Submitted Abstract

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Abstract

In many mountain regions, the cryosphere is a crucial component of water provision to downstream societies, as it contributes to dry-season flows and sustaining diverse ecosystems in many regions of the world. However, many of the world's glacierized watersheds experience far-reaching changes due to declining glaciers and snowpack, climate change impacts on the non-cryosphere part of the catchment, and socioeconomic development. The implications for downstream water supply are therefore manifold and complex. Coupled effects of reduced and less reliable water availability, changes in water quality, and growing water demand exert increasing pressure on water resources and threaten future water security and management.

In this study we argue that the limited understanding of interactions between the cryosphere, glacial and non-glacial water stores, river runoff and people hamper climate change adaptation and long-term water security. Meaningful assessments of mountain water security require therefore a holistic social-ecological perspective that interlinks the wider catchment hydrology considering both, surface and subsurface stores, and people including human water demand with improved data and process understanding. Water security assessments can then be guided by a fully coupled hydrological risk framework. This approach needs to integrate multiple social-ecological vulnerabilities as well as the degree of exposure to water shortage under a variety of possible future scenarios of glacier shrinkage, catchment alteration and socioeconomic development. Essentially, this requires a good understanding of interrelated upstream-downstream systems and the spatiotemporal propagation of meltwater through the terrestrial water cycle.

Improved data and more diverse knowledge collection is a priority, and these should be integrated into a collaborative science-policy-community framework. This can support a wide set of incremental and transformational strategies that guide effective and robust adaptation pathways. These may include, among other, exploring catchment-specific benefits of nature-based solutions to increase the buffer function of wider catchment hydrology to water loss from glacier shrinkage and to enhance long-term water security in a watershed context.