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Climate of the Past Discussions

Interactive comment on "The relevance of mid-Holocene Arctic warming to the future" *by* Masakazu Yoshimori and Marina Suzuki

Anonymous Referee #3

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General comment

This manuscript proposes an in depth analysis of the different radiative and turbulent latent and sensible heat fluxes terms that constraint the seasonal changes in surface temperature in the Arctic. The analysis considers the mid-Holocene climate and the RCP4.5°C scenario for the future, with the objective to derive emerging constraints from the mid-Holocene climate that can be used to assess the results of future climate projections. This analysis is interesting, but the conclusion is not strong enough about the analogies between the two periods and what can be done out of it. It is only during the ice melting period, when albedo decreases and water vapor increases in the atmosphere, that similar feedbacks occur. The forcing factors are very different between the two periods. Even though the different elements are found in the text, similarities and

differences could be better discussed. The abstract could also be more informative on the results and better stress the role of the clear sky long wave radiation. The different figures are difficult to follow, because there is no direct relationship between the names of the different terms plotted in figure 5 (a key figure in this manuscript) and the decomposition done using equation 2 to 7. I therefore consider that this manuscript is worth publishing, but that an effort should be made to clarify the expression of the different terms and better explain their role. The discussion should also be enlarged, so that the paper more clearly address the point listed in the title.

Other comments: - P2 make sure you properly refer CMIP or PMIP everywhere. - P 3 l 15. And section 4.3. The comparison of the MH results with observations is not fully used in the manuscript. Is there a way to go one step further by provided an evaluation that could really inform on the relevant processes between past and future? - P3bl 29. Could you provide an order of magnitude of the uncertainty related to emissivity for models that have a variable emissivity? - P 4 2 Is the equation correct for S? - P4 l 15 what do you call sect. 3a? - P4 end of section 3.1. It could be worth mentioning that the approach is direct because there is no change in land-sea mask between the different simulations. - P4. L 27 are your referring to ice concentration or to ice fraction? - P 5 Would it be possible to rewrite equation 7 so that there is a more direct link with temperature ? or use one example to fully explain what is done and the strength of the diagnosis. This could also be needed to present the different terms of equation (4) and make sure there is no ambiguity on global or local anomaly (or their relative strength). - P4 l 8. May be you could site Hewitt and Mitchell 1997 for the definition of the MH insolation forcing. - P7 There is a large emphasize on clouds before showing the effect of lw_clr. This later term reflects both changes in water vapor and in atmospheric lapse rate. The cloud cld_effect arrives later (in season) compared to albedo and lw_clr. I would suggest reconsidering the way the whole section is written, to better discuss the relationship between the different terms and their monthly evolution. - P8 section 4.5. I am not entirely convinced that OND are the best months to look at to infer model spread. Sea-ice and temperature result certainly of what happens during the preceding

months in terms of forcing and feedbacks. This needs to be clarified. - P9 section 4.5 I am lost in the call to the different figures. Figure 10 also show a large model spread in the lw_clr, not only in clouds. This should be highlighted. The cloud cover is important but results certainly from the other conditions: sea-ice fraction, temperature, lapse rate, water vapor, changes in atmospheric convection or large scale condensation. This should be discussed, at least to tell when there is an analogy or not between the different feedbacks between mid-Holocene and future climates.

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