



EGUsphere, referee comment RC1  
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## **Comment on egusphere-2022-1293**

Anonymous Referee #1

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Referee comment on "Improving statistical projections of ocean dynamic sea-level change using pattern recognition techniques" by Víctor Malagón-Santos et al., EGU sphere, <https://doi.org/10.5194/egusphere-2022-1293-RC1>, 2023

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Review of « Improving Statistical Projections of Ocean Dynamic Sea-level Change Using Pattern Recognition Techniques” by Malagon-Santos et al.

The paper investigates the benefit of using pattern recognition approaches to assess statistical regional sea level projections from coupled climate model outputs. The study shows that using EOF pattern recognition and low-frequency component analysis significantly reduce errors in pattern scaling of regional ocean dynamic sea level change. The authors apply those two methods on the large ensemble MPI-GE simulations. Each member has different initial conditions. Therefore, it is possible to assess the impact of ocean initial conditions on projected dynamic sea level change. The presented results highlight the need to apply such a pattern recognition methods to reduce errors in regional emulation tools of ocean dynamic sea level change especially when a few realizations are available because of the huge computation cost.

The topic of the paper is interesting as the future generation of AOGCM will increase both atmosphere and oceans spatial resolutions. Thus, a few simulation integrations will be preferred from large ensembles because of the computational cost. Therefore, this technique may be relevant for future sea level change investigations.

I find the paper well written. It is well organized. However, the methodology part could be improved as the methodology is not easy to understand especially for a non-expert in pattern filtering. I think the authors can provide more explanations to help the reader.

Overall, the paper is well supported but some parts are unclear. For instance, I struggle to fully understand and interpret Fig1 as it lacks of explanation in the caption (see my comment below).

I find the paper very technical and I wonder if Ocean Science is the right journal to publish this piece of work. I recommend a major revision for the manuscript before a possible publication.

#### Major comments

- When using EOF decomposition, one strong assumption is that all the modes are independent (i.e., they are orthogonal to each other). Is it really the case especially at global scale? This might be discussed in the conclusion as a limitation of the approach.
- What do you mean by 'well separated'? (L143) How is it performed? Are you sure the initial conditions are totally different and independent? Please, clarify.
- As GMTSLR is removed, the underline hypothesis is that the model conserves volume instead of mass. Is that right? If so, this is due to the Boussinesq's approximation. This should be clearly stated to avoid any misunderstanding.
- MPI-GE description is too succinct. Please, provide more insights. There is no mention on the spatial resolution of the MPI-GE simulations especially for the ocean part. I assume that the ocean spatial resolution is about  $1^\circ$  meaning that the oceans have laminar flows. If so, what is the consequence when assessing the internal variability? Are not you underestimated it? Some studies have estimated the ocean-based internal variability from a large ensemble of forced OGCM. When increasing the spatial ocean resolution, the ocean-based internal variability increases in space and time. We can expect the same behavior for the coupled internal variability. I would appreciate some discussion on this specific point in the discussion's section.

#### Minor comments

L54-63: When describing the drivers of regional sea level changes, one might want to know the associated time scales of each processes. Please, clarify. This would help the reader.

L66: What do you mean by natural variability? Could you define this concept? This would help the readers.

L75: What do you mean by 'regional emulation tools'? Please, define any new terminology.

L109-110: How many members do you need to completely cancel out the internal

variability?

L297: What do you mean by 'conventional approaches'? please, clarify.

L323-324: '...that appear to be linked to volcanic eruptions'. Can you bring extra explanation here or a suitable reference?

Figure1: I do not fully understand this plot. Why  $S_k$  is decreasing when pattern number is increasing? Please, clarify it and maybe extend the caption.

Figure2: Please, change SD by standard deviation. This would help the reader.

Figure 4: Are the results consistent when considering RCP 4.5 an RCP 8.5? It would be interesting to add them into the supplementary materials.