

## Reply to the comments of P. Brohan

First, we will like to thank P. Brohan for the comments on the manuscript. The answers to the comments from P. Brohan follow below.

### **Comment:**

A fundamental problem with this work is that it is a report, not a journal paper: It describes what the authors did and what they found; but what it needs to do is to present only new methods and corresponding new results. As a result the paper is both too long and too short. It is too long because much of the background and methods section spells out detail which is already well known and has been published before. And it is too short because the results are limited and predictable.

**Answer:** To improve the manuscript, and make it more like a journal paper we have taken several actions that we describe here. For a start, we have left out the parts that were repetition of previous work. To do further improvement of the manuscript, we have included new data by adding the PMIP3 models to the analysis, which make the results more up-to-date. We do a more thorough analysis of the sea ice response in the MH by considering two selected models that both perform in a similar manner with respect to future climate simulations. From this we show that the background climate plays an important role in the models response to the MH forcing. In particular, we have examined the effects of the cloud shortwave radiative forcing and changes in cloudiness, which prove to be a different factor between the two models. A new discussion of the changes in the seasonal cycle is also included. Further, we have shown (perhaps not unexpected) that there is a correlation between the summer warming and sea ice decrease in the PMIP simulations. What is perhaps less expected, is how good this correlation is.

### **Comment:**

I think, for example, that the introduction could be cut to a couple of paragraphs "Arctic sea-ice is currently declining rapidly ... both an indicator of, and a feedback on, climate change, ... models don't simulate current changes well, ... so we test models in another climate with different sea-ice - the mid-Holocene". Also, much of section 3 is repetition of Thorndike (1992) and Blitz and Roe (2003) and must be cut.

**Answer:** In the introduction we have undertaken major changes. We focus on recent analysis of sea-ice proxy data, to emphasize that there is a new perspective behind the analyses. In the revised manuscript we have done a complete revision of section 3. Parts of section 3 that could be referred to in Thorndike(1992) or Bitz and Roe(2003) are removed, and referred to instead. The new section 3 is now consists of a description of how the model can be applied to study the effect of orbital forcing. This is indeed a new application of the model, even though it may be straightforward.

**Comment:**

The results, while valid, are not very informative. I did not know, for example, that all the PMIP2 MH runs experience an increase in 2m temperature north of 60N in September, or that the simulated MH Arctic changes are less than in a 2\*CO2 run, but I could have predicted both results with high confidence. We need more than this to justify a paper in CP.

**Answer:** In the revised manuscript, we have made an effort to present more informative results and to include a more substantial analysis of the result (see answer to first comment).