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Interactive comment on "Long-term Morphodynamics of a Schematic River Analysed with a Zero-dimensional, Two-reach, Two-grainsize Model" *by* Mariateresa Franzoia et al.

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We are sincerely grateful to the Reviewer # 1 for the valuable comments on our work and the rich literature suggested on this topic. Waiting for the comments of other reviewers, we would like to respond meanwhile to the Comments of Reviewer # 1, which require more details about the novelties of our paper and the validity of the river representation. Additional replies will be given, following the observation of the other reviewers, with the final revision of the text.

GENERAL COMMENTS

Scope of our paper is integrating the ample literature covering different aspects of

downstream fining along rivers with a simple compact model interpreting the evolution of both river profile and bottom grainsize composition at the very large space- and time-scale. Indeed, the variety of scales in river systems plays an important role in our model and is probably the most interesting novelty of the paper.

Morphological changes in rivers take place at very short (flood event), short (seasonal), intermediate (historical), long and very long (geological) scale. However, only at the shortest scale laboratory and field experiments on morphodynamics are feasible, while at intermediate scale numerical investigations can be somehow carried out by means of conventional hydro-morphologic models. At the very large scale, by contrast, morphological simulations require substantial simplifications of the conventional models, mostly based on various types of averaging and aggregating operations. We will see in the following the simplifications adopted in our model.

Another aspect discussed in our paper, clearly connected with the concept of scale, is the "equilibrium configuration" of a river system or subsystem: namely the steady state of all the relevant hydraulic and morphological quantities, eventually attained in response to sufficiently persistent steady boundary conditions acting on the river (sub) system.

In our model the considered space-scale is that of the entire river system (watershed) and the (consequent) time-scale is the geological scale. This does not mean that the river sub-systems at a smaller scale (e.g. tributary, reach, river width, river depth, bed forms, mixing layer etc.) are totally irrelevant for the evolution of the river system, but that their effects are implicitly accounted for by algebraic equations, under the hypothesis of equilibrium conditions with their respective higher subsystem.

At the basin and geological scale, the boundary conditions of the river system are represented by the long-term water and sediment input from the basin slopes, and by the sea level at the downstream end. These quantities are supposed to be steady, even if the controlling climate may experience some oscillations at the geological scale.

In any case, even for middle size hydrographic basins, the response time of the river system proves to be too long for attaining the equilibrium conditions corresponding to these steady boundary conditions. In fact, the model confirms that, for modern rivers, the existence of a “quasi-equilibrium configuration”, which evolves at an extremely slow rate but is quite different and very far from the expected equilibrium conditions.

It is interesting to note that the quasi-equilibrium configuration invariably presents a very plausible profile concavity and downstream grainsize fining, more or less accentuated depending on the basin characteristics. Moreover, owing to its long persistence, the quasi-equilibrium configuration constitutes a stable reference for assessing the effects on the river system of anthropogenic action or climatic change at a shorter (historical) time-scale.

The validity if the system representation adopted in our model is discussed in the attached file.

Please also note the supplement to this comment:
http://www.earth-surf-dynam-discuss.net/esurf-2017-7/esurf-2017-7-AC1-supplement.pdf

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