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Morphometric and meteorological controls of snow avalanche distribution and activity at hillslopes in steep mountain valleys in western Norway

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Snow avalanches are common phenomena in Norway due to the interactions between the prevalent climatic factors and local topography. Research on snow avalanches provides insights into possible effects of predicted climate change on avalanche activity and connected sediment transport in mountain areas. This study focuses on (i) controlling factors of avalanche distribution and activity, and (ii) their relative importance regarding mass transfers in two steep, parabolic-shaped and glacier-connected tributary valleys (Erdalen and Bødalen) in western Norway. Mapping of distribution, extension and run-out distances of avalanches is combined with spatial data analysis of morphometric controls. Based on correlation of climate data with monitored avalanche events the timing and frequency of avalanches is explored and debris mass transfer on hillslopes caused by avalanches is estimated.

The denudative effect of snow avalanches occurs in two steps: firstly throughout erosion directly on the surface of the rockwall and secondly due to their transport ability which causes significant remobilization and transport of available debris further downslope. The spatial distribution of snow avalanches depends on the valley orientation, slope aspect and rockwall morphometry. Especially distinct laterally convex-shaped leeside upper rockwall areas allow a high accumulation rate of snow during winter which is then released as avalanches during spring. The timing and frequency of avalanches in both valleys depend mainly on snowfall intensity, periods with strong winds combined with a stable wind direction or sudden air temperature changes. Snow avalanche activity leads in some valley areas to significant hillslope-channel coupling because debris is transported far enough by avalanches to reach channels.

Snow avalanches represent one of the dominant denudational processes and have a high relative importance regarding mass transfer within the sedimentary budgets of the entire valleys.