Estimating Biophysical Parameters from CO_2 Flask and Flux Observations

K. Schaefer[1], P. Tans[1], A. S. Denning[2], L. Prihodko[2], I. Baker[2], W. Peters[1], and L. Bruhwiler[1]

[1] NOAA Climate Monitoring and Diagnostics Laboratory, 325 Broadway Boulder, Colorado 80305; 303-497-4568; Fax: 303-497-5590; E-mail: Kevin.Schaefer@noaa.gov
[2] Department of Atmospheric Science, Colorado State University, Fort Collins 80523

To assess the impact of increased atmospheric CO_2 or to enact any emission reduction strategy, we must understand the underlying mechanisms that control the net flux of CO_2 into the atmosphere. Using atmospheric transport models, various research groups have successfully estimated regional net carbon fluxes from observed CO_2 concentration from the CMDL global air sampling network. We take this one step further by using data assimilation of observed CO_2 concentration to estimate parameters that control modeled net terrestrial CO_2 fluxes. We will estimate parameters that strongly influence modeled fluxes, yet are very uncertain because they are difficult to measure respiration temperature response functions, initial carbon pool sizes, leaf nitrogen content, etc. Better estimates of these parameters will improve our understanding of the mechanisms and processes that control terrestrial CO_2 fluxes. We present our strategy for assimilating observed CO_2 concentration, our model development status, and preliminary results from data assimilation of observed CO_2 flux from the WLEF tall tower in Wisconsin (Figure 1).

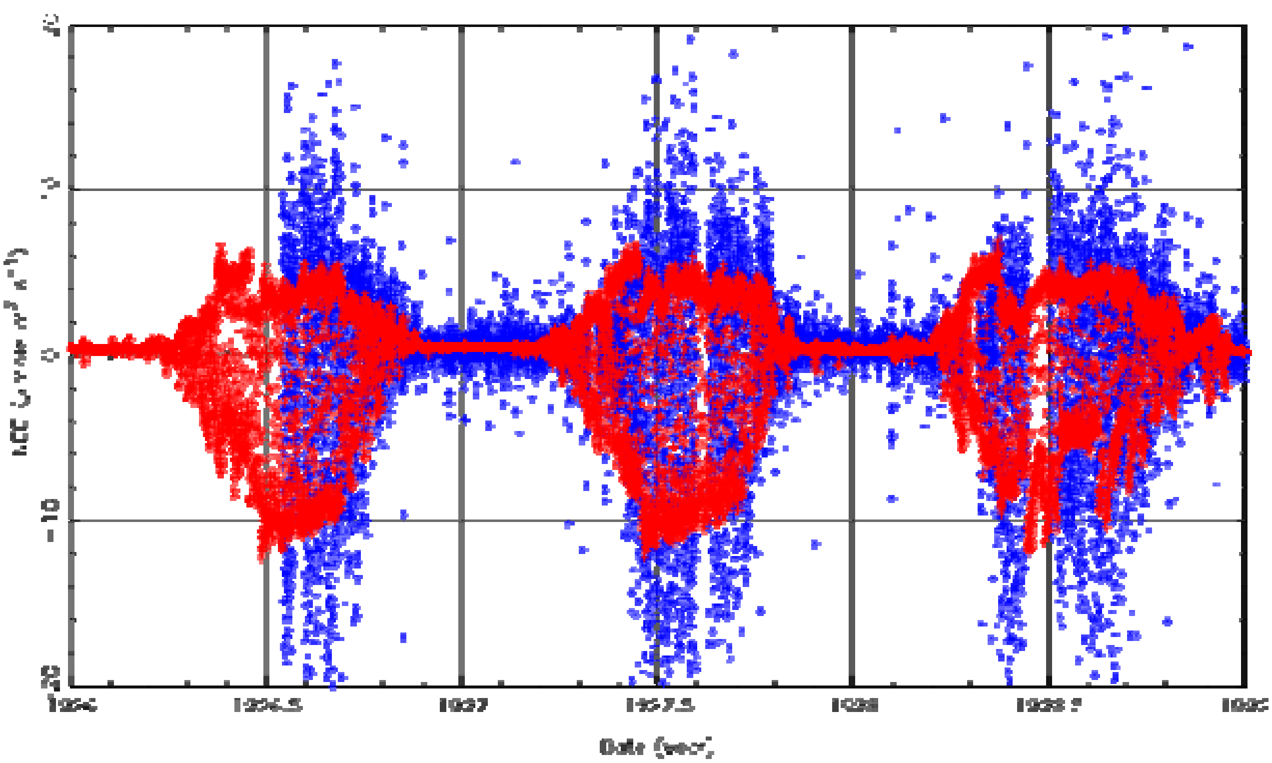

Figure 1. Hourly average observed (blue) and modeled (red) Net Ecosystem Exchange (NEE) at the WLEF tall tower in Wisconsin. Positive NEE indicates a net carbon flux into the atmosphere. Small respiration rates and no photosynthesis results in slightly positive NEE in winter. In summer, NEE is negative during the day due to photosynthesis and positive at night due to respiration, resulting in a strong diurnal cycle which, when plotted at an hourly time scale, produces the characteristic "Mick Jagger" pattern. Our new SibCasa model combines the enzyme kinetic photosynthesis calculations from the Simple Biosphere (SiB) model with the detailed biogeochemistry from the Carnegie-Ames-Stanford Approach (CASA) model.