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Evaluation of three long term mass balance records in Jotunheimen, southern Norway

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The accuracy of glacier surface mass-balance measurements depends on both the accuracy of the point observations and inter- and extrapolation of point values to spatially distributed values. Long series of measurements will seldom be perfectly homogeneous because of changes in personnel and procedure, and as there will be changes in glacier area (and elevation) when averaging the data. The Jotunheimen massif is the highest area in mainland Norway. Direct surface mass balance has been measured at Storbreen since 1949 and Hellstugubreen and Gråsubreen since 1962. These three mountain glaciers are reference glaciers of the World Glacier Monitoring Service. Four more glaciers in Jotunheimen were measured for shorter periods in the 1960/1970s. Moreover, measurements started on a small ice patch in 2010. The reference glaciers have been mapped repeatedly since measurements began, latest by laser scanning in 2009. The geodetic method has been used to calculate the cumulative surface mass balance. In this study the direct and geodetic mass balance results are presented and evaluated.

Measurements reveal a remarked mass balance gradient in this region with smaller mass turnover towards east. All three long term glaciers have had a cumulative mass deficit since measurements began; over 1962-2010 the mean surface mass balance was -0.34 m w.e./a. The mass deficit has accelerated over the past decade, and the mean mass balance over 2001-2010 was -0.84 m w.e./a. Storbreen has lost about 1/5 of its volume since measurements began in 1949. Results reveal that the geodetic and direct measurements compare well for the glaciers, also for the latest mapping period 1997-2009, although discrepancies occur in some periods. Calibration and correction of the direct records with the geodetic results may be appropriate for some periods. The glacier changes of the three reference glaciers are finally compared with results from other glaciers in southern Norway for evaluation of the local and regional representativeness of them.