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A new glacier inventory for the European Alps from Landsat TM scenes of 2003: Challenges and analysis

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For an accurate assessment of glacier changes at a regional scale, glacier inventories in a digital vector format are a basic requirement. For the European Alps, a number of (repeated) glacier inventories were created during the last century. In the recent past a variety of new sensors and methods, including satellite data, aerial photography and laser scanning have been used to update the datasets. However, these inventories are regionally constrained and have different resolutions and quality, depending on the acquisition methods. Nevertheless, for modeling of climate change impacts on glaciers as well as for change assessment, a consistent data set (e.g. acquired in the same year form the same sensor and processed with the same method) is required. Therefore, we have created in the framework of the ESA project GlobGlacier a new glacier inventory from ten Landsat TM scenes acquired within two months in the late summer of 2003. Topographic attributes for each glacier were derived from the SRTM DEM.

After accurately orthorectified Landsat TM scenes were available for the entire Alps from the USGS archive, we converted them to glacier outlines using the standard methods (thresholding of ratio images, manual editing of debris-covered glaciers). Drainage divides for individual glaciers were derived from national DEMs if available or from the SRTM DEM and topographic inventory parameters (e.g. minimum, maximum, mean elevation, slope, aspect) were automatically extracted within a GIS.

The 2003 European Alps glacier inventory consists of c. 3800 glaciers larger than 0.01 km^2 covering about 2050 km^2, which is an overall area reduction of about 30% compared to the 1970s glacier inventory. Several glaciers had to be excluded from the inventory as outlines could not be properly identified due to debris-cover and/or cast-shadow. The normalized size class distribution is very similar in all countries and mean elevation of individual glaciers does slightly depend on aspect and geographic location. With a total volume of about 105 km^3 the mean glacier thickness is 53 m, but only 33 m if the 25 glaciers >10 km^2 are excluded. They contain roughly half of the entire ice volume.