

Review of the revised version of the manuscript entitled “Increased ocean heat transport to the central Arctic despite a well working Barents Sea Cooling Machine” by Shaun A. Eisner, James A. Carton, Leon Chafik, and Lars H. Smedsrud.

The manuscript has improved and the authors have replied to most of my comments. I still have some comments and I recommend minor revisions before publication.

General comments:

I am sorry but I was a bit confusing in my previous review. I still believe the authors should provide a clearer description of the temperature trend in the ACBC core. Since the ACBC section includes both the Barents Sea Branch and the Fram Strait Branch, could the authors calculate the temperature trends for each branch separately? How do both trends contribute to the overall temperature trend observed in the ACBC core. In the model, the temperature in the Fram Strait also exhibits a trend, which is approximately half the magnitude of the SAT trend. Could the authors discuss the respective impacts of these temperature trends—both in the Fram Strait and in the SAT—on the observed changes in the ACBC core. Additionally, in the discussion section, the authors should also add some lines to discuss the novelty of their results regarding the temperature trend in the ACBC core. This could include a comparison with previous studies, such as Richards et al. (2022, JGR).

Specific comments :

L.83 Could the authors show in a figure (7c for example) the area over which the SSH gradient is computed.

Figure S1: Could the authors change the scale for the salinity so that the reader can see some patterns in the Barents Sea. Could they specify if the fields are vertically averaged? Or indicate the depth of the fields.

L.116: I suppose that heat content is computed from the surface to the bottom? Could the authors specify? Could the authors show in figure 1 the limits of the Barents-Kara sea region over which they computed the heat content

L:121-130. I was certainly unclear in my previous review, but I still believe that the section 3.1 should start with the validation of the model. Then the authors can present the new results brought by the model analysis. Or at least, first present the comparison of the mean SODA state with the World Ocean Atlas and then present the trend in the observations and the model.

L.141: “the additional heat advected into the Barents Sea is being lost”: unclear. The authors did not compute any heat budget, therefore there is no indication of which part of the additional heat transport convergence is used to warm the Barents Sea and how much is lost to the atmosphere.

L.144: Could the authors give all the temperature trends in °C/year for an easier comparison between the trends.

L.151: “the true heat convergence” : averaged over the full length of the simulation? Could the authors specify? What is the standard deviation? The SODA value is compared with Smedsrud et al. (2010) estimate. Could the authors specify how this estimate is done. Over

which period. Maybe the comparison between the 2 estimates could be done over the same period?

L.158: The net volume transport through BSO is the sum of an inflow in the southern part of the opening and an outflow in the northern part of BSO. Are the trends of these transports equal to 0.?

L.162. is the first sentence useful? See comment L.141.

L.172: The title of the section 3.4 is maybe a bit misleading, indeed the authors do not really analyze dense water formation. They do not study the properties of the water masses (the dense water product is not defined), and their formation rate. They show that there are "cooler and denser waters in the northeastern Barents Sea" (as mentioned in the abstract).

L173. The mechanism has already been defined in the introduction.

L.188 replace "SSH curl" by "SSH gradient".

L.191: BSO inflow is not defined. I suppose that it is the net volume transport through BSO. Could the authors be more specific? What are the correlations between the SAT net volume transport and the BSO inflow and the BSO outflow respectively? Are these correlations worth discussing? Would a regression of the velocity (barotropic?) in the Barents Sea on the SAT net volume transport give some hints on the link between the SAT net volume transport and the volume transports in BSO?

L.243 "continued" might be removed.