

Monitoring and modeling of cold region hydrological process in a high mountain river basin in the upstream area of the Heihe River Basin of China

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We provide an overview of a high mountain river basin observing system in the Qilian Mountains of China. Mountain cryosphere is very sensitive to climate change, however, monitoring and modeling of cryospheric process and its interaction with hydrology and ecology needs to be further strengthened. We establish a multi-scale high mountain river basin observing system in the upstream area of the Heihe River Basin, Qilian Mountains of China. This system consists of flux towers on alpine tundra, alpine meadow and alpine steppes, a network of automatic meteorological stations, a wireless sensor network of soil moisture, soil temperature, snow depth, and precipitation, and two super observatories for monitoring snow and frozen soil, respectively. Super-high resolution (1 meter) DEMs of four experiment sub-watersheds (each about 20-40 km²) within this river basin were obtained via airborne LiDAR remote sensing.

We introduce the data obtained since 2012 and present some preliminary modeling and data assimilation results. The results show that runoff, precipitation, snowmelt, and glacier melt keep increasing in the upstream area of the Heihe River Basin due to a warming climate. The ratio of snowmelt in total runoff has increased and the onset of snowmelt has gone ahead. The contribution of glacier melt to total runoff has almost doubled in the past decade. Frozen soil melt advances in time as well, and it may also contribute to the increase of the portion of baseflow in total runoff.

This observatory has joined the International Network for Alpine Research Catchment Hydrology (INARCH) and will work as a unique site to monitor cryospheric and hydroclimatological changes in very high mountains.