Sacks, W.J., D.S. Schimel, and R.K. Monson (2007). Coupling between carbon cycling and climate in a high-elevation, subalpine forest: a model-data fusion analysis. OECOLOGIA 151 (1): 54-68

Abstract:

Fundamental questions exist about the effects of climate on terrestrial net ecosystem CO2 exchange (NEE), despite a rapidly growing body of flux observations. One strategy to clarify ecosystem climate-carbon interactions is to partition NEE into its component fluxes, gross ecosystem CO2 exchange (GEE) and ecosystem respiration (RE), and evaluate the responses to climate of each component flux. We separated observed NEE into optimized estimates of GEE and RE using an ecosystem process model combined with six years of continuous flux data from the Niwot Ridge AmeriFlux site. In order to gain further insight into the processes underlying NEE, we partitioned RE into its components: heterotrophic (RH) and autotrophic (RA) respiration. We were successful in separating GEE and RE, but less successful in accurately partitioning RE into RA and RH. Our failure in partitioning RE was due to a lack of adequate contrasts in the assimilated data set to distinguish between RA and RH. We performed most model runs at a twice-daily time step. Optimizing on daily-aggregated data severely degraded the model's ability to separate GEE and RE. However, we gained little benefit from using a half-hourly time step.

The model-data fusion showed that most of the interannual variability in NEE was due to variability in GEE, and not RE. In contrast to several previous studies in other ecosystems, we found that longer growing seasons at Niwot Ridge were correlated with less net CO2 uptake, due to a decrease of available snow-melt water during the late springtime photosynthetic period. Warmer springtime temperatures resulted in increased net CO2 uptake only if adequate moisture was available; when warmer springtime conditions led into mid-summer drought, the annual net uptake declined.