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Environmental controls and geomorphic importance of an extreme snow avalanche event in a steep mountain catchment (Bødalen) in the inner Nordfjord in western Norway

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Due to the existing interactions between the prevalent climatic factors and the local topography snow avalanches are common phenomena in western Norway. Compared to annually occurring regular snow avalanches, so-called "extreme snow avalanche events" are more difficult to monitor and to study as they are characterized by recurrence intervals often longer than a decade. During the winter-spring period 2011/2012 an extreme snow avalanche occurred within the upper valley part of a steep and glacier-connected mountain catchment (Bødalen) in western Norway.

Morphometric and meteorological controls of this high-magnitude/low-frequency snow avalanche event, its geomorphic effects as well as its related relative role in mass transport compared to the annually monitored snow avalanche activity within the Bødalen catchment were explored. Maximum values of snow height, velocity and pressure were predicted by applying a numerical run-out simulation. The formation of this snow avalanche resulted from the combination of extraordinary meteorological conditions and a favourable morphometric setting of the source area. The snow avalanche path covered a total distance of 2900 m, including a stretch of 850 m where the snow avalanche slid downwards on top of the Bødalsbreen outlet glacier. Within the run-out zone, directly located in front of the Bødalen outlet glacier, 2032 stones with b-axes > 5 cm were remobilized which corresponds to a total transferred debris mass of 460 t.

Compared to annually occurring snow avalanches within the Bødalen drainage basin the relative importance of extreme-sized snow avalanches is comparably low with respect to direct erosion and sediment transfer along rockwalls at higher slope areas. However, extreme-sized snow avalanches play a significant role with respect to the remobilization of debris/sediment at lower slope areas. This kind of events can also cause recognizable transfers of debris into the main stream channels of the drainage basin system at locations where extreme snow avalanches reach the main channel. The obtained results point out that this kind of extreme events must clearly be considered within studies of drainage basin sedimentary budgets.