**Climate
of the Past
Discussions**

Interactive
Comment

Interactive comment on "Northern high-latitude climate change between the mid and late Holocene –
Part 2: Model-data comparisons" *by* Q. Zhang et al.

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We would like to thank the third reviewer for his/her careful reading and his constructive comments that will help us to improve the clearness and the quality of our manuscript.

Specific comments

We have followed the suggestion for comments 1-6 and modified the text.

7.As replied to reviewer 1 for major comment 7, we will remove the average of the cost function in the revised manuscript.

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Interactive Discussion

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8.We will briefly add some more description on data assimilation techniques to make it clear that we use this method to find the model simualtions closest to the reconstructions.

9.We try to find a best model (or few best models) which is (are) the closest to the reconstruction by using this objective statistical method. However, we are not trying to rank the model with the value of cost-function, but only to find one or two models which are closest to the proxy data evidence. A good fit (i.e. small CF) between a model (few models) and proxy evidence indicate similar responses to external forcings in the model(s) and reconstruction. Hence, the 'best-fit' model(s) should be better for understanding the dynamical processes than the multi-model ensemble mean.

10.We have mentioned the averaged temperature change seen in the reconstructions in section 2. Since most reconstructions are located over the land areas neighboring the North Atlantic sector, the average for the reconstructions could not represent the whole northern high latitudes. Although the temperature changes from the model simulations could in principle be averaged for the whole Arctic region, we have chosen to calculate the model data average only for the areas corresponding to where the reconstructions are located. The results show that the PMIP2 ensemble is closer to the reconstructions than PMIP1. We will address this calculation results more clearly in the revised manuscript.

11.We calculated the ensemble mean first then calculate the cost function value. We have addressed this calculation process in the revised manuscript.

12.Here we mean PMIP2 is better than PMIP1; that is, coupled model simulation is better than the atmosphere only model simulation. That is why in next step we calculate the cost function only for PMIP2 simulations, both PMIP2-OA and PMIP2-OAV. This sentence has been modified in the revised manuscript.

13. We have referred Gladstone's results in introduction in the revised manuscript.

14. We have followed the suggestions and modified the text.

Technical corrections

Thanks for pointing out these technique problems and we have corrected the text, tables and figures following the suggestions. For question no.13, about the unit of figure.8, both y-axes of panel given in percent.

Interactive comment on Clim. Past Discuss., 5, 1659, 2009.