We greatly appreciate reviewer's insightful and helpful comments on our manuscript. The manuscript has been revised based on reviewer's comments. The revised manuscript has been reduced by 15 pages, by condensing the description of experimental sensitivity and repeated discussion. The revised manuscript is now more concise than the previous version.

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

Anonymous Referee #2
The reviewer comments are formatted in italics and the authors response to the comments are formatted in bold.
Notation *RC2.P#* represents Reviewers Comment. Paragraph Number

Major comments:

RC1. My main comment is about the experimental setup. The "frequency" that is varied here is the frequency of the update of the SST seen by the atmospheric model. While the SST is held fixed, the ocean-model SST evolves in time in response to the surface heat fluxes and vertical mixing. When the SST is updated for the atmospheric model, it increases or decreases abruptly. The less frequent the update, the larger the potential jump in SST. This is probably why, as the frequency is decreased down to 1/(30 days), there is a lot of unorganized variability rather than a simulation that becomes similar to the atmosphere-only simulation, as one could have expected if this experimental setup actually filtered the subseasonal variability of SST (I expect the atmosphere-only experiment to use the classical configuration with smoothly varying SST). The SST jumps seen by the atmosphere raise a number of questions. Potentially, they could themselves, occasionally, trigger the development of an intraseasonal convective disturbance, in which case they become a forcing instead of expressing a feedback. Otherwise, they happen at fixed dates and one can wonder how they can be properly phased with an intraseasonal disturbance. The case with an SST-updating timestep of 18 days is probably optimum because it corresponds to half the period of the MJO: locally, a warm SST jump ushers the development phase of the MJO which extracts energy from the surface, and the downward SST jump starts its decline. But does the ocean feedback on the atmosphere in this case, as we expect for the MJO, or does the atmosphere feedback on the SST jumps? The fact that the signal is so strong is suspicious: considering because there is also a sampling problem associated with this experimental setup: with an SST-update timestep of 18 days and the simulation duration of 30 years, the SST update happens less than twice at the same date, and there are rarely more than 4 MJO events per year. To get a very clear signal, we need most of the SST updates to occur within a couple of days of the maximum or minimum convective activity. This seems unlikely to me considering the small numbers of update days at a given date and the expected number of spontaneously-generated MJO events. The probability that the SST jumps time the MJO events is non-negligible, which probably means that the SST plays some role in forcing these events, instead of providing a feedback to these events.

For this reason, there is a need to better understand the impact of the experimental setup. This could be done by looking at singular MJO events rather than composites and/or conducting additional experiments with different configurations (updating the SST seen by the atmospheric model with smoothed tendencies using the tendency history, maybe).

Response:

Thank you for your comments. Reviewer's comments are insightful and well taken. The reviewer suggested that the unrealistic large SST jump events, which could exist in C–30days experiment due to poor sampling, may play a role in forcing, instead of responding to, the atmosphere.

In response to the poor sampling issue, we examined the SST variation in 10 individual MJO events in the C–30days experiment. Figure RC#2.1 presents the SST variation of each event and composite (i.e., revised Fig. 7j) over the MC. The SST in each single event tended to be in phase but in larger amplitude in certain cases than the composite, i.e. about 3 times of SST variation (±2 K) compared to the composite that was already larger than high-frequency feedback experiments. The larger amplitudes seemed to reflect the nature of purposedly designed experiment with extremely low SST feedback frequency. While the individual SST variation in signal event exhibited significant variability, the SST variation continued to adhere to the lead-lag relationship between MJO circulation and SST, highlighting a positive anomaly in the first half cycle and a subsequent negative anomaly. This result was based on the variation occurring in a limited region (i.e., 110–130° E, 5–15° S). By contrast, the SST spatial distribution could be rather unorganized. Two cases (17th and 27th year with relatively small SST amplitude) are shown in Figure RC#2.2. The unorganized structures can be identified in each event. We found the similar unorganized structure in all 10 events. The comparison suggested that the unorganized structures were not the composited results of cases with different large-scale characteristics. Reviewer's comments on SST as a forcing, instead of response, is interesting. Whereas the SST fluctuations in a MJO are largely the responses to the atmospheric forcing, its feedback (even spontaneous) in a way can be seen as a forcing. The mutual interaction (or forcing) resulted in the unique characteristics of the MJO. However, whether a larger amplitude (not seem to be jumps in Fig. RC#2.1) would induce unorghanized small-scale pertrubation is debatable. As seen in many hypothetic (or theoretical) studies, a sudden initiation of SST (or step-function like) could still induce large

scale response. We have no clear answers for the appearance of unorganiozed spatial distribution that would need purposedly designed experiments to untangle. We choose to leave the issue open in the manuscript as an unanswered question but provide the following discussion in the revised manuscript.

