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Geotechnical properties of salt marsh and tidal flat substrates at Tillingham, Essex

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Salt marshes provide flood defence value by attenuating waves, tidal and storm surge-induced currents. Hence, marshes are an integral component of the coastal profile (the combined influence of the tidal flat, salt marsh and engineered defences) that protects the hinterland from incoming waves and extreme water levels. The ability of marshes to sustain this function depends on marsh stability. Marsh stability reflects the ability of marsh surface and margin substrates to resist erosive hydrodynamic forcing, while also accreting at a rate at least commensurate with sea-level rise (Reed, 1995). Marsh stability depends upon the hydrodynamic force incident upon the landform and the resistance of the marsh platform and margin to erosion. However, while sea wall stability and strength are often well understood, marsh substrate stability is not. Some studies have addressed the effect of certain biological or geochemical properties on marsh erosion rates, but to the authors' knowledge there currently exists no systematic study relating marsh geotechnical properties (e.g. shear strength, compressibility, plasticity) to biological or geochemical properties. Models simulating marsh evolution under future climate change scenarios frequently include an erodibility coefficient (e.g. Mariotti & Carr, 2014), but this index has not been linked to measurable biological or biogeochemical properties, nor does it encompass the range of erosion mechanisms possible (e.g. cliff undercutting, gravitational slumping) (Mariotti & Fagherazzi, 2013).

Here, we present, to the best of our knowledge, the first systematic study of marsh and mudflat substrate geotechnical properties. To assess the resistance of the marsh and tidal flat to surface erosion, we use cohesive strength meter and shear vane measurements of the in situ resistance of surface substrates to erosion by water and the in situ undrained shear strength on the surface, respectively. The in situ methods are complemented by detailed laboratory tests (shear strength, compressibility and consistency limits) to investigate the resistance of the marsh edge to retreat. These geotechnical results are then interpreted within the context of recent lateral- and elevation change at the site.

References:
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