

Science Question: What can the co-variation of biologically-sensitive atmospheric tracers tell us about how the terrestrial biosphere functions?

Data & Results: We used airborne data from ACT-America Earth Venture Suborbital 2 project, and satellite data from the Orbiting Carbon Observatory (OCO-2) and the Measurements of Pollution in the Troposphere (MOPITT), with a multiscale land and atmosphere carbon assimilation system, to study seasonal and spatial variations of carbon dioxide (CO₂), carbon monoxide (CO), and carbonyl sulfide (COS) across three unique regions in the eastern US (**Fig 1**). Flights in the southern US indicate the depletion of CO₂ and COS in the boundary layer is much stronger than expected by biosphere models (e.g., **Fig 2 A-B**). Doubling COS (and CO₂) uptake in temperate evergreen forests in the southeast US improves the predicted co-variation with CO, which is also produced by southern forests through biogenic VOC precursor emissions (**Fig 2C**).

Significance: The unprecedented ACT-America flights uncovered evidence that southern humid temperate forests photosynthesize and absorb CO₂ and COS, and emit CO precursors deeper into the growing season than expected by models. Additional sampling of southern US will more accurately constrain underlying biological processes and climate sensitivities governing southern C dynamics.

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Figure 1: Flow Diagram of Tracer-Tracer Model-Observation Analysis System

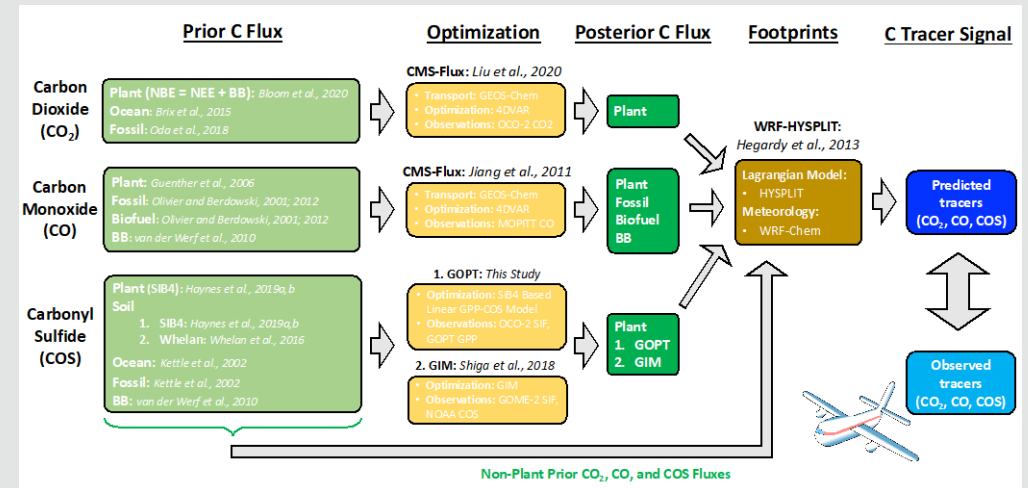
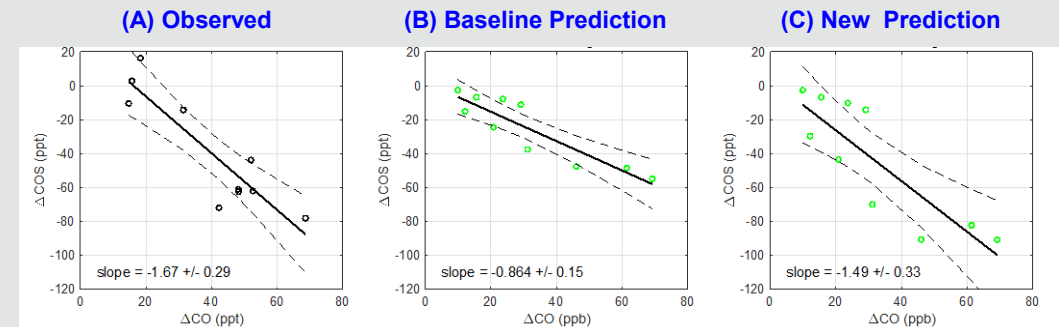


Figure 2: Observed vs Predicted Regression of CO vs COS in Southern US



Our model-observation analysis system offers attribution of biogenic sources of CO₂ variability in the eastern US. (**Fig 1**) We use satellite constrained estimates of biogenic C exchange with atmospheric models to predict the co-variation of atmospheric CO₂, COS, and CO at locations observed by the ACT-America Airborne campaign. (**Fig 2**) Comparison of observed COS/CO covariation to baseline and experimental simulations.