

## ***Interactive comment on “Simulating carbon and water cycles of larch forests in East Asia by the BIOME-BGC model with AsiaFlux data” by M. Ueyama et al.***

**Anonymous Referee #2**

Received and published: 15 January 2010

### Overall Evaluation

This manuscript represents a very nice study using a modeling tool to synthesize and understand the variability in carbon and water dynamics observed with eddy covariance at six larch forests located across northeastern Asia. Model biases are first evaluated and the model is then modified to minimize biases. I was particularly happy to see that the stand history was considered in the model simulations, and that it was demonstrated to be quite important. The use of the improved model was valuable for understanding spatial variability in controls over carbon and water exchange. The identification of the importance of spatial variability in allocation to above vs. belowground tissues

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is a particularly insightful finding from this study. I also thought that the analysis of sensitivity of carbon fluxes to seasonal changes in driving variables was insightful. In summary, this is a very nice synthesis and a nice foundation study before using the model to conduct regional-scale analyses and future projections.

The only substantive issue I identified is the treatment of field-based estimates of GPP and RE as equivalent to field-based estimates of NEE. The estimates of GPP and RE are based on the partitioning of NEE into GPP and RE based on a model that relates nighttime RE to temperature, which is a commonly used approach. However, it is a model and its uncertainty is not well understood in this study. I think that this is an issue that should be acknowledged with a few sentences in section 4.4 on “Further model improvements and potential limitations”.

In general, the manuscript is well organized and well written. The figures and tables are all useful in my opinion. I realize that English is a second language for the authors, and so I’ve made a number of editorial suggestions below (mostly wording suggestions within sentences).

### Specific Comments

Page 8314, line 20: Change “carbon sink” to “the carbon sink”.

Page 8315, line 16: Change “water fluxes spatially distribute” to “water fluxes are spatially distributed”.

Page 8315, line 15: Change “well” to “in simulating carbon and water dynamics”.

Page 8315, line 16: Change “due to lack of enough observations, compared” to “because of few observations in comparison”.

Page 8315, line 20: Change “data accumulation” to “availability of observations”.

Page 8315, line 26: Change “at both temporal and spatial scales” to “temporally and spatially”.

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Page 8316, line 24: Change “with understory of fern” to “with an understory of ferns”.

Page 8317, line 5: Change “vegetations, such as some shrub species and” to “vegetation, shrubs, and species in the”.

Page 8316, line 12: Change “was formed” to “is composed of a”.

Page 8317, line 17: Change “needles” to “trees”.

Page 8317, line 18: Change “families” to “species”.

Page 8317, line 23: Change “average stand height” to “average tree height”.

Page 8317, line 26: Change “needles” to “trees”.

Page 8317, line 29: Change “needles” to “trees”.

Page 8318, line 9: Change “gap-fill” to “gap filling”.

Page 8319, line 3: Change “soil condition” to “soil availability”.

Page 8319, line 7: Change “course” to “coarse”.

Page 8319, line 8: Change “by combing the” with “by coupling the”.

Page 8319, line 9: Change “with the stomatal conductance model” to “with a stomatal conductance model”.

Page 8319, line 18: Change “such as carbon and water cycles” to “of carbon and water dynamics”.

Page 8320, line 5: Change “declines of GPP during the latter” to “decline of GPP later in the”.

Page 8320, line 11: Change “daily the” to “the daily”.

Page 8321, line 17: Change “course” to “coarse”.

Page 8323, line 5: Change “dryer” to “drier”.

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Page 8323, line 12: Change “observations that were made from 1961 to 2000 by the NCDC” to “observations from NCDC that were made from 1961 to 2000”.

Page 8323, line 16: Change “discussions” to “discussion”.

Page 8323, line 19: Has Fig. 2 been cited yet? If so, I missed it.

Page 8324, line 26: Change “observed carbon budget” to “observed NEE carbon budget”.

Page 8325, lines 15-16: Change “responses” to “sensitivity” and change “to the annual climate were” to “to annual climate are”.

Page 8325, line 22: Change “was a more important” to “was the more important”.

Page 8326, line 14: Change “obtained” to “estimated” and change “week” to “weak”.

Page 8326, line 16: Change “trends were” to “trends became”.

Page 8326, lines 17-18: Change “were obtained by eliminating” to “were estimated without”.

Page 8326, lines 21-22: Change “climate, but belowground under colder and dryer climate. The obtained” to “climate. The estimated”.

Page 8326, line 24: Change both occurrences of “most limiting factor” to “most limiting resource”.

Page 8326, line 28: Change “soil temperature positively correlated” to “soil temperature was positively correlated”.

Page 8327, line 1: Change “root system” to “root systems”.

Page 8327, line 4: Change “competed belowground resource rather than light environment” to “competed for belowground resources rather than light”.

Page 8327, line 6: Change “conditions could” to “condition apparently”.

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Page 8327, line 8: Change “through changing in the LAI” to “through effects of allocation on LAI”.

