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Stochastic water table dynamics in groundwater-dependent ecosystems

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Humidlands are environments where the groundwater plays a key role on the ecosystem function. Contrary to water limited ecosystems, where water table is mostly out of reach for the vegetation, groundwater-dependent ecosystems exhibit important interactions between the water table and vegetation dynamics. We propose here an analytical model to study the interactions between rainfall, water table and vegetation in humidland ecosystems. The groundwater dynamics is studied as a random process, stochastically driven by a marked Poisson noise representing rainfall events. Infiltration, root water uptake, water flow to/from an external water body, and capillary rise are accounted for in a probabilistic description of water table fluctuations. We obtain analytical expressions for the steady-state probability distribution of water table depth, which allows us to investigate the long term behavior of water table dynamics, and their sensitivity to changes in climate, vegetation cover, and water management.