Geophysical Research Abstracts,
Vol. 11, EGU2009-11096, 2009
EGU General Assembly 2009

A new inventory of local glaciers for a part of West Greenland: Methods, challenges and changes

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The local glacier and icecaps on Greenland (outside the icesheet) might already strongly contribute to global sea level rise but their contribution is difficult to calculate as detailed glacier inventory data are only available for West Greenland south of 71°N. This previous inventory includes a digitally available compilation of glacier characteristics and printed maps for glacier identification. However, these data are difficult to use, because the year of data acquisition is not recorded and spans more than two decades. On the other hand, glacier outlines (contiguous ice masses) have been compiled around 1984 for the same region and are available in a digital vector format. Additionally, 100 m elevation contour lines and further digital data sets are available and were used to reconstruct a digital elevation model (DEM). Combined with the outlines, the DEM has been used to separate individual glacier units and to derive topographic glacier inventory parameters. It is planned to complete the inventory of local glaciers and icecaps on Greenland within the framework of the GLIMS initiative using Landsat satellite data.

In this study we present results from the new Landsat-derived glacier inventory (scenes 13-9, 10 and 11 from 2001) for a part of West Greenland (from 69 to 73°N). We report on the specific challenges of the input data and of the region (e.g. surging glaciers, rock glaciers, seasonal snow) and present the applied solutions. Apart from a statistical analysis of the inventory data, we also present an assessment of glacier changes since the little ice age (LIA) maximum extent, including an extrapolation for the entire region with lower and upper bounds. While the lower bound assumes that all glaciers without LIA extent measurements have not changed at all, the upper bound assumes that all glaciers have changed in the same way as the observed sample.

The entire sample includes 1172 entities with area changes derived for 659 of them. Overall area loss for the entire region since the LIA is -20% with lower and upper bounds of -16% and -24%. Excluding known surge-type glaciers on Disko Island, the relative changes increase by a few percent in this region. As area changes depend on glacier area, the mean change for a specific region is also governed by the specific size class distribution. Length changes since the LIA are extreme in particular on Disko Island (up to 7 km), but for surge-type glaciers they are somewhat lower when glaciers of the same length are compared. Changes since 1985 are small, but average retreat rates before 1984 (up to 100 m per year) by far exceed those in the European Alps.