



Reconstruction of the surface mass balance of Morteratschgletscher since 1865

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We reconstructed the surface mass balance of the Morteratschgletscher, Engadine, with a two-dimensional energy-balance model for the period between 1865 and 2005. The model considers a parameterisation for the surface energy fluxes, an albedo which decreases exponentially with snow depth as well as the shading effect of the surrounding mountains. The model was first calibrated with a 5-year record of surface mass balance measurements made at about 20 different sites on the glacier between 2001 and 2006 using meteorological data from surrounding synoptic stations. Only records of temperature and precipitation are used to drive the model as these are available from 1864 onwards from MeteoSwiss and from the HISTALP project. The model is able to reasonably well reproduce the observed mass balance (mean rms error of 0.74 m w.e. a⁻¹) except for the lower part during the warmest years. Most crucial to the results are the altitudinal precipitation gradient and the timing of precipitation events, which variables are both hard to quantify from long mean monthly climate records from nearby valley stations. The simulation shows an almost continuous mass loss since 1865, with short interruptions around 1890, 1915, and 1980. A trend toward a more negative mass balance was observed since the beginning of the 1980s. The simulated cumulative mass balance for the whole period from 1865 to 2005 was found to be -48 m w.e.