Understanding Changes in Cloud Simulations from E3SM Version 1 to Version 2
Yuying Zhang et al.

Response to reviewer 2

We thank the reviewer for his/her positive and constructive comments on our work. The revised manuscript has included the changes suggested by the reviewer. Our detailed responses (blue) to the reviewer's questions and comments (*Italic*) are listed below.

Minor Comment

1. *P.5 L.158 "considerable increase of stratocumulus cloud over the eastern ocean basins along the coasts in both hemispheres"*

It would be helpful to readers if the authors specify more explicitly where they can find the increase in the stratocumulus cloud. I assume that they can find the increase along the western coasts of South Africa and North and South America, as stated in L.231.

Response:

Done. The sentence has been revised to "A robust improvement made in E3SMv2 is the considerable increase of stratocumulus cloud over the eastern ocean basins along the coasts, such as the west coasts of South Africa and North and South America."

2. *P.9 L.258 "the CLUBB tuning has led to an increase of clouds regardless of their optical properties"*

It appears to me that the CLUBB tuning has led to a decrease, not an increase, of clouds. This is because, in Figure 8(a), the "v2" run with the tuning shows less cloud compared with the "clubbonly" run without the tuning.

Response: Thanks for pointing this out. Yes, the CLUBB tuning has led to a decrease, not an increase, of clouds. This has been corrected (P10, Line 294).

3. *P.10 L.303 "indicating that the reduction of optically thin clouds shown in Figure 8 from the new trigger are mainly from low clouds"*

Is there any information on middle clouds that supports this statement? I can see from Figure 12(d) that high clouds do not contribute to the reduction of optically thin clouds, but I could not find information on the middle clouds.

Response: To answer the reviewer's question, we examined MODIS middle clouds. As you can see from the figure below (Fig. R1), the new trigger has very minor impact on optically thin middle clouds. Its impact is mainly on increasing optically intermediate and thick middle

clouds over SO and N. Hemisphere storm tracks and the Arctic regions (not shown). This supports the statement "indicating that the reduction of optically thin clouds shown in Figure 8 from the new trigger are mainly from low clouds".

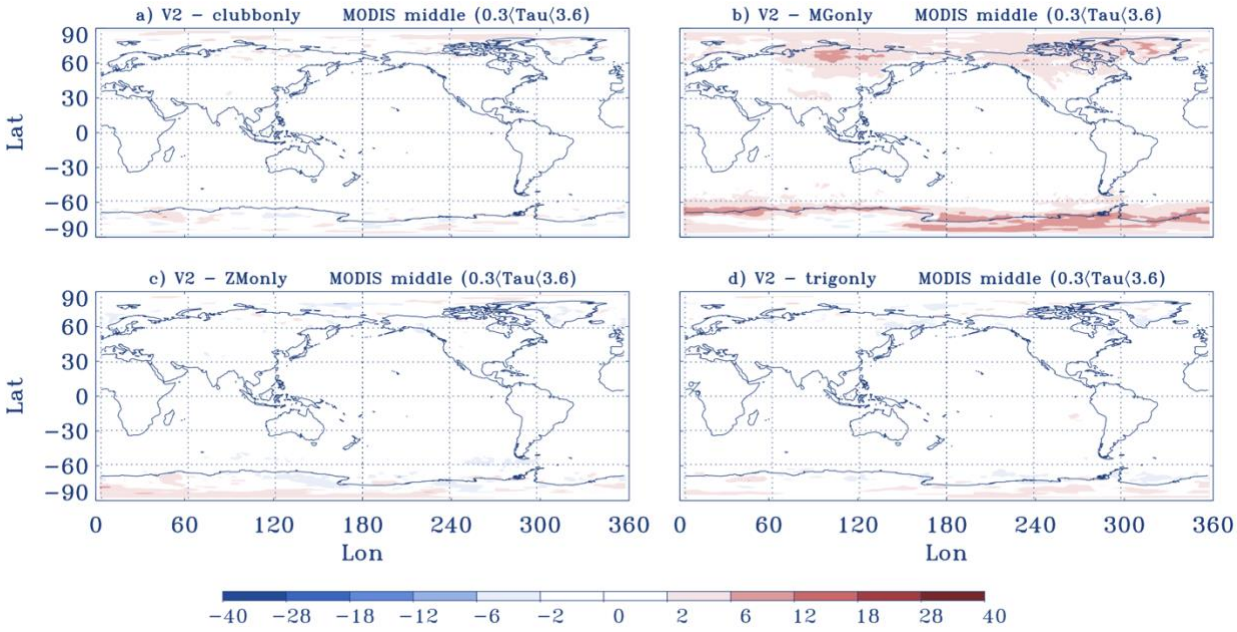

Figure R1. Difference in optically thin middle-level cloud fraction from MODIS simulator (0.3 < Tau < 3.6) between sensitivity tests and the default E3SMv2 run. a) E3SMv2 with CLUBB related parameters changed from v2 to v1; b) E3SMv2 with MG2 related parameters changed from v2 to v1; c) E3SMv2 with ZM related parameters changed from v2 to v1; and d) E3SMv2 with the dCAPE_ULL trigger turned off. All results are from 6-year AMIP-style climatology runs.

Typos

- *P.1 L.11 "165-year historical simulations". Table 2 says that they are 150-year simulations.*
  Response: It is 165-year historical simulations from 1850 to 2014. This has been corrected in the revised manuscript. Thanks for pointing this out.

- *P.2 L.31 "re-turning" retuning?*
  Response: This has been changes throughout the manuscript.

- *P.2 L.41 "To archive our goal," achieve?*
  Response: Fixed.

- *P.4 L.116 "165-year historical simulations": Table 2 says that they are 150-year simulations.*
  Response: It is 165-year historical simulations from 1850 to 2014. This has been corrected in the revised manuscript. Thanks for pointing this out.

- *P.12 L.360 "Figure 12d": Figure 11d?*
  Response: Fixed.

- *P.22 L.535 "a) & d) & h) are MISR observations": a) & d) & g)?*
  Response: Fixed.

- *P.32 L.620 "optically thin cloud fraction": optically thin low cloud fraction?*
  Response: Changed. The figure has been moved to Appendix following Reviewer 1's suggestion.

- *P.33 L.627 "optically intermediate cloud fraction": optically intermediate low cloud fraction?*
  Response: Changed. The figure has been moved to Appendix following Reviewer 1's suggestion.

- *P.34 L.633 "optically think cloud fraction": optically thick low cloud fraction?*
  Response: Changed. The figure has been moved to Appendix following Reviewer 1's suggestion.