Geophysical Research Abstracts
Vol. 16, EGU2014-7428, 2014
EGU General Assembly 2014

Reconstructing 50 years of glacier mass changes in Central Asia

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Recent studies assessing the glacier mass balance at the regional to global scale, have tried to consider different data sources in order to increase the robustness of the results. The combined use of data from satellite gravimetry, satellite altimetry, as well as from in-situ and geodetic mass balance measurements is increasingly found in the literature. Constrained by the need of simultaneous data availability from the various sources, however, such studies have typically focused on rather short time frames. For Central Asia, and the Tien Shan mountain range in particular, analyses have mostly been addressing the time period 2003-2009, concluding that the total mass change rate of the glaciers in the region has to be approximately -7 Gt water equivalent (w.e.) per year.

In this contribution, we use an ensemble approach based on data from (a) the Gravity Recovery and Climate Experiment (GRACE), (b) the Ice, Cloud and land Elevation Satellite (ICESat) mission, and (c) in-situ glacier mass balance measurements, for validating a glacier mass balance model that we use for reconstructing a continuous time series for the glacier mass-change of the Tien Shan mountain range during the period 1961-2012. Our model ensemble takes into account a series of different possibilities for process description, inter- and extrapolation methods, as well as meteorological drivers.

Our results confirm previous estimates derived for the period 2003-2009, and highlight an accelerating trend in glacier mass loss. For 1961-2012, we estimate an average glacier mass-change rate of -6.1$\pm$5.4 Gt w.e. a^{-1}, whilst the average mass-change rate for the decade 2003-2012 is estimated with -7.5$\pm$5.5 Gt w.e. a^{-1}. This further increases the concern about the future of a region that significantly depends on glacier melt for water supply.