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Coupling of a distributed glacier mass balance model to the regional climate model REMO: Down-scaling strategy and first results

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In times of accelerated glacier down-wasting the calculation of future glacier mass balance and discharge becomes increasingly important. Distributed glacier mass balance models (MBM) that are forced by time series of meteorological variables like global radiation (R), temperature (T) and precipitation (P), have proven to accurately reproduce glacier melt and mass balance at several glaciers worldwide. For assessment of future glacier mass balance, a direct coupling of a MBM with a regional climate model (RCM) would be favourable. However, due to the different spatial resolutions of both model types (20 m vs. 20 km) and the highly flattened topography in an RCM, questions of proper down-scaling arise.

In order to find a suitable down-scaling scheme, we applied a MBM of intermediate complexity (modified from Klok and Oerlemans, 2002) to a larger test site in the Swiss Alps (including the glaciers Gries and Basodino) for the two balance years 1997/98 and 1998/99. We force the MBM with daily means of R and T as well as daily sums of P, that are (a) measured at the nearby meteo station Robiei (1900 m a.s.l.) and (b) calculated for the respective climate model grid box by the RCM REMO, which is forced by ECMWF reanalysis data at the lateral boundaries. While R and T from REMO follow measured values at Robiei remarkably well, P is strongly underestimated, in particular during the accumulation season. As such, we correct P with an empirical function that was obtained by a comparison with a gridded climatology (1971-1990) of monthly mean values from Schwarb et al. (2001).

The down-scaling itself is based on the multiplication of the REMO time series with anomaly grids (R, P) and the application of a constant lapse rate (T), both at 25 m cell

size. The same method is used to extrapolate the measured meteo data to the terrain (DEM). Both forcing schemes yield mass balance profiles and net balances in good agreement with measured values at both glaciers. In particular the differences between the two balance years and both glaciers are correctly reproduced.