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Ocean Science Discussions

Interactive comment on "Impacts of Three Gorges Dam's operation on spatial-temporal patterns of tide-river dynamics in the Yangtze River estuary, China" *by* Huayang Cai et al.

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The article used an analytical tidal model to understand the change of freshwater discharge on the tidal dynamics in the Yangtze River, with a specific focus on the impact of Three Gorge Dam. While freshwater discharge's effect on tidal dynamics is well recognized by observations and numerical models, it is rare to use an analytical tool to understand the underlying mechanism (e.g., bottom friction, tidal damping) for the changes in tidal dynamics. I believe the article is a good example study for the influence of dam construction. There are some issues, however, needed to be well resolved before acceptance for publication.

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Discussion paper

Major comments

1. The organization of the paper can be improved. For example, in section 4.1, the description of changed tidal amplitude and mean water level is followed by the analytical analysis of the tidal damping before detailing the model performance. I would suggest moving the later part in section 4.1 to section 4.2. Following a strategy as "observational analysis; model performance and validation; analysis of TGD's influence based on the model results".

2. The wording can be greatly improved. Some sentences have been mentioned again and again. For example, similar sentences as in L154-155 "we mainly concentrate on the tide-river dynamics under the impacts of TGD seasonal regulation over the entire reach of the Yangtze River estuary" can be found in multiple places, in the introduction, methods, results. Please revise them and make the text more concise. I would suggest mentioning such a sentence in the introduction and in the conclusion while avoiding repeating them in methods and results. Extensive minor grammar suggestions can be found in the minor comments.

3. While I agreed that the discharge regulation affects the tidal dynamics, I am not convinced that the influence of geometric or morphological change due to TGD is limited. The authors used 2007 bathymetric data, which might not reflect the alteration due to TGD considering the time-lag of 4-5 yrs in morphological response to the TGD. The morphological change can be more profound in recent years and it is well known that the reduced sediment delivery due to the trapping of TGD affects the erosion/deposition status of the Yangtze River delta. It is possible that the morphological change on the tidal might be less profound compared to the river discharge, but such a conclusion is not supported by the presented analysis. I would suggest rewording the related sentence regarding the influence of morphological change.

4. Regarding the TGD's influence on damping rate as shown in Fig. 3, could you explain why there so many jumping values (e.g., in Fig. 3a,c,d,e)? For an analytical

solution with so many simplification assumptions, the response shall be in a much smoother way. Is such a jumping pattern observed in reality? I think it is important to clarify such abnormal features in your figures. Such types of not explained pattern also exist for figure 6-9, where there is a clear jumping pattern. Is it because you are using two manning coefficients for different regions?

5. As the major focus of this paper is to use the model to quantify the impact of freshwater discharge. It is vitally important to show the model can reproduce the change in tidal dynamics (e.g., tidal range) in response to varying freshwater discharge. For example, a plot showing the observed change of tidal range (using the amplitude of M2 would be better) as a function of freshwater input at selected stations, together with another line showing the modeled amplitude as a function of river discharge.

6. For the captions of many figures, it is necessary to detail what each data point represent for. For example, in Figure 5, it not clear to me how each data point is obtained, is it monthly mean value?

Minor comments

L44: “to the extent” here reads awkward. Please consider to revise it.

L54: a recent work by Du et al. (2018) might be a good reference in concern of the geomorphic constraints on tidal dynamics.

Du et al. (2018-GRL). Tidal response to seaâĂŘlevel rise in different types of estuaries: the importance of length, bathymetry, and geometry

L55: suggest to change “including spring-neap tidal fluctuations as well as seasonal varying discharge” to “in timescale ranging from a fortnight to season”

L57: change “of the river” to “of a river”

L58: delete “being”, only those that have already been built can cause changes in downstream freshwater discharge

L64: suggest moving the part “such as xxxx” forward to as “human intervention, such as xxxx, which are xxxx”

L68: suggest changing “a large river” to “the largest river in China in terms of mean discharge” to emphasize the importance of Yangtze River.

L92: suggest changing “that have been mainly been concerned with” to “on”, making it more concise.

L114: change “the TGD seasonal regulation effect” to “the effect of TGD seasonal regulation”

L119, L121: suggest using past tense of phase, to be consistent to the phase you used at the beginning, where you used “adopted”.

L138: change “Downstream of” to “Downstream”

L143: change “discharge” to “was discharged”

L148: change “a tidal range that extends up to $\sim$4.6m” to “a tidal range of up to 4.6m”

L157: Delete “Sketch”, it is actually a map, not a sketch one. Suggest changing “displaying the location of gauging and hydrological stations” to “with the location of tidal gauging and hydrological stations shown with black solid circles and rec solid rectangles”.

L168: change “difference of “ to “difference between”

L169: “and a half” to “and dividing by two”.

L170: “water levels of xx stations” to “water level at xx stations”

L206: will the solution for rectangle lateral shape channel be different with those with a V-shape? It is better to state here why such an assumption is valid as most part of estuary is not rectangle shape but v-shape

L214-217: These symbols are not used for the four number and it is not appropriate

to use "where" here. I suggest to move it as a note under the table 1, or express the formula for each number explicitly in the text (say, each number is described with its corresponding formula in the text).

L280: “in upstream stations” to “at upstream stations”

L302-309: Isn’t it necessary to describe whey some segments has seen little change or even decrease? It is confusing. Why increased damping denotes weaker friction? For classic understanding, it is thought larger friction lead to a higher damping rate.

Figure 5: what does each data point stand for? Monthly value? Or yearly value?

Section 4.3: the second part in section 4.1 is suggested to move into section 4.3.

L373: “identify” seems not a good word here.

L383: in “the larger the freshwater discharge is, the smaller the velocity number and the phase lag are.”, suggest changing as “the larger the freshwater discharge, the smaller the velocity number and the phase lag.”

Figure 6: why there is sharply jumping in the curve, due to different manning coefficient?

L416: “the river immediately downstream eroded” to “the river bed immediately downstream was eroded”

L426: “therefore” may be a better word than “consequently”

L463-466: this whole sentence reads awkward. Suggesting changing “where the tidal influence dominates that of the freshwater discharge” to “where tidal influence overwhelms the influence from freshwater discharge”.

L500: “drawn lines” to “solid lines”

L519: it is not clear how you determine the value “20-yr” and “10-yr” here.

L574: suggest changing “as a significant case study” to “as an example”

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