Monitoring and modeling of cold region hydrological process in a Third Pole high mountain river basin

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We introduce a high mountain river basin observing system in the Qilian Mountains of China, which is located in the northeastern escarpment of Tibetan Plateau. 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. Super-high resolution (1 meter) DEMs of four experiment sub-watersheds (each about 20-40 km^2) within this river basin were obtained via airborne LiDAR remote sensing.

We also present our modeling and data assimilation results of cold region hydrological processes in the river basin. 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. However, the ratio of snowmelt in total runoff has decreased a bit but the onset of snowmelt has gone ahead. Frozen soil melt advances in time as well, and it may contribute to the increase of the portion of baseflow in total runoff. Our results show that the increase in precipitation and glacier melt can explain the rising runoff in the upstream area of the Heihe River Basin in the past decade, which, in general, can be considered a positive effect because the increase in runoff alleviate water resource scarcity and favors agriculture and natural ecosystems. Early melting of snow and frozen soil also means the spring drought can be alleviated and both the agriculture in the midstream area and natural ecosystems in the downstream area would be benefited.