Answers to reviewers

Constraining local ocean dynamic sea-level projections using observations

Dewi Le Bars, Iris Keizer, and Sybren Drijfhout

We would like to thank the referees for the second round of comments. We answer below in blue.

Anonymous referee #1

The authors have addressed all my suggestions thoroughly and I deem the manuscript ready for publication. I only have two technical comments:

Figure 3, caption: There are two uncertainty ranges shown for the ODSL rates computed from CMIP6 models. It is mentioned in the main text and mostly obvious but for completeness please mention which colour corresponds to which uncertainty range. We added this information to the caption.

Figure 5, caption: Do you mean 13 (not 12) plausible models? Thank you, it is indeed 13, we corrected the caption.

Anonymous referee #2

I have read the revised manuscript "Constraining local ocean dynamic sea-level projections using observations" by Dewi Le Bars et al., submitted for publication to Ocean Science.

First, I want to thank the authors for their efforts to consider my comments. I am satisfied with their approach to accounting for the influence of internal climate variability, though the results confirm what I said previously that, with such influence being as large as it is, choosing the models that best match observations might not be the best strategy. The authors acknowledge that in the discussion, so that is fine. I also think that the new discussion on model limitations and the challenge of estimating ODSL changes has greatly strengthened the paper. Overall, I support the publication of this paper. The paper is rather inconclusive regarding which model selection method is better, but this is also acknowledged and there is some discussion on it, which adds value to the paper.

That said, there is one question that the authors have somehow evaded. In particular, I asked "how sensitive are the results to the choice of the period?" to which the authors responded "We want to select a period that overlaps with the altimetry period that started in 1993, that is as long as possible". This does not really answer my question.

We have added a paragraph in the discussion section to discuss this point:

"We have used the period 1993-2021 (29 years) to select models. The longest period for which satellite altimetry is available. For our selection 2 we found that 13 models were selected. For shorter periods the number of models selected is larger because the uncertainty in computing the rate of sea-level rise from both observations and models is larger. For the periods 1993-2007 (15 years), 1993-2012 (20 years) and 1993-2017 (25 years), the numbers of models selected are 24, 19, and 15 respectively. Out of a total of 26 models. The model selection also depends on the exact period used. For example, while 15 models are selected for the period 1993-2017, for the period 1997-2021 which is also 25 years only 12 models are selected. One model has a rate that is too low to be selected, the same for both periods. The number of models with a too high rate is 10 for 1993-2017 and 13 for 1997-2021 with 9 overlapping models."

Additionally, I find the response that the sharp drop in correlation before and after 2010 is due to a decline of the AMOC in the CMIP6 models that started in 1990 and took 20 years to show up rather unsatisfying. The authors do not provide much evidence to support this statement and, in fact, if the influence of such decline operated on such long time scales, wouldn't we see a gradual drop in correlation rather than the sharp one that we are seeing? There is also the issue that direct ocean observations of the AMOC, at least at 26 N, do not show such a large decline, which again questions the approach to selecting models based on their agreement with observations. I will leave it to the editor to decide on the relevance of the points I raised here.

There is a sharp increase and decrease of correlation before and after 2010 mostly for short periods which we argue are too much influenced by natural variability to use. For the period of 29 years that we use, the increase and decrease are gradual. This can be seen from the graph attached representing the correlation between rate and height in 2090-2100 (y-axis) as a function of the end of the period of computation of the rate (x-axis).