Biogeosciences Discuss., 8, C3428–C3431, 2011
www.biogeosciences-discuss.net/8/C3428/2011/

Biogeosciences Discussions

Interactive comment on "Effects of climate variability and functional changes on the interannual variation of the carbon balance in a temperate deciduous forest" *by* J. Wu et al.

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Received and published: 4 October 2011

Reply to Reviewer # 2 Ref: bgd-8-C3220-2011-supplement.pdf

We thank reviewer #2 (R#2) for their comments and feel we should respond directly to resolve and clarify our different opinions on the application of empirical models and the interpretation of parameter variability. The critiques that we aim to clarify in this first response are:

1) Our study is only curve fitting 2) True parameters in a model should be constant and selection of model should aim to approach this ideal

Reviewer #2 concluded that the simple empirical model applied in this study has led to a flawed analysis as it lacks a detailed description of the processes which could be incorporated in a more ideal mechanistic model. Undoubtedly, we agree that mechanistic modeling is important for both process learning and future prediction. However, we also believe that models of lower complexity (e.g. empirical models) can be equally useful, depending on the scope and objective of the study.

The choice of the model was guided by the principle of using the simplest approach to achieve the purpose of the analysis. The objective of this study was to distinguish between the direct climatic and ecosystem internal effect on CO2 fluxes, rather than to explore underlying principles (e.g. what caused the internal functional change). To achieve this, we used an empirical model that incorporates the ecosystem response to climatic forcing (e.g. radiation, temperature and VPD) and changes in internal functional properties, which are represented by the parameters estimated within short moving windows. As indicated by R#2, the resulting high variation in the parameters could be reduced when more detailed processes are described in the model, e.g. by including changes in the leaf area index (LAI) in the model. However, this is not necessarily, because in our approach, the changes in LAI are considered to be a structural change and therefore part of the seasonal dynamics. These seasonal variations are consequently reflected in parameter changes, translating the role of ecosystem states behind the variability of CO2 fluxes. We agree that the parameter definitions need further clarification to avoid confusion with established concepts in dynamic ecosystem models, for example our parameter β (maximum photosynthetic capacity), actually represents the instantaneous maximum photosynthetic capacity at canopy level. While we accept that further clarification of the methodology and the parameter definitions is necessary, it is our opinion that, within the goals of this study, the selection model and the applied method are appropriate.

The ideal that parameters should be constant is found mostly in physical laws. When dealing with ecosystems research, working with constant parameters is often not fea-

sible. For instance, a large degree of variability is found in observations of Vcmax, the carboxylation rate, both between and within species, and over seasons (Kattge et al., 2011). Therefore, even in complex process-based models, keeping parameter constant over time is an over-simplification of the dynamics of nature. In our approach, allowing these parameters to change enabled us to represent phenological development in the model as an ecosystem internal property. Theoretically, if a parameter truly did stay constant, our model would show it rather than being constrained to a non-dynamic value. The parameter fitting methods we used are well established and based on published methodology (Lasslop et al. 2010). Consequently, we disagree with R#2's conclusion that our model is flawed.

We thank for R#2's more detailed comments, which we will carefully consider and address in a later reply or in a revision of our manuscript, where necessary. In this reply, we comment only on the initial misunderstandings that might have lead to a biased evaluation of our work and hope R#2 will reconsider his review, given the correspondence between the scope of the study and our choice of model.

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Interactive comment on Biogeosciences Discuss., 8, 9125, 2011.