

# Author's response to reviewers, 2nd iteration

Westerlund, A., Miettunen, E., Tuomi, L., and Alenius, P.: Refined estimates of water transport through the Åland Sea, Baltic Sea, Ocean Sci. Discuss. [preprint], <https://doi.org/10.5194/os-2021-56>, in review, 2021

Below, reviewer comments are displayed with a gray background, while author responses are without highlighting.

## RC1: Anonymous Referee #1, 19 Oct 2021

> Review round #2 of submission os-2021-56

> General:

> In my first review, I suggested to take a more explanatory direction of the study by exploring (at least some of) the physical driving mechanisms for the simulated circulation features in the Åland Sea. I also gave plenty examples for interesting questions and possible causal relations to dive in. Unfortunately, none of these were incorporated by the authors. Instead, they decided to stay with a rather descriptive report of the simulated volume transports at different pathways and their comparison to previous estimates. This is a pity, as I believe in this way the study will mainly serve just as a reference for some transport rates in the Åland Sea area. Nevertheless, in the revised ms the authors have made this rather limited aim of the study more clear, compared to the first version. Hence, as a reader, I still think that the study could have been way more interesting, but I no longer feel disappointed due to unsatisfied expectations. Therefore, I can accept the authors decision.

We thank the reviewer for once again providing constructive feedback. We are happy that the reviewer feels the aim of the manuscript is more clear now and that the manuscript can be accepted subject to minor revisions. Hopefully we have been able to resolve the remaining issues in a satisfactory manner. Please find our detailed response below.

> Main:

> If I am not mistaken, there is an incorrect estimation of the flushing time of the Åland Sea basin presented in L338-340. The volume of the basin is divided by the net southward volume flux. Because of the opposite directions of the upper (southward) and deep (northward) circulation, the net southward volume flux could also be zero. Yet, the area would be permanently flushed. Thus, neglecting sink and source terms (e.g. local river runoff, precipitation, evaporation), the total lateral inflow or outflow of the basin has to be considered to properly calculate the flushing time.

Thank you for bringing up this issue. We introduced the calculation of flushing time in the previous iteration following a recommendation by a reviewer, but at that time we did not define terms or discuss the assumptions of this calculation. The addition was also left somewhat disconnected from the rest of the manuscript. Clearly, this was our mistake. As this calculation is of minor importance to the points discussed in the paper, and as proper interpretation of the flushing time and discussion of the underlying assumptions would

require a more complete and careful consideration, including definitions of what is actually being calculated, we decided that this calculation is best left to future manuscripts, where we plan to discuss other similar issues in depth. Thank you again for this useful comment and highlighting this issue.

> *Minor:*

> *I suggest to dedicate a separate section to the model evaluation, e.g. gathering sections 3.1 to 3.2.1 of the present ms version. Section 3.2.2 would be the first result section.*

Thank you for this suggestion. Finding a way of making this change so that it would improve readability and not disrupt the flow of the text turned out to be difficult. It appears that implementing this change would make the structure of the results section hard to follow, as then the material about currents would be scattered across several subsections. Therefore we kept the original order of subsections in this version. We believe this is better for the overall readability of the manuscript.

> *Moreover, I strongly suggest to use present-tense when referring to the author's own work and results and past-tense when referring to the work by others. This is an elegant way that allows the reader to easily identify which parts are new. Besides, it sounds odd when new research is presented as reporting on the past. A few examples are listed below.*

Thank you for the suggestion. We are not native English speakers, and apologize for any linguistic issues remaining in the manuscript, but note that there will be a proofreading stage after acceptance. As noted before, our guideline for the use of tenses is advice from scientific writing manuals. e.g. nature.com (which quotes Doumont (2010)), Day (1998) or Schultz (2009).

According to our understanding, the reviewer suggests that it would be better to use present tense also for our own work. This advice differs from that given in the references. However, we see that the present tense is often a very good choice for describing the results. We are happy to reconsider if presented with differing authoritative views e.g. by the proofreaders.

References:

Day, R. A. (1998). How to write and publish scientific papers.

Doumont, J., ed. English Communication for Scientists. Cambridge, MA: NPG Education, 2010. See <https://www.nature.com/scitable/topicpage/effective-writing-13815989/>

Schultz, D 2009, Eloquent Science : A Practical Guide to Becoming a Better Writer, Speaker, and Atmospheric Scientist, American Meteorological Society, Boston, MA.

> *L11-12: Use present-tense.*

Please see our answer regarding tenses above.

> *L31: "topographic gradients"*

Fixed.

> *L33-34: Use 2x "has a maximum".*

Fixed.

> L43: *"to investigate exchange fluxes through this area."*

Fixed.

> L84: *"in other regional configurations"*

Our understanding is that (at least in Baltic modelling community) the term "regional" most often refers to configurations with a domain covering a larger area than one sub-basin. For this reason we did not add the word "other".

> L92: *Suggest to move L92-95 to L75. The technical aspects explained in L75-91 would become a clearer context.*

Done, thank you for the suggestion.

