PROPOSAL FOR FLUXNET SYNTHESIS PUBLICATION

Coordinator	Christian Beer
Collaborators needing access to data	Dennis Baldocchi, Christian Bernhofer, Nina Buchmann, Philippe Ciais, Alexander Knohl, Barbara Köstner, Werner Kutsch, Markus Reichstein, Jean-Francois Soussana, Christopher Williams
Affiliations	Max-Planck-Institute for Biogeochemistry, ETH Zürich, CEA – LSCE, University of Dresden, Equipe Fonctionnement et Gestion de l'Ecosyséme Prairial INRA, Colorado State University, Policy and Management University of California

TITLE OF PAPER AND OUTLINE

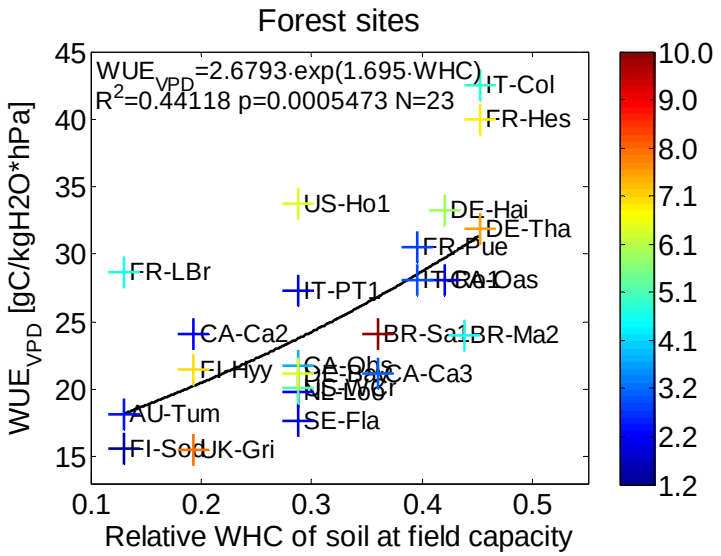
Which environmental factors determine temporal and spatial variability of water-use efficiency on ecosystem level?

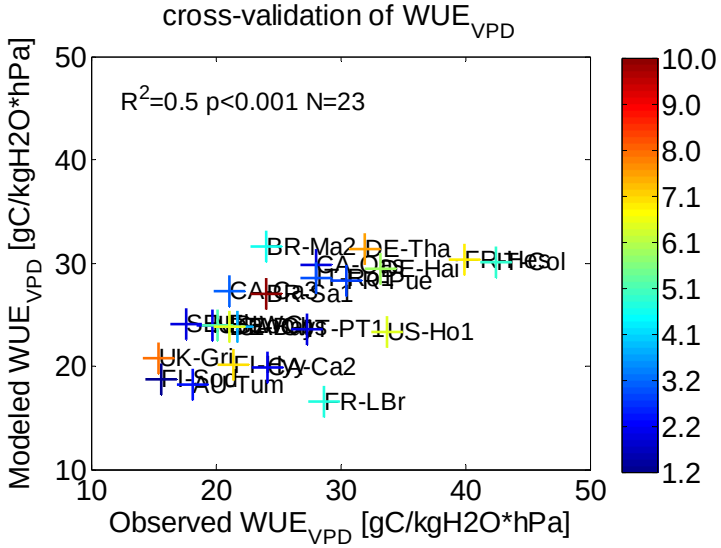
The water-use efficiency concept is built upon the assumption that carbon assimilation per unit water loss or per stomatal conductance (intrinsic water use efficiency) depends either on vapor pressure deficit or c_i/c_a mediated through stomatal aperture. In the first part of this global-scale synthesis paper, we want to examine if this leaf-level functionality holds true (i) at the ecosystem level and (ii) despite the integrated measurements of transpiration and soil evaporation by the eddy covariance technique. Proposed temporal scale would be daily to annual, but maybe analyses of half-hourly measurements will be needed as well. Then, we want to investigate the between-site variability of VPD-corrected WUE (WUE*VPD) on an annual time scale.

In more detail, we want to address the following topics:

1. Which environmental factors determine temporal dynamics of WUE, c_i/c_a and canopy conductance?
2. Does intrinsic water-use efficiency increase with drought?
3. Which hydrological property/ratio relates best to GPP?
4. Characterization of between-site variability of WUE*VPD. Which processes and environmental factors are responsible for differences in annual WUE*VPD among sites and biomes? Here, more ancillary information like isotope discrimination is planned to contribute.
    a. Differences due to species?
    b. Role of vegetation adaptation to environmental conditions like specific leaf area or rooting depth.
    c. Role of plant properties/processes, i.e. role of assimilation.
    d. Differences due to climatic zones?
    e. Role of soil properties/processes, i.e. role of evaporation.
    f. Differences in annual WUE and rain-use efficiency among sites and biomes?
    g. Impact of management practice on annual WUE*VPD of grasslands and croplands?

5. Empirical modeling of annual WUE*VPD, e.g. by predictors like LAI and soil properties as shown in Beer *et al.* (2007), Geophysical Research Letters, L05401. We also like to investigate the dependency of WUE*VPD to leaf nitrogen content. Preliminary results:





Here, water-holding capacity relative to field capacity is meant as a mean of the mineral soil layers.

Understanding of the above mentioned carbon-water relation is important for assessing the response of ecosystems to climate change, e.g. drought (temporal dimension). It can provide insights into adaptation strategies of vegetation to environmental change. In addition, the understanding of spatial variability of annual water-use efficiency will provide opportunities for utilizing the water balance to estimate GPP at the global scale (as was shown for Europe in Beer *et al.* (2007), GRL 34, L05401).

PROPOSED SITES TO BE INVOLVED

We would like to include all sites containing

- at least 1 full year of flux and meteorological data and
- with correlation coefficient between daily GPP*VPD and ET of 0.5 (herbaceous) or 0.8 (woody) or higher.

REQUIRED DATA

We would like to explore latent energy, net ecosystem exchange and derived gross primary productivity, soil moisture and meteorological variables at daily to annual time scale as well as auxiliary information about the state of the ecosystem like soil texture type, leaf nitrogen content and leaf area index. We propose to use analyses of delta ^{13}C in addition to eddy covariance measurements. Analyses of half-hourly LE and NEE data in conjunction with meteorological variables may be of interest as well.

PROPOSED RULES FOR CO-AUTHORSHIP

The rules as proposed in the disclaimer for the FLUXNET2007 synthesis will be applied. We are aware of already published results by Ponton et al. (2006), GCB 12, 294-310 and Lai et al. (2005), GCB 11, 633–643 and like to collaborate with them.