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Earth Surface Dynamics Discussions
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Interactive comment on "The mass distribution of coarse particulate organic matter exported from an alpine headwater stream" *by* J. M. Turowski et al.

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See also the attached document.

Reply Review #1 Bruce MacVicar

We thank the reviewer for his comments. Below we give detailed replies and outline the changes made to the manuscript.

Use of the data from the Ain River: - We agree with the reviewer that it would be better to use the original data. However, in his analysis, the reviewer does not describe the statistical method he used in a lot of detail. We suspected that he used a logarithmic binning procedure, but did not normalize for bin width before calculating the scaling exponent, and this has subsequently been confirmed by the reviewer in personal communication. Accounting for bin width would in this case add -1 to the exponent, pushing it down to -1.8, similar to what we have observed at the Erlenbach.

6/21 – Why was an assumption of 5000 L/s made? Is there any justification for this assumption? What is the sensitivity of your results to this assumption? - The assumption was made based on long-term observations of the catchment. Flood events with peak discharges below 5m3/s export at most a few pieces of LWD (Fig. 1,2). Interestingly, in about 40 years of measurements we have not observed any flood events with peak discharge between about 5 and 9 m3/s, and only four exceptional events showed higher peaks (1984, 1995, 2007, 2010, see Turowski et al., 2009 and 2013). The results are not very sensitive to the assumption, i.e., the data points always plot close to the regression line. We have tried to clarify in the manuscript.

5/6 - In many rivers wood will float at the water surface and thus not be mixed in with the bedload at the bed surface. At an 18 - We actually measured how much of the wood floats, and the majority does not (about 2/3 by weight sink). We are not aware of any literature on this, so the statement that in many rivers wood floats is an assumption. We have collected additional data on this and will prepare a manuscript soon reporting our findings. Note that the vast majority of CPOM transported in the Erlenbach is not LWD and has typical dry weights of a few grams (Fig. 3). Logs delivered to the channel are often incorporated in the bed and gravel bedload will travel over it (Fig. 4).

8/20 – why were the data from the two extreme events not included? - The extreme events were excluded to show that the regression works well when extrapolated. The data are plotted log-log and since the extreme events lie far outside of the region where the other data sit, they would dominate the regression. In addition, the data from the extreme events are the least reliable (as is now explicitly discussed in the manuscript). The good fit gives some support of the plausibility of the extrapolation.

10/4 – bimodal assumption seems uncertain. Branches are more likely to break off than whole trees. Scaling would then be affected by distance from source. - The Erlenbach features active creep landslide complexes that regularly advect whole trees into the channel. We also expect that scaling is affected by the distance to the source, due to break-down of wood particles and changing channel-hillslope connectivity.

Conclusions – interesting to note that there is a possible similarity with other breakdown processes. Most familiar to me is the -5/3 slope on Kolmogorov's (1941, "Dissipation of energy in locally isotropic turbulence in an incompressible viscous liquid", Dokl. Akad. Nauk SSSR, 30, 299-303.) scaling law for turbulence as part of the energy cascade. Big turbulent structures beget smaller turbulent structures. The energy cascade used a reversed axis in comparison with the current work (smaller turbulent structures were to the right) and was measuring the amount of energy in each scale rather than the frequency. Paiement-Paradis et al.(2003, "Scalings for large turbulent flow structures in gravel-bed rivers", Geophysical Research Letters, 30(14), 1773) used conditional sampling to look for the frequency of events of different durations and plotted them in log-log space. They found similar scaling laws with exponents between = 1.44 to 1.82 for these type of events. - This is indeed interesting, but we are not quite sure what to make of it. Is the reviewer suggesting that turbulent structures break down woody debris during transport, and the resulting sizes are related to eddy size? This is an interesting hypothesis, but we deem it to be unlikely. We believe that gravel grinding is a more likely explanation for size reduction during transport. But a final answer to this question cannot be given at the moment.

Figure 2 – Should the relative count not add up to 1.0? How is the relative count determined if not by normalizing by the total number of wood pieces? - The units on the y-axis are essentially arbitrary. Since we used a logarithmic binning procedure, the count in each bin needs to be normalized by bin widths. Thus, the value is actually a density and needs to integrate to one, if correctly scaled. However, in the scope of the article this is irrelevant, since we are only interested in the slope of the curve.

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Interactive Comment

Minor 1/24 – leaves 1/24 – wood fragments over twigs – incorrect use of word ‘over’, meaning not clear 7/21 – ‘borne’ is past tense of ‘to bear’. Figure 8 – Piece length Figure 9 – I don’t think the values on the x-axis can be correct. See the figure included in this discussion for appropriate wood volumes. The caption says mass, so it is possible, in fact likely that the x-axis is mislabeled rather than the values. - We have corrected as suggested.

Please also note the supplement to this comment:
http://www.earth-surf-dynam-discuss.net/1/C57/2013/esurfd-1-C57-2013-supplement.pdf

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Fig. 1. Pictures of the retention basin after the flood event from the 4th July 2009 (on the left, picture taken on the 4th July 2009) with a peak discharge of 4990 l/s (upper gauge, 1-min. data).

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Fig. 2. Pictures of the retention basin after the flood event from the 20th June 2007 (on the right, picture taken on the 21st June 2007) with a peak discharge of 14560 l/s (lower gauge).

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Fig. 3. Typical CPOM pieces found in the basket samplers.

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Fig. 4. Log congestion in the Erlenbach channel, with a large log and smaller pieces incorporated into the stream bed.

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