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Magnitude-frequency characteristics and preparatory factors for debris slide activity in the Northern Faroe Islands

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The Faroe Islands in the North Atlantic Ocean are highly susceptible to rainfall-induced debris slides developing into debris avalanches and debris flows, as defined by Hungr et al., (2001). When debris avalanches and debris flows reach valley bottoms, they constitute a threat to human lives and interests in the Faroese society, since buildings and infrastructure are generally located here. To provide data for a newly started landslide risk assessment project in the Faroe Islands, this study aims at quantifying debris slide magnitude and temporal occurrence as well as identifying which preparatory factors are responsible for spatial debris slide distribution in the landscape. A multi-temporal landslide inventory is created for the analysis, covering a 159km2 study area in the Northern Faroe Islands. The inventory is compiled from aerial photo interpretation (API), fieldwork and anecdotal sources containing information on 219 debris slides on the three islands Borðoy, Kunoy and Kalsoy from the time period 1958 to 2009. The Faroe Islands is a unique setting to compile landslide inventories since trees are absent and slow biological processes keep landslide scars clearly visible for several decades. A magnitude-frequency (MF) relationship, with magnitude expressed as debris slide scar area, and a resulting power-law function is derived to predict magnitude dependant debris slide frequencies. The MF relationship is tested against the Double-Pareto distribution (Stark and Hovius, 2001) and debris slide frequency developments during the 51 year study period are analyzed. Preparatory factors responsible for spatial debris slide distribution are quantified through GIS-supported Discriminant Function Analysis (DFA), with 5 x 5m grid cells as slope units. Nine geological (lithology, dip angle), geomorphological (slope angle, slope height, slope aspect, plan and profile curvature) and land use factors (infield/outfield, sheep grazing intensity) are included in the multivariate analysis. Preliminary results from the MF analysis show that debris slide events larger than 100m2, representing 49% of the events, can be predicted from the power-law function: freq=788.5*area-1.25, r2=0.98. The detected roll-over point and largest observed debris slides ($\sim$ 2000m2) are small compared to similar studies and reveal a limitation in debris slide magnitude caused by local geomorphology. Overall debris slide frequency has increased during the 51 year study period from $\sim$ 3.3 debris slides/year (1951-1999) to $\sim$ 5 debris slides/year in the latest decade. Final results will provide important data to predict debris avalanche and debris flow occurrence in the Faroe Islands.

References

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