Responses to comments by Reviewer #2

We thank the Reviewer's careful consideration of our work. In this rebuttal, we have addressed all the comments formulated by the Reviewer by replying (in black) to her/his remarks (in blue).

General comments:

The manuscript examines the importance of river discharge on tidal damping, residual water level slopes and channel convergence in a seasonal scale in the Yangtze estuary. An analytical model for the tide-river dynamics has been used to understand the underlying mechanisms based on the previous works by the same authors and previous reports from spectra analysis of observed data by other researchers. The authors have identified a critical position of maximum tidal damping along the estuary for a given river discharge as wet or dry season. They also have identified a critical value of river discharge at a given location, beyond which the tidal damping is reduced with increasing river discharge. It is contrary to the common assumption that larger river discharge leads to heavier tidal damping, which is driven by the cumulative effect of residual water level and channel convergence. This is the most important new insight of present manuscript to enhance our understanding of the nonlinear tide-river interactions and guide effective water management in the Yangtze estuary and other estuaries although the methods used were presented. The subject is relevant to the journal, the manuscript is well written and structured. The result analysis is thorough and the discussion is well presented. In conclusion, I recommend its publication after minor revision.

Our reply: We thank the Reviewer for her/his overall positive assessment of our work.

Specific comments:

L55-56: "little effort has been devoted to exploring the effect of river discharge on channel convergence, which is the other control factor for tide-river dynamics": How can the river discharge affect channel convergence? Provide explanations and references.

Our reply: In the revised paper, we shall cite two recent publications concerning the impact of river discharge on channel convergence and revise the sentence into:

"*However, little effort has been devoted to exploring the effect of river discharge on channel convergence (represented by the gradient of cross-sectional area), which is the other control factor for tide-river dynamics (e.g., Matte et al., 2018, 2019). In particular, the river discharge affects the channel convergence primarily through* *residual water level and hence water depth and cross-sectional area (Cai et al., 2014, 2016).*"

L105-106: "Datong hydrological station (where the tidal limit is)": As the authors have read reference about the fluctuation of tidal limit in the Yangtze estuary, you should note the significant fluctuation of the tidal limit during the similar period to the present manuscript. And one of the main identification result by the authors is the critical position of tidal damping controlled by the river discharge. Provide some explanations as the tidal limit is directly relevant to the effect of river discharge on the tidal damping and residual water level. In particular, suggest the authors to insert more words of relevant discussion into the section 5.

Our reply: We thank the reviewer for pointing this out. In the revised paper, we shall supplement the discussion part by including the following sentence:

"*For instance, Cai et al. (2019) explored how the freshwater regulation of the Three Gorges Dam (the world's largest hydroelectric station in terms of installed power capacity) may affect the alteration of tidal limit in the Yangtze estuary by means of the analytical model proposed in this paper. It was shown that the largest change of tidal limit by around 75 km occurred in October owing to the substantial increase in freshwater discharge.*" For more details with regard to the impact of freshwater discharge on the movement of tidal limit, readers can kindly refer to Cai et al. (2019).

L231-234: "a threshold, corresponding to a critical value of river discharge, beyond which the relationship between the tidal damping rate and river discharge switches from negatively to positively correlated": Why the channel geometry is missing for the reason explanation of switch occurred here. Please insert more words into the section 5 of discussion about the correlation of critical value of river discharge with the channel convergence.

Our reply: Indeed, here we did not provide detailed explanations with regard to the relationship between the switch of tidal damping and the channel geometry. This is because here (section 4.1) we aim to illustrate the phenomenon of maximum tidal damping based on the observed time series on a monthly scale. Hence, in the revised paper, we shall mention that "*The underlying mechanism will be elaborated further in the discussion part (see Section 5.2).*"

In particular, in section 5.2 we explicitly mentioned that:

"*The underlying mechanism for achieving a critical river discharge for maximum tidal damping can be primarily attributed to the cumulative effect of residual water level Z altering the water depth and hence the channel convergence and effective friction,* *according to the definitions of estuary shape number γ and friction number χ in Table 1. Figure 11 presents these two controlling parameters (γ and χ) as a function of river discharge Q. It can be clearly seen in Figure 11a that there exists an apparent switch of the estuary shape number γ from positive (indicating a reduction of cross-sectional area in the landward direction) to negative (indicating an increase of cross-sectional area in the landward direction). In addition, more river discharge is required to achieve a switch in estuary shape number γ for the seaward positions where tide exerts more influence. The main reason for such a switch is the consistent increase of residual water level and hence water depth and cross-sectional area with river discharge.*"

Technical corrections:

L353: Replace St by Sr.

Our reply: Corrected as suggested.

L357: Insert a blank space between S and a.

Our reply: Corrected as suggested.

References:

Cai, H., Savenije, H. H. G., and Toffolon, M.: Linking the river to the estuary, influence of river discharge on tidal damping, Hydrol. Earth Syst. Sci., 18(1), 287-304, https://doi.org/10.5194/hess-18-287-2014, 2014.

Cai, H., Savenije, H. H. G., Jiang, C. Zhao L., Yang Q.: Analytical approach for determining the mean water level profile in an estuary with substantial fresh water discharge, Hydrol. Earth Syst. Sci., 20, 1-19, https://doi.org/10.5194/hess-20-1-2016, 2016.

Cai, H., Zhang, X., Guo, L., Zhang, M., Liu, F., and Yang, Q.: Impacts of Three Gorges Dam's operation on spatial-temporal patterns of tide-river dynamics in the Yangtze River estuary, China, Ocean Sci. Discuss., https://doi.org/10.5194/os-2018-138, in review, 2019.

Matte, P., Secretan, Y., Morin, J.: Reconstruction of tidal discharges in the St. Lawrence fluvial estuary: The method of cubature revisited. J. Geophys. Res., 123, 5500-5524, https://doi.org/10.1029/2018JC013834, 2018.

Matte, P., Secretan, Y., and Morin, J.: Drivers of residual and tidal flow variability in the St. Lawrence fluvial estuary: Influence on tidal wave propagation. Continental Shelf Research, https://doi.org/10.1016/j.csr.2018.12.008, 2019.