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Investigating Storm Impacts on Springs in a Karst Region Using Oxygen and Hydrogen Isotopes

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Karst aquifers are vulnerable to contamination because surface runoff can be transported rapidly through sinkholes, underground cavities, and conduits to the subsurface. This study analyzed time-series water isotope data collected before and after Hurricane Idalia to investigate storm impacts on a first-magnitude spring and a nearby second-magnitude spring in a karst region of North Florida. Rain from Hurricane Idalia was highly depleted in the heavy oxygen and hydrogen isotopes (^{18}O and ^{2}H) relative to typical rainfall, providing a distinct tracer for storm-derived water. The isotope data show that the second-magnitude spring is more sensitive to storm-runoff influence than the first-magnitude spring. Short transit times inferred from the isotope data align with previous dye-tracer estimates, reflecting rapid flows through sinkholes and conduits. Isotope mass-balance calculations indicate that, despite differences in hydrodynamics, discharge at both springs is dominated by pre-event aquifer water, even after a major storm. The data further suggest that lakes, sinks, and ponds within the springshed are important groundwater sources, contributing substantial amounts of water to base flow at both springs. These findings highlight the strong buffering capacity of the karst aquifer and the limited direct contribution of storm-event water to spring discharge.