Clim. Past Discuss.,
https://doi.org/10.5194/cp-2018-165-RC3, 2019

Climate of the Past Discussions

Interactive comment on "Equilibrium simulations of Marine Isotope Stage 3 climate" *by* Chuncheng Guo et al.

Anonymous Referee #3

Received and published: 14 January 2019

In the manuscript cp-2018-165 entitled "Equilibrium simulations of Marine Isotope Stage 3 climate" by Guo et al., the authors compared the simulated climate mean state of Marine Isotope Stage 3 (MIS3) and preindustrial (PI) era using the Norwegian Earth System Model (NorESM). They found a cooler climate in MIS3 relative to PI conditions with a thicker and more expanded sea ice. The AMOC strengthen by 13% with reduced AABW reaching the North Atlantic. Moreover the AABW production actually increases due to the increased sea ice cover in the southern oceans in association to the cooler MIS3 climate. They also show a reduced ENSO and NAM variability. Finally, by doing a few sensitivity simulations by reducing CO2 concentration or ice sheet height in the North America, they suggest that abrupt transitions of climate from interstadial to stadial state is not likely, and raised the question whether abrupt climate transition would

Printer-friendly version

Discussion paper

be possible without changes of external forcings. I found this manuscript is well written and easy to follow. The results are interesting to the readership of the Climate Past community. Thus I would like to recommend this manuscript to be accepted after some revision:

Comments:

1. The simulations are primarily focus on the PI and MIS3 climate background, thus it is not surprising that the climate states are stable for both conditions. One question the authors did not specifically clearly state is the initial condition of these runs. It seems that both PI and MIS3 runs state from the same ocean initial state, except an increase of the mean salinity for MIS3 run. Is this true? If so, how will this affect the model sensitivity when icesheet height or CO2 concentration changes?

2. The authors tested the model response of CO2 reduction be 15 ppmv. The question here is whether the MIS3 stadial climate is caused by CO2 reduction or by changes of the AMOC? It seems that the authors assumed that the CO2 reduction is the cause, is it true?

3. Although the experiments done by the authors don't show significant AMOC changes, it seems this is not enough to question the possible multi-equilibria of AMOC, especially the experimental design may not serve the purpose of the authors. A better test is to check whether AMOC has multi-equilibria in the NorESM under glacial condition. If yes, then the authors can test whether an abrupt transition of the AMOC is possible with the absence of the external forcing change. It may be important to test the small changes of the external forcings and whether this small changes can bring the climate state to a critical point in which even smaller changes in freshwater forcing is capable to collapse the AMOC.

Interactive comment on Clim. Past Discuss., https://doi.org/10.5194/cp-2018-165, 2018.