Anonymous Referee#1:

General comment:

The paper examines an interesting phenomenon of warming in the north Bay of Bengal region about 10-15 days prior to Indian summer monsoon rainfall onset and the authors have discussed the possible atmospheric forcing and response to the warming and its impact on monsoon onset. The manuscript is well written and the idea is interesting. I recommend that the manuscript be accepted pending some minor changes and improvements.

=> Dear Referee, thank you for taking the time to review our manuscript and for appreciating our study. We would also like to thank you for your comments, which have helped us revise the manuscript into a better version. We understand that you have minor comments regarding improving the flow of narration (especially in the introduction section) and clarifying some arguments including the use of modeling experiments.

In our point-by-point reply to the referee's comments below, text quoted from the manuscript in our responses is highlighted in green.

Detailed comments:

1. The introduction section needs to focus only on the literature review without mixing it with the explanation of the hypothesis and the methodology used for conducting this study. There can be a separate paragraph for explaining the rationale of the study.

   => We have revised the introduction section following the referee's suggestion. The introduction is now organized as a literature review, followed by an explanation of the hypothesis, and finally an outline of the methodology towards the end. We believe the flow of the narration has improved considerably after this revision. Thank you.

2. Line 30: How does preparation of composites suppress interannual variability? The authors need to explain this.

   => In composite analysis, since all onset dates are aligned, interannual variations are suppressed, yielding a common picture of onset evolution across different years.

   We have included this sentence in the revised manuscript (L53-54) to improve the clarity of our narration. Thank you.

3. In figure 2: Were the onset dates cross verified with IMD onset dates? Is there any discrepancy?

=> We did not cross-verify the dates with IMD onset dates. Nonetheless, Li et al. (2024) provide a detailed overview of how strongly different onset indices correlate with IMD onset dates. The TT index exhibits a significant correlation with IMD onset dates, which is typically true for most monsoon onset indices (Bombardi et al. 2020). We have mentioned this in the revised manuscript (L90-94).

4. Line 34: Can the authors point to any specific index that seems to have arbitrary thresholds?

   => An example of an index that uses an arbitrary threshold is the Onset Circulation Index (OCI), defined as the 850 hPa zonal wind averaged over the southern Arabian Sea (5°N–15°N, 40°E–80°E). The monsoon onset date is identified as the first day when the OCI exceeds a threshold value of 6.2 m s−1 for six consecutive days.

   In the interest of maintaining the flow of the narration, we did not include this specific example in the manuscript. Nonetheless, we have mentioned that (L57-58), "a detailed list of different monsoon indices – large-scale, regional, and local – can be found in Bombardi et al. (2020) and Li et al. (2024)." We hope the referee will agree.

5. Lines 173-175: How can a cold atmospheric column carry higher relative humidity? Or is that a typo. It needs to be corrected.

   =>Yes, it is true that cooler air holds less moisture. However, if the actual amount of water vapor in the air remains the same, a colder atmosphere will exhibit a relatively higher relative humidity. We have revised the statement in the manuscript as follows (L178-181):

   "During early-onset years, the atmospheric column over BoB, 10–15 days before onset, is expectedly colder than that for the late-onset years. We also found the total moisture content (specific humidity) is not substantially different. However, since the atmosphere is colder for early-onset years, it has a relatively higher relative humidity considering the total moisture content is comparable."

   Thank you.

6. The experiments using CAM model seems to add very little to the explanation of the dynamics of the phenomenon discussed in the paper. Is the idea of the paper to understand the dynamics of early and late onset features or to test the fidelity of the model? This needs clarification.

   => Thank you for this insightful comment. The primary aim is to understand the dynamics and to test the associated hypothesis in a model framework, rather than to evaluate model fidelity. As the referee correctly points out, the model has biases—for example, CAM does not simulate an earlier onset in response to a warm SST anomaly in the northern BoB when measured with the TT index. We hypothesize that this could be

due to overly strong homogenization of upper-level temperatures in the model compared to observations and/or biases in simulating the SST-convection relationship. Another possibility is that, since onset in CAM is already relatively early, the large-scale background conditions (e.g., land temperatures) may not support an even earlier onset despite the prescribed SST anomalies. Nonetheless, the circulation response to the imposed SST forcing is captured in the model, which provides proof of concept for our hypothesis.

Relevant revisions can be found in L229-244 of the revised manuscript.

References mentioned in the responses:

Li, X., Wang, L., Zhong, S., and Liu, L.: Comparative analysis of indices in capturing the onset and withdrawal of the South Asian Summer Monsoon, Environmental Research Communications, 6, 031 007, https://doi.org/10.1088/2515-7620/ad352b, 2024.

Bombardi, R. J., Moron, V., and Goodnight, J. S.: Detection, variability, and predictability of monsoon onset and withdrawal dates: A review, International Journal of Climatology, 40, 641–667, https://doi.org/10.1002/joc.6264, 2020.