

PROPOSAL FOR FLUXNET SYNTHESIS PUBLICATION



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DATASET PROPOSED

LaThuile

TITLE OF PAPER AND OUTLINE

Using FLUXNET to assess the sensitivity of land-atmosphere carbon exchange to climate variability

Although coupled climate–carbon cycle studies, e.g., CMIP4 [Friedlingstein et al., 2006], have provided key insights into the sensitivity of carbon fluxes to climatic fields, large uncertainties still remain. Importantly, an observationally-based attribution of land sink variability to discrete environmental drivers is missing. Building on the work by Schwalm and co-authors [Schwalm et al., 2009, 2011a,b], we propose to use FLUXNET data to estimate the sensitivity of carbon fluxes to climatic drivers.

Sensitivities express a change in carbon flux relative to a unit change in climatic driver. The proposed methodology, used in Schwalm et al. [2009], for calculating these sensitivities is outlined below:

1. Before calculating sensitivities, half-hourly site-specific eddy covariance carbon flux data will be corrected for storage, despiked, u^* -filtered, and gap-filled, and integrated to obtain monthly values.
2. The corrected and filtered monthly flux time series are then normalized to have a mean of zero and a variance of one (z-score transformation).
3. Step 2 is repeated for site-specific meteorological measurements.
4. Monthly standardized anomalies will be grouped by climatic season (winter, spring, summer, and fall) and site-specific land-cover class using the International Geosphere Biosphere Program (IGBP) classification.
5. Within each land-cover class and climatic season, the standardized flux anomaly will then be regressed on the standardized anomaly of the environmental driver of interest.
6. Within each land-cover class and climatic season, these dimensionless values (i.e., the slope) will be transformed into flux sensitivities ($\text{g C/m}^2/\text{month}/\sigma$), using the standard deviation (σ) of carbon flux. These flux sensitivities represent the change in flux relative to a unit change in climatic driver expressed in σ units.

This proposed paper will extend the work of Schwalm and co-authors [Schwalm et al., 2009, 2011a,b]. This previous work focused solely on evaporative fraction and emphasized NEE (GPP and TER were treated tangentially) on the monthly time step

and only in the context of droughts and El Niño events. We propose here to consider air temperature (T_{air}), humidity (h), and downwelling shortwave flux (SW). We will also use evaporative fraction as in Schwalm et al. [2009]. This is necessary as the climatic drivers are correlated such that the sensitivities must take the covariance matrix across all climatic drivers into account. In addition to this we will derive sub-monthly sensitivities: 8 and 16-day to interface with MODIS products. The key contribution of this paper will be an observationally-based mapping of the climate-mediated interannual changes in the land sink, as well as the gross fluxes, to discrete climatic drivers. That is, we will provide land cover class-specific estimates of the changes in carbon flux in $gC/m^2/time$ relative to a unit change in all listed climatic drivers. The unit change of a given climatic driver is the observed standard deviation over the period of record.

Note: A companion paper emulating the same approach but using remotely sensed vegetation indices in lieu of tower-based fields is also envisioned and will be submitted at a later date.

Friedlingstein, P et al. (2006), Climate-carbon cycle feedback analysis: Results from the (CMIP)-M-4 model intercomparison, *J. Clim.*, 19(14), 3337-3353.

Schwalm CR (2009) Assimilation exceeds respiration sensitivity to drought: A FLUXNET synthesis. *Global Change Biology*, 16, 657-670.

Schwalm CR et al. (2011a) Does terrestrial drought explain global CO₂ flux anomalies induced by El Niño? *Biogeosciences.*, 8, 1-14, doi:10.5194/bg-8-1-2011.

Schwalm CR et al. (2011b) Carbon consequences of global hydrologic change, 1948-2009, *J. Geophys. Res.*, 116, G03042, doi:10.1029/2011JG001674.

PROPOSED SITES TO BE INVOLVED

The proposal has a global focus. All sites where at 8-day summaries can be computed according to QA/QC guidelines (e.g., fcqok) will be considered for this proposed study.

PROPOSED RULES FOR CO-AUTHORSHIP

Group co-authorship will be included as described in the La Thuile data policy. Co-authorship may also be granted to individual PIs that contribute directly to the intellectual development of the project.