Response to Reviewer #2

Dear Reviewer #2,

Thank you very much for your positive comments and recommendations, which have been very helpful to improve the quality of our manuscript. We shall revise the paper according to your comments, but for now we would like to provide replies to the issues you raised.

Main concerns:

1. The major concern regarding this manuscript is related to the novelty of the analytical treatment. Indeed there are at least two previous papers already published by the one of the present authors (Savenije) specifically aimed at including river discharge in the analytical framework of Savenije (1998). They are Horrevoets et al. (J. Hydrol., 2004) and Cai et al. (J. Hydraul. Eng., 2012). I have gone through them too, but I found some difficulty to isolate the original contributions in the present manuscript with respect to the previous. The authors should make to effort to better emphasize the novel aspects of their present approach.

Our reply: Indeed, you are right. The paper indeed builds on previous work, but it combines methods not presented earlier and it also presents analytical expressions for additional parameters. We shall clarify the novelty of the present contribution compared with previous works by Horrevoets et al. (2004) and Cai et al. (2012b). In the new version of the manuscript, we will add one paragraph in the introduction to clarify this point. We repeat here the reply to referee #1 who raised the same issue.

The present paper builds on a variety of previous publications that described tidal propagation and damping making use of an analytical approach. Horrevoets et al. (2004) used the quasi-nonlinear method of Savenije (2001) in combination with river discharge, but assuming constant velocity amplitude υ, wave celerity c and phase lag ε. This paper makes use of the analytical framework for tidal wave propagation presented by Cai et al. (2012a), but now it includes for this time the effect of river discharge. A similar paper accounting for river discharge presented an application to the Modaomen estuary (Cai et al., 2012b), but this was based on the quasi-nonlinear approach of Savenije et al. (2008), whereas this paper is the first time that we combine the better performing hybrid model of Cai et al. (2012a) with river discharge. Moreover, fully analytical equations accounting for four spatial variables (υ, η, c, ε) of tidal propagation are presented.

2. A second concern regarding this manuscript is related to the validation of the analytical treatment. In order to allow for an analytical description of tidal hydrodynamics a number of simplifying assumptions on the equations governing the tidal motion are made. Remarkably, tidal amplitude is required to be small compared to flow depth and flow velocity and flow depth are described by a single

harmonic. The model is here validated by comparing measurements performed in two tidally influenced estuaries with the analytical model with and without the inclusion of the river discharge from upstream. According to Figure 9 both theoretical models (with and without river discharge) are capable of well reproduce measurements. If I understood correctly such agreement is performed by calibrating the bed roughness (through the Manning–Strickler friction coefficient K). The slightly better performance of the model with river discharge is demonstrated stating that *"without river discharge we would have required an unrealistically low Manning–Strickler value of K = 30* m$^{1/3}$s^{-1} *to fit the data in the upstream part of Modaomen estuary"*. However, the calibrated value of K = 38 m$^{1/3}$s^{-1} does not differ much from K = 30 m$^{1/3}$s^{-1} hence I would not claim that such results represents a a good validation of the proposed model (with river discharge). Also the explanation of the huge variation of K from 48 m$^{1/3}$s^{-1} to 79 m$^{1/3}$s^{-1} and to 38 m$^{1/3}$s^{-1} is not really convincing.

Our reply: We agree that the calibrated value of Manning-Strickler friction coefficient with river discharge does not differ much from the value used for the case without river discharge in the Modaomen estuary. In fact, the difference between these two calibrated roughness values depends on the river discharge condition. We can see that the influence of river discharge in the Yangtze (13100, 17600 m^{3}s^{-1}) is much more significant than that in the Modaomen (2259, 2570 m^{3}s^{-1}). Consequently, the deviation from the calibrated value of K (accounting for river discharge) is bigger in the Yangtze than that in the Modaomen. We shall use a one-dimensional numerical model to validate our findings and to investigate how well the analytical model performs in these two estuaries.

3. In Figure 10 the performance of the model with river discharge is definitely better with respect to the model without river discharge. However it is not clear which value of Manning–Strickler was employed in this case. The same values employed to calibrate the model with river discharge (K = 70 m$^{1/3}$s^{-1} in the upstream part of the estuary)?

Our reply: Yes, both the model with river discharge and the model without river discharge used the same vales of Manning-Strickler friction coefficient K =70 m$^{1/3}$s^{-1} in the upstream part of estuary**.**

4. To this respect I believe that a detailed comparison of the present theoretical treatment with a one-dimensional numerical model solving the full set of governing equations would be appropriate to find the range of values where the present approach is appropriate. Such an effort, in my view, would tremendously improve the quality of this manuscript.

Our reply: We very much appreciate this comment, and we do agree. In the revised manuscript, we shall compare the proposed analytical solution accounting for the effect of river discharge with a one-dimensional numerical model, using the full St-Venant equations, for a wide range of parameters (Q_f, γ, K, ζ_0). In this way we can validate the approach and test if our model indeed predicts the correct behavior for different roughness values.

Editorial comments:

We agree with the suggested corrections, which will be made in the revised paper. We thank the reviewer for the detailed reading.

References:

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