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# Glacier melt buffering sustains river flow in the Pamir Mountains

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Central Asia's water resources and agricultural practices depend on snow and glacier melts in the high mountains. The Amu Darya, the main river draining the Pamir Mountains, exemplifies the resulting seasonality in stream flow. In winter, comparably low amounts of groundwater discharge feed the streams, while the bulk of precipitation is provided and stored as snow. Successive melting of snow cover and glaciers during summer releases these stored waters to the swelling rivers. Despite a strong variability in precipitation and temperatures over the entire Pamir Mountain region, river flow shows severely less variability. We investigate what processes lead to this apparent discrepancy by using a simple but robust hydrological model that we thoroughly validate with remote sensing snow cover observations, Gravity Recovery and Climate Experiment (GRACE) data, highlighting changes in total water storage, and hydrograph comparison. We find that glaciers play a paramount role by buffering extreme meteorological conditions to sustain stream flow. In a simplified scheme, low precipitation amounts in winter result in small snow stocks, compensated for by more intensive glacier melt, and vice versa. By carrying out analyses over the extensive catchment area of the Amu Darya in the high mountain domain, we highlight regional differences in the effectiveness of this mechanism. Regional influences of wind systems and associated moisture transport as well as glaciated area emerge as main factors. Modeled negative glacier mass balances between -0.38 and -0.93 m/year agree with other studies based on geodetic methods and indicate a future reduction in stream flow sustainability. This not only exacerbates the conflict potential between riparian countries downstream, but also means that extreme weather events are more likely to cause floods and droughts.