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Channel activity of debris flows on forested cones – a case study using dendrogeomorphology

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Debris flows are a major threat in many parts of the Alps, where they repeatedly cause severe damage to infrastructure and transportation corridors or even loss of life. So far, studies on the process mainly focused on flow behavior and rheology or on the assessment of threshold values for the triggering of events. In a similar way, the magnitude and frequency of debris flows have repeatedly been reconstructed or the moment of past activity assessed. However, the spatial behavior of past debris-flow activity and the analysis of areas affected during particular events have been widely neglected so far.

It was therefore the purpose of this study to reconstruct spatio-temporal patterns of past debris-flow events on a forested cone in the Swiss Alps (Bruchji torrent, Blatten, Valais).

The analysis was based on a detailed geomorphic map (1:1'000) of all forms related to debris-flows such as lobes, levees and abandoned flow paths as well as on tree-ring series from 401 trees (*Larix decidua* Mill. and *Picea abies* (L.) Karst.) growing on the deposits. The geomorphic map served as a basis for the sampling of injured trees and helped positioning them on the map. The samples were analyzed and growth disturbances related to debris-flow activity - such as rows of traumatic resin ducts, the onset of reaction wood or abrupt growth decrease or increase - assessed.

In total, 960 growth disturbances were identified in the samples, belonging to 39 different event years between 1867 and 2001. In addition, the coupling of tree-ring data with the geomorphic map allowed spatial representation of reconstructed event years.

The results clearly show that before the 1940s, debris flows used seven channels located on the western part of the cone. In contrast, debris flows started to affect the eastern part of the cone in the 1940s. In addition, different protection measurements nowadays prevent debris flows from reaching the western part of the cone.

As a considerable number of trees are normally affected during particular events and deposits left on the cone are relatively scarce, we believe also that debris-flow events normally have a high water content.