

Glacier Variations in High Asia: Research Projects at the Institute of Cartography, TU Dresden

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EXTENDED ABSTRACT

Glaciers are characteristic elements of high mountain environments and represent key indicators for assessing climate change. They are important water (re)sources and can be of high significance for both ecosystems and local population. Snow, glaciers and permafrost bodies of the Tibetan Plateau and its adjacent mountain ranges regulate the headwaters of many major Asian rivers and thus affect to a varying degree the livelihood of more than one billion people living in the downstream areas.

The global mass loss of glaciers mainly associated with rising air temperatures has accelerated in most regions in recent decades. These glacier variations can constitute serious threats to nature and society and their scientific investigation is of high importance. However, glaciers are mostly located in remote mountain areas and very difficult to access. Therefore, remote sensing technologies are an ideal means to detect and observe glacier variations.

Satellite imagery time series permit the reconstruction of glacier area and length changes as indirect signals of climate change. Moreover, multi-temporal Digital Terrain Models (DTMs), generated from historical and recent stereo satellite imagery allow the estimation of glacier thickness changes and consecutively, mass balances, assuming a certain ice density. To depict the glacier situation of the 1960s and 70s, declassified high resolution Corona KH-4 and KH-4B data as well as KH-9 Hexagon data have been used and processed. ASTER, SPOT-5, Cartosat-1 and ALOS-PRISM imagery form the basis to generate DTMs up to the present date.

The suitability of a terrestrial stereo camera system has recently been tested on a sample glacier on the Tibetan Plateau (Zhadang Glacier). Despite large image distortions first results are promising for snow line mapping and potentially for DTM generation. Furthermore, snow cover changes are investigated with time series of NOAA AVHRR and MODIS data from the 1980s to 2012. Besides their significance for a comprehensive snow cover analysis, these data will be incorporated in a statistical permafrost model. Based on remote sensing imagery and borehole data a small-scale approach is currently being developed for modelling the permafrost extent for the entire Tien Shan. The permafrost extent will also provide important information about the thermal state of the glaciers.

In general, glaciers in the Tien Shan and on the south-central Tibetan Plateau lost area and mass throughout the investigated time (Bolch et al. 2010, Gardner et al. 2013, Ozmonov et al. 2013, Pieczonka et al. 2013). Few advancing glaciers with indications of surges could be identified in Central Tien Shan. Glacier surges are common in the Pamir and measurements indicate balanced budgets in this region (Gardner et al. 2013).

Information about the employed methodologies for assessing glacier variations can be found in Bolch et al. 2010, 2011; Holzer et al. 2012 and Pieczonka et al. 2011, 2013. Work is underway to analyse glacier volume changes for larger areas and to extend the study area to further regions on the Tibetan Plateau, in the Pamirs and the Tien Shan. The investigations are funded by BMBF and DFG within the framework of the Sino-German projects “WET”, “TiP”, “SuMa-RiO” and “Aksu-Tarim” where the Institute of Cartography is currently involved focusing on glacier remote sensing (Figure 1).

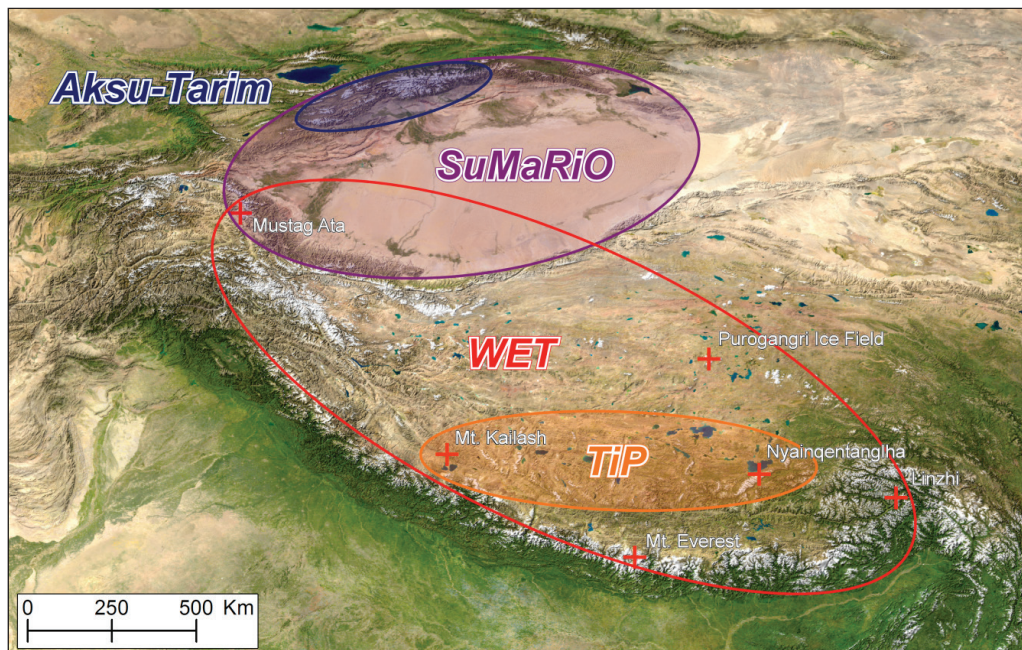


Figure 1. Research Projects at the Institute of Cartography, TU Dresden (Map: N. Holzer, background: Blue Marble/MODIS).

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www.klima.tu-berlin.de/index.php?show=forschung_asien_tibet_wet&lan=en

TiP – funded by German Research Foundation (DFG) (Tibetan Plateau: Formation – Climate – Ecosystems) www.tip.uni-tuebingen.de

SuMaRiO – funded by Federal Ministry of Education and Research (BMBF) (Sustainable Management of River Oases along the Tarim River)

www.sumario.de

Aksu-Tarim – funded by German Research Foundation (DFG) (Climate Change and Water Resources in Western China) www.aksu-tarim.de

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