> L95: *Delete "eventually".*

Fixed.

> L104: *Use present-tense: "The simulated time span covers ..." (also L106)*

Please see our answer regarding tenses above.

> L116: *"sea ice model"*

Fixed.

> L123: *In the first integral, shouldn't it be only a single integral symbol, as you are integrating over  $dA$ ?*

We apologize if it was not clear from the context, but this integral uses the double integral notation, for which two integral symbols are commonly used.

> L133: *"has a resolution"*

Fixed.

> L134-148: *I still feel that this is largely redundant information for the reader and should be condensed to e.g.: "After interpolation of the bathymetric source data, the resulting numerical grid was smoothed with a Gaussian filter with standard deviation of 1.2 grid points to weaken the steepest bathymetry gradients and ensure numerical stability."*

We would argue that this information is not redundant but one of the more important methodological features of this study. It is commonplace in Baltic Sea modelling studies to see model bathymetries that are not checked by hand at all, but rather just algorithmically

processed. This frequently results in issues in model results that could have been avoided, and limits the usability of model results for further studies. These issues often manifest themselves especially in coastal and shallow areas, of which there are plenty in our modelling domain. We have ourselves encountered several modelling datasets that are not usable in certain coastal areas because of such issues. The suggested reformulation would leave the reader with the impression that we had used only algorithmic processing, from which the reader could incorrectly infer that model data is of lower quality than in reality. We have reviewed and edited these paragraphs again to remove redundant information, but strongly feel that most of the information is valuable for readers tackling similar issues.

> L158: *Does this mean that the barotropic velocities prescribed at the open lateral boundaries do not resolve semi-diurnal tidal currents?*

We expect that with current boundary conditions, the model can't be expected to resolve periodic processes on timescales of hours.

> L207: *Not sure whether "clines" is a valid expression. I suppose you mean thermocline and halocline.*

We modified the sentence to be more clear and explicitly state what was meant.

> L210: *"generally" instead of "typically"*

Fixed.

> L210: *"This includes the strength of the thermal stratification and its vertical position, ..."*

Fixed. We also made a similar modification at L207, where a similar phrase was used.

> L235: *"permanent halocline"*

Fixed.

> L236: *"an intermediate layer between the thermocline and halocline"*

Fixed.

> L237: *What is meant by "more pronounced" here? You mean "thicker"?*

We clarified this sentence.

> L251: *"(representing the deepest model layer at the ADCP station)"*

Fixed.

> L256: *"The largest bias and RMSE in the current magnitude occur at depths of the halocline, with up to ..."*

Fixed.

> L260: *southern*

Fixed.

> L262-263: 2x *"northward flowing currents"*

*In fluid dynamics, the term "northerly flow" usually refers to a southward direction of the flow (e.g. we use to say westerly winds when the winds are blowing from west to east).*

Fixed.

> L272: *Regarding the model biases: If my understanding of the model boundary conditions is correct (L158), the prescribed daily barotropic velocities could be an issue here as these are not resolving semi-diurnal tidal currents, in contrast to the used hourly SSH.*

We do not expect issues with tidal currents to be significant in this area. See e.g. Medvedev et al. (2013) for information regarding tides in the investigation area.

Reference:

Medvedev, I.P., Rabinovich, A.B. & Kulikov, E.A. Tidal oscillations in the Baltic Sea. *Oceanology* **53**, 526–538 (2013). <https://doi.org/10.1134/S0001437013050123>

> L280: *"most frequent"*

Fixed.

> L286: *Please make more clear that here you are not referring to the cyclonic recirculation mentioned in the previous 2 sentences (where currents are stronger at the eastern side, L302).*

We clarified this sentence.

> L331-332: *"... as precipitation and evaporation roughly balance to net zero freshwater flux at the sea surface." (true?)*

We clarified this sentence.

> L340: *As mentioned above, the flushing time of 6.5 months is incorrect in my opinion. As the Aland Sea is a 2-layer system, both the upper and lower circulation contribute to water exchange. Therefore, one cannot use the net flow of 24000 m<sup>3</sup> s<sup>-1</sup> to calculate the flushing time.*

Thank you, please see our answer in the beginning of this letter.

> L373ff: *Another example for the odd use of tenses. Please use present-tense.*

Please see our answer regarding tenses above.

> L400 and 403: Suggest 2x "possible" instead of "plausible".

Fixed.

> L426: "It is challenging ..."

Fixed.

> L450: "investigation" instead of "examination"

Fixed.

> L451: "simulates/captures" instead of "interpreted"

Fixed.

> L467: "relevant" instead of "bothersome"

Fixed.

> L470: Well, the surface layer thickness of standard z coordinates is mainly determined by SSH variations due to tides, which is not relevant in the Baltic. Sea ice thickness is another issue, though you did not have extreme winters in your study period.

Thank you for this comment. If we understood correctly, no specific change was requested here.

> L477: By "steeper gradients" you mean strong vertical gradients in the water column? Please clarify.

This sentence has been clarified, thank you.