A method for independent validation of inverse modeling: application to CO₂

**Problem:** Net carbon fluxes are inferred from CO₂ concentrations, e.g. OCO-2, using inverse modeling. Indirect validation approaches compare modeled CO₂ to independent data, e.g., aircraft. What fluxes drive the agreement between predicted and independent concentration data?

Liu and Bowman, GRL, 2016, developed an adjoint method that attributes differences between predicted and independent data back to surface fluxes.

- Using a Carbon Monitoring System Flux (CMS-Flux) Observing System Simulation Experiment (OSSE), posterior (after inversion) CO₂ error is 50% less than prior.
- Only sub-equatorial Amazonian fluxes (in blue) drive improved CO₂ agreement.
- Method is being applied to validate inversions with GOSAT and OCO-2 data.
- Can be used by ATom and ACT-America to validate regional and global inverse models.

Mean RMS difference between modeled and aircraft CO₂, which are located at 4 locations in the Amazon.

Mean RMS

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\text{RMS}(\text{C}_{\text{post}}) - \text{RMS}(\text{C}_{\text{prior}})
\]

Posterior: after inversion

Prior: before inversion

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