QUANTIFYING VADOSE STORAGE AND RELEASE IN A YOUNG, UPLIFTED KARST AQUIFER USING SPECTRAL ANALYSIS

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Karst vadose zone heterogeneity creates complex transmission and storage dynamics that affect the timing and magnitude of aquifer recharge. Young, high-matrix permeability karst aquifers would likely have appreciable storage in the vadose zone. In vulnerable and water-limited karst regions, the timescales of vadose storage would be important for seasonal and sub-seasonal recharge, and thus quantifying storage dynamics in the vadose zone is critical for effective water resource allocation. We create a framework to quantify storage and release in a young, high matrix permeability karst aquifer vadose zone using high-resolution precipitation and groundwater levels from the Northern Guam Lens Aquifer (NGLA) in the US territory of Guam. We estimate recharge using the Water Table Fluctuation (WTF) method and develop transfer functions between precipitation and recharge to quantify vadose zone storage timescales. The transfer functions are partitioned into different flow pathways including conduit, combined matrix/conduit and slowly draining matrix. Probability distributions are fit to each pathway to determine average travel times of infiltrated waters. Results show that aquifer recharge through secondary porosity features typically occurs within a few hours of a rainfall event, and this rapid recharge accounts for 12-28% of total recharge over a 5-year period. The majority of aquifer recharge occurs, on average, within a month after a contributing storm event. A small fraction of recharge (<10%) took longer than 2 months to reach the water table. The established framework can be applied to other karst aquifers to improve our understanding of water storage in the vadose zone and subsequent recharge dynamics.

PRESENTER BIO: Dr. Spellman is an Assistant Professor at the University of South Florida. Her work involves constraining water budgets on small island nations to inform water resource management. She also focuses on problems related to karst aquifer flow and solute transport, and how changing climate and land use impact these dynamics.