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Influence of snow cover on location and extension of avalanche release areas

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Location and extent of release areas are a crucial input in avalanche dynamics modelling, as they determine together with fracture depth the initial volume of an avalanche. Presently, avalanche release areas and locations are directly derived from geomorphological parameters but results are not always satisfactory. To improve existing algorithms, in the operational programme 'Italy-Switzerland, project STRADA', we assume that the spatial variability of the snow cover change the terrain morphology, and thus can have an influence on extension and location of avalanche slabs. One aim of this project is to provide a better understanding of this influence and to ultimately improve algorithms for automatic detection of avalanche release areas.

In the starting zone of an avalanche, a rather homogeneous snow distribution is required to allow the formation of continuous weak layers and slabs which both favors fracture propagation und thus determines the size of the release area. By calculating the surface roughness, we believe to capture this homogeneity notion.

To investigate how different snow cover scenarios may change the surface roughness, we used three different sets of snow depth measurements performed by airborne laser scanning at the Swiss Vallée de la Sionne test site. The data sets are characterized by average snow depths ranging from 1m to 3m. For one scenario, 5 avalanches were artificially triggered and an additional laser scan was performed after the releases.

We show that surface roughness progressively decreases with increasing snow depth up to an average snow depth of about 1-1.5m. Only little differences in roughness are observed if the mean snow depth exceeds this value. Furthermore, we show that release area extent increases with decreasing roughness. In the same manner, slab homogeneity increases with increasing release area extent and thus decreasing roughness.

These findings demonstrate the power of roughness to determine avalanche release area size. The integration of roughness in combination with information about the current snow depth distribution is thus of great potential to improve the avalanche release definition.