

Geosci. Model Dev. Discuss., referee comment RC1  
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## Comment on gmd-2022-175

Anonymous Referee #1

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Referee 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-RC1>, 2022

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Bogenschutz et al. have presented a novel GCM framework that combines regional mesh refinement with vertically enhanced physics to improve simulated marine stratocumulus. The study addresses advancement in GCM and cloud modeling, which is well within the scope of GMD. Although previous studies have explored and documented the performance of regional mesh refinement and vertically enhanced physics separately in GCMs, the combination of the two is new. Therefore, this study presents a sufficiently substantial advance in modeling science. The paper is clearly written, well structured, and easy to follow. The conclusion, mainly that their novel framework can reproduce high resolution benchmark simulation with substantially lower computational cost, is well supported by the results.

I only have a few comments below:

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

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.

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.

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?

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