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A new satellite-derived glacier inventory for Western Alaska

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Glaciers and ice caps are essential components of studies related to climate change impact assessment. Glacier inventories provide the required baseline data to perform the related analysis in a consistent and spatially representative manner. In particular, the calculation of the current and future contribution to global sea-level rise from heavily glacierized regions is a major demand. One of the regions, where strong mass losses and geometric changes of glaciers have been observed recently is Alaska. Unfortunately, the digitally available data base of glacier extent is quite rough and based on rather old maps from the 1960s. Accordingly, the related calculations and extrapolations are imprecise and an updated glacier inventory is urgently required.

Here we present first results of a new glacier inventory for Western Alaska that is prepared in the framework of the ESA project GlobGlacier and is based on freely available orthorectified Landsat TM and ETM+ scenes from USGS. The analysed region covers the Tordrillo, Chigmit and Chugach Mts. as well as the Kenai Peninsula. In total, 8 scenes acquired between 2002 and 2009 were used covering c. 20.420 km2 of glaciers. All glacier types are present in this region, incl. outlet glaciers from icefields, glacier clad volcanoes, and calving glaciers. While well established automated glacier mapping techniques (band rationing) are applied to map clean and slightly dirty glacier ice, many glaciers are covered by debris or volcanic ash and outlines need manual corrections during post-processing. Prior to the calculation of drainage divides from DEM-based watershed analysis, we performed a cross-comparative analysis of DEMs from USGS, ASTER (GDEM) and SRTM 1 for Kenai Peninsula. This resulted in the decision to use the USGS DEM for calculating the drainage divides and most of the topographic inventory parameters, and the more recent GDEM to derive minimum elevation for each glacier.

A first statistical analysis of the results revealed that large parts of the area (48%) are covered by only few (43) but large (>100 km2) glaciers, while glaciers <1 km2 contribute only 6% to the total area, but 25% to the total number of analysed glaciers (>0.1 km2). However, these percentages vary with the specific mountain range analysed. The spatial analysis of mean glacier elevation (as a proxy for the ELA) revealed a strong increase from the glaciers close to the coast towards the interior (from about 100 to 2960 m a.s.l.). This more regional trend has also a high local variability, indicating that the response of glaciers to climate change will differ locally. The entire inventory data will finally be made available in the GLIMS glacier database.