The reason causing the sudden change between C–24days and C–30days is not entirely clear. Two possibilities are discussed below. The first possible reason leading to this disorder is that when the ocean feedback is delayed for as long as 30 days (more than half of the MJO period), both positive and negative fluxes would contribute to the heat accumulation (or loss) in the ocean because of the MJO phase transition and result in unorganized small scale structures in ocean temperature, which could in turn affect the heat flux and convection. The second could be that the SST change become more abrupt and disrupt the large-scale nature of the MJO. However, whether large-amplitude SST fluctuations would induce unorganized small-scale pertrubation is debatable. As seen in many hypothetic (or theoretical) studies, a sudden initiation of SST (or step-function like) could induce large scale responses. This issue remains an open question that warrants further studies with purposedly designed expeirment to untangle.

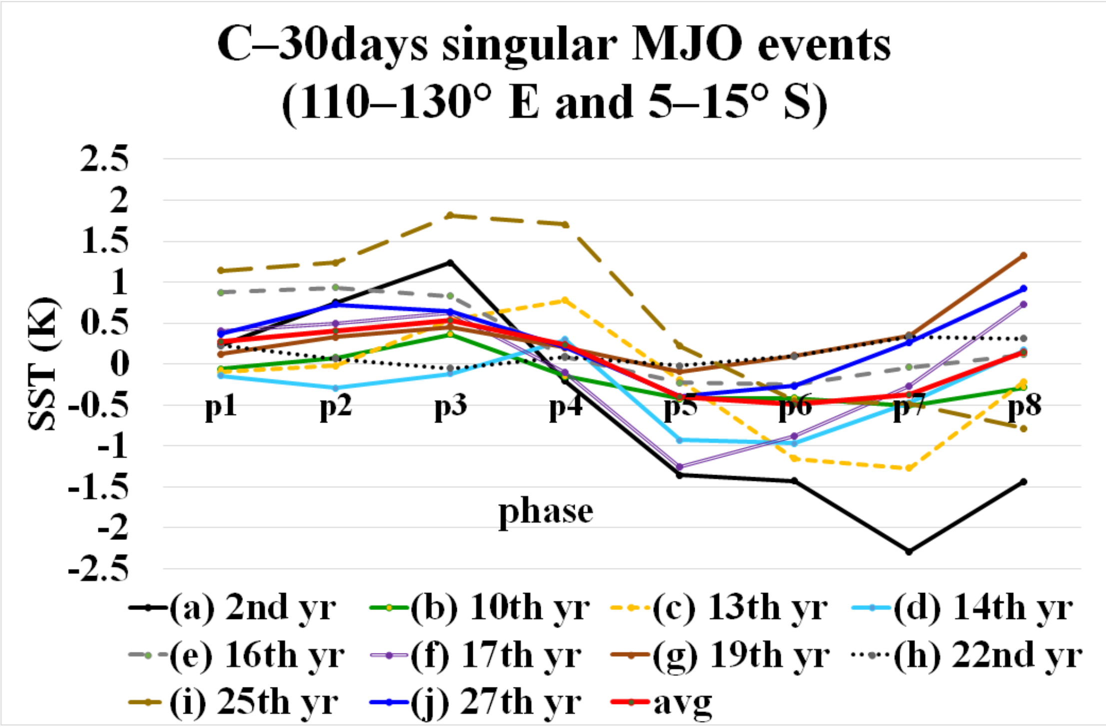

Figure RC#2.1 SST phase's variations of 10 single MJO events in C–30days experiment between phase 1 and 8 within the domain of 110–130° E and 5–15° S, the (a)–(j) denote MJO events from Fig. RC#2.1.

