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Improving North American gross primary production (GPP) estimates using atmospheric measurements of carbonyl sulfide (COS)

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Understanding the responses of gross primary production (GPP) to climate change is essential for improving our prediction of climate change. To this end, it is important to accurately partition net ecosystem exchange of carbon into GPP and respiration. Recent studies suggest that carbonyl sulfide is a useful tracer to provide a constraint on GPP, based on the fact that both COS and CO_2 are simultaneously taken up by plants and the quantitative correlation between GPP and COS plant uptake.

We will present an assessment of North American GPP estimates from the Simple Biosphere (SiB) model, the Carnegie-Ames-Stanford Approach (CASA) model, and the MPI-BGC model through atmospheric transport simulations of COS in a receptor oriented framework. The newly upgraded Hybrid Single Particle Lagrangian Integrated Trajectory Model (HYSPLIT) will be employed to compute the influence functions, i.e. footprints, to link the surface fluxes to the concentration changes at the receptor observations. The HYSPLIT is driven by the 3-hourly archived NAM 12km meteorological data from NOAA NCEP. The background concentrations are calculated using empirical curtains along the west coast of North America that have been created by interpolating in time and space the observations at the NOAA/ESRL marine boundary layer stations and from aircraft vertical profiles. The plant uptake of COS is derived from GPP estimates of biospheric models. The soil uptake and anthropogenic emissions are from Kettle et al. 2002. In addition, we have developed a new soil flux map of COS based on observations of molecular hydrogen (H2), which shares a common soil uptake term but lacks a vegetative sink. We will also improve the GPP estimates by assimilating atmospheric observations of COS in the receptor oriented framework, and then present the assessment of the improved GPP estimates against variations of climate variables such as temperature and precipitation.