

# Reply to Referee

We thank the reviewer for commenting this manuscript one more time. The original review comments are given below in black, [our reply in blue](#), and quotes from the revised manuscript in gray.

## 1 Anonymous Referee #3

The authors did substantial revision and clarification following reviewers comments. I think now the aim of the study and the results are more clear and I really like the detailed explanation on methods section and schematic explanation in Figure A1. Despite the fact that ToE metric it self has numerous discussion,  
5 I think the multi-tracer ToE discussion in this study will be useful for the Large Ensemble Simulations and CMIP6 analysis.

At this point I only have minor (specific) comments before publication.

[We thank the referee for the positive comments.](#)

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### 1.1 Specific Comments

-Section 3.2 (relative vs. absolute ToE): I would like to thank the authors for detailed reply and overall I understood the concept and advantage of relative ToE, basically allows to better compare the common patterns among the models because you remove the global mean bias. I wanted to further clarify but this  
15 means that the difference in relative ToE magnitudes among the models stem from mainly "regional model bias" correct (I would guess not everything)? I was still thinking of interpreting what causes the differences in relative ToE magnitudes among models and I would like further comments from the authors (and add one or two sentences in the main text if necessary).

[Thank you for this comment. We have addressed this issue in our previous reply to referee 2.](#)

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[We have not been able to find any obvious link between the multi-model spread of relative ToE and the multi-model median in ToE, or the multi-model median of the anthropogenic signal, or the multi-model median of the internal variability for both T and O<sub>2</sub> \(see page 14, Fig. 2. of previous reply\).](#)

[The following sentences have been added to section 3.1.1 second paragraph.](#)

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These regional differences in the multi-model spread could not be explained by the multi-model median of ToE, the anthropogenic signal nor the internal variability amplitude for both O<sub>2</sub> and T. Scatter plots of individual grid cell values of the multi-model spread in ToE<sub>rel</sub> versus those of the multi-model median of ToE, the anthropogenic signal or the internal variability amplitude do not show a clear relationship (not shown).

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-P10, L17-18: ... in accordance with (Levitus ... ), minor editorial thing but do you need parenthesis here?

[The end of the sentence reads now:](#)

...in accordance with published observational studies (Levitus et al., 2009, 2012; Bilbao et al., 2019).

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-Abstract L5 P16, L19: The authors did an excellent work on revising and checking the consistency in terminology ("internal variability") and thank you for addressing this. These are additional details but are the "natural variability" in the abstract and P16 also suppose to be "internal variability" or did you intend to leave these as "natural variability"?

[In the abstract, the "natural variability" term has been kept on purpose as we refer to naturally forced and](#)

internal variability. The second mentioned occurrence is however corrected with internal variability and reads now:

For example, in the North Pacific subtropical gyre and the Southern Ocean, both the oxygen depletion and the internal variability are relatively strong.

- 5 -Figure 6, caption: From the caption sentence it is obvious what ToE is but I would still suggest to be more clear stating  $\text{ToE} = \text{ToE}(\text{T}) - \text{ToE}(\text{O}_2)$  in the caption (if I did not miss, I also did not see what ToE is defined as in the main text).

The definition of  $\Delta\text{ToE} = \text{ToE}(\text{T}) - \text{ToE}(\text{O}_2)$  has been added to the caption.

- 10 -Figure 7, i), label: "CESM 1.0" -¿ Is this suppose to be "CESM 1.0-RCP8.5"?

Thank you for this remark. Figure 7 has been updated.

## References

- 5 Bilbao, R. A. F., Gregory, J. M., Bouttes, N., Palmer, M. D., and Stott, P.: Attribution of ocean temperature change to anthropogenic and natural forcings using the temporal, vertical and geographical structure, *Climate Dynamics*, doi:10.1007/s00382-019-04910-1, URL <https://doi.org/10.1007/s00382-019-04910-1>, 2019.
- Levitus, S., Antonov, J. I., Boyer, T. P., Locarnini, R. A., Garcia, H. E., and Mishonov, A. V.: Global ocean heat content 1955-2008 in light of recently revealed instrumentation problems, *Geophysical Research Letters*, 36, doi:10.1029/2008gl037155, 2009.
- 10 Levitus, S., Antonov, J. I., Boyer, T. P., Baranova, O. K., Garcia, H. E., Locarnini, R. A., Mishonov, A. V., Reagan, J. R., Seidov, D., Yarosh, E. S., and Zweng, M. M.: World ocean heat content and thermosteric sea level change (0–2000 m), 1955–2010, *Geophysical Research Letters*, 39, doi:10.1029/2012GL051106, URL <https://agupubs.onlinelibrary.wiley.com/doi/abs/10.1029/2012GL051106>, 2012.