RC2: 'Comment on egusphere-2024-595', Anonymous Referee #2, 13 Aug 2024

RC2-0. This manuscript presents an interesting study attempting to simulate the streamflow in a hydraulic engineering project influenced basin several centuries ago, and illustrate the values of Tone River Eastward Diversion Project in aiding navigation. The reconstructed streamflow is indirectly validated by some proxies, but no datasets of ancient hydrological and meteorological datasets are used to force or validate the model, which forms a significant disadvantage for a streamflow reconstruction study. However, I think this would be a small issue if the research topic can be adjusted slightly. Besides, I find some important methods/results are presented inadequately or unclearly. Consequently, I recommend a major revision before publication, by addressing the following major and specific comments.

> **Thank you for your useful evaluation and constructive suggestions. We hereby hope that you will find our response satisfactory. If there are some points that are still unclear or require further clarification, we will gladly address them with carefulness in the following round of revision.**
>
> **We will reply to the referee comments, with our answer indicated by Answer (in green), corresponding actions indicated by Action (in blue), and textual changes in *italic font*:**

RC2-1. Expression of the research focus

When talking about historical streamflow reconstruction, we would certainly expect the reconstruction of the climate factors, since climate forcing is one of the most important factors influencing streamflow, leading to strong hydrological nonstationarity. This study mainly explores the streamflow produced by different historical maps. Although authors have acknowledged the limitation in this aspect, I still think the lack of climate reconstruction is an inevitable shortage. However, if we regard this study as an investigation on the influence of TREDP on streamflow, the lack of climate reconstruction would not be so important. Consequently, I suggest the authors to change the expression of the research topic, focusing on the influence of TREDP, rather than “reconstructing” the “historical” streamflow.

> **We appreciate your comment. We understand the word “reconstruct” infers a quantitative estimation of the past. We will carefully revise the entire draft and make sure that the word will be only used for river maps. We will further clarify that streamflow reconstruction is not achieved because of the lack of historical climate data.**
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> **Your suggestion is actually already included in research question (3) of our study, which states: „What were the implications of TREDP? Were the implications consistent with the views of Koide and Okuma, who claimed that enhancement of navigation was key?“**

RC2-2. Model calibration

RC2-2-1. I am confused about the calibration procedure. The authors only adopt three different values for each procedure, totally 81 combinations. This seems not a normal calibration procedure, in which simulation discharge produced by a large number of parameters need to be calculated.

We agree with you that the calibration procedure is different from many other models. H08, including surface energy balance calculation, has long adopted this procedure and demonstrated it worked for many large basins (e.g., the Chao Phraya River in Thailand reported by Hanasaki et al., 2014; The Ganges Brahmaputra Meghna Rivers by Masood et al., 2015; The rivers in Kyushu island in Japan by Hanasaki et al., 2022). There are four calibratable parameters and minimal three optional values (the minimum, mean, and maximum values of physical bounds for each parameter). Optional values can be increased (e.g., Masood et al. 2015 used 5 values for each). Due to the fact that quite a limited number of parameters were tested, the parameter set found may not be the mathematical optimum, while the parameter set produces reasonable hydrological simulation in the entire basin (see text).

RC2-2-2. Besides, the T2E bifurcation function is set as 70:30% because the NSE values are highest at this time (L262-264). Is NSE always highest at 70:30% for all the parameter combinations? Several lines afterward, the authors claim that the rationale for this value is the near-equal NSE of Kitasekiyado and Nishisekiyado stations. Is this consistent with the sensitivity analysis described previously?

For your first question, our answer is no. NSE was highest at 70:30% only for the best parameter combinations after the T2E bifurcation (see Figures 7b and 7d; the same NSE data are shown in Table 3 on the third and the fourth columns). For your second question, our answer is yes. We tested various combinations of the discharge ratio at the T2E bifurcation, and we selected the value of 70:30%, which exhibited near-equal NSE for Kitasekiyado (after T2E bifurcation, the eastern route) and Nishisekiyado (the southern route) stations for the best parameter combinations (NSE = 0.67 for both calibration and validation at Kitasekiyado and as NSE = 0.89 for calibration and 0.80 for validation at Nishisekiyado). The near-equal NSE at two stations implies a reasonable bifurcation over time.

RC2-2-3. Shouldn't this bifurcation function be determined by something like project planning?

Thank you for this suggestion. There must be a strict gate operation rule at the Sekiyado bifurcation point (so far, the authors have not yet accessed to the written rule yet), but it doesn't necessarily be the solution because the simulation includes bias and errors. Rather important is that the flow simulation at the upper and lower stations agrees well with the observation. We will further revise the text to clarify our intention.

RC2-3. Method description

The reconstruction of the historical maps seems to be a very important part in this study, because the simulation of historical streamflow is produced by simply replace the present map by historical ones. However, the method producing historical maps is only described by several simple sentences and referring to several literatures. I suggest authors to describe this part in details.

We described the methodology for reconstructing the historical maps in section 3.3.3 (Flow direction data), but we agree that the explanation is insufficient. For instance, we stated that "administrative borders and the

associated terrain slopes were used as guidelines because we assumed that these did not change over time even when the river routes varied", but we did not give a particular example of when this was used (i.e., Kinu and Kokai Rivers). In the revised manuscript, we will enhance explanations about methods used for reconstructing historical maps in very much detail, to the point of high methodological reproducibility.

RC2-4. Figure 8 is an important figure showing the validation of historical simulation, but I find this figure and the interpretation on it extremely difficult to follow. What is the meaning and unit of the colorbar? What do the hollow circles represent? What do the channels with deep and shallow color in each map mean? The units of frame should be added. Also, I suggest the authors to refer to the specific point/line in the figure (e.g., … as shown by the XX point in Figure X) when describing this figure in the main text.

We agree that Figure 8 was difficult to follow. Below are replies to all questions.

The main channel indicates river flow meets the condition of Q20 > 20 m^3/s, which increases over time.

The color bar indicates the river discharge of the basin; it will be replotted differently in the revision.

The hollow circles represent all recorded navigable historical ports except the most upstream navigable ones. They are only in Figure (8d) to not have too many circles overlapping.

Channels with pale color represent river flow slightly bigger than Q20 > 20 m^3/s while the ones with dark blue color indicate bigger discharge up to values in the color bar.

We will add LAT/LON units to the frame.

We will modify the manuscript and Figure 8 by properly specifying figures/panels/points wherever and whenever applicable.

RC2-5. -Figure 6: Maybe replace "before" and "after" by "without" and "with". "Before" and "after" seem to describe the time when an event happens, which may lead to misunderstanding.

Thank you, we agreed and will correct this both for Figure 6 and Figure 7.

RC2-6. -L461: I think Figure 9 is just showing the simulated streamflow of different historical years, not a "validation".

Thank you, we agreed and will correct this.

RC2-7. -Figure 9: 1966 should be 1666?

Thank you, we agreed and will correct this.