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Ocean Science Discussions



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

**Estee Vermeulen et al.**

esteever01@gmail.com

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1) The manuscript is very long and would benefit from shortening. There is a lot a duplication between the latter subsections of section 2 and the whole of section 3. Then the authors repeat the results in section 4 again.

Authors- Thank you for this suggestion, the manuscript has been shortened and duplication removed. Changes in manuscript: Sections 1,2,3 & 4

2) The immediate relevance of the study is unclear. The authors present their results very much as a proof-of-concept for the ACT measuring principle, but the moorings



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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 focused 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

Authors: The goals of the paper were to use the numerical model to test the sensitivity of the transport proxy to i) changes in the vertical structure of the current and how this impacted the linear relationship between SSH slope and transport, and ii) the time period of data needed to build a strong relationship between transport and SSH slope. We appreciate this wasn't clear and have now clarified our goals in the revision. Changes in manuscript: Rephrased this in the Abstract (l 24-26), section 1 (l105-109) as well as in the summary and conclusion section (l430-437).

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

Authors- Txsw is the southwestward component of Tx, we have clarified this in the text. Changes in manuscript: See l 187-191 & l201-210

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.

Authors: Thank you for this suggestion, an important addition to the validation. We have now included a new figure showing the time mean (2010-2013) velocity cross section of the Agulhas Current at the ACT array, for both the ACT in-situ observations and for the HYCOM numerical model. Changes in manuscript: See Fig 2 and l170-176

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

Authors: Unfortunately, this is beyond the scope of the study. The study is focused on investigating the sensitivity of the transport proxy to the underlying assumptions on which it was based. However, it is something we hope to pursue in future.

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?

Authors- Noted, the abstract has now been revised. Changes in manuscript: See Abstract

- line 110: add 'time' before 'length scale'? Authors- Noted, however this sentence was removed.

- line 161: It is unclear whether the nesting is one-way or two-way Authors- One way nesting approach and clarified in the text Changes in manuscript: l 130

- 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? Authors: We agree and have now removed this table. Changes in manuscript: removed Table 1

- 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 Authors- This was the first satellite coordinate point from track 96 (of the TOPEX/Poseidon and Jason satellites) overlapping the starting point of the ACT array

- 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? Authors- We used the 12km resolution as it more closely matches the 10km resolution of HYCOM. The 6km product also adds more noise/submesoscale processes, which is beyond the resolution of HYCOM to resolve.

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

Authors- Yes, they are equivalent and we have changed Yi to Tx Changes in manuscript: See l268 & Figure 8

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

Authors: We have now included the ACT observational results in Table 2. Changes in manuscript: Table 2

- line 490: Is this increase from 86% to 88% is statistically significant? Authors: Yes, clarified in the manuscript Changes in manuscript: l392

- 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?

Authors: the performance of the proxy did not necessarily improve by calculating the linear relationship over longer time scales, suggesting that the current dynamics in the model system are very consistent.

Changes in manuscript: See Table 3 & l 499

type-os etc:

- line 62: 'area' instead of 'field'?

- line 120: Zhu et al should be ncitep{}

- line127: 'but may also be'





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- line 182: remove ’notably’

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

- line 641: ’has’ instead of ’have’

Authors: Thank you for highlighting these errors, all have now been corrected

Please also note the supplement to this comment:
https://www.ocean-sci-discuss.net/os-2018-117/os-2018-117-AC2-supplement.pdf

Interactive comment on Ocean Sci. Discuss., https://doi.org/10.5194/os-2018-117, 2018.