**Ocean Science**
Discussions

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# *Interactive comment on* "Investigating the relationship between volume transport and sea surface height in a numerical ocean model" *by* Estee Vermeulen et al.

**Anonymous Referee #1**

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In this manuscript, the authors use the HYCOM model to assess the accuracy of the ACT array, an observational array that has been in the water to measure the strength of the Agulhas Current and relate that to altimetry data, in order to create a long proxy record of Agulhas Current variability. The authors find that, in their HYCOM model, this approach to create a proxy is indeed feasible

This is an interesting and very thorough study, that could in principle be published in Ocean Sciences. However, before I can recommend publication, there are a few major issues that I suggest need to be resolved

1) The manuscript is very long, and would benefit much from a considerable shorten-

ing. Especially because of the structure with methods and results separate, there is a lot of duplication between the latter subsections of section 2 and the whole of section 3. Since the authors then repeat the results (again!) in section 4, this really makes for a tough read.

2) It is unclear what the immediate relevance of the study is. The authors present their results very much as a proof-of-concept for the ACT measuring principle, but the moorings have already been successfully deployed. The motivation therefore feels a bit redundant. Another motivation could be to improve physical understanding of the relationship between SSH and transport, but for that the manuscript is too much focussed on the statistics of the relation between the two variables, rather than the hydrodynamics. For example, there are quite a few statements (e.g. line 277 & 279) where a careful analysis of the hydrodynamics would be appropriate

3) The construction of Tjet and Tbox is quite confusing. For example, there is a Tx and a Txsw, even though in both cases they are used for the transport in the souwthwest (sw) direction? Use better terms for these? Might it help to add the equations how all these transport variables are constructed?

4) There is no validation of the depth structure of the Agulhas Current in HYCOM. Given that there is quite some mention of the baroclinic nature of the current, this would be good to validate using e.g. the ACT array data themselves

5) It is a missed opportunity I feel, that the authors have not also investigated the temperature/heat transport. That is something that was hard to do in the ACT array itself, yet is crucial for its climate monitoring ambition. Here, the authors have all the information to calculate the relation between volume and temperature transports

Other, more minors comments are

- The abstract is fairly technical and detailed, especially in the second half. I am not sure how relevant this is to most readers. For example, how useful is it to mention the

terms Tjet and Tbox if they are not explained?

- line 110: add 'time' before 'length scale'?

- line 161: It is unclear whether the nesting is one-way or two-way

- Is table 1 really relevant? Most, if not all, of the information is also in the text. And since there is only one model setup, why does it need to be in a table?

- Figure 1: The altimetry line stops just before reaching the shore. Is this an artefact of the plotting, or does this highlight that nearshore altimetry is not used. If the latter, it would be good to mention that

- line 272: I don't understand why the 12km product is used, if the 6km product is more accurate. Why not interpolate the 6km product to the actual mooring locations?

- Eq 2: Why not use Tx here, if it is equivalent to Yi?

- Table 3 would be much more useful if it also listed the observational ACT results?

- line 490: Is this increase from 86% to 88% is statistically significant?

- Table 4: I don't understand why all the r-values are essentially the same. What does this tell us about the system? How to interpret this? And how is the correlation with the observations?

type-os etc: - line 62: 'area' instead of 'field'?

- line 120: Zhu et al should be \citep{}

- line127: 'but may also be'

- line 182: remove 'notably'

- Figure 2: use 'dashed' instead of 'faint'?

- line 641: 'has' instead of 'have'

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