



## **Spatial analysis of rockfall activity, bounce heights and geomorphic changes over the last 50 years**

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Tree-ring analyses have been used to reconstruct 50 years of rockfall behavior on an active rockfall slope near Saas Balen (Swiss Alps). A total of 796 cores and 141 cross sections from 191 severely injured conifer trees (*Larix decidua* Mill., *Picea abies* (L.) Karst. and *Pinus cembra* L.) combined with a series of aerial photographs were taken to investigate the evolution of the forest stand so as (i) to reconstruct past rockfall rates and (ii) to analyze the spatial behavior of maximum bounce heights as well as the spatial compartment of rockfall activity over the last five decades. Detailed examination of the aerial photographs furthermore allowed identification of one major rockfall event between 1958 and 1968.

Tree-ring analysis permitted the reconstruction of the age distribution at the study site; results were perfectly confirmed by the afforestation process pictured by the aerial photographs. Oldest trees thus grow in the lower central part of the study site, youngest individuals at the uppermost lateral boundaries. Reconstructed rockfall rates reveal strong inter-annual variations with single event years with increased activity, namely in 1960/1961 and 1995. Spatial analysis of the maximum bounce heights indicate additionally higher values at the lateral boundaries and lower heights in the lower central part of the forest stand, where a big boulder seems to shield trees growing underneath. The spatial analysis of past rockfall activity finally shows high-active zones at the uppermost north facing boundaries of the forest and least active zones in the lowermost central part of the studied stand. The high rockfall activity at the slope is expressed by a mean recurrence interval of only 9 years per meter and of less than 2

years per meter in the most active areas.