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Precipitation gradients along hillslopes estimated from rain gauge transects

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Topography affects precipitation amount and intensity and in particular orographic complexity plays a crucial role. Accounting for these effects is important for areal interpolation of rainfall data, which is for example required in distributed hydrological modeling. We present the results of the first part of a field campaign investigating the influence of elevation on precipitation. Automatic weather stations were set up in transects along two hillslopes in the Swiss Alps (Zermatt, Canton Wallis, Southwestern Switzerland). Each station measured rainfall, wind and temperature. Two out of 15 stations were equipped with a weighing raingauge and the others were equipped with tipping bucket gauges.
For different events of the summer period 2010 precipitation amount and intensity as well as event timing and duration are analyzed. The precipitation amount at the different stations is estimated by correcting wind induced errors using wind speed measurements. The weighing raingauges, which are able to resolve smaller rainfall amounts, were used as a reference in order to determine the temporal structure of the events. We corrected the temporal structure of the rainfall event measured with the tipping bucket gauges using the data from the weighing gauges as a reference for the event timing and by interpolating the precipitation amount in between consecutive tips.

The gradients of cumulative event precipitation vary between the different events, and positive as well as negative gradients are observed. This observation is also supported by radar data, which show a good qualitative agreement with the cumulative precipitation observed along the transect. In addition to elevation also the direction of the hillslope with respect to the event direction affects the precipitation amount and the temporal structure of the event at the different stations. Using radar images and wind measurements the observed events were categorized according to event direction and weather type. The difference in the sign of the precipitation gradient can to some extent be explained by the direction of the rainfall event with respect to the hillslope.
We show that at the event scale precipitation gradients with elevation show large variations, which we explain by analyzing the associated weather type and direction. However, even for one single event the precipitation gradients on two hillslopes that are close to each other can be different. Implications of the application of constant elevation gradients in the spatial interpolation of rainfall measurements are discussed and, in particular, questioned when working at small temporal scales.