Page 8327, line 10: Change “improve the regional model simulation” to “improve the simulation of regional carbon dynamics”.

Page 8327, line 11: Change “climate data in the regional simulations” to “climate data used to drive the regional simulations”.

Page 8327, line 13: Change “will improve” to “will likely improve”.

Page 8327, line 14: Throughout section 4.3, you use the word “significantly” a number of times, but this word should be reserved for cases where a statistical test has been conducted and found that something is significant. My suggestion is to change “significantly” to “substantially” throughout this section.

Page 8327, line 19: Change “analysis were shown” to “analysis are shown”.

Page 8327, line 20: Most of the references to Table 5 indicate “case ta” for example, but the cases are not labeled in Table 5. I don’t think there is a need to label the case in most cases as they are pretty obvious from the context of the sentence citing Table 5.

Page 8328, lines 4-5: Change “is dependent on the delicate changes” to “depends on the changes”.

Page 8328, lines 10-12: Reword the sentence starting “Considering . . .” to “The high sensitivity of NEE occurs because NEE is a small difference between two large fluxes.”

Page 8328, line 14: Change “the observed studies” to “observations”.

Page 8329, line 7: Change “VPD is not obvious” to “VPD is not strong”.

Page 8329, line 8: Change “showed what the important weather conditions were that” to “identified the important weather conditions that”.

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Page 8329, line 9-13: Change the two sentences spanning these lines to read “In the temperate site of TMK, summer radiation was the most important control over the simulated annual carbon budget. On the other hand, summer VPD was most important in controlling the simulated annual carbon budgets of the boreal sites LSH, SKT, and YLF.

Page 8329, line 13: Change “The change in air temperature” to “Air temperature”.

Page 8329, line 16: Change “simulated to be the most important controlling factor of the carbon” to “the most important controlling factor of the simulated carbon”.

Page 8329, line 19: Change “This study is a” to “This study, which is a”.

Page 8329, line 20: Change “showing several uncertainties of” to “identified several biases in”.

Page 8329, line 26: I think you want to cite Fig. 4 here instead of Fig. 2. Also, change “significantly large” to “substantially larger”.

Page 8329, line 28: Change “whereas the observe ET was not too large” to “compared to the observed ET”.

Page 8330, line 4: Change “was” to “is”.

Page 8330, line 7: Delete “was”.

Page 8330, line 8: Change “inducing” to “and suggests”.

Page 8330, line 9: Change “in the carbon fluxes” to “in the field-estimated carbon fluxes”.

Page 8330, line 14: Delete “the change in”.

Page 8330, line 18: Change “used” to “use” and change “was” to “is”.

Page 8330, line 22: Change “model could be required to simulate the response to water conditions” to “model may be required to properly represent the response to

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water availability”.

Page 8330, line 23: Change “could be due to the” to “may be”.

Page 8330, lines 27-28: Change these lines to read “contain understory vegetation other than larch (shown in Sect. 2.1), which may influence carbon dynamics.

Page 8331, line 7: Change “pointed out” to “point out”.

Page 8331, line 9: Delete “acceptably well”.

Page 8331, line 13: Change “from literature available values” to “from values available in the literature”.

Page 8331, line 14: Change “to the validation of current status” to “to validation of the current status”.

Page 8331, lines 16-18: Change the sentence to read “Consequently, the parameters are applicable to simulate the current status of larch forests of the multiple sites.”

Page 8332, line 9: Change “apply at regional scale simulation” to “conduct regional-scale simulations”.

Page 8332, line 12: Change “from the climate” to “from climate”.

Page 8332, line 21: Change “algorithm at the regional to continental scales” to “algorithm at regional and continental scales”.

Page 8332, line 23: Change “was” to “is”.

Page 8332, line 27: Change “Since the sensitivity analysis has been conducted” to “Our analysis has allowed us to understand sensitivity”.

Page 8333, line 1: Change “for the seasonal to interannual time scale” to “at seasonal to interannual time scales”.

Page 8333, line 2: Change “including” to “through”.

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Page 8333, line 4: Change “When comparing the observed data” to “Through comparison to observations”.

Page 8333, line 10: Change “will reduce” to “will help reduce”.

Page 8333, line 12-13: Change “modeling studies, demonstrating that” to “modeling tools, and demonstrate that”

Page 8333, line 13: Change “could be reduced with the flux” to “can be reduced with flux”.

Page 8333, line 14: Change “could improve” to “improves”.

Page 8333, lines 15-17: Change the sentence to read “In the future we will conduct site- and regional-scale synthesis studies of carbon and water dynamics in East Asia with several biosphere models.”.

Page 8343: Should the reference to Fig. 1 in this Table 3 be to Fig. 2?

Page 8345: In Table 5, change “determined as 3 of the natural variability” to “determined as 3 standard deviations of the natural variability”.

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Interactive comment on Biogeosciences Discuss., 6, 8311, 2009.

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