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The responses of fluvial geochemical signatures to runoff and the inferences of possible flow paths for small mountainous rivers in Taiwan

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Catchment systems are hydrologically complex having varied flow paths which respectively contribute to the streamflow in different hydrological conditions and control fluvial geochemical signatures. In this study, a one-year detailed time series of streamwater chemistry, including non-typhoon and typhoon samples, was monitored in two watersheds, i.e. with and without cultivation, in central Taiwan. In addition, rainwater, soil water and well water were supplemented to discover the mechanism of solute transport and to identify the possible flow paths. The concentration of fluoride, chloride, sulfate, magnesium, potassium, calcium, strontium, silicon, and barium of all the water samples were measured. Besides, end member mixing analysis (EMMA) was applied to link the streamwater chemistry to the hydrological processes in such region. Three major flow paths, i.e. groundwater, sub-surface flow (soil water), and surface runoff, were identified. Surface runoff actually influences the streamwater chemistry via two forms. One is access rainwater having similar chemistry to rainwater and diluting streamwater chemistry. The other is the eroded soil particle attached with particulate-associated solutes enhancing streamwater chemistry. The results of EMMA show that the streamwater chemistry of non-typhoon and typhoon samples could be mostly explained by a binary mixing between groundwater and soil water and between soil water and surface erosion, respectively. The missing end member reveals the great variability in the relative contributions to streamflow from these three major water masses. Fertilizer labels the soil water in the farm making soil water end member more identifiable. More comprehensive end member samples are suggested to fully understand the flow paths for subtropical small mountainous rivers.