Response to Manuscript # hess-2020-55, "Co-incidence analysis of changes in flood magnitude and shifts in flood timing in a large tropical pluvial river basin" by P. Ganguli, Y. R. Nandamuri, and C. Chatterjee

We would like to thank the reviewer 2 for the valuable comments and for providing us an opportunity to improve our manuscript. Our responses are embedded within the comments (in BLACK) in BLUE. The new additions to the revised manuscript are embedded below in BROWN.

Reviewer #2 (Response to Technical Comments to the Reviewer)

Comment 1: This is an important research. The paper is well written. I have only minor comments and edits here and in the PDFs.

Response: We appreciate reviewer comments. In this revision, we have tried our best to address reviewer's comments in the subsequent paragraphs in our response letter.

Comment 2: Please explicitly present the research question and hypothesis in the Introduction.

Response: We agree. We have added following hypothesis and research questions in page 4, line # 88 of the revised manuscript:

Given challenges in flood characterizations and adaptations over Mahanadi River Basin, this paper aims to examine following hypothesis that: *the basin-wide floods are largely controlled by catchment properties, and concurrent (i.e., simultaneous) or cascading (one event preceded/succeeded by the other within a close time interval) occurrences of trends (up/downward) in flood magnitude and shifts (earlier/delayed) in its timing may further complicate the flood risks and associated impacts.*

We address the following three research questions:

1. While previous studies have explored the possibility of '*local*' monotonic trends in flood records at individual river gauge locations, is the nature of trend significant at a regional level considering a collection of all sites? In addition, is there any abrupt change in the peak discharge time series, and could the detected change point be linked to any major anthropogenic activity prevalent over the basin?

2. Is there any possible linkage between the trend in flood severity and catchment properties or processes, which were ignored in most of the previous assessment for a vast river network of Mahanadi?

3. Is there any evidence for the concurrence of trend (up/downward) in flood severity and shift (early/delayed occurrence) in flood timing that may help in identifying the "flood-rich and flood poor" (Merz et al., 2018) region over the basin?

Comment 3: A schematic/flowchart of the methodology would be helpful.

Response: Agreed. We have added the following flowchart in page 6, line # 151 of the manuscript.

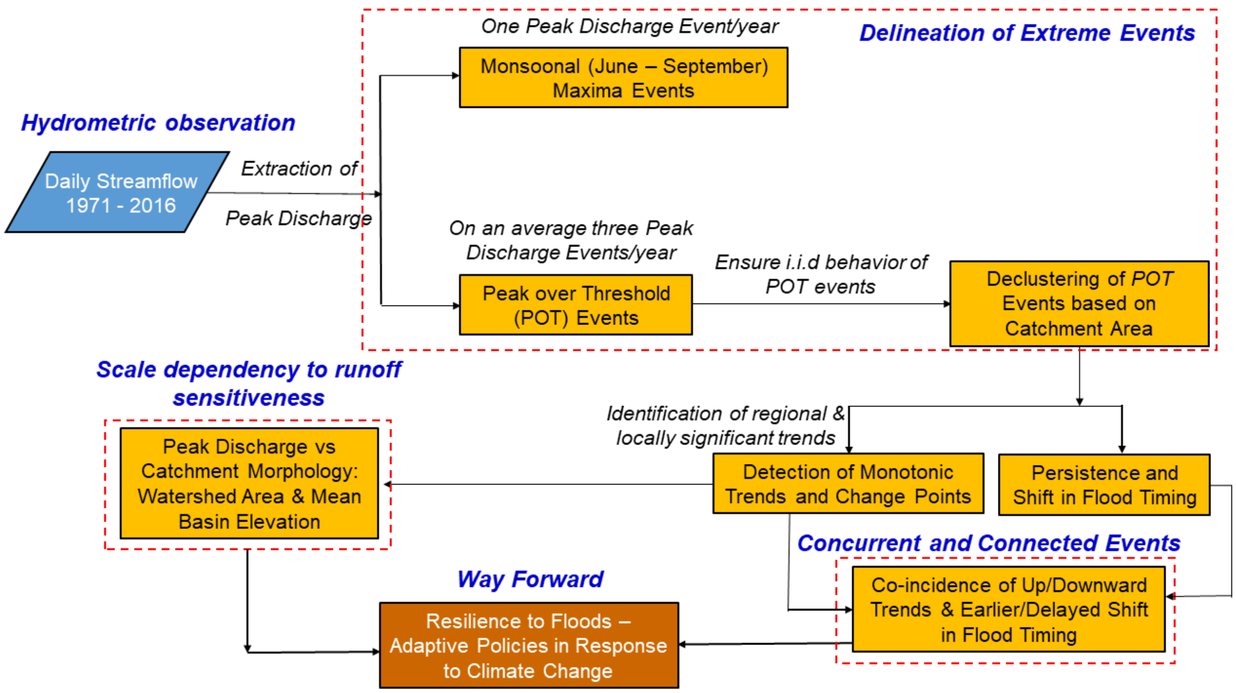

Figure 2. Schematics of the work flow. The color of boxes in blue indicates input steps, yellow indicates the process steps, brown shows the expected way forward to mitigate the impact of large floods in a changing climate. While we identify monotonic trends in the flood time series using Mann-Kendall trend test considering ties and autocorrelation, the abrupt changes in the time series are detected using Pettit's change point test. We detect the persistence and shift in flood timing using circular statistics (see Methods for details). The abbreviation, *i.i.d.* indicates independent and identically distributed.

Comment 4: Why the 98.5th percentile was used as the threshold level?

Response: As explained in Page 6, line # 160, we evaluate different thresholds, varying from 98 to 99.9th percentiles at an increment of 0.5. Finally we select 98.5th percentile as a threshold level that allow us to choose on an average three extreme events per year. To ensure selected peak over threshold events are independent to each other, following earlier studies (Petrow and Merz, 2009; Svensson et al., 2005), we select different time spans ranging between five and ten days to decluster the partial duration time series based on the watershed area of the sub-catchments. The use of 98.5th percentile threshold as an indicator of peak flows from daily stream flow records and the selection of on an average three peak discharge events per year are widely used in practice to attribute extreme floods (Acero et al., 2017; Lawrence, 2020; Mangini et al., 2018; Svensson et al., 2005).

Comment 5: Sources of uncertainty and how they affect your results need to be discussed.

Response: Thanks for pointing this out. We have added following sentences in page 19, line 480 of the revised manuscript:

"While uncertainty in hydrometric observations is one of the prominent sources of uncertainty in the current analysis, especially in the data-sparse delta areas of the lower MRB, further data gathering effort would substantially enhance the confidence in the analyses. Second, spatiotemporal heterogeneity of streamflow observations remains a constraint. For instance, the uneven temporal coverage of the individual streamflow records and regional differences in the spatial distribution of gauges across three reaches of MRB is affecting the obtained results. Nonetheless, the derived insights highlights regional nature of interacting and cascading flood risks over MRB in the present-day era, which provides a stronger basis for understanding and managing such connected extremes (Raymond et al., 2020) in the future. The findings can be used to improve policy recommendations in adapting extreme floods in Anthropocene and support tools to achieve societal resilience."

Comment 6: Please spell out all the abbreviations in the figures, tables and headings. These must stand alone.

Response: Agreed and incorporated.

References

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