Comments on the MS by Ye Liu, Lars Axell, and Jun She
An assessment of the variability in temperature and salinity of the Baltic Sea from a simulation with data assimilation for the period 1990 to 2020
https://doi.org/10.5194/egusphere-2024-3283

The MS presents the application of Baltic Sea physics reanalysis system, based on the NEMO-Nordic ocean model engine set up on the 4 km (2 nautical mile) grid. The model is driven by atmospheric forcing from the UERRA reanalysis product, open boundary data from the northeast Atlantic barotropic surge model, and daily river discharge taken from a dataset by the EHYPE model. Observational data (T/S profiles, SST from remote sensing) are assimilated using the Local Singular Evolutive Interpolated Kalman (LSEIK) filter. The reanalysis system has been developed within the activities of the Baltic Monitoring and Forecasting Centre (BalMFC) of the Copernicus Marine Service (CMEMS), where the authors play an active role.

Presentation of the reanalysis system, including a validation study, is followed by an analysis of mean, variability, trends and seasonal cycle of temperature and salinity.

The MS is interesting, but before publication I recommend clarification of the following points.

A) Relation of the present reanalysis data to the data downloadable from the Copernicus Marine Service

Baltic Sea Physics Reanalysis data, downloadable from the CMEMS portal (https://data.marine.copernicus.eu/product/BALTICSEA_MULTIYEAR_PHY_003_011/description, https://doi.org/10.48670/moi-00013) has growing use in research, reflected in numerous scientific publications. Presently the reanalysis 1993-2023 has been upgraded to 2 km (1 nautical mile) resolution. For the users of CMEMS reanalysis data it remains unclear whether this publication presents the same or alternative data set. It should be explicitly written in the MS and reflected in the section Code and Data availability.

In case the analyzed data set is an alternative to the CMEMS downloadable data, the present reanalysis data originals should be made available. The MS refers only to post-processed data used for drawing the figures: https://doi.org/10.5281/zenodo.13961375. Also, comparative statistics of the present data and of https://doi.org/10.48670/moi-00013 should be presented.

B) Observational data sets

The MS mentions the use of T/S profile data adopted from the SHARK and ICES data bases. Other types of in-situ T/S data (ferrybox, gliders, Argo floats etc) available from https://doi.org/10.48670/moi-00032 and used for https://doi.org/10.48670/moi-00013 are not referred. If the use of observational T/S data is indeed limited, it needs to be clarified.

C) Statistics at different depths over the whole basin

The results contain curious salinity data at different depths, not straightforward for oceanographic interpretation. Namely, mean and min/max values of salinity at the surface and at the 60 and 100 m depth, presented in Table 1 reveal that at the surface, mean salinity is 8.18 psu (from 5.74 to 9.94), but in the depth salinity is much lower, 4.12 psu at 60 m depth and 4.79 psu at 100 m depth, with min/max range from 6.32 to 9.05 and 7.48 to 9.94 psu, respectively. This makes the vertical profile hydrostatically strongly unstable that is not in agreement with oceanographic concepts. While the mean salinity values are not understandable, the time series

analysis of trends (Fig. 9, Fig. 11) and seasonal cycle (Fig. 12) also cannot be trusted. Temperature calculations obviously have the same problems.

The sub-chapter "4.2 Trends and variability of temperature and salinity" should be fully recalculated and rewritten. Conclusions from 2 to 4 should be revised as well. To achieve meaningful information for oceanography, perhaps the revised presentation could follow some aspects of the sub-basin approach.

D) Advancing oceanographic knowledge

If the authors wish to focus the MS on the assessment (instead of data assimilation), the oceanographic aspect of the study has to be strengthened. The publication list is dominated by references to modelling and data assimilation studies. These topics are also dominant in the discussion; one part out of four parts is devoted to comparison with other studies on long-term variability in the Baltic Sea.

In the chapter of results, the sub-chapter "4.1 Validation of the simulation results" is clear in content and it is well written. Regarding variability in temperature and salinity of the Baltic Sea over decadal scales (from the title of the MS), sub-chapter "4.2 Trends and variability of temperature and salinity" has serious data processing problems as indicated above. After making technical corrections, the authors should consider how to advance the oceanographic knowledge of the Baltic Sea beyond the already many publications on that topic.

Some technical comments

1) Presently, the text is overloaded with different numbers. The sub-sub-chapters are too much as mere explanations of figures, starting "Figure 9 and Table 1 provide …", "Figure 10 shows …", "Figure 11 reveals …", "Figure 12 provides …".
2) The statement "This is the first attempt to estimate the T/S variability at various depths within the Baltic sub-basins from a reanalysis perspective" (lines 62-63) is not clear; what would it bring new/different to the previous estimates.
3) It is not directly said what are the numbers in Table 1 in terms of averaging intervals.
4) The statement in lines 340-341 is not understandable, what is new: "This indicates that the temperature variability is larger at the surface than at other depths".
5) Fig. 3, it is not clear where to find "number of profiles at the selected monitoring stations (c)"