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Snow process monitoring in mountain forest environments with a digital camera network

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Snow processes are important components of the hydrologic cycle in mountainous areas and at high latitudes. Sparse observations in remote regions, in combination with complex topography, local climate specifics and the impact of heterogeneous vegetation cover complicate a detailed investigation of snow related processes. In this study, a camera network is applied to monitor the complex snow processes with high temporal resolution in montane forest environments (800-1200 m a.s.l.) in southwestern Germany. A typical feature of this region is the high temporal variability of weather conditions, with frequent snow accumulation and ablation processes and recurrent snow interception on conifers. We developed a semi-automatic procedure to interpret snow depths from the digital images, which shows high consistency with manual readings and station-based measurements. To extract the snow canopy interception dynamics from the pictures, six binary classification methods are compared. MaxEntropy classifier shows obviously better performance than the others in various illumination conditions, and it is thus selected to execute the snow interception quantification.

The snow accumulation and ablation processes on the ground as well as the snow loading and unloading in forest canopies are investigated based on the snow parameters derived from the time-lapse photography monitoring. Besides, the influences of meteorological conditions, forest cover and elevation on snow processes are considered. Further, our investigations serve to improve the snow and interception modules of a hydrological model. We found that time-lapse photography proves to be an effective and low-cost approach to collect useful snow-related information which supports our understanding of snow processes and the further development of hydrological models. We will present selected results from our investigations over two consecutive winters.