Geoscientific Model Development Discussions

Geosci. Model Dev. Discuss., author comment AC2
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Reply on RC1

Peter A. Bogenschutz et al.

Author comment on "Combining regional mesh refinement with vertically enhanced physics to target marine stratocumulus biases as demonstrated in the Energy Exascale Earth System Model version 1" by Peter A. Bogenschutz et al., Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2022-175-AC2, 2022

We thank Reviewer 1 for their time, comments, and helping to make this a better manuscript. Please see our reply to each comment below. For exact wording changes and additions made to the manuscript, please refer to the marked up manuscript.

Reviewer Comment: L195-200: How is "low level cloud" defined?

Response: Text has been added in the second paragraph of section 4.1 to address this and with reference given for the LIDAR retrieval.

Reviewer Comment: L230-235: Presumably, Figure 5b shows the global impact of reduced SEP Sc bias. For example, it shows an increased low cloud amount along the ITCZ. Although it is not within the scope of this paper to discuss the global impact of reduced Sc bias, it would be helpful to provide information on whether the differences we see on Figure 5 are significant. This can help guide future work.

Response: This is an excellent suggestion! We have added stippled areas to this plot to show where differences are statistically significant. In addition, text was modified/added in section 4.1 to discuss these results.

Reviewer Comment: L290: In general, I would like to see more discussion on the mechanisms behind the improvement in SEP-RRM-FIVE. What processes lead to improved Sc with FIVE and with RRM respectively? Here the authors touched on turbulence and cloud top feedback. More detailed discussion would be appreciated.

Response: Thank you for this suggestion. Yes, we agree more description and context was needed. At the end of section 4.1 we added a couple paragraphs to address this.

Reviewer Comment: L315-320: The presence of positive and negative bias along the coast in DJF, MMA, and SON in FIVE simulations suggests that the location of the Sc deck is shifted north of the observed Sc. Is this the case? If so, does it suggest that the bias is related to large-scale circulation instead of BL processes?

Response: This is a very interesting point and thus far our analysis has not shown strong evidence that the errors in the large-scale circulation are the leading cause of this placement bias. We hypothesize that parameterization deficiencies are the first order

cause of the remaining bias, as already noted in the text.

Reviewer Comment: L330: "further refinement of the vertical grid in VEP could lead to additional improvements", are there studies to support this claim?

Response: It was found in the original E3SM-FIVE prototype paper (Lee et al. 2021) that running with increased vertical resolution (16x relative to E3SM in the boundary layer) beyond that used in this paper (8x) has modest improvements to the Sc biases. Thus, It is possible that 16x vertical resolution in FIVE coupled with high horizontal resolution could further reduce the biases presented in this paper. The appropriate reference has been added near original line L330 (at the end of section 4.2) to support our speculation.