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Earth Surface Dynamics Discussions

Interactive comment on "A reduced-complexity model for river delta formation – Part 1: Modeling deltas with channel dynamics" *by* M. Liang et al.

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Liang et al. present in this manuscript a model of "reduced-complexity" for the simulation and study of delta evolution. The results are in very good match with those obtained by more complex models including fluid dynamics. Regardless of philosophical discussions about the approach, my view is to salute the effort: if reduced-complexity models can indeed bring understanding of an inherently complex system, at less expensive computational costs, and with less parameterization than CFD models such as Delft3D, I think it is a useful and complementary approach to solving scientific problems such as those posed by rivers and deltas.

I wanted to share some comments and questions I have on the paper:

1) At the end of Phase 2 (equation 12, page 835), it is not clear to me how the conservation of water mass is insured by the algorithm used to compute water elevation.

2) Line 17, page 839: "for the erosion of both types of sediment parcel. . .": I find this a little confusing as in the paragraphs above you mention "deposition from a parcel", not "of" a parcel. Thus, I understood the "parcels" to be like "packets" of sediment or water that, as they pass on a cell, can leave or take sediment. Could it be better to write "for the erosion by both types of sediment parcel. . .". Now if this is true, could you give a word on why you choose to use this as an erosion law (the Garcia and Parker U/U rule) rather than some classical stream power dependency of bed erosion on water velocity? (I found some of the response in the main paragraph of page 848, but it is still unclear to me).

3) Equation 21b: typo? the >= sign should in fact be <= right?

4) When you erode the bed, how do you know what kind of material is taken in transport? Do you keep a record of the thickness of sand and mud on each cell? How are masses of sand and mud conserved during erosion and deposition? (again, after reading further, I found some response in page 847 and in the conclusion, but it would perhaps be better to make it all clear upfront in the method section).

5) In the Murray and Paola model of braided river, a crucial component to the dynamics of braiding was the inclusion of a rule for lateral erosion (as a proportion of vertical erosion). Here you also have a dynamic shifting of channels, why is lateral erosion not important?

6) Page 847, lines 18-22: how do we know that "a reasonably accurate representation of the water surface and the inclusion of suspended sediment deposition and entrainment" are needed "to achieve even qualitatively correct model results"? It would be good to see model results without the algorithm for water surface, and model results without suspended sediments, but perhaps varying another parameter. The morphological differences observed through variation of the sand/mud ratio could perhaps be

equally achieved by another forcing, e.g. tidal/wave action?

Thanks for submitting this paper to ESurf, All the best, SC

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