Dear Editor, we would like to thank you for pointing out this aspect of the manuscript that needed to be clarified. We respond below (in purple) to your comments and made corresponding changes in the revised manuscript.

Thank you for submitting your revised manuscript. After reviewing the changes that have been made, I am afraid that I find the additions made with respect to the observed versus modelled AMOC changes at the time of MWP1a rather misleading. It is not the case that "a decrease in AMOC strength [associated with MWP1a] is also deduced from 231Pa/230Th data". Rather the opposite is observed: proxy data suggest that the AMOC *strengthens* instead. It is very difficult to see this as merely a question of 'timing' (i.e. the same thing occurring 2500 years later in the model), as the decrease in AMOC strength reconstructed by McManus et al (2004), and coherent with a host of other proxy data, coincides broadly with the onset of Heinrich-stadial 1 (HS1), and not the onset of the Bolling-Allerod and MWP1a. The difference in timing between MWP1a and the onset of HS1 is generally thought to be quite well constrained (at least to within 2500 years).

In light of these issues, I still find that there is a need to address the clear discrepancy between the modelled AMOC effects, and observations (i.e. the most widespread and consistent interpretation of a great deal of proxy data, including Pa/Th, as well as radiocarbon, stable isotopes, oxygenation proxy data). As described before, this discrepancy does not necessarily invalidate interpretations of the differences between model runs with and without organic carbon mobilisation implemented. However, the mismatch and its implications do need to be a accurately noted and discussed. This may require that you delve further into the literature on deglacial chronostratigraphy, U/Th dating of sea level changes, and AMOC/deep-water hydrographic reconstructions. (The timing of WMP1a with respect to reconstructed changes in the AMOC is a long-standing puzzle.)

We first modified the text about the model-data comparison of the LGM AMOC strength, starting line 245 on the new version of the manuscript:

“The LGM AMOC strength is 22.5 Sv (1 Sv = 10^6 m^3 s^{-1}) which is within the range of a multimodel mean LGM maximum AMOC value of 23 ± 3 Sv (Muglia and Schmittner, 2015), even if it is still unclear whether the AMOC was weaker or stronger during the LGM than in the Preindustrial. One data assimilation study supports a strong AMOC during the LGM with a value of 21.3 Sv (Kurahashi-Nakamura et al., 2017). In contrast, a recent estimate based on modelling experiments constrained by isotopic data suggests a weaker AMOC during the LGM, with values between 6 and 9 Sv (Muglia et al., 2018).”

We also corrected and extended the discussion on the modelled AMOC strength and variation in comparison to data. The text below replaces the existing text in the discussion, starting line 268 on the revised manuscript:

“The variability of the simulated AMOC is mainly regulated by temporal changes in the volume of the prescribed ice sheet reconstruction. In our model, the ice sheet volume decrease is considered as liquid meltwater discharge, ignoring the discharge of icebergs. Freshwater inputs deduced from the GLAC-1D ice sheet reconstruction show low variations during the LGM and only a slight increase during the Heinrich Stadial 1. Thus, we can’t expect pronounced AMOC changes during the period of Heinrich Stadial 1 in the model. Between 15-

14 ka, we simulate a decrease of the AMOC strength following massive freshwater inputs in the Northern Hemisphere. This period of MWP1a is also characterized by a rapid sea level increase, which is recorded in radiocarbon dates from the Sunda Shelf and U/Th measurements on corals offshore from Tahiti, confirming a timing of MWP1a between 14.65 to 14.31 ka (Hanebuth et al., 2000, Deschamps et al., 2012). However, the temporal variation of the AMOC strength estimated from $^{231}Pa/^{230}Th$ tends to show already a decrease between 17.5-15 ka, i.e. before the MWP1a, and an increase back to a high value between 15-14 ka (McManus et al., 2004). To achieve a good agreement between simulated and proxy-data derived AMOC variations, He (2011) showed in a modelling study the necessity of meltwater fluxes from Antarctica during MWP1a. Other hosing experiments also emphasize the sensitivity of the oceanic circulation, and thus the AMOC, on the location of the freshwater input (e.g. Smith and Gregory, 2009; Menviel et al., 2011). As previously discussed, the meltwater input deduced from GLAD-1D is located primarily in the Northern Hemisphere, which might explain the different temporal evolution of the simulated AMOC. In the following, we refer to MWP1a as the period of rapid sea level change due to large freshwater inputs to the ocean to evaluate the effect of land-sea exchanges during flooding events."

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