Geophysical Research Abstracts
Vol. 14, EGU2012-9865, 2012
EGU General Assembly 2012
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Regional scale analysis of the topographic signatures of landslide/debris flow dominated processes

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The morphology of alpine headwater basins is strongly influenced by erosion processes. The relationship between landforms and erosion processes has been analyzed based on the relationship between slope and drainage area (Montgomery and Foufoula-Georgiou, 1993), because among parameters derived from a DTM (Digital Terrain Model), slope and drainage area are deemed to be pertinent for studying overall erosion dynamics. Thanks to LiDAR and high resolution topography now is possible to reach a better representation of hillslope morphology, and then recognize in detail the topographic signature of valley incision by landslides and debris flows (Tarolli and Dalla Fontana, 2009). In this work we present a tentative of a regional scale analysis of such signature. In the analysis we derived the slope-area relationship using high-resolution DTMs with 2.5 m cells derived from LiDAR (Light Detection and Ranging) data. We considered 23 catchments, characterized by soil-mantled landscape, and where several debris flows occurred in the year 2009. The results showed that in 83% catchments the topographic signature of debris flow processes is clearly present, while in the remaining catchments only hillslopes, unchanneled valleys and alluvial channels regions are recognized. The slope-area relationships of few catchments where no debris flows were observed during 2009 events, nor reported in the historical database, were then analyzed. For these basins the slope-area relationship does not evidence the topographic signature of debris flow processes. According to these results the presented methodology really can help for a right preliminary analysis and classification of alpine catchments based on their dominant geomorphological processes. The methodology should be used for a first and quick interpretation, in support to field surveys and more complex physically based modeling analysis.

References

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