Response letter

We thank the Editor and the Reviewers for the careful consideration of our work. Their constructive and thoughtful comments and suggestions led to a much improved and complete revision of the manuscript. In the revised paper, we have addressed all the comments formulated by the Reviewers by replying (in black) to their remarks (in blue). The lines numbers in this rebuttal refer to the revised version of the manuscript.

Editor's general comments

Comments:

I now have both referees' comments on the latest version of your manuscript. They are favourable overall but there are some "Referee comments" which I copy below, as well as some of my own, for you to address in a revised manuscript please.

Our reply: We very much appreciate all the comments and suggestions raised by the editor and reviewers. In the revised manuscript, we have completely addressed all the comments.

Responses to Reviewer#1's comments

- 2.2 Datasets. In the study both discharge and water level at the upstream station is used, which implies that there is are continuous measurements of both the stage and flow velocity. Yet measurements methods can change over time, and even if they do not change, they require frequent recalibration to account for morphological changes at the gauging station. Therefore, it would be insightful to provide some information on how discharge at the Datong station is measured, if the method of measurement changed during the study period, and most importantly, if it was regularly updated to account for scouring of the bed, after the TGD had been constructed.

Our reply: In the revised manuscript, we have explicitly mentioned that: "*Here, it is worth noting that the observed river discharges at the DT hydrological station were generally derived from well-calibrated stage-discharge relationship, which is established by concurrent measurements of stage and discharge (through approximately 50-70 filed measurements of flow depth and velocity in each year to account for the cross section changes) over a wide range of river discharge conditions.*" (see Lines 98-102)

- 116-117 standard deviation function → standard deviation

Our reply: Corrected as suggested.

- 120-121 "daily averaged water levels observed at the DT hydrological station are not uniform for identical river discharge" → "There is no unique stage-discharge relation at the Datong hydrological station"

Our reply: Corrected as suggested.

- 121-122 "due to the influence of external forcing [...]". A potentially important factor, the stage-discharge hysteresis, is not mentioned. Is it not relevant at Datong? I suggest to provide a rough estimate of the stage-discharge hysteresis.

Our reply: We thank the reviewer to point this out. Actually, the stage-discharge hysteresis effect is a key factor leading to a non-unique stage-discharge relationship. In the revised manuscript, we have explicitly mentioned that: "*It is worth noting that there is no unique stage-discharge relationship at the DT hydrological station (see Figure S1 in the Supplementary Material) owing to the stage-discharge hysteresis effect caused by flow unsteadiness, together with the influence of external forcing, either the potential influence induced by the tidal forcing (especially during the dry season) or the exerted residual water level slope upstream of the DT hydrological station (owing to the relative importance of river discharge between the main stream and the tributaries, especially during the flood season).*" (see Lines 125-131)

- 139 variance function → variance

Our reply: Corrected as suggested.

- 176 Note that Gezhouba is also a run-of-the-river dam, and therefore should not considerably influence the discharge regime.

Our reply: We thank the reviewer to point this out. Indeed, Gezhouba is also a run-of-the-river dam. In the revised manuscript, we have explicitly mentioned that: "*In addition, we note that the only other dam (Gezhouba, abbreviated by GZB, see Figure 1a) along the main course of the Yangtze River was constructed in 1981 (before the TGD) and should not considerably influence the discharge regime since it is a run-of-the-river hydroelectric system.*" (see Lines 179-182)

- 212 increased → increasing

Our reply: Corrected as suggested.

- 215 "The standard error [...] represents the standard deviation" → "The error-bars [...] represent the standard error"; The standard error and standard deviation are related but not identical (serr $\propto$ sd/$\sqrt{}$nsample).

Our reply: In the revised manuscript, we have revised this sentence as: "*The error bars presented in Figure 3 represent the standard deviation of the estimated linear* *regression coefficients, which suggests that the proposed triple linear regression model is fitting well.*" (see Lines 219-221)

- 217 is robust → is fitting well. ["Robust" in statistics implies that a method to suppress outliers was employed, which is not the case here.

Our reply: Corrected as suggested.

- 215-217 "[...] the standard error [...] suggests that the proposed triple linear regression model is [fitting well] with limited uncertainty". Remove the qualifier "with limited uncertainty", as a good fit does not imply low uncertainty. In general, the goodness of fit to the measured values improves when more parameters are added, but the reliability of predicting values at moments for which no measurements are available decreases (overfit). (See also my recommendation in the previous revision to validate the model through bootstrapping.)

Our reply: In the revised manuscript, we have revised this sentence as: "*The error bars presented in Figure 3 represent the standard deviation of the estimated linear regression coefficients, which suggests that the proposed triple linear regression model is fitting well.*" (see Lines 219-221)

- 312 constant value of local mean sea level → constant mean sea level

Our reply: Corrected as suggested.

- 310-313 "[The] channel deepening [...] tend[s] to increase in the landward direction [..]. This phenomenon can be primarily attributed to the constant value of local mean sea level or the ultimate base level that the topography tends to approach due to erosion."
  I cannot follow this argument, as the constant sea level in combination with the seasonal discharge variation promotes, not prevents, scouring c.f. theoretical work by (Lamb et al., 2012) for the Mississippi and measured longitudinal river profiles of the Mahakam (Sassi et al., 2012) and Kapuas (Kästner et al., 2017). I propose two alternative hypotheses: First, reduced sediment supply initially just results in scouring downstream in the vicinity of the dam, after which the scour slowly propagates further downstream with time. Second, the reduction of seasonal discharge variation by the TGD reduces the overdeepening near the sea.

