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Challenges with the compilation of multi-temporal glacier inventories from different sources

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Glacier inventory data provides the baseline information for several important applications like the modelling of the contribution of glaciers to global sea-level rise or determination of glacier changes. Whereas well established methods for precise mapping of clean to slightly dirty glacier ice from multi-spectral (optical) imagery exist, expert knowledge and additional information such as a DEM or SAR data are needed to map also the more problematic areas (such as debris-covered ice) or to solve methodological problems (like the separation of glaciers from seasonal snow). While it is already difficult to calculate glacier specific changes in length, size or mean elevation when glaciers split, this is even more challenging when glacier extents have been created by different methods or analysts.

The glacier outlines as stored in the GLIMS glacier database are the result of a global collaborative effort and may in the future also serve as the baseline data set for change assessment. However, as the outlines have been created by different experts from a large variety of methods and sources (or sensors) and referring to different entities, a direct comparison is not straight forward and detected changes might not be real. The problem is enhanced when comparisons to tabular data (e.g. as listed in the world glacier inventory) or maps (e.g. digitized by cartographers) are made.

Comparisons with declassified spy imagery from around 1970 in the Nyainqentanglha Range (Tibet/China) and Garwhal Himalaya (India) show a significant overestimation of the ice covered area on the topographic maps from similar years, probably due to the wrong interpretation of seasonal snow. The same applies for data from the Soviet glacier inventory for the Northern Tien Shan. A comparison of digital map data from 1985 for British Columbia with Landsat data from similar years indicates at the same time an overestimation for some regions but an underestimation for debris-covered glaciers. Additional uncertainties occur if (i) the upper glacier boundaries and/or Nunataks are not correctly mapped (e.g. due to adverse snow conditions), (ii) the minimum size of the considered glaciers differ, (iii) the analysts use different ice divides or (iv) the analysis compares data with different resolutions, sensors and/or sources.

In this contribution the challenges for glacier mapping and change assessment from repeat inventories is illustrated with examples from different regions in the world. Some general recommendations are given to overcome them in future work.