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# Re-analysing eleven years of mass balance observations at Langenferner, Ortler-Cevedale Group, Italy

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Long term surface mass balance records of glaciers are of peculiar scientific interest as they reflect the most direct link between the observed glacier changes and the underlying atmospheric forcing. Consequently they provide a unique source of information which is used in a wide range of different models (climate-, mass- or energy balance-, sea level rise- or run-off models). However, both inhomogeneities and unknown error ranges in the observational series limit the usefulness of respective datasets. Hence, the homogenization of long term records, as well as the availability of solid error values can significantly improve the quality of data and is therefore of crucial interest to the community.

The surface mass balance of Langenferner / Vedretta Lunga, a small valley glacier in the Italian Eastern Alps, has been measured since the hydrological year 2003/04. The resulting series of annual mass balances was homogenized using a process based mass balance model in order to calculate the annual mass balance for points without stake measurements during the first observation years. A detailed error analysis was performed considering all significant sources of uncertainties involved in the mass balance determination applying the direct glaciological method.

The homogenized mass balance values differ from the initial series mainly during the first measurement years when the number of measurements in the upper glacier parts was low and consequently large errors in the spatial extrapolation of measurements were made due to a lack of knowledge about changes in the upper glacier part. Hence the largest errors in mass balance calculation at Langenferner / Vedretta Lunga originate from inaccurate spatial extrapolation of point measurements, while other effects such as errors due to surface roughness play a role on the point scale but are canceled out by the high number of measurement points on the glacier wide scale.

A comparison of the surface mass balance to the geodetic balance for the period 2005 to 2013 yields differences in the order of about 10% which can to a large degree be explained by the inherent inaccuracies of the two methods but also by the influence of basal and internal ablation processes not captured by direct measurements.