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Assessment of climate variability and hydrological alterations in Kaidu Basin

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Climate change and hydrological alterations are major concerns in a mountain river ecosystem. We provide an essential assessment of climate variability (1961-2011) in Kaidu basin by means of Mann-Kendall test and cumulative anomalies. The Indicator of Hydrologic Alteration (IHA) was further performed to analyze hydrological alterations (1972-2008). Change in the triggering of snowmelt runoff timing was analyzed by the winter/spring snowmelt runoff center time (WSCT). Results reveal that annual precipitation and temperature show an increase tendency, but with a significant trend in winter and summer, respectively, while the discharge reveals significant rises in both annual and seasonal scales. However, all the hydro-meteorological parameters show an obvious increase tendency especially in the mid-1990s. WSCT has a significant decreasing trend and was observed earlier by nearly 10 days in Kaidu Basin. Higher relationship between WSCT with temperatures (March to April, R= -0.51) and precipitation (February to March, R=0.33) were found that temperature may play a major role in causing the earlier WSCT. Account for the reservoirs influences, the rise rate and monthly flows have increased evidently before and after the reservoirs regulation. Monthly streamflow was found higher in pre-impact (1972-1992) than post-impact period (1993-2008) based on the flow duration curves. Nevertheless, the base flow index displayed no change before and after the impact period. Consequently, both of climate change and reservoir regulation lead to a concentrated streamflow. Research should take this influence into consideration in hydrological analysis and modelling in terms of uncertainties. These findings deepen our understanding of climate change and hydrological alterations in Kaidu basin, and are useful for flood risk regulation, ecological restoration and future hydropower plants.

Keywords:
Climate change; Spring snowmelt runoff time; WSCT; hydrological alterations; IHA