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Integrity of thin fresh water lenses in coastal wetlands to temporal changes of recharge by rainfall

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In coastal zones with saline groundwater, fresh groundwater lenses, that are fed by infiltrating rainwater, may control plant species diversity. Zonation of plant species listens sensitively to soil water salinity. The thickness, both of the lens (M) and the mixing zone (S), determines fresh water availability for plant growth. Recharge variations at seasonal and smaller and larger temporal scales affects these thicknesses M and S. We show how ecological plant composition studies deal with soil water salinity, and how this salinity may vary for a coastal wetland. Numerically, we quantify how M and S are affected by temporal variability or recharge, in a dimensionless setting, considering among others impacts of weather/climate properties, Rayleigh number and Mass flux ratio of saline and fresh water, as these dominantly influence the thickness of relatively thin lenses and their mixing zone. We do so, taking density gradients into account. For recharge we consider sinusoidal variations and actual rainfall/recharge records. The normalized lens volume appears linearly dependent on the main lens and recharge properties, enabling an analytical approximation of the variation of lens thickness. The variance of transition zone thickness (S**2) is compared with that of a Fickian mixing regime and can be related simply with temporal variability of M, for both a sinusoidal recharge variation and actual recharge records. With convolution, the delay between recharge and lens thickness changes can be quantified, besides the amplitude of variations. Hence, the analysis provides us with a first order approximation of lens properties using basic lens and recharge parameters, with minimal use of numerical models. This enables the assessment of the vulnerability of thin fresh water lenses for weather variability.