Review of the manuscript “The coherence of the oceanic heat transport through the Nordic seas: oceanic heat budget and interannual variability” by Anna V. Vesman and co-authors, submitted to Ocean Science.

General comments

Vesman and co-authors seek to investigate the variability in transport of heat through the Nordic seas towards the Arctic Ocean using a gridded dataset of monthly temperature, salinity and velocity fields derived from in situ and satellite data, and to frame this variability in terms of atmospheric forcing of the ocean. An improved understanding of heat transport in this region would be valuable, given its significance for changing ice cover in the Arctic in the coming years.

The paper is clearly structured, and well written. It is, however, difficult to assess the significance of the results presented here in the absence of any discussion of the errors associated with them, which the authors acknowledge are likely to be significant. The authors have attempted to provide some explanation of the physical basis behind the correlations in variability in heat fluxes that they see at various locations along the path of Atlantic Water (AW), but unfortunately this is unconvincing because the patterns of atmospheric forcing in terms of weather types that they present are inconsistent with their results. I offer some more detailed comments below, but I suggest that these shortcomings need to be addressed before the manuscript can be considered for publication.

Specific comments

1. Line 123: I am not familiar with this particular categorisation. Can you provide some background – how it is derived, and why it is an appropriate description of the atmospheric patterns seen over the Nordic seas – for the benefit of readers who are unable to follow the Russian-language references?

2. Figure 2: The maps are small and the detail difficult to make out, but it looks as if you might be losing some of the northward AW flow and periodic southward recirculation at the eastern end of some of your transects, particularly at the southern end of the Barents Sea Opening. The current is strong here, and its position varies a fair amount. (See, for example, Wang et al. 2019.) You mention at Line 160 that your results are sensitive to the position of the transects in relation to the western boundaries of your regions, but do not, so far as I can see, provide any quantification of the uncertainties associated with choice of position.

3. Line 204: “the base of the upper layer”. Is this the AW layer?

4. Line 232: “we compare the statistical properties of all available mooring observations….with those in the nearest grid-point of the ARMOR3D dataset.” Would you see a better correlation if you compared the mooring observations with interpolated values from the ARMOR3D dataset? LaCasce 2005 found low spatial correlations between current meter readings taken from moorings only a few kilometres apart on the Norwegian Slope, and similar lack of correlation might be expected between current meter observations and ARMOR3D grid points over a similar distance. Nevertheless, the spatial resolution of satellite observations underlying the gridded dataset might be insufficient for further interpolation to offer an improvement.

5. Line 236: “data are binned to 100 m vertical bins”. Why 100 m?

6. Line 240: “current velocity...derived from ARMOR3D shows lower…..variability, compared to in situ data”. Variability will depend on the scale over which values are averaged. The mooring data are collected at fixed points, so one might expect them to exhibit higher variability.

7. Line 259: The NwACC carries fresher water of Baltic origin, not AW. (Skagseth et al. 2008, in your reference list.)

8. Lines 261/2: Are these long term mean heat fluxes?

9. Figure 6: Balances can only be given to the precision of the least precise of the inputs, not to 0.1 of a terawatt. But more seriously, what are the error estimates for these calculations?

10. Figure 8. Are these mean sea level pressure fields, as the caption says, or anomalies? (The values on the colour bar are too small to be legible.) If you wish to relate variability in ocean transports to variability in atmospheric forcing, do you not wish to look at the anomalies from long term mean?

11. Lines 331-3: This doesn't seem quite right. The colour shading in Figure 8a. obscures the wind vectors, but they appear to point slightly northwards along the coast at Svinøy, but offshore at Spitsbergen. So we might expect to see some build up of sea level against the coast and consequent enhancement of the shelf current at Svinøy, but no similar Ekman effect at the more northerly transects.

12. Lines 334-7: It is a convergence or divergence of Ekman transport in association with the coast that generates the sea level gradients which lead to the variability in the geostrophic slope current. Ekman transport in a southerly (along slope) direction cannot, therefore, decrease the NwASC, because it does not involve convergence or divergence of transport. It should have no effect.

13. Line 337: The along slope winds shown for Type E in Figure 8b. do not appear to be significantly weaker than those for Type W in the same region.

14. Line 352: "since 2005 it [the heat advection] started to decrease". Figure 9b. appears to show a recovery of heat flux in the final two years. Do we not just we decadal-scale variability here, rather than any trend?

15. Line 358: How sensitive are these results to choice of transect? Would they show similar periodicity and coherence if you chose the Vøring and Isfjord transects, for example?

Technical corrections

All figures: small text is difficult to read. Can you make the labelling clearer? Colours are also difficult to distinguish in Figure 7.

Line 141: "the currents are strongly bottom trapped". Do you mean "topographically steered"?

Line 268: "stronger northerly winds". This English expression is commonly understood to refer to winds blowing <u>from</u> the north, whereas I think you are talking about winds blowing from south to north. I suggest "northward-blowing winds".

Line 272: Delete the comma after "heat flux". It changes the meaning of the phrase.

Line 320: "<u>into</u> the Barents Sea"?

Line 326: "the correlations go to zero". Go to zero, or just become small?

References

LaCasce, J. H. (2005). Statistics of low frequency currents over the western Norwegian shelf and slope I: current meters. Ocean Dynamics, 55: 213–221.

Wang, Q., Wang, X., Wekerle, C., Danilov, S., Jung, T., Koldunov, N., et al. (2019). Ocean heat transport into the Barents Sea: Distinct controls on the upward trend and interannual variability. Geophysical Research Letters, 46, 13,180–13,190.