Title: NASA's Carbon Monitoring System Flux-Pilot Project: A Multi-Component Analysis System for Carbon-Cycle Research and Monitoring

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Abstract

The importance of greenhouse gas increases for climate motivates NASA's observing strategy for CO2 from space, including the forthcoming Orbiting Carbon Observatory (OCO-2) mission. Carbon cycle monitoring, including attribution of atmospheric concentrations to regional emissions and uptake, requires a robust modeling and analysis infrastructure to optimally extract information from the observations. NASA's Carbon-Monitoring System "Flux-Pilot Project" (FPP) is a prototype for such analysis, combining a set of unique tools to facilitate analysis of atmospheric CO2 along with fluxes between the atmosphere and the terrestrial biosphere or ocean. NASA's analysis system is unique, in that it combines information and expertise from the land, oceanic, and atmospheric branches of the carbon cycle and includes some estimates of uncertainty. Numerous existing space-based missions provide information of relevance to the carbon cycle. This study describes the components of the FPP framework, assessing the realism of computed fluxes, thus providing the basis for research and monitoring applications. Fluxes are computed using data-constrained terrestrial biosphere models and physical ocean models, driven by atmospheric observations and assimilating ocean-color information. Use of two estimates provides a measure of uncertainty in the fluxes. Along with inventories of other emissions, these data-derived fluxes are used in transport models to assess their consistency with atmospheric CO2 observations. Closure is achieved by using a four-dimensional data assimilation (inverse) approach that adjusts the terrestrial biosphere fluxes to make them consistent with the atmospheric CO2 observations. Results will be shown, illustrating the year-to-year variations in land biospheric and oceanic fluxes computed in the FPP. The signals of these surface-flux variations on atmospheric CO2 will be isolated using forward modeling tools, which also incorporate estimates of transport error. The results will be discussed in the context of interannual variability of observed atmospheric CO2 distributions.