Response to additional reviewer comments: *Simulated stability of the AMOC during the Last Glacial Maximum under realistic boundary conditions* (cp-2020-135)

We thank reviewer#1 for the additional comments and the particularly helpful suggestions that have helped to further improve the manuscript.

The original reviewer comments are in black and our responses are colored blue. Rephrased or added paragraphs are marked in italics.

Poppelmeier et al. have adequately answered the previous round of comments and have appropriately revised the manuscript. There remain a few ambiguities regarding the novelty of the work that needs to be taken into account in a revised version.
From the title, abstract and discussion, the novelty of the work is not clear and a few statements can be misleading as they would imply that "realistic boundary conditions" have not been used in previous LGM studies: the Bering Strait is closed in most (if not all) LGM simulations. LGM simulations performed with coupled models also include glacial winds (apart from a few which do not include a complex enough atmospheric model). A few LGM studies, particularly model-data comparisons, have also added meltwater into the North Atlantic to weaken the glacial AMOC (similar to the flux adjustment, apart from the fact that no salt was added to the North Pacific, but a debate onto whether there should also be enhanced runoff into the North Pacific during glacial times is out of topic here). The new part in this study is the change in tidal dissipation, which is currently not mentioned in the Abstract, and should be made more obvious throughout. Below are a few suggestions to make sure there is no confusion, particularly for readers who are not numerical modellers. Line numbers refer to the track-change version.
Reply#1: We are grateful to the reviewer for the suggestion to more clearly highlight the novel aspect of considering changes in tidal dissipation for glacial AMOC simulations as well as pointing out statements that were ambiguous. We now revised these aspects throughout the manuscript with particular emphasis on the detailed points listed below.

Title: I would suggest to remove the "under realistic boundary conditions" as this implies that other studies have not been done "under realistic boundary conditions", which is not the case.
Reply#2: We agree with the reviewer on this point and have therefore removed "*under realistic boundary conditions*" from the title.

Abstract: It would be appropriate to mention the tidal dissipation in the abstract as this effect has received little attention.
Reply#3: Indeed, the effect of changed tidal dissipation has rarely been considered for simulations of the LGM AMOC state. We therefore now mention the addition of this process for our LGM simulations also in the abstract as well as in the discussion.

L. 346-348 needs to be amended to make it clear that most LGM simulations already include a closed Bering St and appropriate glacial wind fields. This statement could cause confusion with readers that are not numerical modellers.

Reply#4: We clarified this statement, which now reads: "*The closure of the Bering Strait and wind stress anomalies, are often considered in LGM model runs, andbut changes in tidal dissipation, are neglected in most studies. Our simulations emphasize that all these processes have substantial impact on the ocean circulation here leading to a total increase in AMOC strength of ~5.5 Sv, and a and therefore all of them need to be considered for paleoclimate model simulations.*"

Similarly L. 348-352 should be amended as numerical studies investigating abrupt climate transitions of the last glacial period are performed with a closed Bering Strait, and the impact of Bering St closing is not new.

Reply#5: We agree with the reviewer that investigations of abrupt climate change performed with OGCMs consider the state of the Bering Strait (closed versus open). However, they usually do not investigate transient openings or closings as potential triggers for abrupt climate change. In order to more clearly state this point, we added the following sentence: "*It is thus also important to investigate the impact of transient changes in the state of the Bering Strait, which could act as possible triggers for abrupt climate changes.*"

L. 360-362: This statement needs to be amended as you cannot reach that conclusion in your study. You can say what the Bern3D simulates under the forcing applied, and particularly I would suggest to explicitly state the NADW depth you find, but you cannot say if it is the "true" LGM NADW depth. This is also particularly true as you are not showing/simulating oceanic d13C and comparing it with proxy records. You can also discuss the limitations of your study, since the ocean model of the Bern3D is not an OGCM, and is of coarse resolution both horizontally and vertically.

Reply#6: We feel that in the previous version of the manuscript it was already relatively clear that our inference regarding the LGM AMOC depth might be model specific as we note that "*the simulations presented here suggest that the LGM AMOC did not …*". In order to further clarify this point, we added the following sentence: "*While we note that this conclusion might be model specific, it is in line with revised interpretations of the updated $\delta^{13}C$ data in follow-up studies.*"

L. 362-363: This statement needs to be more precise: What was the previous depth, and what is the new one?

Reply#7: We added the information that the Bern3D model simulates virtually no shoaling between PI and the LGM while nutrient-based proxy reconstructions initially suggested a shoaling of ~1 km.