Sensitivity of Carbon Flux Estimates to Past, Present, and Future Observational Networks

L.M. Bruhwiler[1], A.M. Michalak[1,2], and W. Peters[1,3]

[1]NOAA Climate Monitoring and Diagnostics Laboratory, 325 Broadway, Boulder, CO 80305;
303-497-6921; Fax: 303-497-6290; E-mail: Lori.Bruhwiler@noaa.gov
[2]UCAR Visiting Scientist Program, Boulder, CO 80307
[3]Cooperative Institute for Research in Environmental Sciences, University of Colorado, Boulder 80309

Fluxes of long-lived atmospheric species may be estimated using network observations, an atmospheric transport model, and an inverse technique. The resulting fluxes for a chosen distribution of emission regions provide the best fit to the observations given the modeled transport. Currently, the CDML Cooperative Air Sampling Network is too sparse to adequately constrain the observations, although coverage is good over certain regions, such as North America. The flux estimates for poorly constrained regions tend to be noisy and unrealistic for the case where no a priori flux estimates are used. If priors are used, the resulting flux estimates are essentially unchanged from the priors for unconstrained regions.

In this study we show the effects of the expansion of the observational network on carbon dioxide flux estimates from 1985 to 2002. In 1985 there were only about 25 observation sites. Over the past few years the number of sites has grown to over 100. As a result, the estimated error of the fluxes has decreased substantially in many regions. On the other hand, many recently added sites are located where they sample continental air and may be sensitive to spatial and horizontal variability in local fluxes that is not adequately resolved by the transport model. In addition, the continental boundary layer is difficult for the transport model to simulate because of the importance of subgrid scale mixing processes. It is clear that as more sites are added over continental regions, the simulations of the continental boundary layer in models will need to improve. Furthermore, higher resolution will be necessary to take full advantage of the network expansion, especially for North America and Europe where sampling will be most dense.