What Have We Learned About the Carbon Cycle from GOSAT and OCO-2?

D.F. Baker[1], A. Jacobson[2,3] and S. Crowell[4]

[1]Cooperative Institute for Research in the Atmosphere (CIRA), Colorado State University, Fort Collins, CO 80521; 303-497-6999, E-mail: David.F.Baker@noaa.gov
[2]Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado, Boulder, CO 80309
[3]NOAA Earth System Research Laboratory, Global Monitoring Division (GMD), Boulder, CO 80305
[4]University of Oklahoma, Norman, Oklahoma 73019

Many of the science questions posed by the GOSAT and OCO-2 projects require that CO_2 estimates retrieved from satellite observations be interpreted using atmospheric CO_2 models. To this end, the OCO-2 project has assembled a large team of modelers, representing the most important ensemble of models since TransCom. With two full years of OCO-2 data in hand and 8 years of GOSAT data, we can now assess how constraints from these instruments are helping to answer fundamental questions about the global carbon cycle. Primary among these is how increased observational coverage in low latitudes is refining our understanding of the carbon balance in the tropics. The recent El Niño gives us a rare opportunity to explore this, as assimilation of satellite data yields a distinctly different picture of this perturbation to the carbon cycle compared to assimilation of traditional *in situ* data. We also report on progress towards assessing and understanding biases in satellite retrievals, and how over-constraining the models with data refines our estimates of uncertainties deriving from transport error and inversion methodology.

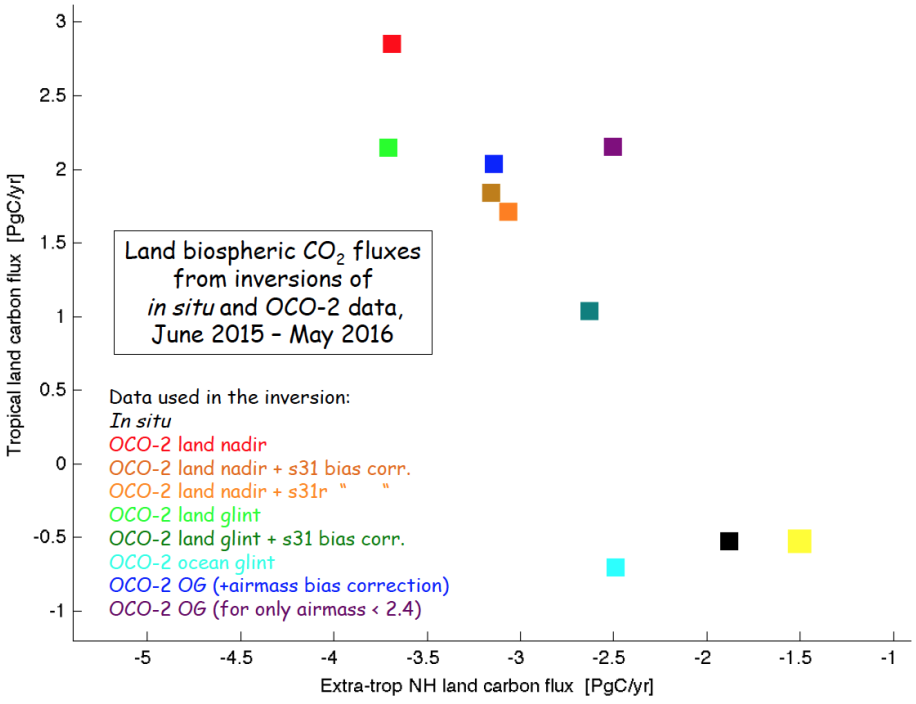

Figure 1. The partition of the land biospheric CO_2 flux (extra-tropical NH vs. tropics & SH)for June 2015 - May 2016, from global flux inversions of *in situ* data (black) and various types of data from the Orbiting Carbon Observatory (OCO-2) satellite (colors). Different modes of OCO-2 data (land nadir, land glint, ocean glint) have been used in separate inversions to assess consistency, with different post-hoc bias corrections applied. Despite some scatter due to uncertainties in the proper bias correction to use, the satellite data consistently show that the tropical land regions released from 1.5 to 2.5 more PgC/yr during this span, which coincided with a strong El Niño, than is given by the *in situ* data. A single atmospheric transport model (PCTM) and inversion scheme (Baker 4Dvar) is used in all cases.