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Seasonal variation in ecosystem parameters derived from FLUXNET data

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The carbon dioxide sink is related in a complex way to weather and climate. In order to better understand the relationship and feedbacks, we present a methodology to simulate observed carbon dioxide flux data with a simple vegetation model (5PM) with weekly varying model parameters. The model parameters explain the interaction between vegetation and seasonal climate more general than the flux data. Two parameters (R_{ref} and E_0) are related to ecosystem respiration and three parameters (J_m, λ and α) to photosynthesis and transpiration. We quantified the weekly variability of ecosystem parameters as a function of vegetation type and climate region.

The objective of this paper is to quantify the short term variability of ecosystem parameters of different vegetation types and climate regions. Specific questions we want to address: (1) are the model parameters clearly different between PFTs and (2) do the model parameters vary in an understandable way and (3) does the variation in model parameters have implications for our understanding of the feedback between vegetation and climate?

After statistical quality checks, 122 FLUXNET sites were available for analysis of the weekly varying model parameters. The simulations of these sites have high correlation coefficients (r^2 = 0.6 to 0.8) between the observed and simulated carbon and water fluxes. With weekly parameters we determined average seasonal cycles for the different combinations of vegetation type and climate regions (PFTs). The variation between PFTs is large, which provides an excellent dataset to study the differences in ecosystem characteristics. In general we observed that needleleaf forests and grasslands in warmer climates have relatively constant parameter values during the year. Broadleaf forests in all climate regions have large seasonal variation for each of the five parameters. In boreal regions parameter values are always lower than in temperate regions.

A large seasonality of the model parameters indicates a strong relation between vegetation and climate. This suggests that climate change will have the largest impact on the terrestrial carbon fluxes in boreal regions and for deciduous forests, and less for grasslands and evergreen forests.