Our reply: We thank the reviewer to point this out. Based on the phenomenon that the geometric changes Δ_{GEO} (mainly caused by channel deepening) tend to increase in the landward direction (see Figure 6c in the manuscript), we agree with the hypotheses proposed by the reviewer. In the revised manuscript, we have explicitly mentioned that: "*In addition, this phenomenon is also closely related to the scouring downstream near the TGD, which slowly propagates further downstream due to the reduced sediment supply (see also Lamb et al., 2012; Sassi et al., 2012; Kästner et al., 2017). Moreover, the reduction of seasonal discharge variation due to TGD's regulation may probably reduce the overdeepening near the sea.*" (See Lines 322-326)

- 323-328: Since the TGD continues to deprive the Yangtze of sediment, it is reasonable to assume that the scouring will continue. Can the authors hypothesize how the water levels will evolve in future?

  This also points to a potential methodological limitation of the study, as the mean conditions are treated as if they were stationary before and after the dam construction, while the geometric influence has likely gradually increased since construction of the dam due to ongoing scouring.

Our reply: We thank the reviewer to point this out. Indeed, we agree with the reviewer that the souring will continue owing to the sediment trapping effect due to TGD's operation. And we also agree that the assumption of stationary condition before and after the TGD is one of the model limitations. Thus, in the revised manuscript, we have explicitly mentioned that: "*It is also worth noting that in this study we assumed a more or less stationary condition before and after the TGD's construction for the regression model, which is not completely true due to the gradually increased geometric influence caused by the TGD.*" (See Lines 338-341)

Responses to editor's comments

- 125. "extern" → "external"

Our reply: Corrected as suggested.

- 129-130. "In this study, the DT hydrological station was chosen as the upstream end, while the TSG gauging station was used as the downstream end." I think this sentence should be moved to before the present line 120 where DT is referred to but the reader does not presently know that it gives Zup.

Our reply: We thank the editor to point this out. In the revised manuscript, we have moved the sentence "*In this study, the DT hydrological station was chosen as the upstream end, while the TSG gauging station was used as the downstream end*" before the present line of 120.

- 186-188. Not a sentence – no verb! Maybe (line 186) ". . (see Figure 2) for . ." although this makes a long sentence.

Our reply: We thank the reviewer to point this out. In the revised manuscript, we have revised the sentence as: "*The proposed triple linear regression model was applied to reproduce the water level dynamics observed during both the pre-TGD and post-TGD periods for the given upstream river discharges and water levels observed at the DT hydrological station and the water levels observed at the TSG gauging station(see Figure 2).*" (see Lines 190-193)

- 192. Omit "accounting for" which tends to suggest that the model only accounts for 4-13% of the standard deviations.

Our reply: Corrected as suggested.

- 207-208. "(estimated using the Matlab 'regress.m' function with 95% confidence intervals)" is unnecessary, it repeats the figure 3 caption.

Equation (3) tends to identify "tidal" Pt with Zdown. Indeed Zdown will include tides, but it will also include effects of "wind, ocean-temperature and ocean-salinity" (Reviewer comment on earlier manuscript). The last paragraph of section 4 should discuss these other influences.

Our reply: We thank the editor to point this out. In the revised manuscript, we have deleted the sentence: "*(estimated using the Matlab 'regress.m' function with 95% confidence intervals)*". In addition, in the previous manuscript, we have explicitly mentioned that: "*It should be noted that the imposed downstream water level Z_{down} also implicitly accounts for other nontidal factors, such as wind, ocean temperature and ocean salinity, which are assumed to be negligible in the regression model when compared with the tidally induced water level fluctuations featured by a typical spring-neap cycle (see Figure S2 in the Supplementary Material).*" (see Lines 135-139)

- 257 232-239. I think the Reviewer comment (on the earlier manuscript) about errors in estimated slopes is still relevant. See the reviewer comment above about lines 215-217; the figure 5 plots of slopes show signs of over-fitting. Anyway, how does the Matlab "gradient.m" function estimate / interpolate slopes?

Our reply: We thank the editor to point this out. Actually, we interpolated the reconstructed water levels along the channel from JY to WH with the interval being 1 km using the cubic spline interpolation. Subsequently, the water level slope can be derived by calculating the slope between the adjacent points along the channel, which is done by the Matlab "gradient.m" function. In the revised manuscript, we have explicitly mentioned that: "*Subsequently, we used the Matlab 'gradient.m' function (i.e., 'gradient' calculates the central difference for interior data points, while it calculates values along the edges of the matrix with single-sided differences, see details in https://www.mathworks.com/help/matlab/ref/gradient.html) to estimate the residual water level slope based on the reconstructed water levels along the YRE.*" (see Lines 227-231)

- 315-316 and figure 9. The text and figure agree but Z1 as original and Z0 as new is confusing especially as they give ΔZ = - change in Z.

Our reply: In the revised manuscript, we have used the absolute value $|\Delta Z|=|Z_0-Z_1|$ instead of $\Delta Z= Z_1-Z_0$ to avoid any confusing understanding.

References

Kästner, K., A. J. F. Hoitink, B. Vermeulen, T. J. Geertsema, and N. S. Ningsih, Distributary channels in the fluvial to tidal transition zone, Journal of Geophysical Research: Earth Surface, 122, 696–710, 2017.

Lamb, M. P., J. A. Nittrouer, D. Mohrig, and J. Shaw, Backwater and river plume controls on scour upstream of river mouths: Implications for fluvio-deltaic morphodynamics, Journal of Geophysical Research: Earth Surface, 117, F01002, 2012.

Sassi, M. G., A. J. F. Hoitink, B. Brye, and E. Deleersnijder, Downstream hydraulic geometry of a tidally influenced river delta, Journal of Geophysical Research: Earth

Surface, 117, F04022, 2012.