Review paper "Improving Madden–Julian Oscillation Simulation in Atmospheric General Circulation Models by Coupling with Snow–Ice–Thermocline One-dimensional Ocean Model".

[RC1]

This is an interesting work investigating the improvement of the MJO simulation by coupling the AMIP to the Sea-Ice-Thermocline single-column model. And the most important is the fine resolution of the upper oceanic temperature could play such an important role. From the MSE analysis, it is apparent to observe the prominence of the latent heat, which has been underestimated in AMIP simulation. However, it is not sure if that is also the case in the coupled models. The authors mentioned the diurnal warm and cold skin; however, it is not addressed well in the paper. If the authors could provide more explanation or references on it is suggested. Figure S5 is a very interesting plot. Although all experiments use the same SIT module, the temperature penetration depth seems very different in between models. The depth is different, but the stronger variance is shown in the ECHAM5-SIT experiment. To have the storage when running the HIRAM-SIT is understandable, but the magnitude of the 3m at the 1.5S, 90E seems much weaker at the 9m, and the centre seems shifted. What will cause that different pentation? I hope the authors could provide a little explanation, and it might be useful information for the global coupled model teams. I am happy with this version of the article and agree the article meets the standard of the GMD journal. However, an extra description of the oceanic dynamics and the labelling adjustment in Figure 5S will be more appreciated.

Reply to reviewer:

Thank you for the sincere comments regarding our manuscript, as well as taking the time to provide several suggestions for the improvement. In particular, the comment about the oceanic response is less addressed in our previous manuscript. Here, our point-by-point responses to each of the individual comments are outlined below.

1. From the MSE analysis, it is apparent to observe the prominence of the latent heat, which has been underestimated in AMIP simulation. However, it is not sure if that is also the case in the coupled models.

   In the coupled model, the synchronous ocean surface temperature is varying associated with the MJO variability. Therefore, the LH flux biases are smaller than AMIP simulations. It is the main contribution of the coupling during the MJO preconditioning phase. Previous studies have identified that coupled models tend to perform better simulations (Demott et al., 2019; Jiang et al., 2015).

2. The authors mentioned the diurnal warm and cold skin; however, it is not addressed well in the paper. If the authors could provide more explanation or references on it is suggested.
   Thank you for the reminder. More details and references are added.

   "Cool skin is a very thin layer that has a direct contact with the atmosphere and warm layer is the warmer sea water immediately below the cool skin in the top few meters of the ocean. They fluctuate diurnally in response to atmospheric forcing. SIT with high vertical resolution realistically simulates the warm-layer (within top 10 m) and cool-skin (the top layer with 0.001 m thickness), and improve the simulation of upper ocean temperature (Tsuang et al., 2009; Tu and Tsuang, 2005). The model has been verified at a tropical ocean site (Tu and Tsuang, 2005), in the South China Sea (Lan et al., 2010), and in the Caspian Sea (Tsuang et al., 2001). The melt and formation of snow and ice above a water column has been introduced (Tsuang et al., 2001)."

3. Figure S5 is a very interesting plot. Although all experiments use the same SIT module, the temperature penetration depth seems very different in between models. The depth is different, but the stronger variance is shown in the ECHAM5-SIT experiment. To have the storage when running the HIRAM-SIT is understandable, but the magnitude of the 3m at the 1.5S, 90E seems much weaker at the 9m, and the centre seems shifted. What will cause that different pattern? I hope the authors could provide a little explanation, and it might be useful information for the global coupled model teams.

Thank you for the suggestion. We have moved Fig. S5 to main figure (Fig. 6). The differences between models are likely due to the different atmospheric model configurations, because they were coupled to the same 1-D ocean model. Since the atmosphere is the main driver to extract heat form the ocean, different responses of atmospheric models likely have different effects on SST. In our study, we clearly demonstrate that coupling improves the simulations in three AGCMs with very different configurations and parameterization schemes. The cause of quantitative differences in subsurface temperature between models is not explored in this study. Further detailed analysis is needed to pinpoint. We have added this discussion.

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