Author's reply to community comments

Below, the community comments are displayed with italic font, highlighted with a grey background. Our replies are without highlighting.

CC1: 'Comment on egusphere-2023-1547', Maria Matos, 25 Aug 2023

> *This review reflects comments and contributions by Júlia Sambugaro and Maria Carolina Matos resulted from the graduate-level course "How to Read and Evaluate Scientific Papers and Preprints" from the University of São Paulo, which aimed to provide students the opportunity to review scientific articles, develop critical and constructive discussions on the endless frontiers of knowledge, and understand the peer review process.*

We thank Júlia Sambugaro and Maria Carolina Matos for taking time to write community comments to our manuscript and help us improve our work.

> *The preprint examines circulation and water transport in the Archipelago Sea, Finland. Earlier works in the study area failed to estimate the water transport due to the complex topography of the archipelago, leading to an overestimation. The vulnerability of this region justify the necessity of understanding the transport dynamics.*

> *Using a high-resolution NEMO configuration, the study reveals that currents are influenced by the area's geography, resulting in stronger currents in narrow channels and weaker currents in more open spaces. Seasonal and interannual variations in transport volume and direction were observed, emphasizing the intricate dynamics of the Archipelago Sea's water exchange processes.*

> *The work rectifies past limitations and offers valuable insights for managing this unique marine ecosystem, presenting an advancement in understanding transport dynamics in the Archipelago Sea.*

> *MAJOR COMMENTS*

> *Introduction*

> *Consider adding a concise statement about the main research goal to improve the last paragraph that previews of what the preprint aims to achieve.*

Thank you for the suggestion. We aim at expressing the main research goal more precisely in the revised version.

> *Your study group has been conducting various research projects in the region, contributing to a better understanding of such a complex area. We believe that in order to reach broader audiences, it would be beneficial to include a map depicting a larger surrounding area, along with a reference to the corresponding country in the text (beginning of the Introduction). With this addition, the current Figure 1 in the introduction could be relocated to the Methods section, where it would fit more appropriately.*

It is true that not all our potential readers know the Baltic Sea region beforehand. However, we think that including an additional map would unnecessarily increase the number of figures. In the revised version, we added the names of the surrounding countries to the smaller map to make it more informative.

> *Methods*

> *There is a concern regarding observing seasonal variations through a model validated using measurements that don't have complete seasonal data coverage. Maybe in the future, collect data seasonally would bring more reliability to modeled seasonal variations.*

We agree that temporally (and spatially) more extensive observation dataset would be helpful in model development and validation. Our validation dataset includes measurements both from autumn/winter, when the water column is mixed, as well as from summer when the water column is thermally stratified. Even

though for example the timing of thermocline formation cannot be validated, comparison with the available data gives some indication that the model can reproduce both mixed and stratified conditions. Moreover, in our earlier paper (Westerlund et al., 2022), we present validation of the modelled sea surface height against continuous water level measurements, which indicates that the model is able to describe the barotropic dynamics in the model area quite well. This earlier SSH validation is now summarised at the beginning of Section 3 in the revised manuscript.

> *Model validation*

> *Another concern revolves around the differences in depth between what was measured and modeled. Despite the RMSE being lowest for the first ten meters, the magnitude of the value is high enough to raise doubts about the ability of the model to predict data.*

These are typical RMSE values for circulation models of this type and for this region. Considering the range of yearly temperature variations in this region (from freezing point to approx. 20°C), we think these values are acceptable.

> *It was mentioned that "Direction distribution of the modeled currents is slightly narrower than that of measured currents both in Norrgrundet and Utö (Fig. 2)", perhaps the bigger discrepancy between the current speed and direction should also be mentioned.*

The differences between measured and modelled currents in both stations are discussed in more detail in the paragraphs following the above-mentioned sentence.

> *Currents in the Archipelago Sea*

> *Very interesting that wind can be represented by mean values while currents can't due to its bi-directional nature.*

It is true that we refer to the long-term wind distribution as "long-term mean". However, the wind roses include all wind directions and magnitudes from the presented period, not mean values.

> *Discussion*

> *To show the interannual variation was presented the wind and its variability data. Therefore to show the seasonal variation the importance of wind and fluvial discharge was mentioned. So, it would be helpful to provide the fluvial discharge data.*

As the focus of this study is on the overall circulation dynamics of the Archipelago Sea region rather than the different components of the water budget of the Gulf of Bothnia, we think that including the river discharge data is not needed here. The river discharges to the Gulf of Bothnia have their maxima during the spring and early summer due to melting of snow in the catchments. Of course, this is not obvious to all readers from outside the Baltic Sea region, so we added a reference to support this statement in the revised manuscript.

> *It is great that you recognize the uncertainties of the model and already suggest the next improvement in the method: "As noted already by Westerlund et al. (2022), one way to address the issues caused by the boundary conditions would be to develop a two-way nested configuration with a coarse resolution Baltic Sea model and the high-resolution local model."*

Thank you. This is indeed an important development step for us to work on.

> *MINOR COMMENTS*

> *It is mentioned in the text "Fig. 1b", but in the figure itself the maps are not named "a" or "b".*

Thank you for pointing this out. We added the missing labels for subfigures in the revised version.

> *The smaller map in Figure 1 could be improved by coloring the land masses another color to make it distinct from the sea area.*

We modified the map for the revised version and marked the land with the same grey colour that is used in the bigger map.