



Effect of spring-neap tide and evaporation on the salt dynamics in estuarine marshes

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Salt dynamics in estuarine tidal marshes are strongly associated with their intrinsic hydrological processes and ecological behaviors, which are not well understood. Numerical simulations were carried out to investigate the transport and distribution of pore-water and salt in a vertical cross section perpendicular to a tidal creek that subjects to spring-neap tide and evaporation. Vaporizing pore-water from the unsaturated soil surface with salt left in, the time-variant actual evaporation is affected by aerodynamic factors as well as soil conditions, including pore-water saturation, salinity and the thickness of salt precipitation above the soil surface (efflorescence). Different simulation cases were performed by adjusting the potential evaporation rate, tidal signals, marsh platform slope and soil properties. The simulation analysis indicates that, the tide-averaged soil salinity increases with the reduction of inundation period under a spring-neap tide cycle. As the salt accumulated by evaporation could leave soil from seepage back to seawater during ebbside, the pore-water salinity at the surface within the tidal range remains below solubility. Coarse soils tend to have more intensified seepage flow and hence less pore-water salinity than fine soils. With the presence of hyper-saline soil and efflorescence, salt flat develops only in the area where capillary connection between evaporating surface and water table is maintained while tidal inundation absent. On the contrary, the supratidal marsh where hydrological connections are disrupted keeps a relatively low soil salinity (40-60 ppt) and pore-water saturation as evaporation remains low throughout the tidal cycles.