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Runoff generation processes in permafrost-influenced area of the Heihe River Headwater

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Permafrost degradation under global warming may change the hydrological regime of the headwater catchments in alpine area such as the Tibetan Plateau (TP). In this study, the runoff generation processes in permafrost-influenced area of the Heihe River Headwater were investigated with the following results: 1) The observed stable isotope values of various water types on average was roughly in the order of snowfall and snowmelt < bulk soil water (BSW) < rainfall, stream water, mobile soil water (MSW), and lateral subsurface flow. The depleted spring snowmelt and enriched summer rainfall formed tightly bound soil water and MSW, respectively. The dynamic mixing between tightly bound soil water and MSW resulted in BSW with more depleted and variable stable isotopic feature than MSW. 2) Along with the thawing of the frozen soil, surface runoff and shallow subsurface flow (SSF) at 30–60 cm was the major flow pathway in the permafrost influenced alpine meadow hillslope during spring snowmelt and summer rainfall period, respectively, with the frozen soil maintaining supra-permafrost water level. 3) Comparison between two neighbouring catchments under similar precipitation conditions indicated that streamflow of the lower catchment with less permafrost proportion and earlier thawing time has larger SSF and higher based flow component, indicating the potential changes of hydrological regimes subject to future warming.