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Earth Surface Dynamics Discussions

Interactive comment on "Catchment power and the joint distribution of elevation and travel distance to the outlet" *by* L. S. Sklar et al.

Anonymous Referee #1

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This study attempts to understand the joint distribution of elevation and travel distance to the outlet and explore how it varies across a few study catchments which remarkably differ with respect to the width function and hypsometric curve. The joint distribution of elevation and travel distance is then used to define indices of "source-area power" and "catchment power", with the hope to express how varying rates of water and sediment transport throughout different catchments can be expressed by such metrics. Finally, an empirical algorithm is suggested for generating synthetic source-area power distributions to explore the effects of topography on the water and sediment fluxes passing through catchments.

Specific comments:

1) In some parts of the paper, it is claimed that the proposed methodology can be

used to answer some specific questions. Here are the examples: - Lines 23-23 saying that the empirical algorithm for generating synthetic source-area power distributions can be used to explore the effects of topography on the water and sediment fluxes passing through catchments. - Lines 64-65 saying that do the distributions of elevation and travel distance to the outlet differ in ways that systematically reflect the factors that drive landscape evolution, such as weathering, climate, and tectonics? - Lines 71-73 saying that if the synthetic catchments are able to explore how factors such as area, relief, and profile concavity influence catchment power. Unfortunately, none of the above questions are addressed in this paper, except a few qualitative explanations.

2) In figure 1, do the given profiles correspond to the longest flow path in those catchments? Also what extra information does this figure provide in comparison to figure 4?

3) Lines 118-120 are not clear at all from figure 2. Authors might want to clarify it directly in the figure 2.

4) In lines 166-167, it is said that "the joint distribution plots generally show dense concentrations of data points at low elevations for any given travel distance". This is not definitely true based on the color bar given in figure 4d. For instance in the Providence Creek, very small concentrations of data points exist at low elevations over a wide range of travel distances less than 4000 m. Similar observation can be made for the Inyo Creek for travel distances less than 3000 m, except some high concentration data points spanning around travel distances of 1500 m.

5) In lines 169-171, it is said that "for a given travel distance, as elevation decreases, data point density generally increases to a peak and then quickly tapers to zero." Should not it be as elevation increases? At least all the plots (4c, 4e, 4f) show that for any given travel distance, the data point density goes to zero at the highest elevations (depicted by black colors).

6) In lines 171-172, it is said that "they also show that the density of paired values is

highest at 60 and 80% of the maximum travel distance". This is not true at all except for the Noyo River, while the statement is given in a general sense.

7) First of all, direct comparison of figures 3 and 4 is not easy as the horizontal axes show the same quantity, but different ranges (authors might want to make it consistent throughout the paper). Second, figure 3 shows that at the Noyo River, the majority of the area pertains to long travel distances and low elevations. Can the authors explain why this is not reflected in figure 4f where highly dense data points correspond to mid travel distances and relatively high elevations?

8) In lines 231-233, it is said that "in landscapes where rates of precipitation and erosion are spatially variable and sometimes correlated, we expect the distributions of power and mean slopes to differ". Then the Inyo Creek catchment is mentioned as an example of this case. But comparing figures 5 and 6a does not support this at all, i.e., the spatial patterns of "water" power and mean slopes are very identical to each other in this catchment. How do the authors explain this?

9) In figure 12, it seems that the hypsometric curves and width functions generated with the partially-synthetic formulation using actual profiles fits better to the real data than the fully-synthetic formulation using modeled profiles in the Noyo River. But the reverse is observed for the Providence Creek. Can the authors explain why the partially-synthetic formulation using actual profiles should not always result in better fitting?

Technical corrections:

Line 438: figure 11 instead of 10

Line 444: figure 11A instead of 10A

Line 456: figure 12 instead of 11

Line 477: figure 11 instead of 10

Line 478: figure 12 instead of 11

Line 482: figure 12a-b instead of 11a-b

Line 484: figure 12c-d instead of 11c-d

Line 486: figure 12c-d instead of 11c-d

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