Review of “Potential modulation of Indian Ocean basin mode on the interdecadal variations of summer precipitation over the East Asian monsoon boundary zone” by Jing Wang et al.

Many thanks for your constructive and valuable comments, which have greatly improved our manuscript.

This study looks into the link between the Indian Ocean Basin mode (IOBM) and the summer precipitation over the East Asian monsoon boundary zone (EAMBZ). The authors discusses, during cold phase of IOBM, the EAMBZ has enhanced precipitation. This is through the formation of an anomalous cycolonic circulation in the North-East corner of tropical Indian Ocean driving a North-low-South-high pattern taking place in the interdecadal timescales.

Overall, this study attempts to understand the features of precipitation over EAMBZ on interdecadal timescales. I would recommend this study for major revision and has to address below queries:

We have revised the manuscript based on your comments. The revisions are highlighted in red color in the revised manuscript. In the following, we summarize our point-by-point replies to your comments.

Major comments:

1. The title is not clear. It seems to not highlight that this study investigates how modulation of IOBM causes a a change in precipitation in the EAMBZ on interdecadal timescales. The title could be changed to “Modulation of Indian Ocean basin mode potentially drives the interdecadal variations of summer precipitation over the East Asian monsoon boundary zone”. The authors ought to think on this and clarify.

Reply: Thanks for your insightful comments. The verb “modulate” seems to show a similar meaning of “drive”. Considering your comments, we changed the title into “Role of Indian Ocean basin mode in driving the interdecadal variations of summer precipitation over the East Asian monsoon boundary zone”, highlighting the driving role of IOBM. Please see **Line 1-3** in the revised version.

2. The study primarily provides mechanistic explanation on the link between IOBM and precipitation over EAMBZ during the cold phase only. The authors need to provide and discuss the processes during the IOBM warm phase and corresponding precipitation over EAMBZ, or is it that the authors discuss this somewhere and I have missed it.

Reply: Thanks for your valuable comments. We have discussed the processes during the IOBM warm phase and the corresponding precipitation over EAMBZ. Please see

Line 372-374 in the revised version and **Figure S5** in the Supplementary File.

Line 372-374

"Notably, circulation and precipitation anomalies during the warm phase years of the IOBM (Fig. S5) highly mirror those tied to the IOBM cooling with opposite signs."

