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Discussions

Interactive comment on "Analytical approach for determining the mean water level profile in an estuary with substantial fresh water discharge" *by* H. Cai et al.

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Responses to comments by Bin Guo

Dear Bin Guo,
Thank you very much for your comments! Below are our responses to your comments.

General comments:

1. Thanks for addressing my concerns from the authors. According to the authors, it still seems that the paper just applied an existing analytical model proposed by Cai et al. (2014).

Our reply: In the revised paper, we shall include a new paragraph in the Introduction part to clarify innovation of this contribution:

"The current work is not just an application of a model to a case study, but an analysis that provides new analytical tools to assess the influence of fresh water discharge on water levels in estuaries. For the first time, we used a fully analytical approach to quantify the contributions made by different components (tide, river, and tide-river interaction) to the residual water level, which sheds new light on how backwaters are generated as a result of tide-river interaction. The method is subsequently used to estimate the frequency of extreme high water along the estuary, which is particularly useful for water management and flood control."

2. Furthermore, the authors did not think the South Branch and the North Branch were considered as an entity, and cited the previous studies of Zhang et al. (2012) to support their points. However, Zhang et al. (2012) have considered the South Branch and North Branch as a unity morphologically. The morphological evolution of the Yangtze River estuary was the combined results of tidal and riverine dynamic. The morphological factor also affects the interaction between tidal and riverine dynamic. And tidal progradation in the North Branch may influence the water level profile along the estuary, and it may be particularly true for the upstream of the estuary and the dry season. In this paper, the authors didn't provided enough evidence to support their points. Therefore, the points of the authors may be misleading. And I don't think the authors know the Yangtze River Estuary well.

Our reply: As you can see from the abstract in Zhang et al. (2012) that our approach is consistent with their results with regard to the "entity" behaviour of the branched estuary. Literally, Zhang et al. (2012) state: "This study shows that the analytical model developed for a single-channel estuary can also accurately describe the tidal dynamics in a branched estuary, particularly in the downstream part. *Within the same estuary system, the North Branch and the South Branches have a distinct tidal behaviour: the former being amplified demonstrating a marine character and the latter being damped with a riverine character.* The satisfactory results for the South Channel and the South Branch using both separate and combined topographies confirm that the branched estuary system functions as an entity." The North Branch and the South Branch have a very poor hydraulic connection. Exchange flow between the branches is very small. The North Branch has a close to standing wave character (amplified and marine in character), whereas the South Branch is more riverine with manifesting a damped nearly wave with a more progressive character. Although there is very limited hydraulic interaction, during low flow, pockets of more saline water from the North Branch can enter into the South branch, causing salinity problems near intakes, but these are exchanges that have hardly any influence on the hydraulics. Also Zhang at al. (2012) consider these systems as separate, both hydraulically and regarding the salinity intrusion.

For more details of the "entity" behaviour in the branched system, you can refer to Section 5.4 entitled with '**"entity" behaviour of the branched estuary**' in their paper.

In the revised paper, we shall clearly clarify that we only consider the branched system downstream from the junction between the South Branch and the North Branch, which in our view functions as an entity for tidal hydrodynamics, so that we may treat it as a whole.

As we mentioned earlier (see the previous responses), we do agree that the net water, salt and sediment fluxes from the North Branch into the South Branch may have influence on the estuarine processes (e.g., salt intrusion) in the South Branch. However, since we focus on the dominant tide-river interaction process in the Yangtze estuary, the effect from the North Branch may be neglected. In the revised paper, we shall clarify that we assume a negligible influence of the net water, salt and sediment fluxes from the North Branch into the South Branch on the tide-river interaction.

References Zhang, E. F., Savenije, H. H. G., Chen, S. L., and Mao, X. H.: An analytical solution for tidal propagation in the Yangtze Estuary, China, Hydrol. Earth Syst. Sci., 16, 3327–3339, doi:10.5194/hess-16-3327-2012, 2012.

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