOSAT XCO_2 measurements (Schuh 2014), is also shown (blue). While there is good agreement, the satellite measurements suggest a larger CO_2 source in austral summer for certain years, especially 2009-10 and 2012-13.