Compilation of a glacier inventory for the western Himalayas from satellite data: challenges and results

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Detailed information about glaciers and glacier changes in the Himalayas (in particular for India) are so far only very sparsely present in global glacier databases like the World Glacier Inventory or the GLIMS glacier database. However, information about Himalayan glacier characteristics and their potential future development are of high interest as recent debates have shown. Due to the high variability of the climatic regime (monsoon type to continental) and the special glacier characteristics in this region (e.g. heavily debris-covered tongues avalanche fed glacier parts), any regionalization of the behavior of individual glaciers is error prone. Moreover, runoff from these glaciers feed the Ganges and Indus rivers, which are the lifeline of hundreds of millions of people and makes the compilation of such a dataset especially important.

To provide a baseline dataset for improved modeling and change detection, a glacier inventory for the western Himalaya in the Indian states Jammu and Kashmir, Himachal Pradesh, Uttaranchal, and parts of the adjacent Tibetan Plateau was compiled in the framework of the ESA project GlobGlacier. Based on eight Landsat ETM+ scenes, more than 10'000 glaciers were mapped by band ratioing and manually corrected by deleting wrongly classified water bodies and adding debris-covered glacier parts. Local orographic clouds that covered some glaciers caused an additional challenge. In part, this problem was solved by the use of multi-temporal imagery. Due to high solar elevation and a related lack of optical contrast, it was nearly impossible for many debris-covered glacier tongues to accurately delineate their extent by visual interpretation. To confront these problems, five coherence image pairs from ALOS PALSAR acquired during summer 2007 were used. The movement-related decorrelation over glaciers is in strong contrast to the generally non-moving surrounding terrain and allows precise delineation of their extent. Drainage divides and basic topographic glacier inventory parameters were calculated by using the publicly available global ASTER DEM (GDEM), which was of higher quality compared to the void-filled SRTM DEM. In total 11'780 glaciers larger than 0.02 km2 and covering a total area of 9372 km2 were mapped and analyzed. The inventory data will be provided to the GLIMS glacier database for free access.