

## A novel approach to estimate glacier mass balance in the Tien Shan and Pamir based on transient snowline observations

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Summary  
Glaciers are recognised as an excellent proxy for climate change and their centennial mass loss has accelerated during the past decades. The Central Asian mountain ranges Tien Shan and Pamir host over 25,000 glaciers that have been observed to respond heterogeneous to climate change. Glacier changes in the region have very important consequences on the water availability for the densely populated lowlands. Despite the significance and severity that climate change exerts on the Central Asian water towers, the glacier response is still poorly understood, hampering sound interpretations and predictions of future threats and opportunities. A significant data gap in the field measurement series from the mid-1990s to around 2010, limits the analysis of long-term trends. Despite the recent efforts to re-established the historical cryospheric monitoring network, continuous long-term glacier mass balance time series remain sparse for Central Asia. Thus, improved temporal and spatial coverage of glacier monitoring is essential.

Remote sensing techniques are a powerful tool to study a large number of remotely located and unmeasured glaciers and provide a possibility to partly bridge the aforementioned deficit in data availability. However, the coarse temporal resolution of geodetic mass balance assessments is not suitable to improve the understanding of ongoing processes. This accentuates the indispensable need for improved and extended annual to seasonal observations of mass change of inaccessible and remote glaciers on a cost and labour effective basis as well as for a more elaborated and enhanced, process-orientated methodology.

This work provides a combination of detailed in situ measurements and remote sensing based glacier mass change observation from local to regional scale. A multi-level strategy is applied to complement data from long-term glaciological surveys and remote sensing (snowline observations and geodetic mass balance measurements) with numerical modelling to obtain information at high temporal and spatial resolution for individual glaciers. Through modelling constrained with transient snowlines, annual mass balance time series for a large amount of glaciers located in the Tien Shan and Pamir were made available. Such mass balance estimates provide valuable baseline data for climate change assessments, runoff projection, hazard evaluation and enhance process understanding. A better understanding of the regional annual variability of glacier response to climate change in the Pamir and Tien Shan became possible based on the outcome of this thesis.

In the presented thesis the results are discussed in detail, the weaknesses and strengths of the developed methodology are unfolded and the relevant perspective and future research outlined.

Jury:

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