

Interactive comment on “Mid-Holocene ocean and vegetation feedbacks over East Asia” by Z. Tian and D. Jiang

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Dear Referee, we sincerely thank you for your review of the manuscript. Because the Chinese Spring Festival is coming, we are going to have a vacation for the whole February of this year. Here we first would like to reply to your comments briefly.

Major comments:

In the present study, the authors separate ocean and vegetation feedbacks by appropriate settings of GCM experiments. These GCM experiments are able to give important results if both the purpose of the study and the method of analysis are appropriate. However, I recommend that this paper should be rejected by following reasons.

- 1) The authors spent major part of pages by "averaging values over China and com-
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paring them with PMIP results". Because China includes many regions with different geographical and climatological characteristics (e.g. Tibetan Plateau, monsoon regions, inland arid regions and northeast regions), averaging over China reduces and mixes signals of specific independent mechanisms in different regions. As far as China, averaging inside political border does not represent scientific information from model results (for both PMIP results and GCM results by the authors).

We agree that China is composed of many regions with different geographical and climatological characteristics. The purpose for us to examine the national climate is to investigate the extent to which the climate of the whole country responded to the orbital forcing at the mid-Holocene. As mentioned in the manuscript, it has been widely reported based on proxy data that stably warmer climate conditions prevailed over China during the mid-Holocene, whereas the mid-Holocene temperature was shown to be colder in part of China in the recent works of Guiot et al. (2008) and Bartlein et al. (2011), implying a level of uncertainty in reconstructions. By contrast, we revealed that 35 out of 36 PMIP1 and PMIP2 models simulated colder annual temperature for that period, and hence simulations were opposite of the reconstructions (Jiang et al., 2012). This raises an important issue as to model-data comparison over China as a whole. As a further attempt to investigate the mid-Holocene climate over China, the present study was undertaken to assess the effect of vegetation and ocean feedbacks over East Asia at the mid-Holocene. This is because their roles have been well recognized for past climate changes, but they have not been specifically investigated for East Asian regions. As such, we think it is necessary to assess the influence of vegetation and ocean feedbacks on the climate of the whole of the country. Given that we have discussed the national average climate a little bit more, as you kindly suggested, we will revise the manuscript accordingly.

By the way, it should be mentioned that the geographical distribution of surface air temperature and precipitation changes at the mid-Holocene had been shown in Figures 1, 3, 7, 9, 10, and 11 of the original manuscript, from which we can clearly see regional

climate changes over the country.

Reference:

Bartlein, P. J., S. P. Harrison, S. Brewer, S. Connor, B. A. S. Davis, K. Gajewski, J. Guiot, T. I. Harrison-Prentice, A. Henderson, O. Peyron, I. C. Prentice, M. Scholze, H. Seppä, B. Shuman, S. Sugita, R. S. Thompson, A. E. Viau, J. Williams, and H. Wu, 2011: Pollen-based continental climate reconstructions at 6 and 21 ka: a global synthesis. *Climate Dynamics*, 37, 775–802.

Guiot, J., H. B. Wu, W. Y. Jiang, and Y. L. Luo, 2008: East Asian monsoon and paleoclimatic data analysis: a vegetation point of view. *Climate of the Past*, 4, 137–145.

Jiang, D., X. Lang, Z. Tian, and T. Wang, 2012: Considerable model–data mismatch in temperature over China during the mid-Holocene: Results of PMIP simulations, *Journal of Climate*, 25, 4135–4153.

2) Related to 1), it is not clear why the authors compare results with PMIP results so often. Do the authors intend to interpret the discrepancy of PMIP models by this feedback analysis? Just for confirming the reproductivity of common large-scale response of GCMs?

Comparing the present CCSM4 simulations with PMIP simulations do not intend to interpret the discrepancy of PMIP models by vegetation and ocean feedbacks. Actually, as you mentioned, we want to quantitatively confirm the reproducibility of common large-scale response of atmosphere, atmosphere–ocean, and atmosphere–ocean–vegetation components of CCSM4 to the mid-Holocene orbital forcing. As you known, the response to the same or similar forcing is somewhat different among the individual models, owing to the differences in the physics and dynamics of the models, the boundary conditions, and the experimental designs. Model-model comparison for the standard experiments of PMIP1, PMIP2, and PMIP3 is therefore necessary to confirm the reliability of the present CCSM4 simulations. On this basis, the ocean and veg-

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etation feedbacks can be well discussed. Following your suggestion, we will reduce model-model comparison part in the revised manuscript.

3) It is ambiguous what aspect or mechanism of nature (or behavior of PMIP models?) the authors are going to reveal in the present study. It is not discussed if T31 GCM is able to resolute what the authors are going to reveal. On the other hand, there are too many topics in the present study (and less analysis for understanding of each topics). Feedback analysis, comparison with PMIP results and comparison with geological evidences can be published as individual three (or more) papers if the authors carefully select purposes, choose appropriate methods and consider robustness of mechanisms in T31 resolution. Since setting of these six GCM experiments in the present study is very good, they provide unique material for feedback analysis, interpretation of PMIP results and interpretation of discrepancy between data and model. I encourage the authors to analyze these results again with careful selection of purposes and methods.

It should be first noted that the core of this study is to investigate the ocean and vegetation feedbacks over East Asia at the mid-Holocene. In the text, model-model comparison is to confirm the reliability of the present CCSM4 simulations for the standard AGCM-, AOGCM-, and AOVGCM-type experiments under the framework of the PMIP phases one to three, while model-data comparison is to assess whether ocean and vegetation feedbacks can improve model-data mismatch in annual and winter temperature over the country that had been revealed using the 36 PMIP1 and PMIP2 models.

We agree that the underlying dynamic mechanism is critically important to understand the mid-Holocene ocean and vegetation feedbacks over East Asia. In this aspect, we had examined vegetation feedback through vegetation-induced changes in surface albedo, surface shortwave radiation, evapotranspiration, and so on in the original manuscript. Ocean feedback had been investigated by SST changes due to the large thermal inertia of the ocean, by the changes of evaporation from the ocean, and by the changes in large-scale and local atmospheric circulations. According to this comment, special attention will be paid to the dynamic mechanism for ocean and vegetation feed-

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backs. Chief among these includes additional analysis of vegetation distribution and leaf area index, more detailed insights into vegetation-induced changes in albedo and surface radiation, and more detailed analysis of ocean-related atmospheric processes. At the same time, model-model and model-data comparison sections will be reduced accordingly.

Minor comments:

Page76, Line9. Difference of 0.0003K seems insignificant.

Page84, line4. It is better to show precipitation itself because it is a fundamental variable of climate.

Page89, line 12, 0.0003K is insignificant.

Page91, 4.2 Dynamic vegetation feedback. It is better to show vegetation distribution in each 6ka experiments.

At last, we would like to take this opportunity to sincerely thank you for the above helpful comments and suggestions. All of the above major and minor comments will be fully considered when we revise the manuscript after the vacation, and we will provide a point-to-point response to each of them in more detail at that time.

Sincerely,

Zhiping Tian and Dabang Jiang

Interactive comment on Clim. Past Discuss., 9, 75, 2013.