EGU2020-10058, updated on 05 Jan 2021
https://doi.org/10.5194/egusphere-egu2020-10058
EGU General Assembly 2020

Snow avalanche activity above Innsbruck, Austria: a dendrogeomorphological approach

Nuria Guerrero-Hue[1,2], Michaela Teich[2], Kurt Nicolussi[3], Thomas Pichler[3], Marc Adams[2], Christian Scheidl[1], and Jan-Thomas Fischer[2]

[1]Institute of Mountain Risk Engineering, University of Natural Resources and Life Sciences (BOKU), Peter-Jordan-Strasse 82, 1190 Vienna, Austria

[2]Department of Natural Hazards, Austrian Research Centre for Forests (BFW), Rennweg 1, 6020 Innsbruck, Austria

[3]Department of Geography, University of Innsbruck, Innrain 52f, 6020 Innsbruck, Austria

Snow avalanches are natural disturbances that can cause substantial damage to forests, and endanger people and material assets. Knowledge of past avalanches is crucial for forest management and planning technical mitigation measures. Dendrogeomorphology can provide information on previous disturbances, for example tree damages, caused by avalanches in forested terrain. By analysing the past growth of trees, both temporal and spatial reconstructions of the avalanche activity in forests are possible.

We use a dendrogeomorphological approach to study the past avalanche activity on an avalanche path above the city of Innsbruck in Austria. The area is of high importance for recreation (e.g. hiking, biking and skiing) as well as avalanche mitigation. Protection forest and technical protection measures are already in place (breaking mounds, catching and deflection dams) and frequently interact with avalanches. In January 2019, an avalanche with a destructive size of 3 - 4 released above the Arzler Alm mountain hut and caused considerable damage to approx. 25 ha of forest. This event provided us with the opportunity to conduct the present study. We sampled 104 trees along three longitudinal transects at elevation bands of 1200, 1100 and 1000 m a.s.l. covering the damaged area. We furthermore applied a selective sampling scheme below the forest damage along a gully where avalanches that reached the city of Innsbruck had previously been observed. Using an increment borer at least two cores per tree were taken from damaged and undisturbed trees. A mixture of conifers and broadleaved trees (mostly *Picea abies* (L.) Karst, *Fagus sylvatica* L. and *Abies alba* Mill.), as well as old and young trees was selected. In addition, we recorded the exact position of each tree and measured several tree parameters (e.g. diameter at breast height, tree height, damage description). Each core was then prepared following a standard dendrochronological procedure. Tree-rings were counted and ring-width was measured using a stereo microscope and a time-series analysis program (TSAP Win). Additionally, a visual detection of growth reactions (traumatic resin ducts, reaction wood, scars, callus tissue, growth suppression or releases) was performed, and tree-ring series were cross-dated and compared with local reference chronologies. Years with tree-rings showing growth anomalies potentially caused by ecological or climatic factors were discarded as possible avalanche years.

Going forward we will compare years with major avalanche events identified by the dendrogeomorphological analysis, with existing extensive archival data and orthophotos. We expect this to confirm known events, but also to provide new information on unknown events. Based on the location of sampled trees, we will furthermore reconstruct the spatial extent of past events to estimate magnitude and frequency of avalanche activity in the area. Our results will also contribute to better predicting size and periodicity of future avalanche events and revealing potential changes in the avalanche regime. This in turn is relevant to calibrating and validating avalanche simulation models as well as for the design of technical and silvicultural protection and mitigation measures, which is especially important for an Alpine city like Innsbruck.