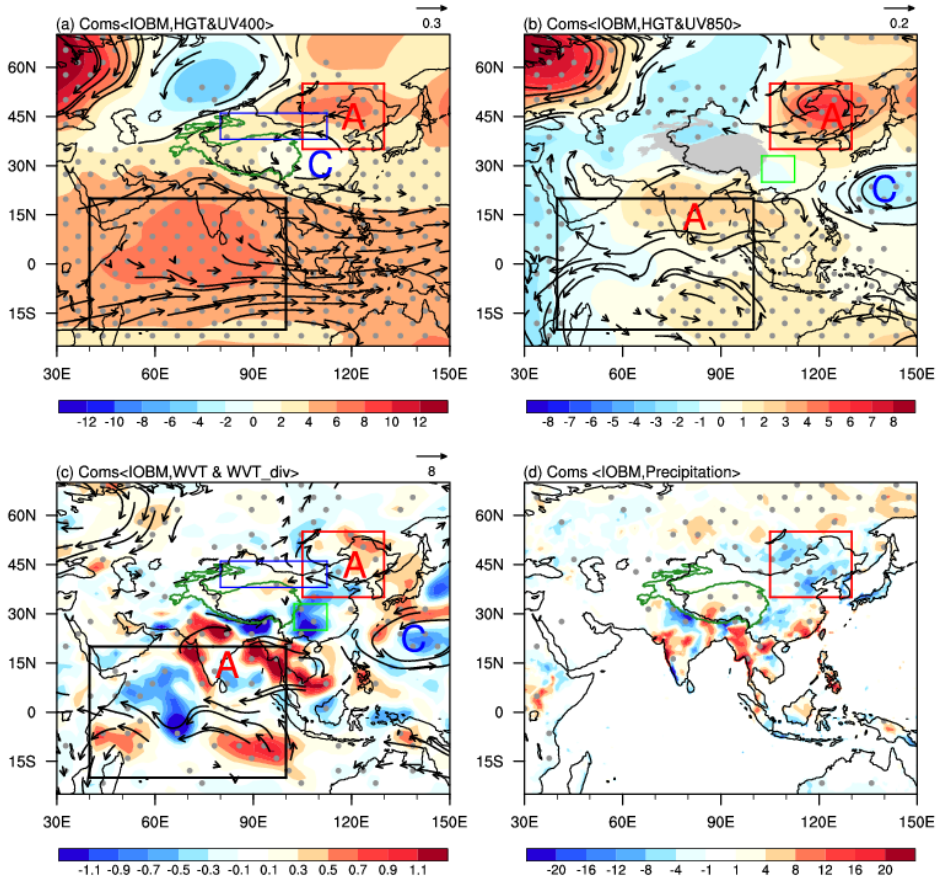

Figure S5. Composite anomalies of JJA-mean (a) Z400 (shading; m) and UV400 (vectors; m s^{-1}), (b) Z850 (shading; m) and UV850 (vectors; m s^{-1}), (c) <WVT> (vectors; kg m^{-1} s^{-1}) and <WVT_div> (shading; 10^{-5} kg m^{-2} s^{-1}), and (d) precipitation (mm $month^{-1}$) during the warm phase years of the IOBM. All variables are detrended and 11-year low-pass filtered. Areas with significant values of Z400, Z850, and <WVT_div> that exceed the 95% confidence level are stippled, respectively. Only vectors that are significant at the 95% confidence level are shown. The base period is 1901–2014. The warm phase years of the IOBM are selected based on the 0.5 standard deviations of the observed time-evolving SSTAs during the based period, as shown in Fig. 6b (blue line). The precipitation is derived from the CRU TS3.26 precipitation data; whilst other variables are from the 20CRv2c datasets.

3. I would urge the authors to make clear discussion on past studies (it is there already but somehow the present structure mingles them) which investigates the interannual variations of precipitation over EAMBZ. I recommend the literature review made in the "Introduction" to be more structured. Right now it reads unclear and less motivating to read through. Section 2 in the manuscript for instance, is very well structured and written. Another concern, far too many acronyms are used.

Reply: Thanks for your valuable comments. We have improved the "Introduction" section in the revised manuscript, avoiding the structure mingling issue. Specifically, in the third paragraph of the "Introduction", we highlighted the discussion on past studies, which investigates the interannual variations of precipitation over EAMBZ. Please see **Line 61-82** in the revised version.

Furthermore, we have removed the sparingly used acronyms and kept the frequently used acronyms in the revised manuscript. For easy reading and reviewing, we have included the "Glossary of acronyms" in the revised Supplementary File. Please see the Glossary of acronyms in the Supplement File.

4. IN addition, as the authors have discussed several processes that are interlinked and connects the IOBM and EAMBZ precipitation. It is necessary that they provide a schematic and/or flowchart showing the interlinkages and processes. This is would be very helpful for the readers.

Reply: Thanks for your valuable comments. We have included a schematic diagram showing the interlinkages and processes. Please see **Line 422-424** and **Figure 12** in the revised version.

Line 422-424

"As a summary of our major findings, Fig. 12 schematically synthesizes how IOBM-associated SST mode remotely drives the interdecadal precipitation fluctuations via a tropical route."

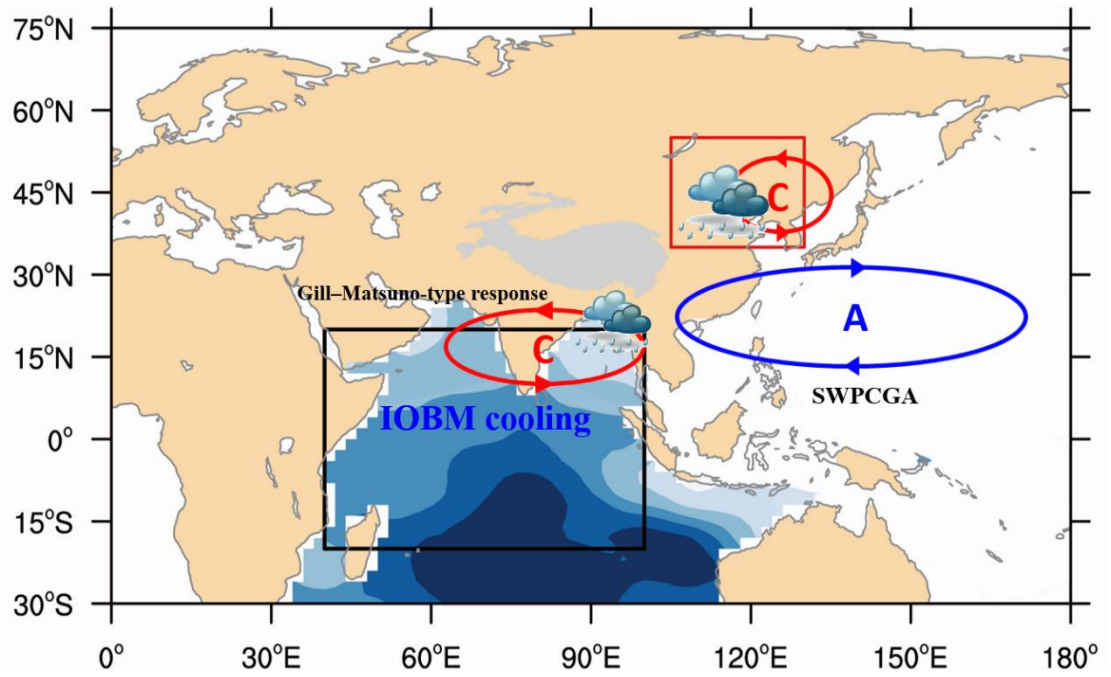

Figure 12. Schematic diagram showing how IOBM-related SST anomaly pattern drives the summer EAMBZ precipitation fluctuations at interdecadal timescales. Blue shading illustrates the IOBM cooling. Letter A (C) indicates the center of the anticyclonic (cyclonic) gyre anomaly.

