Response to the Editor

The changes and additions requested are marked to the manuscript with red font.

28: You could provide more details of how hydrograph shape affects the geomorphic response.

Response: Thanks for the comment, we added more details “Double-peaking floods resulted in relatively more heterogeneous and complex morphological outcome compared to single-peaking floods”

63: You could explain why the order and duration of flood peaks is important.

Response: Added a sentence ” In multi-peaking floods, the order and duration of different peaks significantly affects the sediment transport volume and the pattern of sediment transport hysteresis because the flow conditions are controlling when, how much, and what type of sediment is mobilised, reworked, or deposited within the river system (Mao, 2018).”

164 and 276: In both places, say what years the sediment samples were collected from.

Response: Added the year to both lines

187: It would be helpful to include the comment in your response document about why the Pulmanki discharge might go down as the Tana discharge goes up, as readers might have the same question.

Response: Added explanation to the text: “The Tana River discharge continues rising even though the Pulmanki River discharge decreases due to the fact that the Tana River drains 20 times larger catchment compared to the Pulmanki River. The Pulmanki River catchment (sub-catchment of Tana) is located on the downstream of the Tana River and has much lower topography than the Tana catchment, which drains areas up to 1,1 km from the sea level. This causes delay in the snowmelt and the runoff peaks occur later compared to the Pulmanki catchment.”

293: Is it surprising that bedload looks coarser than grab samples - is this because samples come from different years maybe?

Response: The samples are collected during spring and autumn flow conditions in 2019. The bed load samples are finer than the grab samples (100 microns = 0.1 mm, 1000 microns = 1mm). This can be Helley-Smith error as it has tendency to “vacuum” in the smaller grain sizes.

393: It’s not clear what you mean by occurrence - date of the year when that event occurred, or just whether it occurred in that year? If you were just looking at whether it occurred in that year, then what statistics did you use – can you apply a M-K test to a dataset of ones and zeros?

Response: M-K test can be problematic when applied to binary data since this kind of data does not have a gradual trend. That’s why we first calculated the intervals between the annual occurrence (number of timesteps between the events). This way we could apply M-K test to see if the spacing interval between the events is increasing or decreasing over time.

419: Specify somewhere that TTS is calculated across the entire model, rather than being at a single x-section.

Response: We now mention that the TTS was calculated across the entire model area.

488: Define geomorphic activity. Why is it plotted as a pie chart?

Response: Geomorphic activity was calculated based on the amount of total mobilized sediment within the active area (TTS divided by the active channel area in the model). Pie chart is probably not the best choice to plot it since the values are individual instead of percentages of whole. However, we felt that it is easier to separate the charts from each other in the figure if the charts describing different factors are different types.

513: Can you add reference to a figure that shows that type B floods increased in volume?

Response: Added reference to Figure 7.

584: In this paragraph there are lots of sentences starting with just 'this' - try and avoid starting sentences with ‘this’ as there is a risk that the reader does not know what ‘this’ refers to.

Response: Thanks for the comment, we have now modified the chapter to avoid using “this”.

590: Not clear to me if the higher fine sediment from bank erosion is a possible explanation for the model results, or what you would expect to see in the field. Clarify whether the model included bank erosion.

Response: In the section ” 3.4. Morphodynamic modelling “ we tell that “The default scheme for dry-cell erosion of banks was applied without further adjustment, as the focus of the study was on longitudinal sediment transport and vertical changes to the channel bed”. So yes, bank erosion was included with the default values. So that’s the reason we consider that bank erosion might be possible contributor to the fast response of TTS and the hysteresis pattern.

556: I can see why this has been added in response to the reviewers. However, it would be good to also consider uncertainty as specific to this study. For example, if you have selected a different flood to be characteristic of each of the four flood types, do you think that you still would have seen the same patterns between the flood types? i.e. how much variability would you expect to see between floods of the same type as compared to between the different groups?

Response: Thanks for the note, we have added discussion about the issue you have raised as follows “In addition, only one hydrograph was modelled for each flood-event type, meaning that choosing a different hydrograph of the same type could have resulted in different volumetric changes and amount of total transported sediment, as these depend on the flood’s volume and transport capacity. However, the findings of this study, along with previous laboratory (Mao, 2012; 2018) and modelling studies (Kasvi et al., 2015), support the view that the shape and sequence of the hydrograph play a crucial role in determining morphological outcomes. Thus, we can expect that by selecting different hydrograph of each flood-event type, we would have resulted to similar type of morphological patterns relative to the magnitude and transport capacity of the flood even though quantitative outcomes might have differed.”

Additional private note (visible to authors and reviewers only): Apologies for the time it's taken me to turn this around!