



## **Forecasting the snowfall limit for pre-alpine areas – Towards a better preparedness to extreme flood events**

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The snowfall limit has important implications for different hazardous processes such as flash floods or rain-on-snow (RoS) events. Particularly in alpine and pre-alpine areas, such floods are expected to increase in the near future. However, in these areas, the estimation of the snowfall limit remains challenging. In this study, we investigate operational approaches to estimate the snowfall limit at different temporal and spatial scales. Regarding the monitoring, we show that the interpolation of surface temperatures tends to overestimate the altitude of the snowfall limit and can thus lead to highly uncertain estimates of the precipitation type. To reduce systematic error, we perform a bias correction based on local micro rain radar and disdrometer measurements and demonstrate the benefit of such measurements for hydrological purposes. A similar correction is also proposed for the Integrated Nowcasting through Comprehensive Analysis (INCA) system, which provides estimates of the snowfall limit up to 6 h ahead. Finally, we explore the medium-range forecasting of RoS events by coupling global weather models of the European Centre for Medium Range Weather Forecasts (ECMWF) with a conceptual hydrological model. This model chain is calibrated in two progressive stages using estimates of snow covered area, local snow height measurements, and discharge. We show that valuable disposition warnings for RoS event can be issued several days ahead, and we illustrate this idea with a case study. We conclude that local measurements are important for improving the estimation of the snowfall limit at different temporal and spatial scales and for increasing preparedness to risk situations.