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Ten years of mass balance observations at Langenferner - meteorological controls and regional representativity

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Langenferner is a small valley glacier in the Ortles-Cevedale Group, Northern Italy. Since the hydrological year 2003/04 Langenferner has been subject to detailed glaciological observations performed by the University of Innsbruck in close collaboration with the Hydrographic Office of the Autonomous Province of Bozen. The investigations comprise snow accumulation measurements in spring and consequently the calculation of the winter balance, as well as traditional ablation stake readings and accumulation pit analyses for the annual net surface mass balance.

Additionally, data from three airborne laser scanning (ALS) campaigns were used to calculate the geodetic mass balance of the glacier during two multi year periods. A comparison of geodetically derived mass changes to the direct glaciological method revealed a generally good accordance between the two methods. Multitemporal ALS-data from numerous glaciers in the Ortles-Cevedale Group and the neighboring southern part of the Ötztal-Alps were used to evaluate the regional representativity of the mass balance program at Langenferner. It was found that Langenferners mass balance is more negative than the regional mean.

The strong mass loss of the glacier during the observation period (2004 – 2013) was analyzed using a high resolution state-of-the-art mass and energy balance model driven with data from seven automatic weather stations (AWS) in the vicinity of the glacier. The model was optimized using data from a new AWS installed at the surface of the glacier at an altitude of 3240 m.a.s.l. In order to identify the governing meteorological controls an extensive sensitivity analysis was performed. Results reveal that besides the influence of generally warming summer temperatures, the mass balance of the glacier is strongly tied to surface albedo and therefore to the occurrence and frequency of snow falls during summer. The distribution of the surface mass balance strongly reflects the radiation budget with considerable differences between years with dominating short wave radiation and years with stronger long wave input. Topographic adjustment and related shading play a minor role.