

Response to Anonymous Referee 3: Reviewer comments in black, author comments in blue.

Hobbs et al. compared trends of observed Antarctic sea ice with those of CMIP6 simulations. This investigation sheds light on the model's performance and its ability to capture and reflect the dynamic changes in Antarctic sea ice in the face of recent, dramatic declines.

The authors find that between 1979-2018, the model did not compare well with the sea-ice observations, since the SIE/SIA increased over the first 35-years and the model concurrently showed a decline. However, when the analysis was extended to include the 2022 and 2023 lows (encompassing the full satellite record) a more favorable alignment between the model and observations emerged. They concluded that this was potentially due to being able to assess the trend over a longer time period, which gives a greater confidence to CMIP6 simulations.

Overall, I am not 100 % convinced with the authors' conclusions. The CMIP6 model has consistently underestimated the SIE and SIA in the Antarctic, and thus did not reproduce the 1979-2014 sea-ice trends. Although the model seems to align better with recent data showing a decline in sea ice trends, especially in 2022 and 2033, I find the authors' argument insufficient to establish the model's reliability and instill a higher level of confidence in its capabilities.

Based on these comments and the one below, we believe it is possible that the reviewer may have misinterpreted the data and our aims in the paper. This highlights that we may need to be clearer in the manuscript. CMIP6 is not 'a model' but is instead an ensemble of coupled climate models. In this study, we are considering the results of 98 model simulations from 39 models.

INTENDED ADJUSTMENTS: We will add to the text at line 58 to make the nature of CMIP6 more explicit (mentioning our analysis constitutes 39 models from multiple modelling centres with multiple different model components and resolutions).

It would be beneficial for the authors to provide a more detailed account of the enhancements made to CMIP6 that contribute to its improved simulation of sea-ice trends, particularly when considering the extended satellite record, and recent sea-ice lows. Given the well-documented temporal and regional variations in Antarctic sea ice, where trends and regions often exhibit stark differences, a more comprehensive explanation of the model modifications would help readers better understand the factors leading to its purported improvement in capturing these complexities.

We are not arguing that the CMIP6 models have improved over previous generations of models. Rather, we are arguing that the recent changes in the observations affect our assessment of the models, and that if we use annual-mean ice area trends as a metric, the CMIP6 models now do not disagree with observations. Therefore, a discussion of model enhancements is not relevant.

Of course we still agree that there are many other metrics for which CMIP6 sea ice area does disagree with observations. The manuscript already discusses in detail the disagreement of trends over the 1979-2014 period, as well as other variables on which modelled sea ice may be assessed and found to disagree (penultimate paragraph of the discussion in the original submission).

INTENDED ADJUSTMENTS: We will add text to line 46 to clarify we are not examining a changed set of models but rather our interpretation in the light of changing observations.

Specific comments:

Line 54: Figure B1 is referenced here and in two other places, but there is only a Table B2 in the Appendix B.

We thank the reviewer for spotting this. Table B2 is labelled in error in Appendix B; we will correct this to 'Figure B1'

Lines 81-82: This sentence is a quite confusing and convoluted.

We will rephrase this sentence.

Line 105: I would suggest changing the sentence to "This makes it less likely that the observed..."

We will change this as suggested.