where a and b are the slope and y-intercept, respectively, of the LMWL $\delta^2H = 7.15\ \delta^{18}O + 9.28$ (R^2 0.93, n =145) from (Klaus *et al* 2015). This LMWL was derived from the Upper Fourmile Branch at the Savannah River Site, South Carolina. Like our study site in SE Georgia, the Savannah River Site is also in the Coastal Plain physiographic region of the Upper Atlantic, and thus (in the absence of locally derived, SE Georgia MWL) represents the best and most applicable LMWL there is to date.

2.3 Water level data and analysis

We analyzed daily water level records from 1978 to 2025 for two USGS groundwater wells—27G003 near Waycross and 27E004 at Jones Island—and for surface water in Jones Island Swamp, within the Okefenokee region (Okefenokee National Wildlife Refuge 2025). Elevation data were converted to meters above mean sea level and resampled to a common daily time base using vectorized interpolation to address temporal gaps and averaging algorithms to resolve duplicate values.

To assess hydrologic connectivity between swamp and aquifer, we applied complementary statistical tools. Pearson correlations captured linear covariation, while dynamic time warping quantified pattern similarity independent of time shifts (Hemri and Klein 2017, Sammour *et al* 2019). Frequency-dependent coherence was evaluated using magnitude-squared coherence computed via Welch's method (Malekpour *et al* 2018). Directional dependencies were probed using simplified Granger causality (Guo *et al* 2010, Shojaie and Fox 2022, Tuttle and Salvucci 2017), and mutual information (Tiwari *et al* 2020)—estimated from histogram-based distributions—provided a nonparametric measure of shared variability. We focused detailed analysis on the most complete and continuous data interval (July 2017 to August 2020; n = 1,135 days), maximizing statistical power and minimizing interpolation artifacts.

We estimated aquifer hydraulic properties by modeling the impulse response between surface and groundwater levels at Jones Island (Strupczewski *et al* 2003, Lu *et al* 2022). The response function is estimated using ordinary-least-squares regression deconvolution (Rasmussen and Mote 2007, Toll and Rasmussen 2007, Rasmussen and Crawford 1997). The analytical response function is,

$$R(\tau) = 1 - \frac{4}{\pi}\sum_{n=0}^{\infty}\frac{(-1)^n}{2n+1}\exp\left[-(2n+1)^2\pi^2\tau\right]$$

(Eq. 3)

where τ is the dimensionless time defined by $\tau = \frac{D}{tb^2}$. Here, t is the elapsed time (days), D is the vertical hydraulic diffusivity (m²/d), and b is the vertical thickness (m) of the leaky layer through which vertical flow occurs (see Supporting Information). This formula represents the aquifer's theoretical response to a unit step change in swamp

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