Tracking of snow-avalanche activity with tree rings in Chornohora (Ukrainian Eastern Carpathians)

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The steep slopes of Chornohora (Ukrainian Eastern Carpathians) are prone to snow avalanche activity due to favorable topo-climatic conditions. As in the last decades tourism activities in the area are continuously increasing, tourists and related infrastructure became exposed to different levels of risk, especially during winter seasons with snow-avalanche occurrence. Our study is a first attempt to test the potential of tree to record in their growth rings the information regarding the past snow avalanche activity in the area. In a first step, spatial distribution of snow avalanche paths was mapped firstly on orthophotoplans and topograpic maps, then checked in the field and the data collected was integrated in a database for subsequent GIS analysis of the morphometric characteristics of the paths. An avalanche path located on the north-eastern slope of the Hoverla Peak (2061 m a.s.l.) was chosen for tree-ring investigations. In this sense, Norway spruce (*Picea abies* (L.) Karst.) trees with clear signs of external disturbances (tilted, decapitated, uprooted and/or wounded trees) were sampled using a Pressler increment borer. Additionally, undisturbed trees growing nearby outside the avalanche path were sampled, in order to build a local reference chronology which serves for cross-dating with the individual chronologies of disturbed trees. The tree-growth anomalies resulted as a consequence of the mechanical impact produced by snow avalanches on stems (e.g. scars, traumatic resin ducts, compression wood and growth suppression sequences) were identified within tree rings and served to reconstruct past snow-avalanche events. The frequency and spatial extent of past snow-avalanche activity reconstructed with tree rings provided the most consistent avalanche event chronology in the study area. It may further serve cu obtain an accurate hazard zonation. A better knowledge of snow–avalanche history which may be gained through tree-ring reconstructions represent nonetheless useful information to consider before the development of tourism activities and related infrastructures in this mountain avalanche–prone area.

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