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Looking inside out: tracing internal moisture and salinity changes in dunes on the west coast of Ireland

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Coastal sand dune systems are some of the most physically dynamic landscapes; their susceptibility to geomorphic change is rooted in a host of interconnected processes and feedbacks. Soil moisture and salinity are two fundamental environmental variables capable of exerting a geomorphic influence but have not been thoroughly investigated in coastal dunes. In northwest Europe, coastal dunes are predominantly sediment-limited systems with reduced capacities to avoid severe morphological changes arising from storms. Climatic changes over the next century are predicted to manifest in more frequent and intense storms with the potential to enact severe geomorphic change in coastal settings. A lack of data pertaining to internal dune hydrosaline dynamics suggests we are missing part of the bigger picture.

We conducted a pilot study of moisture and salinity dynamics within the upper 50 cm of the vadose zone in a vegetated dune system at Golden Strand, Achill Island on the west coast of Ireland. Golden Strand is a roughly 800 m long embayed sandy beach, backed by vegetated dunes that protect a low-lying machair grassland. A study transect was established across this dune-machair system, perpendicular to the shore. Innovative instrumentation in the form of capacitance probes and internal dune thermochrons were deployed to sample at 10 cm depth intervals at a sampling rate of 10 minutes and coupled with on-site rainfall data.

Results indicate that dune moisture tracks rainfall inputs up to 30 cm depth. Antecedent moisture at depth was found to influence infiltration of water through the dune profile. Salinity within the study transect decreased with distance from the beach, suggesting that salt spray is the primary salt delivery mechanism in the dune system. We also noted that moisture and salinity below 30 cm depth failed to respond to rainfall events of varying intensities. Relatively constant moisture and salinity were observed at all depths within the machair.

Predictions of climatic change for Ireland suggest more intense short-period precipitation events, this may increase infiltration depth. Baseline data collected will prove informative in predicting the response of Irish coastal dunes via changes in vegetation and dune stability.