PROPOSAL FOR FLUXNET SYNTHESIS PUBLICATION

Initial coordinators:: Collaborators needing access to data:

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DATASET PROPOSED

LaThuile and it's 2013/2014 successor

TITLE OF PAPER AND OUTLINE

TITLE

Assessing long-term changes in terrestrial carbon and water cycling, and their coupling through ecosystem water use efficiency.

Description

Carbon and water cycles, and their coupling through plant water use efficiency, are strongly affected by atmospheric composition and climate, both of which have changed significantly in recent decades. It is therefore reasonable to expect that the terrestrial biosphere is not in equilibrium, and that both carbon and water cycling may exhibit long-term trends associated with changes in the earth system.

Indeed, as the flux-data record extends, long-term trends in forest carbon and water cycling are emerging that demand investigation (Dragoni et al. 2011, Pilegaard et al. 2011, Keenan et al. 2012, Keenan et al., in press, Keenan et al., in prep.). Different hypothesis exist to explain these long-term trends, including CO_2 fertilization, direct effects of climate change, indirect effects of climate change, such as changes in phenology, changes in stand structure, and changes in nitrogen deposition and nutrient cycling, to name but a few.

In this proposal, we build on previous work (NOAA project (2011-2014): "Assessing long term changes in carbon cycling in the Northeastern USA") to analyse direct, long-term measurements of whole ecosystem carbon and water exchange across a variety of ecosystems worldwide. Previously, long-term changes in carbon and water cycling were attributed to CO_2 fertilization (Keenan et al., in press) and changes in phenology (Keenan et al., in prep.). These studies used freely available data from a limited number of forested

FLUXNET sites and important open questions remain as to what extent the results apply to different biomes around the world.

The current proposal will expand previous work by merging all available data in the FLUXNET dataset with a variety of different data sources (remote sensing, atmospheric chemistry and ancillary site information). The overall goal is to identify global long-term trends and patterns in ecosystem carbon uptake and water use (and thereby water use efficiency), scale those trends using empirical and process-based upscaling techniques, and evaluate the ability of current state-of-the-science models to reproduce them. An integral part of the proposal focuses on testing a variety of hypothesis with the aim of identifying what aspects of ecosystem function are directly responsible for the observed trends. This will lead to greatly improved understanding of long-term dynamics in the terrestrial biosphere, and test the ability of models to reproduce those dynamics. Importantly, the results will highlight the utility of long-term FLUXNET observations, capable of providing unprecedented information on long-term dynamics.

PROPOSED SITES TO BE INVOLVED

List of sites or criteria.

All sites in the La Thuile dataset (or it's successor if otherwise named) with five or more years of available data.

PROPOSED RULES FOR CO-AUTHORSHIP

What is requested to the PIs to be coauthor

We will follow the rules as proposed in the disclaimer for the FLUXNET2007 synthesis/La Thuille dataset (http://www.fluxdata.org/Shared%20Documents/Policy_LaThuile_Final.pdf.)

Literature cited:

Dragoni, D., H. P. Schmid, C. A. Wayson, H. Potter, C. S. B. Grimmond, and J. C. Randolph. 2011. Evidence of increased net ecosystem productivity associated with a longer vegetated season in a deciduous forest in south-central Indiana , USA. **Global Change Biology** 17:886–897.

Keenan, T. F., E. Davidson, A. M. Moffat, W. Munger, and A. D. Richardson. 2012. Using model-data fusion to interpret past trends, and quantify uncertainties in future projections, of terrestrial ecosystem carbon cycling. **Global Change Biology** 18:2555–2569.

Keenan, T.F., Hollinger, D., Bohrer, G., Dragoni, D., Munger, J.W., Schmid, H.P., Richardson,

A.D., 2013 Increasing forest water use efficiency as atmospheric CO2 levels rise. **Nature** (in press).

Keenan, T.F., Richardson A.D., et al., (in prep.) Long-term Increase in carbon storage in the northeast US due to changes in phenology.

Pilegaard, K., A. Ibrom, M. S. Courtney, P. Hummelshøj, and N. O. Jensen. 2011. Increasing net CO2 uptake by a Danish beech forest during the period from 1996 to 2009. **Agricultural and Forest Meteorology** 151:934–946.