Earth Surf. Dynam. Discuss., 1, C454–C456, 2013
www.earth-surf-dynam-discuss.net/1/C454/2013/

Earth Surface Dynamics Discussions

Interactive comment on "Morphodynamics of river bed variation with variable bedload step length" *by* A. Pelosi and G. Parker

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Received and published: 26 December 2013

Comments from VR Voller on

"Morphodynamics of river bed variation with varibale bedload step length"

by A Pelosi and G Parker

This paper is excellent, making some significant advances in our understanding of non-local transport in sediment systems.

In particular this paper:

Offers an explicit and quantitative connection between physical behavior (particle stepping) and non- local transport.

Demonstrates that non-local transport does not require heavy tailed behavior.

Suggests a dimensionless value (epsilon) that can indicate the "strength" of non-locality related to the domain size.

Provides an alternative mechanism for explaining how to arrive at appropriate surface curvature predictions in experimental sediment transport systems.

It is to the last of these points where I have some comments and questions.

1. It seems to me that eq. 18 is based on the assumption of equilibrium yet it is ultimately used in non- equilibrium calculations. I suspect this is fine but it might require some explanation.

2. The results clearly illustrate the curvature modification of the landscape surface arising from the proposed non-local treatment. In the long-time equilibrium limit, however, I note the surface shape prediction match the local non-linear behavior. Is this always the case? Or is this just a feature of the by-pass example problem solved in the paper?

3. In regard to the above observation that under equilibrium conditions the non-local and local non-linear models coincide, it is worth noting that in a recent paper

F Falcini, E Foufoula-Georgiou, V Ganti, C Paola, VR Voller A combined nonlinear and nonlocal model for topographic evolution in channelized depositional systems Journal of Geophysical Research: Earth Surface 118 (3), 1617-1627

we show a similar result when using an alternative, fractional calculus based, non-local treatment. That is, in the study of an equilibrium deposition system, our predication of the land surface profile exactly matches that predicted by a local non-linear transport model.

However, when we apply our fractional calculus non-local model to the equilibrium by-pass system, essentially identical to the one studied in the current paper, we predict a concaved down profile for the land surface profile. Thus we see (predict) a signal of

non-locality in the equilibrium landscape.

In contrast in the non-local model proposed in the current paper, as we approach equilibrium in the system, it appears as if the nature of the non- locality adjusts in such a way to remove its signal in the landscape.

So as I see it there is a difference in the predictive outcomes between the non-local treatment based on particle step size distributions proposed here and those based on power-law thick tailed distributions and fractional calculus (presented in the JGR paper noted above)

At this point I find it difficult to argue for the validity of one approach over another. More research is needed. And as noted above the paper presented here makes significant steps toward this objective.

One small correction–on page 1105 line 22 I think the "beta" should be an "epsilon"

Interactive comment on Earth Surf. Dynam. Discuss., 1, 1097, 2013.