

## ***Interactive comment on “Changes in extreme regional sea level under global warming” by S.-E. Brunnabend et al.***

**S.-E. Brunnabend et al.**

sandra.brunnabend@io-warnemuende.de

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A point-by-point reply to all comments follows below.

Anonymous Referee #2 The future sea level change is an important issue in an area that need investigating. The authors describe the future sea level change focusing on the extreme dynamical sea level change using eddy-resolving ocean model comparing with the lower resolution version. The results show that the changes in dynamical sea level extremes are mainly due to the changes in eddy pathways related ocean circulation changes. My only concern with the manuscripts is the lack of explanation of the statistical significant. This result is based on a single ocean circulation model under a single atmospheric condition, which is from results of a coarse resolution climate model. However, some global distinctive features are consistent with previous studies.

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The main points of the conclusions are plausible. They also use higher resolution model than previous studies. Therefore, I think these results are meaningful for further understanding of the extreme sea level change.

The authors thank Referee 2 for the useful comments on the manuscript. During the review process two additional simulations were finished and used to show that the change of extremes having a 10-year return time are robust.

How about referring to use of the statistical method in abstract or introduction as high-resolution model. It makes it easy to understanding the following sections.

The statistical method “generalized extreme value theory” is mentioned in the abstract and the introduction. In addition, “strongly eddying version” is changed to “high-resolution version” for clarification.

Line 60: Do you mean “slow shutdown beyond 2100”? Please clarify.

In the study of Weaver et al. 2012, two out of 30 of the investigated models project a substantial decrease of the AMOC under the RCP8.5 scenario until year 2100 and no model shows a abrupt transition after the 21st century. The sentence has been extended to make it clearer.

Line 97: The authors should refer the reason to choose the member. Are changes in ocean circulation, discussed in this manuscript, seen adequately in the all ensemble members? If not, we should also consider the other mechanism of extreme sea level change.

The member was chosen arbitrarily. However, during the time of review of the manuscript two more high-resolution simulations have been finished. To show that the mechanisms leading to extreme sea level change under the A1B scenario are robust, Fig. 9 is extended by showing the change of extreme DSL values for a 10 year return period for the other two simulations. From the similar results one can conclude that similar changes in behavior of the AMOC, ocean circulation and DSL occur. A

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discussion is added to the manuscript.

Fig. 2: It would be better to add the contours of mean SSH on Fig. 2, that would make it easy to compare the sea level variability to the location of ocean current paths. Coarse resolution model cannot resolve mesoscale eddies. Is the variability seen in the low-resolution simulation related to seasonal cycle?

We have added these contour levels only in the panels c and g with a short discussion. Indeed, the variability in the low-resolution model is mainly related to the seasonal cycle as internal variability is weak. This is now mentioned in the revised manuscript.

Line 165: It would better to add the AMOC in low-resolution simulation to Fig.3

The figures corresponding to the low resolution results are now added to figure 3.

Line 167: I feel that this sentence is not accurate. It is a kind of "Chicken or the Egg".

The sentence is modified, where 'caused' has been changed to 'associated with'.

Line 180: Is this related to the NADW formation region in the model? Similar features are also seen in the low-resolution version? Please add more information.

Yes, the cooling is due to the changes in deepwater formation; we refer now to Weijer et al. (2012) who have discussed this.

Line 219: The PDF shifts lefts in both region2 and region3. Does mean sea level rise affect the PDL shift in the region3 or changes in eddy pathway in the region3? Is it possible to show the PDF of minimum DSL? The PDF of minimum DSL could shift right if the intensification of eddy activity affects the sea level change in these regions.

This is an interesting point, which is now addressed, in the revised paper.

Fig. 7: Blue and green lines indicate fitted GEV distribution? Please explain it.

The DSL extremes follow a Generalized Extreme Value (GEV) distribution. Therefore, one can fit a Generalized Extreme Value (GEV) distribution function whose parameters

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(location, scale and shape) characterize the behavior of the extremes. We have added a short explanation to the caption of Fig. 7 and to the manuscript.

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