Earth Surf. Dynam. Discuss., 2, C432–C434, 2014
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Earth Surface Dynamics Discussions
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Interactive comment on "Erosional response of an actively uplifting mountain belt to cyclic rainfall variations" *by* J. Braun et al.

Anonymous Referee #3

Received and published: 1 October 2014

This manuscript uses the stream power model to explore the effect of cyclical variation in precipitation on fluvial erosion. The authors use three different numerical methods of addressing this question – an approximate analytical solution, a 1D numerical solution, and a 2D numerical solution, all of which show consistent a consistent relationship between the period of the rainfall variability and a time lag in the response of the system. The study is interesting, well-presented, and I think makes an important contribution. I think it is a good fit for ESurf and certainly worthy of publication. However, I do think that there can be improvement, particularly to the discussion. I'm going to approach from a somewhat different perspective than the other reviewers (as I think they've already made a lot of good points) and focus on some bigger-picture concerns. My main concern has to do with the connection from the stream power model world to the real world, particularly as the authors propose and demonstrate that their findings may be

applied to observed data. I appreciate the simplicity of the stream power model, I agree that modeling of a simple system can be very valuable, and I think that this study is a good example of the value of this approach. That being said, I would like to see more (any?) discussion of the factors that aren't included in the model, and how they might affect the response of the system - in particular, hillslope processes and sediment transport. As one of the other reviewers mentions, how might a transport limited system behave? What about a system that switches back and forth as the erosion rate increases and decreases? And what about hillslope erosion and contribution to sediment flux? A climate driven change in, say, the rate of landsliding may have a far bigger effect on sediment flux than a change in the fluvial erosion rate. I know that full answers to these sorts of questions are not what this paper is about, and I appreciate that. I'm not suggesting more analysis, but I would like to see some discussion that acknowledges and adds some thoughts about these sorts of effects. Again, if you are going to convince us that variations in the sediment flux calculated just from fluvial erosion are representative of variations in sediment delivery to the southern Bengal Fan, you need to discuss some of the missing complexity.

On a similar note, the manuscript is well written, and I found it easy to follow, but I'm used to thinking about the stream power equation and in terms of m and n. For a general audience, I would suggest some more explanation of what is going on in the system from a physical, instead of a mathematical, perspective. This is already done well in some places (ie pg. 978 lines 4-5 and 26-28), but there could be more. Things like: what's going on in the river as the waves of erosion propagate upstream, how the changes in erosion rate relate to changes in the long profile, or why the gain and time lag increase with increasing area dependence. The manuscript does a very good job presenting the math, but people not used to thinking in terms of math may not come away with a clear understanding of why the system behaves as it does.

Just a few line-specific comments:

Pg 974, 1-5: Can you refer us to any literature on variability in precipitation at Mi-

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lankovitch periods?

Pg 977, 9: What is “small”? and how does it compare to the variation expected in the Himalaya, since that’s the test case used.

Pg. 979, 12-13: So 10% is still small? What is the upper limit?

Pg 983, 5-6: what controls the propagation rate of the erosion rate wave?

Pg 984, 15-16: You should explain how εNd records erosional flux.

Interactive comment on Earth Surf. Dynam. Discuss., 2, 971, 2014.