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Glacier retreat accounts for more than 25 percent of summer runoff in the central Pamirs

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The Gunt River is a major headwater stream of the Amu-Darya River system, located in the Aral Sea basin. It drains a 14,000 km^2 basin in the Pamir Mountains ranging from 2000m to 6700m a.s.l with an average altitude of 4300m. Almost five percent or 610 km^2 of the Gunt basin is glaciated. The cold-arid catchment receives most precipitation in winter and spring and the runoff regime is dominated by snow and glacier melt. A remote sensing-based glacier monitoring was applied to measure glaciated area and its hypsometric distribution. Results show a decrease in area of 23.7 percent between 1977 and 2011. We ultimately deal with the question what impact glacier retreat has on the water balance in a typical headwater catchment of the Aral Sea basin. For this purpose we apply the GlabTop model to simulate glacier thickness distributions over the entire river basin and estimate changes in glacier volumes. Even though calibration sources are limited, uncertainty analyses show robustness in estimating volume changes. For the period from 1998 to 2011 we find the total ice volume being reduced by 11 percent or 4.6 km^3. The ablation period was estimated using satellite-based snow-cover data and interpolated temperature data along with the glacier hypsometry. Temperature lapse-rates and their seasonal variance were derived from nine climate stations. Daily runoff time-series of 14 years (1998 – 2011) were analyzed. We find the ablation period to last 66 days on average. In that period, more than 25 percent of the total river discharge results from the retreat of glaciers. Hence, recent discharge is enriched by glacier retreat between mid of July and mid of September. The deglaciation will result in a significant reduction of river discharge in these months in future. We discuss uncertainties of the approach and potential impacts on the water resources in the Aral Sea basin, which is prone to water scarcity.