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Comment on esurf-2021-91

Damien KUSS (Referee)

Referee comment on "Numerical modelling of the evolution of a river reach with a complex morphology to help define future sustainable restoration decisions" by Rabab Yassine et al., Earth Surf. Dynam. Discuss., <https://doi.org/10.5194/esurf-2021-91-RC1>, 2022

General comments

This article is original and particularly interesting with the use of a 2D hydromorphological numerical model in a torrential context. The task is challenging as the study concerns the modeling of a reach of braided river with wandering flows which are by nature random and are therefore particularly difficult to model in a deterministic way.

From a methodological point of view, the numerical aspects are very well described. On the other hand, the study site and the modeled domain deserve to be better described: length, slopes... A longitudinal profile, encompassing the modeling domain, would make it possible to better understand the problem of deposition during floods in link with the weirs and with the decrease in the longitudinal slope. The influence of the solid volume taken into account, linked with the slope, could be discussed in the results section.

The hydromorphological modeling is carried out taking into account only bedload (with Meyer Peter and Recking formulas). But you mention, by exploiting the data from dredging, that the fraction of the volume transported by bedload would represent only 8 to 16% of total transport (lines 417 to 417). There is an inconsistency:

- The altitudinal evolutions observed by DoD are compared to the modeled bed evolutions, which only include sediment transport by bedload;
- On the other hand, the modeled transported volume is compared to the total volume observed minus the fine fraction (volume transported by suspension).

The performance of each modeling scenario is evaluated with the BSS score. In a braided river context, the scores obtained are not good (BSS = 0.06). You discuss the representativeness of this metric for such river morphologies. If the metric can be criticized because of the random nature of the wanderings, it would also seem relevant to question the added value of a 2D model compared to a 1D model in such a context. You could precise the configurations where a 2D model is appropriate.

Specific comments

Reference Reisenbüchler et al., 2019 at the end of sentence line 19. What does it refer to ?

Line 19 : "They showed". "They" refers to Rickenmann et al. or Reisenbuechler et al. ?

Line 38 to 40 :

- a mention could be made of more recent formulas partially based on field data (Recking, 2013 ; Lefort, 2015).

- are bedload transport formulas established in 1d narrow channels directly transposable in 2D models ?

Lines 40-41 : the slope used for the sediment transport calculation at the upstream boundary condition of the model is a key parameter to perform realistic simulations. It must be apprehended by a geomorphological analysis based on the longitudinal profile.

Line 63 : "The TELEMAC-MASCARET modelling system has been considered well suited to perform 2D morphodynamic simulations on the LDG reach". Why ?

Line 92-93 : you could add a reference at the end of the sentence.

a longitudinal profile would complete the description and would allow to better understand the effects of the two weirs during the floods.

Lines 101-104 : you could add references concerning the peak discharges.

Figure 3 : you could add the reference for each picture

Lines 164-166 : you could add a reference : Rickenmann and Recking (2011) ?

Lines 185-188 : please define all the terms used in equation 5

Lines 195-208 : note that the recking formula : (a) is mainly based on lab experiments for high shields numbers ; (b) is very sensitive to the choice of the shields mobility parameter. So the advantages of using this formula for intense floods where the shields number exceeds the mobility parameter could be discussed.

Lines 225-226 : it is not clear how you use the dredging data.

Lines 234-235 : "However, the recorded volumes represent both very fine sediments probably transported by suspension and very coarse sediment via bedload transport". The model used in the study takes into account only the bedload transport, Is it right ?

Lines 269-270 : you therefore make the assumption of no downstream influence.

Line 276 : what do you mean by "instabilities" ?

Lines 276-278 : the slope of the LDG reach is never given. What is slope at the upstream boundary condition ? Is the hypothesis of stable riverbed evolution justified ? What was the observed evolution of the river bed at the upstream condition during the floods ?

Lines 286-287 : you could detail what you mean by numerical and physical parameters.

Figure 6 : how do you transform 2D results into 1D longitudinal profile ?

Lines 326-327 : "To date, numerical models cannot predict channel migration processes that occur in braided rivers. These phenomena are uncertain and random. A modeler should thus not expect the model to predict channel migration accurately during a flood.". I agree. But in consequence you should better justify why you have chosen a 2D hydromorphological model for this case study.

Lines 331-332 : is the 2019 LiDAR realigned ?

Figures 10-11 : I regret that the 2016 profile was not drawn with a solid line. it's hard to see the position of the fall. You could also explain how you transform 2D results with a bed level not constant over cross sections into longitudinal profiles.

Figure 13 : how do you explain the deposits above the max water level ?

Figure 14 : the initial profile is missing. It could be a useful information.