AC: The authors would like to thank Anonymous Referee #2 for the comments and feedback. We will answer the questions and comments below and indicate the changes we plan to make in the revised manuscript.

This study investigates the cause of the stronger AMOC in the PlioMIP2 ensemble and how Atlantic OHT and North Atlantic SSTs are influenced by this strengthening. In alignment with the findings of Otto-Bliesner et al., the authors conclude that the closure of the Bering Strait and Canadian Archipelago is the primary cause of the strengthening of the AMOC in the PlioMIP2 ensemble as it leads to a decrease in the southward freshwater transport into the Labrador Sea promoting high salinities and hence deep water formation. The authors go on to investigate the relationship between changes in the strength of the AMOC and changes in ocean heat transport. They find that AMOC driven increases in the ocean heat transport are partially compensated by a reduction of the gyre component, which helps to explain the model spread in ocean heat transport responses. I found the paper clearly written and analysis presented to be very thorough.

Major comments

When comparing simulated and reconstructed Pliocene SSTs Ln 110 mentions that an observational pre-industrial SST dataset is used to calculated the Pliocene minus Preindustrial SST change for the six different sites. If core top values are available they should be used rather than the pre-industrial SST dataset as using the former provides more of an apples with apples comparison and can have an impact e.g. The Haywood et al. (2020) analysis shows no Pliocene warming off California when differencing the Foley and Dowsett Uk37 records from the preindustrial SST dataset, but in Tierney et al., 2019 which differences these records from core top shows significant warming.

AC: While it is an interesting idea to use core top values as pre-industrial SSTs, the time that is represented by the core top differs from core to core depending on local sedimentation rates. Therefore, the time that the core top value represents will be different for each site while PlioMIP2 experiments are temporally consistent, using prescribed forcings equivalent to 1850 for the pre-industrial experiment. We think that in this case it is a more consistent comparison to use the pre-industrial SST dataset for data-model comparison. In addition, performing a core top analysis would be beyond the scope of this study and could introduce additional complications in interpreting the difference between proxy data and model-derived SST anomalies.

In establishing the mechanism responsible for the higher North Atlantic salinities in Fig. 5 I am not 100% convinced by the analysis that led to the statement "we find no indication that the PmE freshwater flux is the driving force behind the mid-Pliocene AMOC strength increase". While the analysis provided in Section 3.2.2 is thorough and provides a case for the role of reduced freshwater transport associated with the closure of the Canadian Archipelago (0.04 Sv), I do not find the analysis in Section 3.2.3 convincing in ruling out the role of changes in the Pliocene-Preindustrial North Atlantic surface freshwater flux. Fig. 8 shows that the MMM P-E is more negative over most of the subtropical gyre and parts of the subpolar gyre in the Pliocene simulations. This leads to more saline surface waters within the subtropical gyre (Figs. 4 & 5) that are advected into the subpolar region. Evidence of this is also seen in Fig. 6c if one takes the divergence (derivative) of the red and black lines respectively. The more rapid decline in the wind-driven northward freshwater transport (Fig. 6c, blue dashed line) is presumably due to enhanced surface evaporation due to warmer sea surface temperatures (particularly given the results of the gyre transport analysis in Section 3.4). This implies that another major cause of the higher Pliocene salinities is enhanced subtropical evaporation which is not adequality captured when using the local region defined in Fig. 8a (due to the role of advection). Therefore in addition to the closure of the Canadian Archipelago mechanism, perhaps the warmer north Atlantic SSTs due to more positive regional radiative feedbacks or forcing changes in PlioMIP2 relative to PlioMIP1 might also help explain the stronger MMM AMOC result? An ocean salinity budget such as those conducted in Emile-Geay et al., 2003 and Burls et al., 2017 provide a framework that would account for the relative roles of freshwater transport and surface freshwater flux changes. While conducting such an analysis might be beyond the scope of the current study, the authors need to either provide an analysis that rules out a significant role for surface freshwater flux changes (e.g. converting mm/day x area to a Sv change over the subtropical and subpolar regions respectively to compare with the 0.04Sv change in the freshwater transport at 65N) or discuss this caveat in their interpretation accordingly.

