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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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General Comments

This paper presents a well-thought out and novel reduced-complexity-model (RCM) predicting delta morphodynamic evolution and stratigraphy. The authors take great effort to identify the minimum physics necessary for capturing delta dynamics, and this elevates the research from simple model description to insightful science. As such the paper addresses relevant scientific questions within the scope of ESurf. Besides offering a useful tool to the community, the paper offers two important ideas. Firstly, it convincingly argues that delta systems are fundamentally different from other morphodynamic systems such as erosional landscapes, braided fluvial, and eolian dunes because of 3 factors: 1) deltas are a low-gradient gravity-driven system in which

water surface gradient and fluid inertia play a much larger role than say, erosional landscapes; 2) the low Froude Number of deltaic flows enables information from both upstream and downstream to propagate into the system; and 3) the macroscopic emergent behaviors of deltas can NOT be decoupled from the microscopic physics. Secondly, the authors point us towards the key processes and state variables that any model must accurately predict, such as bar growth at channel mouths, evolving backwater profiles in response to bar growth, both suspended and bedload fluxes, and cross-channel water surface slopes. These are substantial conclusions that follow from sound analysis.

Specific Comments

1. The model is tested by comparing its output against experimental and other numerical deltas, but the authors use words like "the resultant deltas. . ...are consistent with", and "our results give similar behaviors. . .", rather than a more rigorous comparison using metrics like number of distributaries, avulsion frequency, etc. It would be comforting to the reader to see some quantitative comparisons.

2. There are a great number of user-defined (and sometimes seemingly ad hoc) constants/parameters in this model, e.g.,$h_{dry}, \theta, \epsilon, \gamma, U_{ero},$ etc. It would be useful to comment on how many there are, and the logic you used to set the magnitude and ranges of each.

3. The amount of erosion and deposition of the bed by a sediment parcel is limited by certain criteria. Please explain the logic of the criteria and the specific magnitudes.

4. The model attempts to incorporate the effect of fluid momentum (inertia) in determining flow direction, but not in flow velocities. Also turbulent energy is not carried

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around so it can impede grain settling in cells where it would otherwise deposit. Can the authors comment on the magnitude of errors expected from these simplifications?

5. It would be helpful to include a table defining symbols, abbreviations, and units

Technical Corrections
1. p. 831/line 3: insert “an” after “carries.”
2. p. 831/line 6: Replace “And” with “Likewise.”
3. p. 831/line 7: insert “an” after “carries.”
4. p. 831/line 21: delete “s” on “interests.”

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