PROPOSAL FOR FLUXNET SYNTHESIS PUBLICATION

Initial coordinators:: Dave Bowling, Michael Bahn

Collaborators needing access to data: to be determined

Affiliations: University of Utah, University of Innsbruck

DATASET PROPOSED

LaThuile

TITLE OF PAPER AND OUTLINE

Synthesis of land-atmosphere carbon and water fluxes in seasonally snow-covered forests

see attached for description

PROPOSED SITES TO BE INVOLVED

see attached for list of sites

PROPOSED RULES FOR CO-AUTHORSHIP

What is requested to the PIs to be coauthor:

We expect that co-authors will make intellectual contributions to the analysis or interpretation (beyond providing data). We will of course adhere to the guidelines in the La Thuile Data Policy.

NB: add the CV of the proposers:

Please see attached CVs.

Synthesis of land-atmosphere carbon and water fluxes in seasonally snow-covered forests

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Climate warming is changing the nature of seasonal snow cover in many areas of the globe: the length of the snow-free season is increasing, spring snowmelt and runoff occur earlier, and a greater fraction of winter and spring precipitation falls as rain rather than snow. Climate models suggest that these trends will continue and perhaps intensify.

Seasonal snow cover is an important controller of ecosystem processes, and as climate changes there will likely be important changes to land-atmosphere carbon and water exchange. Here we will examine the influence of seasonal snow cover on biosphere-atmosphere exchange of carbon and water, focusing on both the snow-covered and snow-free seasons. We will focus on two questions.

1) How does snow cover influence ecosystem respiration during the winter?
2) How does snow cover influence ecosystem carbon cycling during the summer?

Our work will initially be guided by the following hypotheses, which we will examine across as broad a range of sites as possible. These hypotheses conflict to some extent with each other, and all have some degree of support from previous studies. Central to our analysis will be examination of the legacy effects that may link the snow-covered and snow-free seasons (for example, winter conditions influence winter processes and also summer processes).

1) Brooks et al. (2011) presented a conceptual framework for heterotrophic activity in winter as a function of snow cover duration. This model suggests that shallow, intermittent snow cover limits activity through reduced soil temperature and moisture, and deeper, longer snow cover provides a more favorable environment enhancing activity. However, carbon limitation of the subnivean microbial community likely leads to decreased activity with very long winters.

2) Haei et al. (2013) showed that intensified soil freezing in winter can lead to enhanced dissolved organic carbon supply and associated heterotrophic respiration in summer. However, this increase was offset by reduced autotrophic or rhizospheric respiration.

3) Muhr et al. (2009) showed that soil frost, associated with reduced snow cover, can increase sensitivity of (soil) respiration to summer drought.

4) Hu et al. (2010) showed that the timing of plant physiological activity can be decoupled from the timing of precipitation: winter snow provides the water for summer transpiration in water-limited conifer forests. This leads to lower summer net carbon gain following shorter winters. This contrasts with deciduous forests,

where more time with leaves in a longer growing season leads to greater net carbon gain over the summer (Goulden et al. 1996).

Expected timeline:
Spring 2016 – Identify appropriate flux tower sites, identify snowpack-related data sets, and contact collaborators.
Summer 2016 – In depth analysis with a subset of sites with longest records and most favorable data availability.
Fall 2016 – Expand analysis to as many sites as possible.
Spring 2017 – Present results at EGU General Assembly.
Summer 2017 – Submit papers for publication.

Sites to be used:
We will focus our analysis on forested FLUXNET sites in the northern hemisphere, and intend to work with data from as many sites as possible. We would like to use the LaThuile dataset.

At this stage we are uncertain which sites will have suitable data availability. In particular, we anticipate the need for observations of snow water equivalent (SWE) which may limit the number of suitable sites. Snow cover may be suitable for some analyses.

Snow data sets:
In western North America we will take advantage of the USDA/NRCS Snow Survey Program and Provincial Snow Surveys in Canada that provide direct observations of SWE. In Europe we will seek snow survey information at the national and regional levels (e.g. MeteoSwiss, HISTALP). We will investigate the variety of snow data products available (GlobSnow2, European Environment Agency, European Climate Assessment, NOAA Snow and Ice Products, AMSR-E/Aqua L3 Global Snow Water Equivalent, etc.).

Finally, we have examined the list of existing FLUXNET synthesis projects to check for competing projects. A project by Shilong Piao, P. Ciais, M. Reichstein, and S. Luyssaert titled "Effect of snow change on the C balance in various northern ecosystems: a synthesis based on Fluxnet data" is listed. We have contacted these scientists and they informed us that their analysis is now complete and they don't see any conflict with their current research. The primary result from that work was the paper of Wang et al. (2011). We hope to engage these colleagues directly as we move ahead.

References

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