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# Reply on RC2

Leicheng Guo et al.

Author comment on "River-enhanced non-linear overtide variations in long estuaries" by Leicheng Guo et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2021-75-AC2, 2021

**RC2**: 'Reply on AC1', Xiao Hua Wang, 17 Apr 2021

**The authors have not addressed my comment on R2T=1 for maximum M4 generation satisfactorily. The R2T ratio close to unity for maximal M4 generation can be explained by explaining the optimum generation of quadratic frictional coefficient terms in the algebraic development discussed in Godin (1999) as we did in Table 5 in our paper. In lines 555-558, the authors mentioned that the quadratic bottom stress term leads to significant M4 generation. The authors can use their model results to analyze the relationship between the R2T ratio and quadratic frictional terms for the generation of M4 tide to explain the unity of the R2T ratio.**

**It also should be noted that R2T =1 is not applicable to different estuaries (or indeed at different locations in an estuary) for maximum D4 generation. Our paper has demonstrated that an optimum balance between residual velocity and tidal velocity components is also found at R3 and R5 for the Q20 and Q40 scenarios, respectively.**

**A:** We have looked at the paper Elahi et al. (2020) carefully and was indeed inspired and have more thoughts on this issue. Firstly, Elahi et al. (2020) adopted the decomposition method proposed in Buschman et al. (2009) to calculate the friction under different river discharge (Eq. 1-4 in Elahi et al., 2020), and then used the decomposition to explain the overtide changes. However, it is noteworthy that the method was originally proposed to examine subtidal friction changes, in order to explain subtidal water level variations related to low-frequency tides like MSf etc. The method is not to explain the dynamics related to high-frequency tidal changes like $M_4$, because the energy transfer to the higher and lower-frequency tidal components by friction differs greatly.

Secondly, the optimum condition proposed in Elahi et al. (2020) was a balance between the river-induced residual velocity and tidal velocity components. It explains the location of the maximum overtide amplitude within an estuary under specifed river discharge. The residual velocity increases in the landward direction, while the tidal velocity decreases. Thus the location of the balance varies for different river discharge scenarios. In other words, this balance may not be reached at the same time throughout the entire estuary. The optimum river discharge condition thus is not the same at different locations. As the overtide amplitude varies significantly along an estuary, a local optimum balance is not necessary to indicate the overall overtide generation and dissipation for the entire estuary as a whole. In this work, we looked at the integrated overtide energy by taking the entire estuary into consideration, and found a universal maximal threshold. In this case we use the river discharge to tidal discharge ratio at the mouth section of the estuary as an indicator of the optimum threshold for the estuary as a unit system. A R2T ratio=1 at the mouth of an estuary characterizes identical river flow velocity and tidal component velocity at the mouth (as that in Elahi et al., 2020). Overall, Elahi et al. (2020) examined the local optimum conditions while this work looked at the global maximum. As tidal waves are long waves, the integrated optimum and local peaks in overtide amplitude are simply two different ways of considering the variations in the relationship. In the revision, we will have a look at the spatial variations of the friction and the local overtide optimum conditions as suggested by the reviewer to see the differences.