Responses to the comments of Reviewer 2

We thank anonymous Reviewer 2 for reviewing the article and providing constructive suggestions which have improved the quality of the article. We will address these in the revised manuscript and accordingly our responses to each comment is given below. We marked our replies in blue font, while original reviewer comments are presented in black font.

Although this study would be worthy of publication in HESS, I think its current version does not meet the overall quality of HESS journal. The paper is not well written, and the structure ("key story") is not provided in a logical sequence.

Response: We will improve the structure of this detailed paper, taking on board the comments provided by both reviewers.

The idea that hydrogeological drivers (e.g., monsoon rainfall and antecedent soil moisture) determines the characteristics of floods Brahmaputra and Ganges rivers is not novel.

Response: We will endeavour to improve the clarity of our results, because this is not the idea of our paper. This study is about hydrometeorological not hydrogeological drivers, and our conclusion is not that antecedent soil moisture determines the characteristics. In addition, neither the abstract nor conclusion features any mention of antecedent soil moisture.

We believe our study is novel because it looks at the drivers of floods of different characteristics, something that has not been previously addressed. In addition, the existing literature mostly analyses the contribution of monthly or seasonal rainfall to flooding in Bangladesh, however the monsoon rainfall has strong intraseasonal variation that is reflected in the often multiple flood pulses that occur during a monsoon season.

I believe that the authors have done a lot of work analyzing the data, but authors failed to convince the readers why they are doing so.

Response: The aim is to determine the drivers of floods of different characteristics in the Brahmaputra basin, to provide information that can improve our forecasting of such floods in future. The different characteristics are important; high flood magnitude places larger numbers of the population at risk, flood duration affects livelihoods for longer, and the rate of rise increases vulnerability as people are potentially unable to evacuate in time. We will make this clearer in the revised text.

The style of this manuscript is more like "this is what we did". As a reader, I am not convinced by the authors that their findings are novel and interesting.

Response: We believe our study is novel because it looks at the drivers of floods of different characteristics, something that has not been previously addressed. In addition, the existing literature mostly analyses the contribution of monthly or seasonal rainfall to flooding in Bangladesh, however the monsoon rainfall has strong intraseasonal variation that is reflected in the often multiple flood pulses that occur during a monsoon season.
The need for this study was also driven by a positive trend in annual maximum water level in recent years which necessitated research to understand and then communicate the findings to water and disaster management authorities.

Here I provide three general (personal) suggestions for authors' review which may help improve the overall quality of this manuscript:
State the key objective or research question clearly and revise the introduction accordingly.

Response: We will revise the final paragraph of the introduction to make it clear that these are the aim and objectives. We will also provide clearer signposting at this part of the article to enable the reader to navigate their way through the analysis.

The current version of this manuscript covers, at least, two main topics: attribution of flood characteristics into hydrometeorological drivers and comprehensive analysis of three historical flood events in Brahmaputra basin. However, none of them is well defined and presented in a logical structure. If the first case is the objective, authors should increase their sample size (i.e., over 30 years flood data) to make a robust conclusion. If the second case is the goal, authors should focus contrasting three flood events (i.e., types) and highlighting the key features that cause the difference. A good example of analyzing single flood event can be found: Smith, James A., et al. "Extreme flood response: The June 2008 flooding in Iowa." Journal of Hydrometeorology 14.6 (2013): 1810-1825.

Response: Thank you for your comments, we agree that the aims and objectives should be more clearly defined, and this should help address the lack of clarity here. We don't necessarily agree that the two topics are different: we look at the most extreme of three different flood types and draw a hypothesis as to the drivers of each type of flood. We then use the wider record to determine whether other flood events support these hypotheses. There are obviously limitations when only using a 33 year record, but we are limited by the length of the available hydrological record in Bangladesh.
Thank you for suggesting that reference, this should have been included in the introduction but was overlooked.

Based on the determined research objective, authors should consider remove some unnecessary analyses which fail to directly support the main conclusion. The current study used GEV distribution, trend analysis, correlation between climate indices with floods, wavelet transform etc. However, some of the analysis does not directly support the conclusion. For example, authors show there is a trend in water level but failed to attribute this trend to any of the hydrometeorological drivers and to explain how this trend affects the flood characteristics in general. If authors want to include a conclusion or result, defend it in detail. Otherwise, drop it.

Response: We include analyses when they directly respond to the aims and objectives, we wouldn't only include results which supported the main conclusion because it is important to understand and communicate the limitations of our findings.

Failing to find any hydrometeorological driver for the trend in water level is a key finding, not one that should be 'dropped', because an upward trend in water level affects millions of lives. Highlighting that further scientific research (and data collection) is needed to understand the cause of this upward trend is an important message for the scientific community.

Go through the paper and make every sentence convincing and logical. Also, delete the sentences conveying the same idea. As a reader, some sentence sound vague and does not provide the information I am expected to understand. Here are two examples:

Line 556: "*However, due to spatial variation of rainfall there can also be cases of a more rapid rise in water levels.*" I am expected to understand the reason why rainfall heterogeneity causes the rapid rise in water levels at the gage. Is it because rainfall hit the region where the watershed slope is high? Are these rainfall have similar temporal distribution?

Response: We agree that this paragraph could be better written. We will change it to: "The part of the Brahmaputra basin inside Bangladesh is a floodplain river delta and rivers usually gradually rise during floods. The Brahmaputra river at the Bahadurabad station shows a higher rate of water level rise during the 2017 flood compared to all other years (Fig. 11a), something which caught FFWC by surprise (FFWC, personal communication). In 2017, the river experienced a rapid rise for three consecutive days (50 cm per day) compared to two extreme years of rapid rise floods in 1988 (37 cm per day) and 2019 (40 cm per day). The timing of the water level rise in the lower sub-basins of Dharla, Dudkumar and Teesta tributaries was almost similar to the main course of the Brahmaputra, suggesting that the high rate of rise in the Brahmaputra river was due to the spatial pattern of rainfall over these three tributaries (Figure 7b) on a flood-triggering hydrological sweet spot. The rate of water level rise is important in order to forecast and provide timely flood warnings, as it determines how quickly the water level will cross the flood danger level and how fast decision makers and communities need to take actions ahead of floods. However, due to spatial variation of rainfall there can also be cases of a more rapid rise in water levels."

Line 534: *"The estimated annual maximum discharge in 2019 and 2017 was lower than the one in 1998, despite higher water levels"* In most gages, the discharge is estimated using rating curve and water level. So, I am expected to understand why high water level is linked to a low discharge, which authors failed to provide.

Response: We don't believe we have failed to provide this. Section 3.1 provides a description of the hydrological observed data used in this study, and Lines 191 to 192 in particular state that river flow is measured using 'a current meter (or Acoustic Doppler Current profiler)', in addition to estimates of river flow from a rating curve. In the Results section 5.2.4 details where the flows used are the measured flows or the estimated (rating curve) flows.

We will include the following text to explain why there can be higher water level / lower discharge:

The Brahmaputra is a braided river which undergoes changes each year due to erosion and sedimentation. The Bangladesh Water Development Board (BWDB) has recalibrated the compound rating curve from three segments to two segments since the 2007 monsoon season due to morphological changes such as decreases in river width and depth at the gauging station (personal communication with the hydrologist, BWDB). Therefore, as the channel capacity has got smaller, the same discharge would lead to higher water level.