

## PROPOSAL FOR FLUXNET SYNTHESIS PUBLICATION



<b>Initial coordinator:</b>	Miguel Mahecha (1), Markus Reichstein(1)
<b>Collaborator needing access to data:</b>	Nuno Carvalhais (2)
<b>Collaborators on theoretical work (no data access):</b>	Holger Lange (3)
<b>Affiliations:</b>	(1) Max-Planck-Institute for Biogeochemistry, Jena, Germany (2) Department of Environmental Sciences and Engineering, Faculty of Sciences and Technology, New University of Lisbon, Portugal (3) Norwegian Forest and Landscape Institute, Ås, Norway

### TITLE OF PAPER AND OUTLINE

#### **Extraction and quantification of hysteretic behavior and phase synchronizations at different time scales in ecosystem-atmosphere fluxes inferred from a global network of eddy covariance flux sites**

This study aims at identifying and quantifying phase synchronizations as well as hysteretic behavior of ecosystem-atmosphere carbon, water, and energy fluxes, as well as on derived variables. This should lead to a synthesis paper, reporting such nonlinear ecosystem-atmosphere interactions relevant on global scales.

**METHODS:** Extraction and projecting the time series to temporal scales will be achieved by applying advanced spectral methods, e.g., SSA which has proved to be very useful for “empirical variance partitioning” in flux time series (Mahecha et al. 2007) or still unexplored methods, e.g., EMD (Huang et al., 1998).

**RESEARCH QUESTIONS:** The paper will focus on answering both methodological questions on how to identify, extract and quantify unexpected (nonlinear) cross relationships from ecosystem fluxes, as well as on ecophysiological questions at global scales. While the first problem concerns data mining and machine learning, the latter will involve a whole set of questions which are listed here in detail:

- I. To what extent and on which temporal scales do phase synchronizations and hysteretic behavior shape ecosystem-atmosphere carbon, water, and energy fluxes? Does this differ between different ecosystem types?
- II. Can we identify large scale (spatial) gradients which influence these nonlinear phenomena?

- III. To which extent are nonlinear time series patterns directly related to eco-physiological processes and where do emerging patterns remain unexplained by means of our knowledge on ecosystem functioning?
- IV. Are climate induced global scale variations of flux data detectable by means of nonlinear time series analysis and can we identify atmospheric tele-connections on intermediate spatio-temporal scales?

#### PROPOSED SITES TO BE INVOLVED

All sites containing at least 5 full years of flux and meteorological data may be considered for this analysis.

#### PROPOSED RULES FOR CO-AUTHORSHIP

The rules as proposed in the disclaimer for the FLUXNET2007 synthesis will be applied.

#### REFERENCES

Huang, N.E., Shen, Z., Long, S.R., Wu, M.C., Shih, H.H., Zheng, Q., Yen, N.C., Tung, C.C. and Liu, H.H. (1998) *The Empirical Mode Decomposition and the Hilbert spectrum for nonlinear and nonstationary time series analysis*. Proceedings of the Royal Society of London, Series A, 454, 903-995.

Mahecha, M.D., Reichstein, M., Lange, H., Carvalhais, N., Bernhofer, C., Grünwald, T., Papale, D., and Seufert, G. (2007) *Characterizing ecosystem-atmosphere interactions from short to interannual time scales*. Biogeosciences Discussions, 4, 1405-1435.