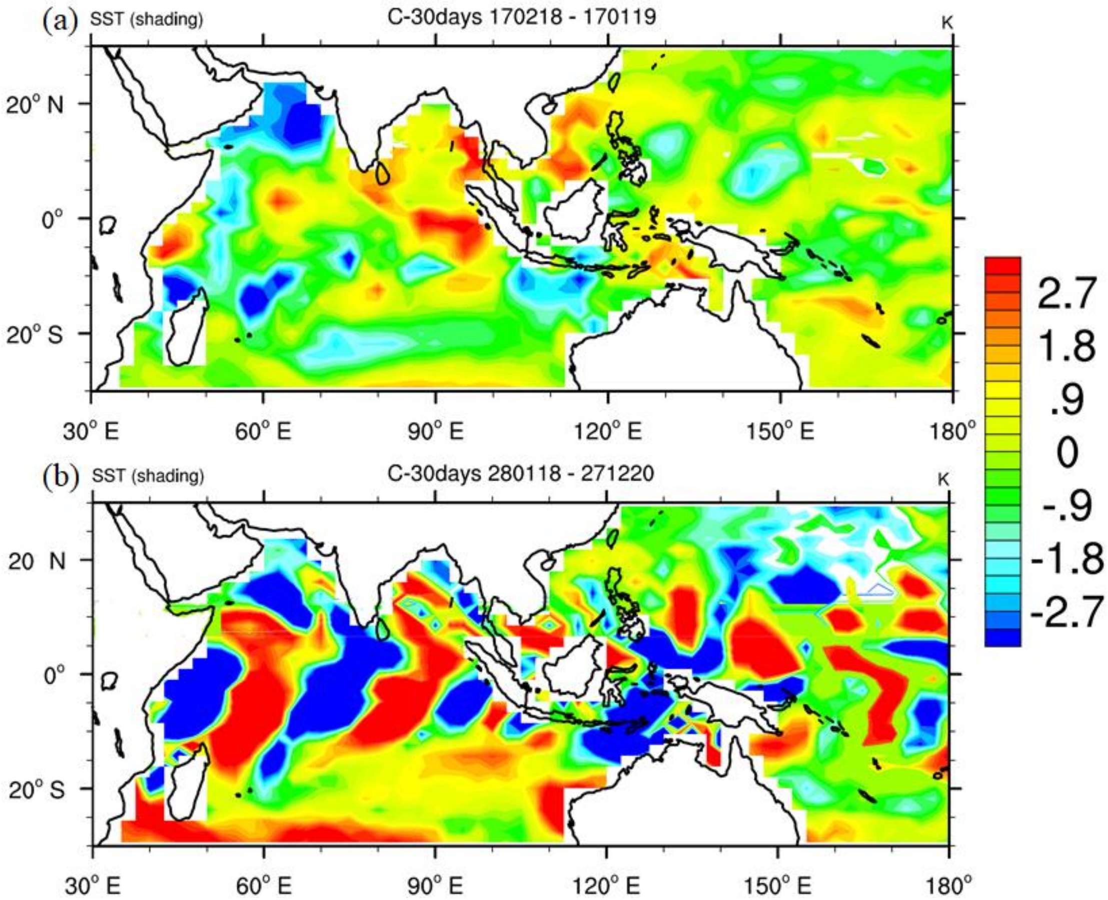

Figure RC#2.2 The spatial distribution of daily-averaged SST differences is examined in two specific single MJO events by subtracting the starting date (Jan. 19) from those 30 days later, (a) SST different between Jan. 19 and Feb. 18 in 17th year (Fig. RC#2.1f); (b) SST different between Dec. 20, 27th year and Jan. 18 in 28th year (Fig. RC#2.1j).

RC2. My second comment is on the length of the manuscript. I feel that some figures and analyses aim to show modest sensitivities and don't explain their physical cause. I think the manuscript would benefit from being more concise and to the point.

Response:

Thank you for suggestion. We have condensed the description of experimental sensitivity, primarily addressing the physical reasons in the Conclusion and Fig. 13 and make the revised manuscript be more concise.