Review on “The coherence of the oceanic heat transport through the Nordic Seas: oceanic heat budget and interannual variability” by Vesman et al.

General comments

Using observation-based datasets, Vesman et al. studied the connectivity of advective heat flux across a number of sections in the Norwegian Sea. They have further discussed the driving mechanisms for the heat flux variability, including NAO, AO, the meridional (C) and western (W) weather types. Results from this study have implications on the heat (and salt) transported to the Nordic and Artic Seas, which is important to understand the high latitude climate state and variability.

The paper is overall clearly written and the focus on the heat flux connectivity is of interest to the community. However, throughout the paper, the authors computed heat flux with a reference temperature along a non-conserved section. This is actually a calculation of temperature flux instead of heat flux, and the difference between the two can be huge (see Forget and Ferreira, 2019). While the variability may not be significantly influenced, as the authors have suggested, the mean heat budget discussed in section 3.2 (Figure 6) is meaningless. I strongly suggest the authors to carefully address this issue before considering publication. One possible approach is to calculate heat flux along closed section and apply mass conservation. Another is to repeat calculations with different reference temperatures to test the sensitivity of the results.

Detailed comments

[1]. Line 23: This sentence is hard to understand without reading the manuscript. Suggest to re-write.

[2]. Line 48-49: For those without a knowledge on the current system (e.g. Yermak brach) or topography features (Yermak Plateau) in the Norwegian Sea, it is very difficult to navigate. I suggest labeling them in Figure 1.

[3]. Line 67: Where is the Norwegian Atlantic Coastal Current? Could you also label it in Figure 1?

[4]. Line 87: I suggest adding a paragraph describing motivations of this work.

[5]. Section 2.3: Estimates based on different atmospheric products could be quite different (Chavik and Rossby, 2019). I strongly suggest estimating with different products to derive an ensemble mean and a standard error.

[6]. Section 2.5: To derive heat flux, it is necessary to have a closed basin (from coast to coast). While I understand the authors’ focus is on heat carried by AW, such a calculation is only a temperature flux and should not be used to infer heat changes (heat changes are not only influenced by warm waters flowing northward but also by cold waters flowing southward at the section).

[7]. Section 2.8: Vertical mixing or diapycnal mixing? Are you estimating the mixing at the base of the AW, which is along an isopycnal? If so, how robust is it to use vertical mixing coefficient Kz to estimate mixing across an isopycnal?

[8]. Line 238-239: The correlation seems to result from the trend. What is the correlation after detrending the time series?

[9]. Figure 5: Suggesting adding error bars to the time series plot.

[10]. Figure 6: Suggest adding uncertainties to the budget analysis. There is a clear difference of the mean meridional velocity between the ARMOR and the mooring (Figure 5), implying large uncertainties in the estimated advective heat flux. Again, the calculated heat flux is really a temperature flux, whose mean may be significantly modified with a different reference temperature.

[11]. Line 301: The correlation between Svinoy and Jan Mayen is as high as 0.7 according to Figure 7. Why is that a loss of correlation?

[12]. Figure 9c: There seems to be an increase of the dominant period with time. For example, in months 192-288, there is a dominant period of >84 months. Is there an explanation for that?

Reference

Forget, G. and Ferreira, D., 2019. Global ocean heat transport dominated by heat export from the tropical Pacific. Nature Geoscience, 12(5), pp.351-354.

Chafik, L. and Rossby, T., 2019. Volume, heat, and freshwater divergences in the subpolar North Atlantic suggest the Nordic Seas as key to the state of the meridional overturning circulation. Geophysical Research Letters, 46(9), pp.4799-4808.