



Snow avalanche synchronicity detected by a multi-path tree-ring based approach in the Făgăraș Mountains, Southern Carpathians

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Snow avalanches are natural hazards prepared and triggered by a combination of climatic and topographic features. Efficient management of snow avalanche related hazards and risks requires knowledge on past occurrences. Unfortunately, in many mountain regions of the world, archival records on past snow avalanches are scarce, generally focusing on events which caused victims or extensive damage. This is also the case of the Southern Carpathians, a region with continuously growing winter tourism. To overcome this lack of information, natural archives such as tree-rings are very useful in providing proxy data on the past occurrences of snow avalanches and other geomorphic processes.

The present study is a tree-ring based approach which aims at reconstructing the snow avalanche regime in the Făgăraș Mountains, Southern Carpathians. The study uses information extracted from a total number of 933 *Picea abies* trees growing on 17 snow avalanche paths located in the central-northern part of the Făgăraș Mountains. The multi-path approach, with a high number of different individual sites, is quantitatively unique in the dendrogeomorphic literature, and provides a high-resolution century-long avalanche reconstruction at local scale. The results reveal a mean return period of 4,5 years for major avalanche events in the region. Several years show high inter-path synchronicity. In 1988, 1997 and 2005, 80% of the analyzed paths experience major events, and more than 50% in 1967, 1992 and 2002. Reviewing the dendrogeomorphic literature this situation is rather unusual. However, the similar topographic and climatic settings of the analyzed paths advocate for a synchronous behavior of avalanches. In addition, the results of several other studies undertaken in various mountain ranges of the Southern Carpathians (Parâng, Bucegi, Șureanu, etc.) show that major event years identified in Făgăraș are present in other regions of the Southern Carpathians as well. This suggests a common climatic trigger or specific synoptic conditions favoring major snow avalanche events in a larger region. The identification of such conditions would be of utmost importance to update the risk management in areas with intense winter tourism activities, hiking or off-piste skiing.