Ecohydrology of Salt-Affected Ecosystems: From the Plant-hydraulics- to the Catchment-scale

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Abstract

Soil salinization represents one of the most widespread forms of land degradation worldwide, posing an enormous threat to food security, sustainable development, and ecosystem resilience across a wide range of climatic, hydrological, and socio-economic conditions. Globally, it already affects an area about the size of Continental United States (circa 1.1 Gha) and is expected to further intensify in response to climate change, sea-level rise (SLR), and increasing demand for crop production. Salt-affected soils are prevalent in arid regions, which are naturally prone to salt accumulation due to elevated evaporative demand and low precipitation input. However, salinity also plays a crucial role in regulating vegetation-climate interactions in highly carbon-intense tidal ecosystems - now threatened by SLR and coastal salinization. This contribution explores the hydrological controls of soil salinization across a wide range of temporal and spatial scales - ranging from the plant to the catchment scale. We focus, in particular, on how salinity affects the bi-directional interaction between vegetation and climate in both the dry land and tidal critical zone. Using both process-based models and observations, we unveil the central role of plant-salt tolerance in regulating soil-plant-atmosphere interactions and show how salinity acts as an aridity enhancer, able to exert major controls on vegetation-climate interactions in the critical zone.

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