Rainfall-separate runoffs relation of the Hydrohill experimental catchment

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Rainfall-runoff relation is the basic and critical issue in hydrology, as well as in the hydrologic experiments. Supported by Chuzhou Hydrology Laboratory, this study conducted experimental investigation of the rainfall-runoff relation of Hydrohill experimental catchment during its historical (1982-1995) and modern (2013-2018) practice periods. Hydrohill is equipped with a separate-runoff system which can measure the runoffs in different layers: the uppermost trough collects rain; the next lower trough collects surface runoff (RS); the three lower troughs collect subsurface low from soil layers of the depths of 0–30, 30–60, and 60–100 cm (inferred as R30, R60, and R100). A network of 21 aluminum alloy access tubes for neutron moisture gauges were constructed in the historical period. Since the last month of 2012, all aluminum alloy access tubes have been displaced with 31 profile soil moisture sensors (PR2) with six sensor points located at the 10, 20, 30, 40, 60, and 100 cm. Eight profiles with another kind of soil moisture sensors (SM-1) were installed as well since 2017. This type of SM-1 has nine sensor points located at the 10, 20, 30, 40, 50, 60, 70, 80, and 90 cm. An array of 22 galvanized tube wells intersect through the soil till the concrete aquiclude. Water table measurement is performed with pressure-type sensors (LEV1) located at the bottom of each well. According the experiment results, conclusions are determined as following: (1) The proportion of RS decreased from 57.3% during the historical period to 35.3% during the modern period, and thus the runoff structure became subsurface runoff dominated from surface runoff dominated. During the historical period, the proportion of RS accounted for 54.4%, 57.3% and 70.3% under the conditions of $10 \leq P < 25$ mm, $P \geq 25$ mm, and $P < 10$mm (P represents rainfall amount of events), respectively. (2) the synthetic runoff coefficient of RS decreased while that of R100 increased from historical period to modern period; the synthetic runoff coefficient of R30 decreased but R60 increased under the condition of $P \geq 25$ mm. (3) The maximum discharges of all separate runoffs during historical period were larger than those during the modern period. (4) The average rising times of RS, R30 and R60 during historical period were longer than that during the modern period, but R100 was just the opposite. The average peak times of RS during historical period were shorter than those during the modern period. The duration of all separate runoffs in both catchments were during historical period were longer than those during the modern period. (5) The depths of soil distinction layers were located at the range of 30-40 cm based on the data of profile soil moisture. (6) Saturated overland flow just occurred in the unchanneled upstream based on the analysis of the dynamics of water table in Hydrohill. This investigation can enhance the in-depth understanding of rainfall-runoff relation in the small headwater catchments.