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Automated detection and analysis of gliding snow

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Full-depth avalanches caused by snow gliding are a particular type of wet-snow avalanches. Many observations have shown that a thin wet layer reduces friction between the snow-soil interface before a glide crack or complete failure occurs. The occurrence, however, of glide cracks and their evolution to a full-depth glide ava-lanche are still poorly understood. Permanent monitoring of glide cracks is an essential step towards glide avalanche risk assessment. The aims of the presented work are (1) to develop an algorithm for automated glide crack detection and mapping, and (2) to gather more information about the main triggering factors leading to glide avalanches. We tested two approaches for automated detection of glide cracks using very high spatial resolution satellite images (WorldView-1). The first approach combined GIS and statistical modelling techniques; the second one included an object-based image analysis. In addition, we installed two automatic weather stations nearby two slopes which are known to often produce gliding-snow events. The stations recorded meteorological parameters, but also volumetric liquid water content and water potential at the snow-soil interface. Two automated cameras were installed to monitor glide-snow avalanche occurrence. The panchromatic WorldView-1 images with a spatial resolution of 0.5 m were suited to identify glide cracks, however, with coarser spatial resolution (>1 m) detection was not possible. The object-based image analysis approach worked as well and seems to be the more practicable approach in terms of computation rate and general applicability. Some problems with misclassifications existed, in particular in snow-free areas and open forest stands. Gliding-snow activity was weakly related with air temperature, especially during events early in the winter when large parts of the snowpack can still be dry and well below 0°C. In most cases, only the layer above the soil was wet. The water potential decreased rapidly shortly before high gliding-snow activity, while the water content increased towards the events suggesting a ponding of water due to different percolation characteristics at the snow-soil interface. The evolution in water potential and water content, however, cannot be related with a failure below the open crack. Here other properties such as terrain roughness or terrain breaks may play a major role.