

## ***Interactive comment on “Damage costs due to bedload transport processes in Switzerland” by A. Badoux et al.***

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Received and published: 15 October 2013

### General comment

The paper presents an estimation of bedload-related damages in Switzerland during a 40 yr period. Such an evaluation is indeed novel to my knowledge, and it demonstrates with actual figures how fluvial morphological processes may represent a substantial cost for society in mountain areas. The paper is well written and well structured, whereas data analysis could be improved in my opinion, as suggested in the following points.

### Specific comments

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- a) The distinction between bedload- and debris flows-related damages is key in this paper, but in my opinion is not sufficiently explained. Please clarify what “clues” (descriptive characteristics) you relied on. Also, what about the intermediate type of process commonly labeled as “debris flood”? Did you include it in the bedload category?
- b) it would be extremely interesting to analyze the role of wood in the bedload event. I don’t know whether this is feasible with existing database, but I suspect this could imply quite a work. Nonetheless, I think wood could have played a major role – in conjunction with channel aggradation – in bridge clogging, as evident from many floods elsewhere. The authors should at least present some qualitative discussion about it.
- c) the methodology to determine the lower and the upper estimate for bedload damages remains a bit unclear. As this issue represents the core of the ms, please provide more details for the different types of objects. Also, a brief description/analysis of the characteristics of the events/areas featuring casualties would be useful.
- d) The analysis of the “explicative” causes for variability in bedload costs (section 4.2) is in my opinion the weakest part of the ms. Rather than the average of the entire channel network within a basin, the average channel slope in the upstream proximity of the damaged areas (typically an alluvial fan or floodplain) should be used in my opinion. Otherwise high gradient values are obtained, well within the range of debris flows, with little significance to the actual process responsible for the damages. The information about the whole catchment steepness is better conveyed by the Melton number. The geological setting of the different subareas is not consider at all, and I think it should. Also, some more discussion about the influence of elevation should be added, describing whether sediment supply from glacial or permafrost origin likely played a role or not. The analysis of the role of precipitation should be enhanced by including parameters related to rainfall intensity for given recurrence intervals, possibly using regional depth-duration-frequency curves already available for Switzerland. All these additional variables should be analyzed statistically in more detail by means of

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multiple regression models, and possibly also by multivariate methods (e.g. PCA). This would greatly increase the international impact of the paper, otherwise too focused on the Swiss territory alone.

e) the section on bedload prediction in my opinion is not necessary in this paper, and I would delete it to make more room for the data analysis suggested above. It would only if contained an application of equations to some of the events with evaluation of their performance. Also, the relevance of macro-roughness correction discussed in the section bears limited benefit/sense (i.e. which boulders and bedforms would move and which not during a large flood ?) when predicting high magnitude flood events as the ones object of this paper.

#### Technical corrections

The term “torrent” in English suggests debris flow processes, whereas in the ms it is always used together with streams. I suggest to remove the term torrent and use “steep channels” or “steep streams”

p. 1482, line 2: sediment erosion rather than bedload erosion. Also elsewhere in the bedload erosion should be removed. Also “fluvial bedload transport” could become “bedload transport” throughout the ms

p. 1482, line 24: worldwide without hyphen

p. 1487, line 14: I don’t think the term “certainty” is the best here. Better “Reliability” or “Degree of confidence”

p. 1490: here or later it could be worth mentioning – even if it deals with a longer scale – the work by Schmocke-Fackel P, Naef F. 2010. Changes in flood frequencies in Switzerland since 1500. *Hydrology and Earth System Sciences* 14: 1581–1594

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Interactive comment on *Nat. Hazards Earth Syst. Sci. Discuss.*, 1, 4181, 2013.

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