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Physical and numerical modelling of tidal influence on saltwater intrusion in an unconfined coastal aquifer

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Studies of saltwater intrusion in coastal unconfined aquifers typically assume a static boundary condition at the shoreline defined by the mean sea level, neglecting oceanic oscillations including tides and waves. In this study, both physical and numerical models were developed to investigate the behavior of the saltwater wedge under the influence of tidal oscillations. The physical experiments demonstrated that the tidal oscillations led to the formation of an upper saline plume (USP) in the intertidal zone. This USP pushed the freshwater discharge zone seaward to the low tide mark and restricted the landward advancement of the saltwater wedge. We also modified the variably saturated density-dependant flow model, SUTRA, to incorporate the tidal forcing on the coastal boundary and the formation of seepage face in simulating the responses of the coastal aquifer to tides. The simulation results matched well the phenomena as observed in the physical experiments. The outcomes indicate that neglect of tidal influence leads to overestimation of saltwater intrusion and misplacement of the outflow location of inland groundwater discharge.