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Debris-flow frequency and dynamics of an Alpine catchment during the past 150 years, the Schimbrig drainage basin, Central Switzerland

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This paper focuses on links between landsliding and debris-flow activity in a ca. 4 km2-large drainage basin located at the northern foothills of the Central Swiss Alps. Debris-flow frequency of the recent past was reconstructed using dendrogeomorphic methods. In addition, the source area was mapped in detail to assess the spatial distribution of landslides, and to determine the connectivity between hillslopes and the channel network.
The geomorphic map indicates that the hillslopes host abundant landslides sourced in Paleogene Flysch and Molasse sandstone-mudstone alternations. Major differences in the landscape architecture between the eastern and western sides were identified. In particular, the eastern segment is characterized by a >300'000 m2 large earth flow (Schimbrig landslide) that is 5-10 m deep. This flow experienced a phase of high slip rates >2m day-1 between September 1994 and May 1995, transferring a total of 350'000 m3 of material. In contrast, the western side is characterized by a network of deeply incised channels (>50 m) bordered by hillslopes that host landslides that generally measure <15'000 m2. On these hillslopes, the downslope transfer of sediment is dominated by soil creep or by rotational and translational slip.
The depositional fan at the outlet of the catchment has an approximate size of 50'000 m2. The surface is characterized by levees, lobes and channels and is covered by a conifer forest comprising spruces (Picea abies (L.) Karst.) and firs (Abies alba Mill.). A total of 325 increment cores were sampled from 162 trees obviously influenced by past debris-flow activity. Preliminary analysis of the tree samples indicate that 64% of the tree grew up between 1900 and 2009. 34% of the tree samples showed germination dates between 1800 and 1900, and the remaining 2% of the sampled specimens germinated before 1800. Dendrogeomorphic analyses depict that nearly 50% of the sampled trees were affected by debris-flow activity in the 1990s. This period of high activity might be related to enhanced sediment transfer to the river system in response to the high slip rates of the Schimbrig earth slide between 1994 and 1995. Other periods of enhanced debris-flows activity seem to have occurred around 1960, 1950, 1940 and at the end of 19th century.