Dear editor and reviewer,

We appreciate editor's positive comments and reviewer's insightful remarks. The manuscript has been revised based on reviewer's comments and the grammatical and typographical errors have been corrected to meet the high-quality standard of GMD. In response to reviewer's comment, one figure is added in the revised manuscript as Fig. 5. Below are the point-by-point replies to reviewer's comments.

Sincerely,
Yung-Yao Lan, Huang-Hsiung Hsu, Wan-Ling Tseng, and Li-Chiang Jiang

Anonymous Referee #1
Reviewer's comments are formatted in italics and the authors' response are formatted in bold.

RC1.general comment.

This is my second time for reviewing the manuscript drafted by the authors (Lan et al.). Compared with the previous version, I would like to complement their efforts on reorganizing the structure. At least for now, it is more readable to me for understanding the messages they want to deliver. The points in their response also answer most of my concerns in the previous version. To be honest, the current status of the manuscript is publishable, after some minor revisions are done. However, I hope the authors can spend some efforts in revising or adding more details about the ocean model parts. It may benefit more readers for understanding the importance for each experiment mentioned in section 2.3. If both the editor and authors think these comments are unnecessary, it is ok to just move on to the next step.

Response:

We agree with reviewer that adding this discussion would be helpful to readers in understanding the significance of each experiment. A detailed explanation of the ocean model is provided in the appendix.

Section 2.3 now clearly lists the five experiments finished in this manuscript. However, it will be useful to describe the reasons behind each experiment more. For example,

A. Section 3.1. describes that the C-30NS is aimed to compared with A-CTL. I hope some descriptions can be added either in the introduction or section 3.1. for explaining why coupling in the tropical region is more important than that in the high latitudes (yeah, people can guess MJO as a tropical atmosphere system, but it can still be helpful).

Response:

Thank you for the suggestion. Reasons are added to explain the purpose of each experiment design.

B. *The reason behind the experiment in section 3.2 is about the effect of fine vertical resolution in the ocean model. However, it is very interesting to see that the authors try to demonstrate it by making the thickness of the layer (the one below the SST layer) up to 10 or 30 m. I hope the authors can give more physical explanations on the reasons for doing it. I can expect less temperature changes if this layer is thicker, but why testing it? Normally, it may be done by changing vertical resolution near sea surface. Because the vertical resolution in the upper 10 m of C-30NS is ~1 m, I may decrease the vertical resolution in the upper 10 m, instead of setting a thick near-surface layer.*

Response:

We agree with reviewer's point that testing different vertical resolutions in top 10 meters would be another way demonstrating the necessity of high vertical resolution for better MJO simulation. In this study, we did not attempt to identify the optimal vertical resolution for MJO simulation, instead we chose to demonstrate the significant improvement that a fine vertical resolution can achieve compared to the coarse resolution (e.g., tens of meters) that is often adopted in slab ocean model. Through the comparison we also demonstrated the crucial role of air-sea interaction, which can only be well simulated with fine vertical resolution, in shaping the characteristics of MJO. Reviewer's suggestion is well taken. We'll test the idea in a following experiment and hopefully to

present the results in another report. Our hunch is that the incremental decrease in vertical resolution likely worsens the simulation gradually, but not as dramatically as demonstrated in the C–LR12m and C–LR34m simulations. We added Fig. RC1 in the revised manuscript to demonstrate the dramatic changes in vertical profile of ocean temperature between the fine and coarse vertical resolution simulations. Amplitude of ocean temperature decreases dramatically in coarse resolution simulations. In addition, there is a clear vertical stratification of ocean surface temperatures in C–30NS, whereas C–LR12m and C–LR34m are well mixed without obvious stratification. This demonstrates the necessity of fine vertical gridding for resolving the fast fluctuation of ocean temperature when interacting with the atmosphere.

