

Ocean Sci. Discuss., referee comment RC2
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Comment on os-2021-102

Anonymous Referee #2

Referee comment on "Seasonal extrema of sea surface temperature in CMIP6 models" by Yanxin Wang et al., Ocean Sci. Discuss., <https://doi.org/10.5194/os-2021-102-RC2>, 2022

Review of "Seasonal extrema of sea surface temperature in CMIP6 models" by Wang et al.

This is an account of seasonal sea surface temperature (SST) biases in CMIP6 models with respect to the observed World Ocean Atlas climatology for the period 1981-2010. The authors document and discuss discrepancies between the multi-model mean as well as individual model seasonal cycles, and observations. They find model diversity in cold and warm season SST biases, as well as annual mean biases and seasonal cycle amplitude biases. Model bias is shown to increase with decreasing vertical ocean model resolution, highlighting promising future model development activities. These findings have important implications for the model specific assessment of regional climate projections. As such, the present study will be a valuable reference in the climate model evaluation literature.

I find the manuscript to be interesting, relevant, and well-written. The presented results are novel and important within the ocean modeling community. The paper is therefore a good fit for Ocean Science. After some mostly minor concerns of mine have been addressed, I think this manuscript will make a welcome addition to the scientific literature.

Main concern:

A somewhat substantial concern of mine is the use of the first realisation of each model for drawing fundamental conclusions about the model's biases. Individual ensemble

members are subject to substantial chaotic climate variability, which might as well influence the seasonal cycle of SST. To address this issue, I suggest the authors compare r_1 to the ensemble mean of individual models (or r_2) to get an idea about how strongly SST seasonal cycles depend on the realisation of the models. This would make their analysis more rigorous and give their reported results more weight.

Specific comments:

I. 3 Should these "commonly used climatologies" be defined here?

I. 9 I suspect that the authors report "no significant relationship" of SST extrema bias "with horizontal ocean model resolution", but suggest the authors be specific about that.

I. 21 Suggestions: move the abbreviation "CMIP5" into the brackets and the long form out of the brackets.

II. 31-32 Drawing conclusions about projected seasonal cycles from the analysis presented in this paper assumes i) stationarity of the biases, and ii) that the biases are consistent between r_1 (analysed here) and the ensemble mean (used for projections) of the individual models. While i) is difficult to test and could (should?) be discussed as a caveat, I think that ii) requires some attention in the revision of the manuscript (see my main concern above).

II. 32-34 I do not see the value of a table of contents here and thus suggest deleting it.

II. 41-42 The extra information about INM-CM5-0 (Volodin, pers. comm.) could be placed more appropriately in Table 1. Please consider moving it accordingly.

II. 51-52 I wonder if the averaging of T values from different months in case of a shifted seasonal cycle would be problematic. Could the authors please comment?

I. 53 To avoid potential confusion, I suggest being specific here that the RMSE of the four different T quantities is calculated against observations for global SST.

II. 60-61 Where are the excluded grid points typically located? Maybe add a sentence about that here.

I. 77 I cannot make out to what the "it" at the start of this sentence refers. Please be specific.

I. 80 Explicitly stating once in this paragraph that high latitudes show a larger bias than low latitudes would make the entire story easier to follow. Please consider this addition.

I. 97 I think it should be "...salinity biases in the Arctic."

Figure 7 The different x axes of a-f compared to h-i are somewhat confusing to me. The message of this figure might be easier to grasp if the figure was split in two separate figures.

II. 104-105 The two occurrences of "is larger" in this sentence lack clarity without a reference (larger than what?). I recommend using absolute language such as "shows a maximum".

II. 131-132 Which part of the cloud is underestimated? From the sentence itself, it is unclear if it is cloud cover, formation, ...

I. 150 Separate "Namibia" and "as"

II. 229-230 What is the significance level at which this correlation is significant? Which significance test was used? Without this information, the statement of significance is not worth much. Similarly, I suggest adding p-values to figures 8 and 9.