Referee comment to:

Journal: HESS

Title: Sediment transport modelling in riverine environments: on the importance of grain-size distribution, sediment density and suspended sediment concentrations at upstream boundary

Author(s): J. Lepesqueur et al.

Hydrol. Earth Syst. Sci. Discuss., 2019, revised version

General comments:

This paper presents a hydromorphodynamic modelling study in a small river system, the Orne catchment in France. The objective of the study was to assess the importance of sediment characteristics (i.e. grain size distribution and distributed sediment densities) using the existing fully coupled hydromorphodynamic models TELEMAC 3D and SISYPHE. The latter allows for consideration of cohesive and non-cohesive sediment regimes and was further developed for the use of 10 grain size classes with varying densities for each class. In the framework of the modelling study, the sensitivity of SISYPHE to grain size distribution, sediment density and suspended sediment concentration at the upstream boundary was evaluated.

The modelling study in combination with the flood event data monitored at the Orne river and presented in this manuscript is well placed in HESS and worth publishing. In particular, with regard to the prediction of the resuspension and transport of particulate pollutants, it is necessary to consider several particle classes. However, I have some general comments regarding the configurations of the modelling study:

The standard configuration of the SISYPHE model allows for 2 grain size classes. This is clearly not enough for modelling suspended sediment concentrations. It is thus not surprising, that the model configuration with 10 size classes performs better than the configuration with only 2 classes. However, the 4 configurations (Page 12, Table 1) are a bit arbitrary chosen and too few tested possibilities for a sensitivity study.

In my opinion, it would be interesting, to find out, how many size classes are needed to receive a good prediction of the suspended sediment concentration and evolution of bathymetry. Are 10 classes necessary or can it be less? Therefore, the authors should consider testing also model configurations with other numbers of grain size classes.

Furthermore, the modelling study shows that the configuration with size specific sediment densities outperforms the configuration that uses the standard density of 2600 kg m^{-3} for each class. This is also not surprising, since the average measured density for the sediments in the Orne river is 2300 kg m^{-3} (Page 11, line 11). Therefore, a further model configuration with the measured average density of the sediments in the Orne should be modelled in order to see, if the distributed densities per size class are really needed or if an average measured value would also be adequate. The latter would also be less effort to measure than distributed densities for each class.

Some process representations of the SISYPHE model are simplified and pragmatic. This is adequate, since many sub-processes of erosion and deposition as well as the interaction of particles (in particular when cohesive sediments are involved) are too complex for a precise

physical description. Nevertheless, it is important to think about improvements of the model, as the authors have done in section 6, Future Scope. But, in my opinion, too many improvements are mentioned, which are unlikely to be achievable in the near future. I thus suggest, to mention only a few and feasible model adaptations.

In general, the Figures, in particular the cross comparisons in Figures 8 and 9, are informative and catchy. However, the overall presentation quality of the text could be improved. In the Results and Discussion section, many assumptions are made, which are not supported by observations or references in the literature. The discussion should be more precise. Furthermore, the present manuscript version contains many grammatical and typing errors. It should thus be thoroughly proofread.

Specific comments and technical corrections:

- Page 1, line 13: This study has a main objective to… → The main objective of this study is to…
- Page 1, line 16: allow → allows
- Page 1, line 21 and 24: insert ‘configuration’ behind ‘model’
- Page 2, line 1: inputs → emissions
- Page 2, line 7: …of mineral particles of amorphous or poorly crystalline…. → a word is missing
- Page 2, line 16: ‘transport formula’ → better ‘transport equation’
- Page 2, line 20 and 22 and also later in the manuscript: ‘fall velocity’ → better ‘settling’ or ‘sink’ velocity’
- Page 2, line 34: insert ‘distributed’ before ‘sediment density’
- Page 3, line 2 and also very often later in the manuscript: SYSIPHE → SISYPHE
- Page 3, line 5: mad → made
- Page 3, line 12: ‘This modelling framework has the following interests’ → rephrase
- Page 4, line 12: deposit → deposition
- Page 6, line 10-21: I do not understand if the representation of deposition is the same for the cohesive and non-cohesive regime. Please clarify.
- Page 8, Figure 1: Pleas add a scale bar in the sub-figure on the right.
- Page 9, Figure 2: Please add the monitoring period and number of SSC measurements in the Figure caption.
- Page 10, Figure 4: Please add number of samples in the Figure caption.
- Page 11, line 8-11 and Figure 5: In Figure 5 the distributed densities for 10 grain size classes of the Orne river are displayed. How many samples were measured? Please consider to add error bars to show the variation of the sediment densities per grain size class. In addition, the high density of the 100 µm size class is interesting. Is there an explanation for that?

- Page 11, line 16-21: add dates of field campaigns.
- Page 12, Table 1: I suggest testing of additional model configurations (see general comments).
- Page 12, line 19: insert ‘class’ behind ‘100 µm’
- Page 12, line 23: delete ‘obtained’
- Page 12, line 24: insert ‘upstream’ before ‘boundary condition’
- Page 13, line 9: delete ‘for the discussion’
- Page 13, line 16: underestimate → underestimates
- Page 13, line 12: increase → increased
- Page 13, line 21: move ‘’in the 10 CLD (2600 kg m^{-3})’ to line 20, between ‘whereas’ and ‘we’
- Page 14, Figure 6: explain abbreviations in the Figure caption or refer to Table 1
- Page 15, line 10-11. This statement is not clear: What other kind of processes should influence the transport of suspended particles than advection and diffusion? Please clarify.
- Page 15, line 15: insert ‘the’ before ’63 and …’
- Page 15, line 19-23: Please try to verify the assumptions in this paragraph.
- Page 16, Figure 7: it is very difficult to identify the grain size classes in the graph from the colors in the legend. Please use colors which are clearly differentiated
- Page 17, line 4: delete ‘the’ before ‘erosion and…’
- Page 17, line 15: delete ‘the’ before ‘deposition’
- Page 17, line 15-17: This statement is unclear. In addition, is there a reference in the literature?
- Page 19, line 18-19: This statement is imprecise. Please clarify.
- Page 20, line 11: ‘;;;;’ → missing reference?
- Page 20, line 5-21: In my opinion the list of improvements of the modelling framework is too comprehensive in the context of the manuscript. I thus recommend to focus on feasible improvements in the existing model framework.