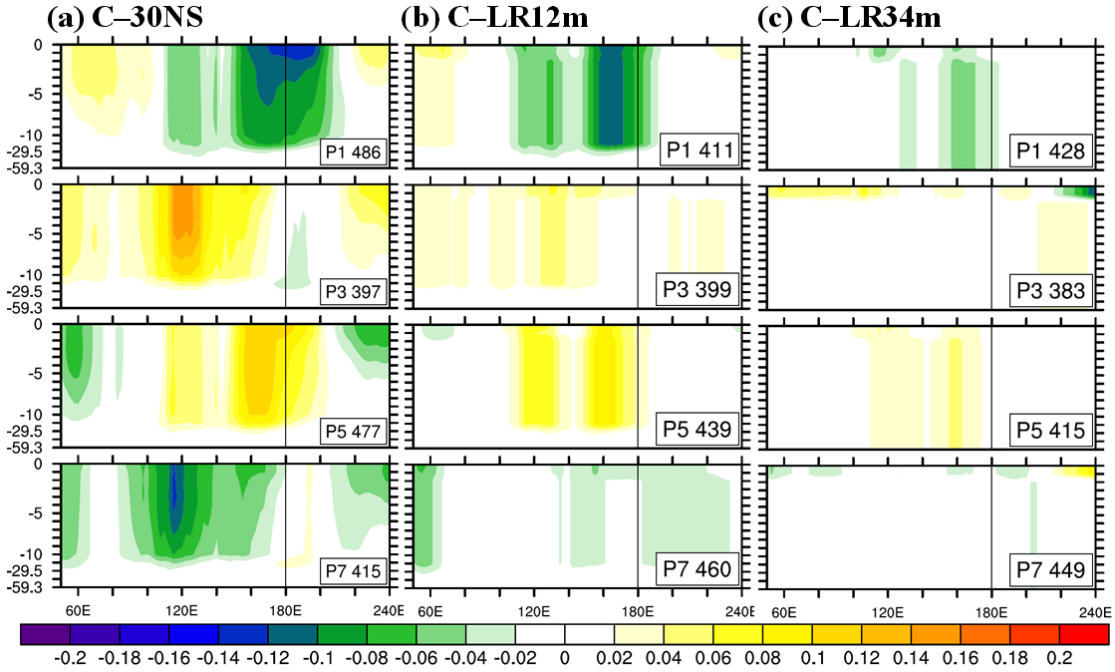

Fig. RC1 Composites of 20–100-day filtered oceanic temperature (K, shaded) between 0 and 60 m depth for MJO phase 1, 3, 5, and 7, shown at the top right of each panel in C–30NS, C–LR12m and C–LR34m.

C. Section 3.3 is the experiment I still cannot understand after the revision… Line 462 wants to study how thick a vertically-gridded ocean mixed layer. It makes me expect the authors will artificially average the temperature or salinity structure near the sea surface. Line 464 then mentions "the ocean model (SIT) bottom at 10, 30, and 60 m, which included the top 12, 14, and 16 levels". From Table 1, the authors describe it as the thickness of the ocean model is 10, 30 and 60 m, respectively. It seems like a confliction between line 462 and 464 to me. To me, artificially mixing the near-surface layer is more reasonable, because the heat during the air-sea interaction can be downward transported to more than 60-m depth via turbulent mixing. Setting the bottom of ocean model less than a certain number is to force the heat to be trapped. It will for sure affect the SST, but may not be consistent with the authors' purpose in discussing the effect of surface mixed layer.

Response:

We apologize for not well explaining the essence of the experiment reported in Section 3.3. In this set of experiment, all experiments retained same vertical resolution (e.g., 1 meter in the first top 10 meters of the ocean) but with various ocean bottom (i.e., 10, 30, and 60 meters in the experiment). The purpose is to demonstrate how the total ocean heat content, which depends on the total depth of the ocean, can affect the MJO. Considering two models with the same vertical resolution, the model with thinner ocean (e.g., 10 meter) would interact as efficiently as another model with thicker ocean (e.g., 60m) but with much less heat to release to or to absorb from the atmosphere. The former would have less impact on the atmosphere than the latter. Perhaps, the word "thickness" or "mixed layer" confuses the reviewer to think the model has a well-mixed upper ocean. In fact, the ocean in the model could still be stratified if in stable condition (e.g., under calm weather condition). We make this point more clearly in the revised manuscript. The corresponding text has been rewritten. We avoided using those terms such as mixed layer that would confuse readers.

D. I don't have any questions for the sections 3.4 and 3.5.

Response:

Thank you.

Because I do not expect I will review this manuscript once again, and the manuscript may be published after this revision, I suggest the authors pay extra efforts in checking the grammar or errors within sentences. For example,

- *Line 64: may, in turn, "yield"*
- *Line 142: which "considered" the (tense needs to be consistent in each paragraph)*
- *Line225: "air-sea"*

Response:

Thank you for the suggestion. We have carefully revised the manuscript and corrected grammar errors. The errors spotted by the reviewer have been corrected. Please see lines 65, lines 144 and lines 243.