Review of paper nhess-2020-72

What controls the coarse sediment yield to a Mediterranean delta. The case of the Llobregat river (NE Iberian Peninsula)

16th May, 2020

The authors study the importance of several factors in the sediment yield of the lower Llobregat River. The main finding is that flow regulation due to dam construction, and the construction of infrastructure in the floodplain, are the main factors explaining the change in sediment yield in the last decades. The manuscript presents a broad historical overview of all interventions and changes in the basin, as well as a comprehensive data set. Data from different sources is compiled, which makes the manuscript of interest for all future studies about the Llobregat River. The less strong point regards the estimation of sediment transport. From my point of view, the authors could have used some other tools that would allow a more precise estimation. Overall, the manuscript is interesting for the scientific community as well as for practitioners and certainly contributes to the understanding of the dynamics of the Llobregat River. Hence, I would recommend its publication, possibly after considering the comments below.

There are some major points to be discussed. The authors estimate the change in supply of bed load by measuring the change in alluvial surface area (Section 9). They also estimate the change in bed load carrying capacity (Section 10) and study the difference between these two parameters for predicting change in bed elevation. This would not be the approach I would follow, as a local reduction of the alluvial area does not indicate a decrease in the sediment supply at the same location. The sediment yield is indeed dependent on the basin area (studied in Section 5), but not on the floodplain area. A reduction of the width at a certain location does not decrease the load at this location, also not immediately downstream. A local reduction of the river width, and subsequent decrease in alluvial area, would, in general, cause an increase in the flow velocity (and bed shear stress), which would cause an increase of the sediment transport rate at the narrowed section, which implies an increase of the sediment yield to the downstream sections. Thus, a reduction of the river width causes short term aggradation downstream of the narrowed reach, as well as degradation at the upstream end of the narrowed reach. *Jansen et al.* (1979) provides a general overview of the effect of such interventions.

In estimating changes in bed elevation, one could simply apply mass balance (i.e., the *Exner* (1920) equation). Gradients in sediment transport rate lead to changes in bed elevation. For instance, in Table 5, one find that the sediment transport capacity of Reach 2 is more than twice the sediment transport capacity of Reach 1. Assuming, as the authors mention, that locally there is no lack of alluvial sediment (i.e., there is no bed rock or non-erodible layer), one would expect degradation to have occurred.

The paper is mainly about data analysis. Nevertheless, when estimating sediment transport and changes in bed elevation, I would have proposed to use a standard one-dimensional numerical model coupling the *Saint-Venant* (1871) equations to the *Exner* (1920) equation. Although the authors seem to have data for building a model with the actual geometry, a simplified model with schematic cross-sections would suffice to estimate orders of magnitude. This approach would, for instance, prevent the crude limitation of assuming that changes propagate from one reach to the next one (with different lengths) in the time in which data is available (which is not constant). A second benefit would be the capacity of assessing certainty in the results, as one could easily estimate the load using different sediment transport relations and grain size. Moreover, it would allow to estimate the change in bed elevation due to particular flood events, which is currently not possible to estimate, although the authors mention that are very relevant.

As a minor point, I would highlight that the manuscript reads well, but closer to a book than to a research article. The manuscript is organized in 15 sections, including an epilogue. I find the data presented in the epilogue to be as important (probably even more) as the data presented in previous sections and makes me wonder why it is considered an epilogue. Although a matter of taste, some readers may find clearer to have the usual structure with methodology and data sources, results, discussion, and conclusions.

At some locations in the paper, I missed references. For locals, the sources may be obvious, but international readers would benefit from a reference to the sentences in lines 49 and 50 where it is mentioned that "archaeologist say" and "geologist say". Similarly, the authors mention that the travel time of a flood wave is 22 h and a reference would help the reader. In Line 125 the authors mentions that "land use changes (...) have been analysed with the best aerial photographs (...) and a modern land use map". I would like to know more about the analysis itself. Please also check references. I could not find the reference in Line 455 in the text.

A last minor point is about the use of tables. While easier for reading the exact values, in my view trends are more easily perceived from plots. Also, please consider Table 1, where the reader finds surplus and deficit with signs. Possibly a bar plot may be a good way to present the results. Please also consider adding the figure about the duration curves (Line 178).

Concluding, the manuscript is interesting for the community and in my view it deserves publication. A stronger modelling would substantially increase the value of the work done, but I understand that the focus is on data analysis. A different structure may help certain readers, although this is more of personal taste than an objective assessment.

References

Exner, F. M. (1920), Zur Physik der Dünen, *Akad. Wiss. Wien Math. Naturwiss*, *129*(2a), 929–952, (in German).

Jansen, P. P., L. Van Bendegom, J. Van den Berg, M. De Vries, and A. Zanen (1979), *Principles of river engineering: the non-tidal alluvial river*, 509 pp., Pitman London.

Saint-Venant, A. J. C. B. (1871), Théorie du mouvement non permanent des eaux, avec application aux crues des rivières et à l'introduction des marées dans leur lit, *Comptes Rendus des séances de l'Académie des Sciences*, *73*, 237–240, (in French).