

Ocean Sci. Discuss., referee comment RC2
<https://doi.org/10.5194/os-2021-56-RC2>, 2021
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Comment on os-2021-56

J. H. Reißmann (Referee)

Referee comment on "Refined estimates of water transport through the Åland Sea in the Baltic Sea" by Antti Westerlund et al., Ocean Sci. Discuss.,
<https://doi.org/10.5194/os-2021-56-RC2>, 2021

general comments:

The authors configured a numerical model to investigate currents and resulting volume transports in the Åland Sea located between the Baltic proper and the Gulf of Bothnia in the northern Baltic Sea. This work is based on former model configurations with the aim to improve the performance of the the simulations in that challenging region with the focus on volume transports in unprecedented detail.

Large parts of the manuscript are dedicated to model description and validation even outside the validation section in the results chapter. Also the results sections on currents and transports describe the simulations more or less in comparison with data and general knowlege in large parts and, consequently, do not contain much new facts. However, some new insight about seasonal current patterns, the surface transport and the pathways of deep water is given. Nevertheless, also the discussion focuses on the plausibility of the results, possible causes for deviations from existing findings, and ways to improve the model setup. Motivated by e.g. the importance of nutrient fluxes through the Åland Sea for the eutrophication status of the Gulf of Bothnia, unfortunately, neither implications of the findings on this nor the role of any relevant physical phenomena or driver for them and implications from that are discussed in detail and the manuscript remains more technical in this way. For this reason, the manuscript just has to be seen as a basework to develop modelling skills for the investigated region as the authors note themselves.

The language is good and clear. The content has some repetions from the introduction throughout the intermediate chapters all the way to the conclusions. The figures are of good quality and easy to understand.

specific comments:

line 102: I think it would be good to briefly explain the physical meaning of the Samagorinsky parameter.

line 107: Maybe some examples from literature should be given here.

line 163: Is there some literature proving this and the opposite for Föglö Degerby?

line 188: I agree that timing of the events seems good for which Figure 2 is appropriate. However, absolute differences are in the order of 0.1 m over most of the time shown. This would be much easier to see in a difference plot which is by definition much more appropriate to show differences. For me the following questions arise here: Is 0.1 m difference really quite small or what is to be called small here and why? And what is about the reference levels? Are they comparable at all? Are they determined in a comparable way? Can a target difference of 0 be expected from this point of view? Depending on your answers to these questions, it may be better to skip SSH differences as a mean for validation, explain why a difference of 0 cannot be expected (mainly different reference levels I would assume) and focus validation on the timing and magnitude of the shown variations. Else, it should be explained why 0.1 m can be considered as small here and what implications these differences have on the dynamics and transports.

line 198: Similar problem than before with SSH: What is the expected accuracy and why? Which accuracy is needed for the planned investigation to be reasonable?

line 206: Why (see comment on line 198))? Which implications does this have for the investigations?

line 238 and before: How large is the error or accuracy of the numbers given in this paragraph and that one before?

Figure 3: It is a bit a pity that it is not possible for all profiles to unambiguously assign the corresponding NEMO profile to the monitoring profile. I thought about indicating corresponding profiles from monitoring and model by colour, but for this the needed 12 to 32 different colours for all profiles is definitely too much and not manageable.

Figure 5: General problem with these plots: They are not normalised to phase space. But here this seems not to be very relevant for the discussed findings.

line 266: A good measure to show that would be to present the magnitudes of the vector means normalised to the means of the vector magnitudes. The effect itself is trivial and simply geometric.

lines 341/343/348/355: The mesoscale is defined by the first baroclinic Rossby radius. It would be good to give a number of its absolute size in this region. I suspect it to be quite small in this region and the model showing only mesoscale structures. Is the model capable to simulate submesoscale structures reasonably at all?

line 457: This also raises the question how much bigger the model domain should be in relation to the investigated area. Would the model results be more robust against disturbances or biases in the boundary data if the model domain is somewhat larger than the investigated area? Why is the relation between both chosen as it is here?

technical corrections:

line 41: Witting (1908) is missing in the references.

line 45: Granquist (1938) is missing in the references.

line 54: Is F64 correct? In Figure 1 station F69 is located in Långskär Deep. If F64 is correct it should be emphasised somehow that a station quite far away was used to draw this conclusion. Suggestion: ‚He also concluded from data from station F64, although it is located in the Åland Sea proper, that at Långskär Deep ...‘

line 78: Suggestion: Change ‚big depth gradients‘ to ‚large depth gradients‘.

lines 206/407/434: Suggestion: Replace ‚sensible‘ by ‚reasonable‘.

line 268: Suggestion: ‚In the other winters‘ instead of ‚Of the other winters‘

line 334: Suggestion: Better write 'are plausible' than 'were plausible'. Check used times like this in the whole section! I would suggest to use present time to describe your findings in general in the whole manuscript, especially also in section 3.

line 352: Suggestion: Put 'at our disposal' to the end of the sentence for better readability.

line 361: Suggestion: 'are' instead of 'to be' to make it a correct sentence.

line 372: Suggestion: 'direction of the mean seasonal current' sounds more correct.

line 386: Although the Knudsen theorem is commonly quite known, maybe it would be good to add the reference here.

line 387: 'note' instead of 'notes'

line 422: Suggestion: Omit 'than', just 'less ideal' reads better and maybe is more correct.

line 426: Suggestion: 'a minor issue' instead 'less of an issue'.

line 485: 'flows' instead 'flow'