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Comment

# ***Interactive comment on “Regional flood susceptibility analysis in mountainous areas through the use of morphometric and land cover indicators” by M. C. Rogelis and M. Werner***

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## GENERAL COMMENTS

This paper proposes a twofold approach to the characterisation of the susceptibility to debris flows in Colombia: an index that integrates morphometric catchment parameters and land use is developed and is combined with the results of a debris-flow propagation model.

Although affected by some problems (e.g. the selection of the morphometric parameters, discussed below), the approach is sound and potentially effective in classifying

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catchments based on the expected type and severity of hydrogeomorphic processes.

The paper, however, suffers from a major limitation, i.e. the lack of a convincing comparison of the susceptibility index with actual occurrence and type of hydrogeomorphic processes. Although the authors claim that “the distribution of flood records is well captured by the susceptibility index” (page 7567, lines 9-10), they admit that “The lack of information in the records of past floods in the area prevents a systematic characterization of the type of floods that occur in each watershed of the study area” (page 7573, lines 27-28). Data on the type of flood (streamflow or debris flow) were available only for three catchments: the agreement between predicted and observed catchment response for a so small number of cases does not permit any conclusion on the performance of the method proposed in this paper.

As a matter of fact, the lack of documents describing occurrence and characteristics of floods does not prevent the assessment of the hydrogeomorphic response of a catchment: geomorphological and sedimentological field evidences, sometimes referred to as “silent witnesses” (Aulitzky, 1982) can provide information suitable to recognize the occurrence of debris flows, hyperconcentrated flows and water floods, even at distance of several years from event occurrence. Most of the papers aimed at the differentiation of debris-flow catchments from fluvial catchments cited in the introduction and in the section 2.2.1 of this paper did not rely on archive documents, whereas they were based on field recognition of past floods and debris flows. Field evidences suitable for differentiating debris flows from water floods have probably been obliterated in urbanized catchments near Bogotá, but these evidences could be found in other regions, especially where low density of population is associated to the absence of documental flood records (e.g. upper Tunjuelo River basin, page 7567, lines 2-4). Of course, the recognition of hydrogeomorphic processes from geomorphological and sedimentological evidences at the spatial scale of this study requires systematic field work and cannot be performed by means of GIS analysis and remote sensing techniques.

The authors briefly mention the issue of data availability and the time required for field

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observation at page 7551 (lines 25-29). The development of the predictive method has been possible even with limited data on flood and debris flows observed in the study area, but failure in validating the devised susceptibility index by means of evidences of catchment response undermines the scientific relevance of the paper.

Another issue that would have deserved more attention is the choice of the parameters for the development of the morphometric indicator. Some of the parameters listed in table 1 describe similar catchment characteristics, and one could argue that they are closely correlated. As an example, does it make sense to use in the same equation (eq. 3) watershed length and main stream length? The same observation could apply to the shape factors SF, C, E and LW in eq. 2. The paper does not clarify if a preliminary analysis aimed at a sound selection of morphometric parameters has been carried out.

As the main objective of the study is to recognise the possible occurrence of debris flows, the title “Regional flood susceptibility. . .” is misleading and could be replaced by “Regional debris-flow susceptibility”.

## SPECIFIC COMMENTS

The term “energy” has been used to describe one of the classes of morphometric variables that explain occurrence and delivery of debris flows. As no explicit assessment of the energy involved in the transport processes has been performed, it should be clarified, also in the abstract, that some morphometric parameters have been used as indicators of the potential energy associated to elevation differences within the catchments.

The text from page 7555, line 23 to page 7556 line 4 provides some very general comments on the conditions required for debris-flow occurrence: this part of the text could be omitted as these concepts are well-known to the readers of NHESS interested in floods and debris flows. The reference to Sanchez-Marre et al. (2008) at page 7556, lines 2-4 requires a comment. The statement: “prerequisite conditions for debris flows include an abundant source of moisture (rainfall or snowmelt) and sparse vegetation”

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is from a well-known paper by Costa (1984, page 269): the original work should be cited. Moreover, the reference to Sanchez-Marre et al. (2008) is wrong: the authors of the paper referred to in the references list are Salvetti et al. (2008); M. Sànchez-Marrè, J. Béjar, J. Comas, A. Rizzoli and G. Guariso are the editors of the volume.

In the introduction and in the section 2.2.1, the authors cite a number of papers dealing with the differentiation of debris flow, hyperconcentrated flow and flood catchments by means of morphometric parameters, but, surprisingly they do not mention the pioneering study by Jackson et al. (1987) in the Canadian Rocky Mountains. Another paper that deserves to be considered has recently been published by Bertrand et al. (2013): it combines datasets from several previous studies and performs linear discriminant analysis and logistic regression to differentiate debris-flow catchments from fluvial catchments.

The discussion on the slope-area diagram (page 7558) is not clear and the reader could find it difficult to recognise the sectors corresponding to hillslopes, unchanneled valleys, debris-flow dominated channels and alluvial channels.

At the pages 7561 (line 24) and 7562 (lines 7 and 8), the authors cite three times a paper published in a recent multi-author book. These cites do not focus on new findings: they remind, in a very general way, the protective role of vegetation and the increase of runoff and slope instability caused by deforestation. Such general observations, which could be found in many handbooks of hydrology and geomorphology, are probably unnecessary in this paper.

The paper cited as “Santos (2006)” was actually authored by R. Santos and R. Menéndez Duarte.

## REFERENCES

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