Biogeosciences Discuss., 12, C2635–C2638, 2015
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Biogeosciences Discussions
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Interactive comment on "Responses of leaf traits to climatic gradients: adaptive variation vs. compositional shifts" *by* T.-T. Meng et al.

Anonymous Referee #1

Received and published: 8 June 2015

General comments

This paper addresses the issue of trait variability within plant functional types in relation to climate. The authors argue that most traits vary in relation to climatic gradients but that change occurs sometimes through trait change within PFTs, and sometimes through shifts in the occurrence and abundance of PFTs with innately different trait values. These ideas are not new and have been suggested and shown in various earlier papers, but the authors present an impressive dataset that is in my opinion more reliable than those upon which earlier analyses have been based. Other tests of trait-environment relationships at similar spatial scales often rely on data collated from multiple studies and environmental data of poorer quality than that used in this manuscript.

The manuscript is very well written and a pleasure to read. The research questions are clearly stated and clearly addressed by the data and analyses. I have few major criticisms, and most of my comments are merely suggestions that I believe would improve the quality and readability of the manuscript and do not point to major flaws in the methodology or interpretation.

There is only one major issue that I would like to see addressed in the manuscript before publication. My problem with most studies investigating trait-environment relationships is that despite identifying statistically significant relationships among environmental predictors and trait means, the ability to predict trait values from environmental forcing alone is often quite poor. That is, after accounting for the variance explained by the environmental predictors, and differences among PFTs, most of the trait variability still remains (there is overlap in the traits values observed at either extreme of the environmental gradient and in almost all PFTs). Given that vegetation models are attempting to simulate vegetation and biogeochemistry with these same environmental forcings alone – which account for so little of the observed trait variation – I think it is important to acknowledge limits to the predictability of the vegetation traits we actually observe when using only macroclimate and a few simple soil variables to force models and discuss other potential sources of variation (e.g. microclimatic variation, disturbance, heterogeneity, evolutionary constraint). Specifically I would like to see a paragraph highlighting these issues and some attempt at variance partitioning in the analyses that highlights the proportion of trait variation explained by climate, PFTs, and unexplained variation. I would also really like to see another plot, similar to figure 2, but with PFTs plotted in trait space to highlight to massive overlap in trait values among PFTs

Specific comments

Table 1 seems unnecessary. With most of the important information contained within it repeated in figure 1. I would suggest moving it to the Supplementary info

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DGVMs typically use Amax and Vcmax as parameters to describe photosynthetic rates. I understand that chlorophyll florescence offer advantages over Amax/Vcmax, but perhaps the authors should state this because otherwise it seems that it would have been more appropriate to measure parameters used by DGVMs.

It is not stated in the methods what the sampling unit is that is being analyzed. Are the GLMs applied to trait values of individual plants and the environmental variable at the site levels or (as is plotted in figure 3 and 4) species-level means?

I would be interested to know how the analyses look when they are repeated within- and –between species rather than PFTs. In terms of trait change along environmental gradients this is more relevant as species are real entities rather than PFTs which are the invention of modelers. There isn't room for this in this manuscript, which is focused on the utility of traits and PFTS for models, but I look forward to seeing this analysis in anther publication.

Does the entire PCA analysis of climate space in China and the climate space covered by the sites only exist to make the point that the sites cover a wide range of climate conditions that are representative of Chinese climate? This point seems to be adequately made in figure 1. I would suggest moving this analysis to the supporting information.

Please add some discussion of the confounding role of nutrients. Many of the traits included in this analysis would be expected to be profoundly altered by different soil nutrient conditions. It is understandable given the poor quality of most soil nutrient maps that this was not included as a predictor variable in the analysis, but I believe further discussion and an acknowledgment of their role should be included.

Technical corrections

In the discussion it is stated: "On the other hand, the LPJ-family models treat SLA as a PFT-specific parameter and thus do not allow for covariation of SLA with Narea." This is not true. Please see the recently published LPJml-FIT model:

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Sakschewski, B., von Bloh, W., Boit, A., Rammig, A., Kattge, J., Poorter, L., Peñuelas, J. and Thonicke, K. (2015), Leaf and stem economics spectra drive diversity of functional plant traits in a dynamic global vegetation model. Global Change Biology. doi: 10.1111/gcb.12870

Interactive comment on Biogeosciences Discuss., 12, 7093, 2015.