Effect of spring onset and autumn senescence date on forest-atmosphere CO_2 exchange: A multi site FLUXNET synthesis

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Motivation:
Phenology is generally assumed to represent a major control on spatial and temporal variation in biologically-mediated sources and sinks of C. Understanding these patterns is crucial given that phenology has been shown to be sensitive to short- and long-term variation in climate, particularly interannual variation in spring temperature, as well as recent warming trends.

Cross-site studies give strong support for the idea that increases in growing season length are correlated with increases in productivity and/or carbon sequestration (e.g. Baldocchi et al., 2001; Churkina et al., 2005). However, within individual sites, data from Howland and Harvard AmeriFlux sites suggests that the relationship between spring onset dates and annual NEE, GPP or Reco tends to be quite weak (Richardson et al., in preparation). A related study has suggested that warmer temperatures at high latitudes have resulted in enhanced C losses, rather than enhanced uptake, in high-latitude ecosystems over the last 15 years (Piao et al., in review). Thus the role of climatically-mediated variation in phenology in regulating interannual variation in C exchange is unclear.

Proposal:
We propose to conduct a synthetic analysis using data from the FLUXNET database to evaluate how both across- and within-site variation in annual C exchange (both NEE and the fluxes of the component processes, GPP and Reco) is regulated by spring and autumn phenology. We will use both physiological measures of spring and autumn onset (source/sink transition, onset of photosynthetic uptake, threshold values of Amax, changes in Bowen ratio or evaporative fraction, etc) as well as climatic (accumulated degree days) and optical (based on changes in the canopy albedo or canopy transmittance) measures.

Analysis of the flux data will be complemented by a comparison with predictions of the ORCHIDEE model (Piao et al., in review), which will be run using long-term climate data for the pixel closest to each flux site. We will compare spring onset measures derived from flux tower data with those from a new phenology product derived from satellite archives i.e. AVHRR (1980-1999) and MODIS (2000-present) (Maignan, Breon et al., accepted).

Data:
We will use only sites for which 5 or more years of data are available. We will focus primarily on data from forested (both conifer and deciduous) and grassland sites in temperate and boreal regions (i.e., sites with a pronounced "summer active" and "winter dormant" period). Data from other ecosystems with strong seasonal cycles (e.g.,

Mediterranean or seasonally dry tropical systems) will also be analyzed, provided first that enough site-years of data are available in the final data base, and second that robust indicators of dormant/active season transitions can be developed.

Authorship policy:
All data contributors making an intellectual contribution will be included as named coauthors. Data contributors not making an intellectual contribution will be included as group coauthors in the author list, if possible with the journal (likely Global Change Biology)--i.e., "and the FLUXNET Synthesis Group". Group coauthors will be identified by name in the acknowledgements.