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Understanding snow deposition on mountain slopes

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Snow water storage in the mountains is vital for summer water supply in many areas of the world and snow deposition determines the avalanche danger. While mountain snow covers have been investigated for many decades, we only now have the technology to measure high resolution snow distribution in steep terrain. High resolution airborne and terrestrial LASER scanner data are used in this contribution to assess snow distributions in two high Alpine catchments. For the first time, multiple measurements during the accumulation phase are analyzed. The measurements show that sub-areas in the investigation have persistent inter- and intra-annual accumulation patterns, which differ from area to area. These observations motivate the use of simple parameters of terrain exposure to predict accumulation patterns. The Winstral parameter showed a locally high predictive skill, provided a good knowledge on local wind direction is available, which can be found from measurements or simple parameterizations. For a more detailed investigation of physical processes, three-dimensional flow fields are needed. Detailed wind fields are created with an atmospheric numerical model (ARPS) and used to drive the physical process description of snow deposition in the numerical model Alpine3D. The numerical simulations with a grid resolution of 5 m show that snow redistribution (in particular saltation) lead to the formation of inhomogeneous snow distributions in a particular slope in the form of drifts, while homogeneous deposition of snow is achieved through preferential deposition in other slopes. These results help to understand that typical assumptions on altitudinal precipitation gradients appear to poorly represent real snow distribution.