Great to see the revised version of this manuscript. I think that it is much improved and will form a significant contribution to our understanding of overturning in the subpolar North Atlantic. I only have a few remarks.

General comments:

My first general comment was only partially addressed. I understand and accept the reasoning for keeping the perimeter contour at the 1000 m isobath. As a consequence, the contour is for large parts of the domain oriented along the major boundary current system (particularly in the Irminger Sea along east Greenland and in the Labrador Sea, e.g., Figure 2). This implies that the dominant isopycnal slope along this depth contour is across the boundary current system and that the cross-contour component of the flow is a relatively small residual relative to the much stronger along-contour flow. I did not register that this issue was discussed in the manuscript.

Thank-you for the additional suggestions for the manuscript. We agree that regions with a strong along-contour component to the flow will be particularly sensitive to temporal or spatial biases in the sampling. However, as we accumulate the geostrophic transports around the basin the distances over which the along-contour isopycnal slope is evaluated are large relative to the across-contour slope. Therefore, while along-contour flows may contaminate the signal for individual grid cells, they should have minimal impact on the accumulated transports. The uncertainties arising from our perturbation experiments provide some insight into the sensitivity of the results to local sampling errors (e.g. Fig. 5). Added text to clarify this point in the methods section of the manuscript [Line 200].

Specific comments:

Line 20: I am surprised to see that there is no evidence of the substantial export of freshwater from the Arctic Ocean (e.g., Haine *et al.*, 2015) in the subpolar gyre budget, that you can close the budget considering only the atmospheric fluxes.

The exported freshwater from the Arctic ocean enters and exits the SPG interior through the data curtain, so if the freshwater content is to remain in equilibrium, we would expect the advective flux across the data curtain to be approximately balanced by (precipitation - evaporation) over the SPG domain. In fact, Bryden et al. (2020) report a net loss of freshwater at a rate of 0.062 Sv for the region 26-70° N between 2008-2016 which would suggest less freshwater imported by surface fluxes than is exported through advective fluxes. As discussed after Line 738, we do see a small freshwater deficit, but it is within our error bounds. A proportion of the freshwater from the Arctic will pass around the perimeter of the basin in boundary currents and coastal currents without contributing to our budget.

Line 27: Perhaps rephrase, dense-water formation is not considered a “driver” of the AMOC (Kuhlbrodt *et al.*, 2007).

Agreed; replaced with “determinant” [Line 27].

Line 54: Lozier *et al.* (2019) did not distinguish south and north of the Greenland-Scotland Ridge, they only concluded that most of the overturning occurs east of Greenland.

The basins listed in brackets implied that we were only considering overturning south of the Greenland-Scotland Ridge, which was not our intention. We have removed these basins from the sentence which should make it clearer [Line 53].

Line 127: I think that the statement ”some profiles are used in more than one grid cell” is an understatement. If the minimal search radius is 150 km, which is the same as the distance between grid points, most of the profiles will be used in the two nearest grid cells. If you plot the search radius used for each grid cell on a map such as Figure 2a, I think this should be evident. Davis (1998) provides good justification for using a search radius that is reduced in the across-slope direction compared to the along-slope direction.

Agreed; changed to "…most profiles are used in more than one grid cell." Thank-you for the reference: the point that decorrelation scales are greater in the along-slope direction is certainly relevant too. Added to text [Lines 124, 128].

Line 299: I think the statement that geostrophic flow is largely out of the subpolar gyre shallower than 500 db and opposite below 500 db should be elaborated on.

Agreed; this is a significant statement given the later overturning investigation. Added a sentence to expand on this observation [Line 310].

Lines 348 and 351: Your estimates of the transport of Atlantic Water from the subpolar gyre into the Nordic Seas could be compared to the transport estimates from the monitoring efforts along the Greenland-Scotland Ridge (e.g., Østerhus *et al.*, 2019).

Thank-you; added these comparisons to the text [Line 361].

Line 421: It appears that the values of 8 and 14 cm/s were simply estimated from Figure 2b. This could have been approached more quantitatively, for instance by making a frequency histogram of the speed between successive surfacings of individual floats within the basin perimeter.

We now compute float speeds using displacements between successive surfacings as suggested [Line 433 to 449]. This has resulted in a small increase in the estimated bottom Ekman transport (from 2.4 to 2.5 Sv), but this does not otherwise impact the results.

Line 474: East Greenland south of Denmark Strait is not a major overflow region. While the East Greenland Spill Jet may contribute some dense water to the lower limb of the AMOC (Pickart *et al.*, 2005), the Faroe Bank Channel = Iceland-Scotland Ridge and Denmark Strait are the only major overflow regions.

Agree that this statement was misleading; removed the reference to East Greenland [Line 498].

Line 521: Please elaborate on why there is substantial densification in summer, when the air-sea heat fluxes are very low or even warming the ocean.

The quantity we measure on the boundary is excess inflow at lighter densities and excess outflow of denser water. We interpret these flows as densification within the boundary (by surface fluxes). However, on seasonal timescales the inflow/outflow will be balanced by a combination of densification by surface fluxes and changing average density in the bounded volume. This density storage in the interior will result in a lag before modified water is registered at the boundary curtain, thus attenuating the seasonal cycle. Added this point in the overturning discussion [line 643].

Line 540: There is an apparent inconsistency with line 34 (heat transport of 0.31 PW). The 0.27 PW quoted here may be more appropriate when considering only the Atlantic Water component, but the difference with the previously quoted heat transport should probably be explained.

The more appropriate measure of heat transport is probably the 0.27 PW quoted at the second instance, as this is specific to the Greenland-Scotland Ridge. We have also attributed this figure to Chafik and Rossby, (2019) who are referenced by Tsubouchi et al., 2021 [Lines 34, 564].

Line 631 and elsewhere: The uncertainty estimate in the overturning strength is provided in the conclusion (line 836), it should also be included in the discussion section.

Added uncertainty estimates [Line 522, 721].

Line 675: Please explain how the surface Ekman forcing introduces a lag in the overturning.

Added an explanation of the mechanism by which surface Ekman influences the lag in overturning. Also clarified that, by removing Ekman forcing, the lag disappears in our results [Line 706]. As highlighted above, the seasonal cycle in overturning as measured by the flow across a section/boundary, is not constrained be in phase with the surface cooling cycle due to the storage term.

Line 714: The Atlantic Water inflow from the subpolar gyre to the Nordic Seas east of Iceland is roughly evenly split on either side of the Faroe Islands (Østerhus *et al.*, 2019). Hence it would be more appropriate to ascribe this flow to the Iceland-Scotland Ridge than to the Faroe-Shetland Channel.

Modified as suggested [Line 749].

Line 818: Note that the magnitude of the overflows east of Iceland (including entrainment) are of similar magnitude as the Denmark Strait overflow (Johns *et al.*, 2021). This should be reflected in the discussion, even if the model does not fully capture that component of the overflows from the Nordic Seas.

Thank-you for highlighting this. We have modified the discussion to reflect the comparable magnitude of the overflows. We have also stressed that VIKING20X may underestimate the Faroe Bank Channel overflow [Line 763, 855, 859, 866, 870].

Detailed comments:

Line 30: Arctic Ocean or Arctic Mediterranean would be more appropriate than Arctic (which by itself is ill-defined and typically also includes surrounding land masses) alone.

Text modified [Line 30].

Line 394: For clarity, perhaps specify that you mean the OSNAP West crossing.

Text modified [Line 408].

Figure 12: A sign is probably missing from the magnitude of the downward fluxes (all of the other transports have signs).

Modified Fig. 12 as suggested.

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