Gross Uptake of Carbon in the U.S. Is Largest in the Midwest Region

T.W. Hilton[1], A. Zumkehr[1], M. Whelan[1], S. Kulkarni[2], J. Berry[3] and J.E. Campbell[1]

[1]University of California at Merced, Merced, CA 95343; 415-314-7478, E-mail: thilton@ucmerced.edu
[2]California Air Resources Board, Sacramento, CA 95812
[3]Carnegie Institution for Science, Department of Global Ecology, Stanford, CA 94305

Regional photosynthetic carbon dioxide fluxes (gross primary production, GPP) are a first-order uncertainty in future climate predictions, but direct observation of these fluxes is not possible because of confounding ecosystem respiration fluxes of roughly equal magnitude but opposite direction. Carbonyl sulfide (COS or OCS) may offer a new and independent constraint on regional GPP, but uncertainties in key leaf-level COS exchange parameters and concurrent non-plant terrestrial surface COS fluxes must be accounted for. Here we analyze North American airborne COS observations with a regional chemical transport model and a wide range of source and sink parameterizations. We found that GPP in the U.S. growing season is concentrated in the Midwest region. While these results are not consistent with some process-based ecosystem models and emerging data-driven models, they are supportive of recent space-based estimates from sun-induced chlorophyll fluorescence. Extension of our modeling approach with increased capabilities from remote sensing may provide information on gross carbon fluxes in other regions.

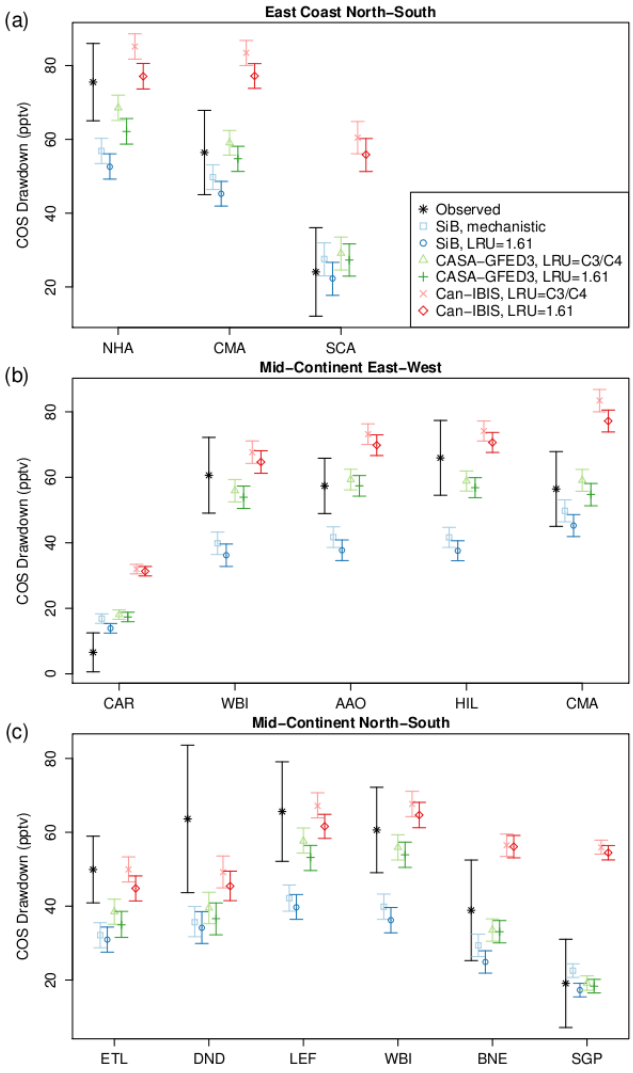

Figure 1. July and August mean COS vertical drawdown for 48 STEM simulations with bootstrapped 95% confidence intervals. Site locations (horizontal axis) refer to NOAA ESRL observation site codes. COS drawdown values shown here include all model components (COS plant flux, COS soil flux, COS anthropogenic flux, and boundary conditions) and all COS plant flux models (mechanistic, C3/C4-varying COS–CO2 leaf-scale relative uptake (LRU), and fixed LRU. We calculated drawdown to approximate the difference in COS concentration between the atmospheric boundary layer and the free troposphere.