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Will warming exacerbate the shrinkage of the "water tower" in Central Asia?

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Tianshan Mountains, with the status of "water tower in Central Asia", is the main water source and ecological barrier of the silk road economic belt. Recent observational temperature has been in a state of high variability, which may cause the meltwater-based system even more vulnerable in the Tianshan Mountains. The characteristics of water formation, spatial and temporal distribution in the Tianshan Mountains are very distinct, the unique water cycle has a strong sensitivity to climate change. This project clarifies the influence mechanism of precipitation fraction, snowfall rate, glacier / snowmelt water process on water resources under the content of high variability of temperature, and reveals the physical processes and spatial distribution of glaciers and snow. The newest research results show that: the temperature experienced a "sharply" increase in 1997 in Central Asia, the average temperature during 1998-2013 is about 0.93 °C higher than the average of 1960-1997. Global warming accelerates the water cycle, which indicates a general prospective benefit for water availability. However, in regions where water resources are dominated by glacier and snow melt from mountains, the availability is more complicated. The rapid warming affected precipitation fraction as well as snow cover, glaciers, and total water storage. The ratio of snowfall to precipitation (S/P) experienced a downward trend, along with a shift from snow to rain. Spatially, the snow cover area in Middle Tienshan Mountains decreased significantly, while that in West Tienshan Mountains increased slightly. Approximately 97.52% of glaciers in the Tienshan Mountains showed a retreating trend, which was especially obvious in the North and East Tienshan Mountains. The total water storage in the Tienshan Mountanins also experienced a significant decreasing trend in Middle and East Tienshan Mountains, but only a slight decreasing trend in West Tienshan Mountains at an average rate of -3.72 mm/a, which indicated the ‘water tower’ had lost about -2.23×10ˆ9 m3/a in just 10 years. Combined the components of water composition and sensitivity of climate change, this project estimates the trends of water resource in different scenarios in the future. The median prediction indicated that water storage will slight decrease until the 2040s, but will then experience a large deficit in the latter half of the 21st century, especially under RCP8.5. These understanding will then lay a scientific basis for the water resource management and silk road economic belt construction.