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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Determinants of modelling choices for 1-D free-surface flow and erosion issues in hydrology: a review" *by* B. Cheviron and R. Moussa

Anonymous Referee #2

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The paper presents an interesting attempt to draw links between different modelling approaches and to find appropriate time and length scales for different types of models. The approach adopted in the paper intends to be a general approach considering very different types of flows, from runoff to flows in large rivers. However, it must be stressed that this generalization still remains in the field of hydrology, with a point of view that is not as general as it could be. In particular, the Navier-Stokes (NS) equations are mentioned, but without being considered in their general fluid mechanics framework. So, the NS model is presented as the most general one, which is certainly the case, but turbulence is not discussed. However, considering that the flow velocity is the sum of a mean velocity and a fluctuating component, the NS equations can be solved to resolve

as many as possible of the turbulence scales in DNS type simulations, also in flows with significant water depths. These DNS simulations are not discussed here, and NS models always appear in the “runoff” range of applications, which is quite limiting. Of course, if one remembers that the general review concerns hydrological modelling, then it becomes acceptable. But if this is the intention of the authors, then it should be stated much more clearly in the objectives of the paper. In a similar way, it then appears quite strange to read the word “turbulence” only when RANS models are discussed. Indeed, RANS models were developed because performing DNS simulations to resolve all turbulence scales is impossible in practice due to excessive computational cost. Current research tends to push this limitation of NS still further away because of increasing available computational power using e.g. parallel computing. This is also an issue that deserves to be discussed. On the way erosion processes are handled, there can also be some debate. The references used by the authors are certainly pertinent in the field. However, the attempt of classifying the different approaches for erosion and grain movement at the same level as the NS, RANS, SV and ASV models is questionable. The distinction is not so clear, and a different classification, not directly linked to the flow models, but rather to the type of grain movement considered would maybe have been more appropriate. In particular, the authors mention that the SV framework offers a wide field for innovative research about sediment transport, which is certainly the case. But in these recent researches, many different types of sediment transport models are considered, depending also on the necessary level of simplification of the reality that is required. Indeed, the detailed composition of the soli to be eroded is not always known, or it is not possible to include that level of detail in the representation. So it is necessary to resort to averaging concepts, such as a representative grain diameter, then some factors to account for the non-uniformity of the grain-size distribution. The concentration of sediment in the flow could also be discussed: debris flows or mud flows are not handled in the same way as clear-water flows with sediment transport, and this distinction does not really appear here. Minor comments and detailed suggestions for improvement will be submitted later as an attached file.

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