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Rainstorm characteristic and antecedent condition are clues to time-variant transit time modelling of event-water

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Transit time distribution (TTD) characterizes the transport process of catchment system controlling biogeochemical process, chemical weathering, and containment transport. It is recognized as a function of water storage with catchments. Thus, the TTD has evolved from time-invariant to time-variant during the past decade. However, few studies focus on determining the TTD and the potential time-variance in event scale, particularly in subtropical montane catchments. In this study, we applied transfer function hydrograph separation model (TRANSEP) to eight typhoon event records (during 2012-2015) of rainfall and stream 18O isotopic concentration onto a montane catchment Pinglin, located in northern Taiwan. The high sample frequency (2-3 hr) of isotopic data offered an potential opportunity to access time-variant TTD. Then, we explored a comparative assessment of inter-event variability in event-water TTDs and resulting mean transit times (MTT = $\alpha\beta$) inferred by the gamma distribution. The results showed that event-water MTT during events range from 4–34 h, which is compatible to other small-scale catchments worldwide. Meanwhile, the inter-event analysis showed that both maximum rainfall intensity and 7-day antecedent precipitation primarily control the event-water TTDs. The parameter α decreased with maximum rainfall intensity increase (R2 = 0.60). It implicates that high intensity rainfall activated the preferential flowpaths and quickly transport event-water to the stream network. In contract, the parameter β was found to be positively related to 7-day antecedent precipitation (R2 = 0.51), indicating that event-water had the low mixing volumes for rainstorms with dry antecedent conditions, resulting small β parameters. Combined the possible change altering water storage (maximum and antecedent precipitation), a nonlinear regression was further proposed to estimate the time-variant TTDs in different events. This approach is well suited to estimate event-water MTT (R2 = 0.97) in a subtropical, high rainfall intensity environment.