

PROPOSAL FOR FLUXNET SYNTHESIS PUBLICATION



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DATASET PROPOSED

Open Access LaThuille or its 2014-2015 Synthesis Analogy as available

TITLE OF PAPER AND OUTLINE

TITLE: Dynamical sensitivity of terrestrial eco-climate systems to climate forcings: Global eco-climate Process Network Modeling at FLUXNET sites

Key words: eddy covariance measurements; dynamical process network; eco-climate system sensitivity model; climate change; FLUXNET

Problem motivation:

1. We want to apply our theoretically novel Dynamical Process Network (DPN) approach to model the sensitivity of global ecosystems to climate change. The model depends on the availability of flux tower data. Preliminary work suggests that the model needs to be trained individually for each different ecosystem functional type. We therefore need access to flux tower data for as many ecosystem functional types as possible, in order to develop a more general model. In future work we intend to apply the model using global climate model forecasts to predict the vulnerability of ecosystems to future climate changes.

General Research Questions:

Main question: can we create a predictive map or a set of maps on the sensitivity of integrated eco-climate systems to climate change at the global scale based on our previous work?

- a. What are the differences and similarities between the DPNs of PFTs (or ecoregions)?
- b. What kind of role does each factor (air temperature, precipitation, EVI) play in the DPN of each individual ecosystems and each PFT (or ecoregion)?
- c. Are there relationships between the coefficients (and elasticities) of each climate forcings and phenological variables and PFT, latitude, and elevation?
- d. Is it possible to use DPN-based modeling to predict transition from one PFT to another?

Data:

1. FLUXNET data: net ecosystem exchange of CO₂, air temperature, precipitation, possibly other energy balance observations, probably using the 1 hour resolution as it has higher availability than 30 minute resolution (40% data available for 30 minute data and 80% data available for 1 hour data)
2. MODIS EVI and remote sensing subsets from ORNL-DAAC
3. Site description data including PFT, latitude, elevation, disturbance, etc.

Methods:

1. Dynamical process network (DPN) of information flow based on dynamical time series data: calculate the DPN for eco-climate system at each available flux site. These DPNs will focus on two main couplings: from air temperature to NEE and from precipitation to NEE. See Ruddell and Kumar (2009) in Water Resource Research for background.
2. Eco-climate system sensitivity model: a. statistically model the DPN for each site and month/season; b. examine the relationships between the coefficients (and elasticities) of each climate forcings and phenological variables and PFT, latitude, longitude, and altitude; c. produce the site-specific map (or extrapolate to all terrestrial ecosystem)

PROPOSED SITES TO BE INVOLVED

List of sites or criteria.

IGBP class: All classes

Years of data: All years available

Has phenology camera: It does not matter

Disturbance: It does not matter

Variables needed: net ecosystem exchange of CO₂, air temperature, precipitation, possibly other standard eddy covariance data

Data availability: 40% data available for 30 minute data and 80% data available for 1 hour data

PROPOSED RULES FOR CO-AUTHORSHIP

Co-authorship can be extended to the PIs who provide an intellectual contribution for

the study or work with us to perform analysis and writing tasks. We are particularly interested in intellectual contributions regarding statistical modeling, phenology, and global climate model forecast and output. PIs are welcome to contact us if they want to work on the project.

This is a theoretical cross-PFT analysis of the open network dataset using a novel but untested systems approach that is dissimilar in purpose to the primary motivation and purpose of eddy-covariance sites. It is intellectually distinct from the network's primary scientific goals. As such, PIs of individual sites are not automatically included as coauthors.