Minor Comments:

Figure 1- Improve the resolution. It is a key figure.

Reply: Revised as suggested. We also uploaded a PDF format of Figure1, which shows the well resolution.

P2L82-83: I would urge the authors to be elaborate here.

Reply: Thanks for your helpful comments. Please see **Line 88-92** in the revised version.

Line 88-92

"For example, J. Wang et al. (2022) reported that the late spring (May) southeastern TP underwent wet conditions for 1928–1961 and 1989–2003, and experienced dry conditions preceding 1927, 1962–1988, and 2004 onwards. Si and Ding (2016) documented that East Asia experienced dry summers from the early 1920s to the 1940s, as well as wet summers from the late 1900s to the early 1920s, in the 1950s, and from the 1980s to the 1990s. Piao et al. (2021) found that the decadal-filtered summer precipitation over Northeast Asia underwent a sudden decease around the late 1990s."

P6L241: I also find dry summers around 1940. Authors mention about Si et al. 2021 here. Please write the context, since that paper looks into Northeast Asian summer monsoon and AMO.

Reply: Thanks for your helpful comments. Please see **Line 252-257** in the revised version for our modifications.

Line 252-257

"For example, EAMBZ experienced dry summers during the periods preceding 1927, 1939–1945, 1968–1982, and 1998–2010, but underwent wet summers during the periods of 1928–1938, 1946–1967, and 2011 onwards. Note that Si et al. (2021) explored the interdecadal variations of summer precipitation over northeast Asian, a domain that largely matches our focused EAMBZ domain. The observed major interdecadal fluctuation periods of EAMBZ precipitation are basically consistent with those suggested by Si et al. (2021), with dry summers around 1940."

P8L320: "localised atmospheric responses" Please explain.

Reply: Thanks for your comment. Please see **Line 333-337** in the revised version.

Line 333-337

"Moreover, there are striking suppressed precipitation around the northeast corner of the TIO domain (Fig. 7b), suggesting profoundly localized atmospheric responses (viz. the release of regional anomalous atmospheric cooling) to the warm TIO SSTAs. Note that corresponding to cold TIO SST years, there exist positive precipitation anomalies around the northeast corner of TIO,

suggesting the release of anomalous atmospheric heating (figure not shown)."

Moreover, your concerned "localised atmospheric responses" is tied to a low-level cyclonic in situ in terms of a typical Gill–Matsuno-type response. Please see **Line 361-366**.

Line 361-366

"One may ask how IOBM cooling induces the above-mentioned meridional seesaw pattern. Previously, we have revealed that negative SSTAs over TIO may exert remote interdecadal impacts through an atmospheric bridge, i.e., vigorous convective activities around the northeast corner of TIO (Figs. 7 and 8). In effect, there exists a low-level cyclonic anomaly in situ (Fig. 9b). Such cyclonic anomaly can be interpreted as a typical Gill–Matsuno-type response (Matsuno, 1966; Gill, 1980) to the regional anti-symmetric atmospheric heating caused by IOBM cooling with the coldest center located south of the equator, which is more clear within the lower levels (Fig. 9b)."

Equation5: The P-E model, please discuss the possible inabilities of this model. Also, is this model developed for this study (as mentioned in abstract) or does it follows from past studies such as Jeong et al. 2021. Please make this clear.

Reply: Thanks for your valuable comments. We have extended the discussion concerning the shortcomings of our proposed physical-based empirical model in Section 3.5. Please see **Line 411-416** in the revised version.

Line 411-416

"Although our proposed physical-based empirical model could confirm the concurrently intimately interdecadal relationship between IOBM and EAMBZ precipitation, we should acknowledge the shortcomings of the model. First, the amplitudes of the hindcast estimates are fairly lower, which cannot capture the extreme precipitation years (e.g., years around 1960; Fig. 11). Second, the simultaneous signal of IOBM cannot be served as a predictor for summertime EAMBZ precipitation variations. As such, this model inherently lacks the ability to predict the interdecadal EAMBZ precipitation anomalies in advance."

In addition, this model is developed for this study, and we only follows the method of Jeong et al. (2021). Please see **Line 405** in the revised version.

Line 405

"Following the method of Jeong et al. (2021),…".