Ocean Science Discussions

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Comment on os-2021-36

Anonymous Referee #3

Referee comment on "Causes of uncertainties in the representation of the Arabian Sea oxygen minimum zone in CMIP5 models" by Henrike Schmidt et al., Ocean Sci. Discuss., https://doi.org/10.5194/os-2021-36-RC3, 2021

General comments:

This paper aims to assess the representation of the Arabian Oxygen minimum zone (ASOMZ) in 10 CMIP5 model historical simulations and relates the error to water mass properties. The topic is interesting and important. However, there are several major issues that should be addressed. The authors stated that none of the selected CMIP5 ESMs reproduces the observed oxygen distribution. It would be interesting to examine these aspects in their upgraded CMIP6 versions to check if they had substantially improved or worsen in representing OMZ and water mass properties.

The water mass properties over the north Indian Ocean region and their implications on ocean biogeochemistry in CMIP models have not been studied extensively. This paper presents important and fresh perspectives through the use clustering and quantification of uncertainties in water mass mixing ratios. However, the paper has not been written clearly. This manuscript was not structured well, especially the introduction and results sections. Introduction needs to be organised. Re-structuring of the manuscript can be done to make it easily readable and highlight the novelty of the study. I would recommend a major revision.

Specific comments:

Why did the authors choose 50 threshold to define OMZ? Please clarify in the methodology section.

Are there any criteria adopted in selecting the specific ESMs? Are they good at representing the Arabian Sea mean state? Provide references if available.

Description of OMZ along west coast of India can be included in the introduction section.

The description of mixing ratio coefficients is not clear. Please elaborate. Define in terms of their corresponding water mass.

Apart from the errors associated with ventilation, it would be interesting to describe the static stability and solubility parameter in these models. Stratification of upper layers associated with warming and weakened surface winds restrict mixing oxygen-rich surface waters to intermediate depths, leading to oxygen depletion. Please clarify.

Page 5, line 10: "We chose our threshold to be 50 ". But a threshold of 60 is referred to state the general underestimation of OMZ volume (e.g.: Abstract section). Please clarify.

Page 16, line 5: "…….physical model components show no obvious deficiencies in

circulation and mixing". The analysis presented in this paper is not sufficient to conclude this. Please clarify.

Technical corrections:

Page 4, line 20: "……..OMZ between 200 and 1800m". Provide references.

Page 4, line 25: "…….depth levels ranges from 31 to 63". Please rewrite this sentence. What are the numbers 31 and 63?

Page 5, line 10: "We thus compare the volume of the OMZ for a wide range of thresholds." Please provide the values.

Page 5, line 25: "…….Oxygen profiles in the AS for all models and the observations." All models or selected ESMs?

Page 5, line 30: Is that the area shown in Fig. 4c? The location of the central AS can be better shown on a map.

Page 6, line 30: "…… three different source water masses". Please mention three source water masses.

Page 7, line 5:” ……IODW, RSW and PGW and ICW”. Please rewrite this sentence. Should it be like……PGW/RSW?

Please provide proper references to the methods described to determine the source water masses (Page 7, line 5-15).

Provide references or describe the method to obtain the age of water masses in selected models (Page 9, line 30).