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## ***Interactive comment on “Thermal adaptation of net ecosystem exchange” by W. Yuan et al.***

**W. Yuan et al.**

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We are very grateful to the reviewer for the constructive comments. Here are our detailed responses to their comments. Please note that the comments from the reviewers are in bold followed by our responses in regular text.

General comment: The ms of Yuan et al. tackles the interesting objective how ecosystem net CO<sub>2</sub> exchange are controlled by temperature, thus in the long-run, carbon sequestration. The authors focus on 72 sites located within the Northern Hemisphere mainly covering deciduous broadleaved and evergreen needleleaf forests, plus few grasslands and shrublands. They find that threshold temperature  $T_b$  (ecosystem changes from source to sink) and optimum temperature  $T_o$  (NEE is maximum) decline with latitude, that both  $T$  values are related to other  $T$  surrogates. In generally, this manuscript is well written. There are a very few remaining ambiguities in the text

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and these should be addressed before publication. Thanks! We have carefully studied the comments and revised the manuscript accordingly, and please see the following responses.

1. Figs. 3 and 4 are rather redundant. Fig. 3 could be cut since even the authors state that latitude is strongly related to temperature. Thanks. We agree this comment and would like to remove the Fig. 3.

2. I do not understand the reasoning behind testing age effect. In the discussion, the authors conclude that "thermal adaptation is independent of flux magnitude" but they never give a reason why they expect a relationship. Thus, I suggest to cut this topic out of the mss. We investigated the impacts of stand age on the thermal response of NEE within seven adjacent forest sites following fire chronosequence (Fig. 5). Our results did not show significant differences of Tb and To among the ecosystems with the stand age from 30 to 160 years, suggesting that thermal environment is more important than successional stage in determining thermal optima. Two out of seven sites showed higher Tb and To partly because the vegetation was dominated by deciduous broadleaf seedlings and grasses. In generally, the reason for testing the age effect is to indicate that our conclusion about thermal adaptation of NEE is robust over the multiple sites. So, we would like to keep this topic in the revised manuscript.

3. The last part of the discussion about the use of To in DGVMs is still rather weak. While this would need much more space (and probably a different mss), I recommend to shorten this even more. Obviously, another mss has been submitted elsewhere probably going into much more details. The last paragraph is to discuss one of the importances of our results. Briefly, our results in this study indicate that we can use intrinsic physiological connections to constrain ecosystem models and also can evaluate the accuracy of these independent temperature functions across models. We introduced the major results from our unpublished manuscript on the implication of thermal adaptation of NEE. Probably, it is not necessary in this manuscript. So, we would like to cut this part at the revised manuscript (i.e. P12, L30 – P13, L6).

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Specific comments: 4. p.4 l.12 and l 14: Besides repeating “our results” you basically repeat the same what you already wrote from l.10. Thanks. We should remove the sentences (P4, L12 - 14) which are repeat with the previous sentences.

5. p.6 l.8 You refer to data from Ameriflux and Euroflux – were all sites included in the Fluxnet Database? And were the European sites only part of Euroflux? Otherwise you should mention CarboEurope and the national databases or you easily refer to the FluxnetDatabase, which I assume you were using. I am sorry that we download the flux data from Ameriflux and CarbonEuropeIP database. We should change “Euroflux” to “CarbonEuropeIP” at the revised manuscript, and update the relative information. We directly downloaded flux data from Ameriflux and CarboEuropeIP website. These sites are included in the FLUXNET database. However, FLUXNET has its own data policy, and it is not appropriate to refer the FLUXNET database.

6. p.6 l.110: 380 site-years of data – as already mentioned before. This is just a large number which always sounds impressive, but does not give any relevant information for the analysis done in the ms. Yes. We should add some basic information for selecting data criterion. Briefly, we directly download the data of about 100 eddy flux sites from Ameriflux and CarbonEuropeIP database. In this study, we selected the non-crop sites which include at least two years measurements. Eventually, 72 sites with 380 site years of data were included in this study.

7. p.6 l.16: remove the “-“ in online. Thanks. We should change the sentence “Supplementary information on the vegetation, climate, and soil of each site are available on-line.” to “Supplementary information on the vegetation, climate, and soil of each site are available online.”

8. p.7 l.1-2: Repetition of “Nonlinear regression methods”, also correct the grammar: use continuously the same tense, you are jumping from writing in the past, past perfect to present perfect. We should change the original sentence “Nonlinear regression methods were used to fill Fc data gaps (Falge et al., 2001). Nonlinear regression

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relationships between measured fluxes and controlling environmental variables were fit using a 15-day moving window.” to “Nonlinear regression methods were used to fill Fc data gaps (Falge et al., 2001), and the correlation measured fluxes and controlling environmental variables were fit using a 15-day moving window.”

9. p.8 l.14: Are there seriously start and end days of NEE? NEE can shift signs but there aren't start and end days. Rephrase. Thanks. We should change the original sentence “The start and end dates of NEE were identified as the day when daily NEE shifted signs” to “The start and end dates of carbon uptake were identified as the day when daily NEE shifted signs”.

10. p.10 l.10: wording – “almost all of studied 12 forests: : :”. We should change the original sentence “The net ecosystem production decreased with increasing water stress at almost all of studied 12 forest flux sites (Granier et al., 2007).” to “The net ecosystem production decreased with increasing water stress at almost all of investigated 12 forest sites (Granier et al., 2007).”

11. p.10 l.13: simple instead of simply Sorry for this mistake. We should change “simply” to “simple”.

12. p.11 l.13: There is something missing, e.g. “time scales” after : : : at diurnal, seasonal and annual ??? Yes, we should change the original sentence “The variation of soil respiration and its temperature sensitivity are both strongly correlated with GPP at diurnal, seasonal and annual (Janssens et al., 2001; Tang et al., 2005; Sampson et al., 2007; Ma et al., 2007).” to “The variation of soil respiration and its temperature sensitivity are both strongly correlated with GPP at diurnal, seasonal and annual scales (Janssens et al., 2001; Tang et al., 2005; Sampson et al., 2007; Ma et al., 2007).”

13. p.11 l.14: References for the increasing number of evidences : : : Sorry for missing references at the end of this sentence “An increasing number of evidences further show that this complex influence on plant growth rate also determines the microbial processing of carbon in the soil”. We will add the following three references at the manuscript.

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Christopher SF and Lal R. 2007. Nitrogen management affects carbon sequestration in North American cropland soils. *Critical Reviews in Plant Sciences*, 26, 45-64. Fornara DA and Tilman D. 2008. Plant functional composition influences rates of soil carbon and nitrogen accumulation. *Journal of Ecology*, 96, 314-322. Cable JM, Ogle K, Tyler AP, Pavao-Zuckerman MA and Huxman TE. 2009. Woody plant encroachment impacts on soil carbon and microbial processes: results from a hierarchical Bayesian analysis of soil incubation data. 320, 153-167.

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