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Runoff generation mechanism in a headwater experimental catchment with semi-humid monsoon climate in North China

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An experimental headwater catchment has been setup in a typical monsoon-influenced semi-humid mountainous forest of North China and long-term field measurements of hydrological processes have been conducted. Samples were collected for isotope ($\delta^{18}O$ and $\delta^{2}H$) and hydro-chemical analysis since 2014. Based on long-term hydro-chemical and isotopic data, the principal components of streamflow were defined and fractional components of stream flow separations were estimated, the result shows that groundwater and streamflow isotopic compositions are very similar and streamflow is controlled by a deep groundwater system that is recharged only in one or two large events (or clusters of events) each year. The two-component isotope hydrograph separation has been applied in 6 intensively sampled events, the results suggest that groundwater makes up 63-94% of the storm runoff□event water plays a relatively tiny role. Based on numerical modeling and statistics methods, impact of rainfall and hydraulic conductivity heterogeneity on Hortonian overland flow patterns have been analyzed, possibilities of Hortonian overland flow occurrence have been estimated in different climatic and underlying occasions, the result shows due to high permeability and low rainfall intensity, in more than 95% of total events, Hortonian overland flow couldn't occur in the study area. Runoff generation mechanism in semi-humid mountainous catchment have been revealed based on multi-scale measurements and numerical modeling, when rainfall intensity and duration are lower than certain threshold, surface runoff generation is consisted of groundwater runoff, direct rainfall on channel and saturation overland flow. Onsite observation shows that surface runoff contributing area in the watershed mainly distributed in riparian zone, and our result shows saturation overland flow is the dominant type of surface runoff generation in most summer rainfall events.