



A GIS-assisted reconstruction and 3D data integration of Eastern Alpine glaciers using satellite imagery and georeferenced historical and archive maps

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The recent melting of temperate valley glaciers is one of the most obvious facts that demonstrates the climate change. Actually the phenomenon attracted public awareness for centuries especially because of the hazardous aspects of the melting processes. Accordingly, the researchers and authorities (or their contemporaneous equivalents) tried to document the extent of the valley glaciers in various ways.

In our GIS-based approach we try to integrate these data in 3D. Unfortunately some of the data are difficult to access or georeference with the required accuracy. The most reliable archive data source is the so-called Second Military Survey (Zweite Militärische Aufnahme) of the Habsburg Empire. The georeferenced sheets of this survey served then as data source for the determination of the glacier extents. Although the surveying and the creation of the map sheets took a relatively long period of time (some 70 years), the actual map sheets in Tyrol have been created in a decade, so the assumption of contemporaneousness from the point of view of the glacier extents is feasible. The accuracy of the reconstruction is on the order of 250 m.

The other (newer) map sheets already having a solid geodetic base are characterized by far higher accuracy. The satellite imagery (e.g., Landsat TM) is expected to be accurate at 1-2 pixels, so the actual resolution defines their accuracy. However, the determination of the glacier extent on satellite images, despite the integration of multichannel data including infrared channels, has a larger uncertainty, so the final accuracy of the derived data can be on the order of 100 m.

To have an estimate not only on the retreat in the extent, but also on the volumetric change of the glacier, the aforementioned data were integrated with a medium-resolution DEM. As a result, beside of the quantitative estimates, our 3D approach allows also 3D visualizations that can be used for education purposes as well.