

I am mostly good with authors' response and revision.

I have some points regarding the authors response, and a few comments:

- Violating CFL criterion would cause the model to stop, not the reason for budget closure. Data Assimilation “artificially correct” some variables, though it could be minor.
- To be rigid in equation (2), I would use “approximately equal symbol \approx ” or add a “Residual”, ESPECIALLY given that volume is not conserved and it is reanalysis. And you can find there is a diffusion term in many other heat budget studies.
- I would make it clear that sea ice pack formation is GLORYS behavior.
- “total surface heat flux” in fig2, “Downward turbulent heat flux” in Fig5, “upward net surface turbulent flux” in Methods, positive flux in Fig2 then Negative flux in Fig5 are used interchangeably and confuses me. Instead of mentioning sub-components Q_{rad} , Q_{thf} , downward or upward, using the “net surface heat fluxes” is succinct.
- Fig5 and equation (2) and related response, the authors still consider ocean heat flux convergence CONV term as the residual relative to surface heat flux term, which is fine. Mathematically it does make sense, you choose one and the rest is the residual. But in terms of quantity, full-depth CONV term is much larger. Using colorbar range on the scale of thousand (-3000 to 3000 W/m²) for heat flux on range of hundreds (~700 to 100 W/m²) of course makes it less evident. Nevertheless, if not to add up more work on CONV, authors may be able to find some literature to support their consideration and convince readers. Either surface CONV or Mixed-layer CONV, or full-depth CONV using model data has been done elsewhere (e.g, Isachsen et al., 2012, Fig6 in Årthun & Eldevik, 2016)
- Authors mentioned “ocean currents and eddies” 6 times and pointed to fig5b,5c,3e. It is obscure and no argumental supports. “regions with strong currents or eddies (fig x)”, then somewhere with brackets “strong currents and associated eddies (Norwegian Sea and West Spitsbergen Current”, then somewhere “In the boundary current region, xxx strong currents and eddies”. I guess that authors wanted to point to the eastern Nordic Seas but note that EGC is also a strong current with eddies around, and under influence of CAO.

GLORYS is not eddy-resolving in the Nordic Seas, though it is described as global eddy-resolving reanalysis.

Line 289, “the ocean surface in the Nordic Seas becomes deeper”?

Nevertheless, it is publishable subject to minor/technical correction.

Reference:

Isachsen, P. E., Koszalka, I., & LaCasce, J. H. (2012). Observed and modeled surface eddy heat fluxes in the eastern Nordic Seas. Journal of Geophysical Research: Oceans, 117(C8).

Årthun, M., & Eldevik, T. (2016). On anomalous Ocean heat transport toward the Arctic and associated climate predictability. Journal of Climate, 29(2), 689–704.