SPATIAL VARIABILITY OF SNOWPACK PROPERTIES ON SMALL SLOPES

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The spatial variability of alpine snowpacks is created by a variety of parameters like deposition, wind erosion, sublimation, melting, temperature, radiation and metamorphism of the snow. Spatial variability is thought to strongly control the avalanche initiation and failure propagation processes. Local snowpack measurements are currently the basis for avalanche warning services and there exist contradicting hypotheses about the spatial continuity of avalanche active snow layers and interfaces. Very little about the spatial variability of the snowpack is known so far, therefore we have developed a systematic and objective method to measure the spatial variability of snowpack properties, layering and its relation to stability. For a complete coverage, the analysis of the spatial variability has to entail all scales from mm to km. In this study the small to medium scale spatial variability is investigated, i.e. the range from centimeters to tenths of meters. During the winter 2000/2001 we took systematic measurements in lines and grids on a flat snow test field with grid distances from 5 cm to 0.5 m. Furthermore, we measured systematic grids with grid distances between 0.5 m and 2 m in undisturbed flat fields and on small slopes above the tree line at the Choerbschhorn, in the region of Davos, Switzerland. On 13 days we measured the spatial pattern of the snowpack stratigraphy with more than 110 snow micro penetrometer measurements at slopes and flat fields. Within this measuring grid we placed 1 rutschblock and 12 stuffblock tests to measure the stability of the snowpack. With the large number of measurements we are able to use geostatistical methods to analyse the spatial variability of the snowpack. Typical correlation lengths are calculated from semivariograms. Discerning the systematic trends from random spatial variability is analysed using statistical models. Scale dependencies are shown and recurring scaling patterns are outlined. The importance of the small and medium scale spatial variability for the larger (kilometer) scale spatial variability as well as for the avalanche formation are discussed. Finally, an outlook on spatial models for the snowpack variability is given.