DECIPHERING STORM-EVENT RUNOFF BEHAVIOR IN A COASTAL PLAIN WATERSHED USING CHEMICAL AND PHYSICAL HYDROGRAPH SEPARATION TECHNIQUES

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Interpreting storm-event runoff in coastal plain watersheds is challenging because of the space- and time-variable nature of different sources that contribute to stream flow. These flow vectors and the magnitude of water flux is dependent on the pre-storm soil moisture (as estimated from depth to water table) in the lower coastal plain (LCP) region. For example, sites with typically sandy, well-drained soils can exhibit runoff behavior similar to sites with low-permeability, poorly-drained soils if the pre-storm water table position is close to the surface. Interpreting source contributions to storm runoff include physical (hydrograph separation) and chemical (end member mixing analysis [EMMA]) methods, among others. Our main objective was to reduce uncertainty in calculations of stream flow contribution following storm events by analyzing the water isotope signatures of prospective sources to stream flow. Ratios of the stable isotopes of water (18/16 oxygen, and deuterium/hydrogen) were measured for the different prospective contributing sources and in stream water for storm events; EMMA was performed to characterize the percentage contributions of sources to stream flow. This was compared to physical hydrograph separation techniques that separate quickflow and baseflow components of stream flow response to storms. Chemical and physical hydrograph separation methods can show storm-specific discrepancies raising the question of which method correctly identifies the relative contributions of different sources such as groundwater, soil water, and overland flow to stream flow. The study sites were in the lower Atlantic coastal plain of the Southeast U.S., from the headwaters to the downstream US Geological Survey stream gage (ID 02172035) at Turkey Creek above Huger, South Carolina. The Turkey Creek watershed is a 5,240-hectare, third-order system in the Francis Marion National Forest in Berkeley County and has a confluence with Nicholson Creek, forming Huger Creek which drains to the East Branch of the Cooper River and ultimately to Charleston Harbor. This forested, wetland-rich watershed is an important reference system for the rapidly-developing Charleston metropolitan area and is of interest to watershed managers and stakeholders wishing to understand the hydrological processes influencing storm water dynamics. Our results will illustrate the complexity of runoff production dynamics in LCP watersheds and show that using multiple methods provides a more nuanced understanding of hydrological processes. We will also show that a hydrogeochemical approach to understanding processes on the LCP watersheds is not cost- or time-prohibitive, and can provide critical information to land managers and policymakers who oversee the urbanization of these watersheds.

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