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On the suitability of the SRTM DEM and ASTER GDEM for the compilation of topographic parameters in glacier inventories

Holger Frey and Frank Paul
Department of Geography, University of Zurich, Switzerland (holger.frey@geo.uzh.ch)

Topographic parameters in glacier inventories are a requirement to analyze glacier characteristics and are of vital importance for several subsequent applications. To obtain the topographic information a digital elevation model (DEM) is required; however, in many regions of the world no national or local DEM of sufficient quality is available. With the SRTM DEM and the ASTER Global Digital Elevation Model (ASTER GDEM), two datasets of reasonable resolution and promising quality are freely available for nearly all glacierized mountain ranges in the world. However, both DEMs have artifacts and errors, caused by the different acquisition techniques and the challenges posed by the rough high-mountain terrain and the special surface characteristics of glaciers. In this study, topographic glacier parameters as derived from both DEMs were compared to reference values as derived from a high-quality Swiss national DEM. All DEMs were reprojected to the (metric) UTM system and resampled to a 25 m and a 100 m cell size. For each of the resulting DEM versions, seven topographic parameters (minimum, maximum, mean, and median elevation, mean slope, mean aspect, and mean aspect sector) were calculated for 1786 glaciers lager than 0.1 km2 in Switzerland.

We found, that both the SRTM and the ASTER GDEM are suitable for compiling topographic parameters for glacier inventories. Nevertheless, SRTM acquired with SAR interferometry seems to be of slightly higher quality over the typically smooth glacier areas with low optical contrast than the photogrammetrically derived ASTER GDEM. On the scale of individual glaciers, larger differences to reference values occur; however, for larger glacier samples mean differences to the reference values are small. For the parameters minimum and maximum elevation, which depend on single cell values, larger differences to reference values occur than for parameters, which are averaged over the entire glacier area (e.g. mean elevation, mean slope, mean aspect). Apart from spatial resolution and acquisition technique, also the acquisition date has an influence on the results.

These results demonstrate that, if no DEM of higher quality is available, information about topographic characteristics of glaciers can be obtained from these two datasets. Updating and including these topographic parameters in existing and new glacier inventories would be an important step towards a more complete picture of the world's glaciers. With the already digitally available glacier outlines in the GLMS glacier database, this task is straightforward.