Emile-Geay, M. A. Cane, N. Naik, R. Seager, A. C. Clement, A. van Geen, (2003) Warren revisited: Atmospheric freshwater fluxes and "Why is no deep water formed in the North Pacific." J. Geophys. Res. Atmos. 108, 3178–3112

Burls, N J, A V Fedorov, D M Sigman, S L Jaccard, R Tiedemann, and G H Haug, (2017) "Active Pacific Meridional Overturning Circulation (PMOC) during the Warm Pliocene." Science Advances 3, 9, e1700156.

AC: We agree that our current analysis does not rule out a significant effect of the PmE on the North Atlantic salinity and should be supported by a more thorough analysis of the effect of changes in freshwater input (both via transport and surface fluxes) on the North Atlantic salinity. It is unfortunately not possible to perform an ocean salinity budget due to lack of data concerning the surface freshwater flux. However, using available data we will perform additional correlation analyses and elaborate on the respective effects of the altered Arctic freshwater influx and of PmE in the mid-Pliocene on the North Atlantic salinity in our revised manuscript. Preliminary results have shown that the role of the negative PmE anomaly in the high mid-Pliocene North Atlantic salinity may be greater than assumed before. We will therefore adjust our discussion and expect to nuance our conclusion about the gateway closure being the sole cause of the high North Atlantic salinity and AMOC strengthening.

Minor comments and suggestions:

Ln 30-35: When comparing the response of the AMOC in future warming scenarios with Pliocene warming one has to take into account the timescales of the mechanisms involved and if the transient or equilibrium response is being assessed e.g. the short-term stratification of the Ocean which leads to AMOC decline in 21st century in projections will weaken as heat defuses downwards and there can be recovery as equilibrium is reached. A sentence or two acknowledging this subtility is needed here.

AC: We will add a comment about this in the introduction.

Eqn 1: I suggest changing vT to \bar{vT} to indicate that this is the 100-year mean of the product of v and T as opposed to the product of the 100-year mean of v and T respectively as in equ 3. Similarly for Ln 145, change vT to \bar{vT}

AC: We will replace these two instances with \bar{vT} to indeed make clear that this is the 100-year mean of the product.

Ln 167-168: Are COSMOS and HadCM3 the only two model for which the total OHT is inferred from the SHF? Is the \bar{vT} save and provided for all the other models?

AC: Yes, COSMOS and HadCM3 are the only two models for which the total OHT is inferred from the SHF. The \bar{VT} is not part of the model output and provided for all *of the other models, but they have all provided the total OHT that has been calculated either on- or offline based on this product.*

Figure 2 caption: I am confused about the calculation of Fig. 2b is "with respect to the average MMM North Atlantic SST (30N-70N)" supposed to be "with respect to the average MMM North Atlantic SST (30N-70N) anomaly"?

AC: Yes, we will change this into "with respect to the average MMM North Atlantic SST (30N-70N) anomaly"

Section 3.1.2 and Fig. 3: This is for zero lag-lead and the annual times scale. The correlations between AMOC and SST could be stronger, and perhaps more similar, if the lag/lead of maximum correction for subpolar SST is shown? Also if a ten-year running mean is applied to filter out the influence of processes influencing SST associated with atmospheric noise.

AC: A lag-lead analysis did not show significant differences in correlation patterns or strength to the results shown in Figure 3. In addition, it leads to complications in terms of models having different optimal lag-lead times. For consistency purposes, we have chosen to show the lag zero correlation. We have also performed the correlation analysis using a 10-year running mean. While such filtering generally increases the correlation coefficient, it does not significantly change the correlation patterns or the individual model trends in the correlations as presented in Table S2. As smoothing of the data causes complications when interpreting the significance and there are no qualitative changes to our results when using the 10-year running mean, we think it is best to show the correlation plots of the annual data.