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The effects of tidal range on saltmarsh morphology

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Saltmarshes are highly productive coastal ecosystems that act simultaneously as flood barriers, carbon storage, pollutant filters and nurseries. As halophytic plants trap suspended sediment and decay in the settled strata, innervated platforms emerge from the neighbouring tidal flats, forming sub-vertical scarps on their eroding borders and sub-horizontal pioneer zones in areas of seasonal expansion. These evolutions are subject to two contrasting influences: stochastically generated waves erode scarps and scour tidal flats, whereas tidally-generated currents transport sediment to and from the marsh through the channel network. Hence, the relative power of waves and tidal currents strongly influences saltmarsh evolution, and regional variations in tidal range yield marshes of differing morphologies.
We analyse several sheltered saltmarshes to determine how their morphology reflects variations in tidal forcing. Using tidal, topographic and spectral data, we implement an algorithm based on the open-source software LSDTopoTools to automatically identify features such as marsh platforms, tidal flats, erosion scarps, pioneer zones and tidal channels on local Digital Elevation Models. Normalised geometric properties are then computed and compared throughout the spectrum of tidal range, highlighting a notable effect on channel networks, platform geometry and wave exposure. We observe that micro-tidal marshes typically display jagged outlines and multiple islands along with wide, shallow channels. As tidal range increases, we note the progressive disappearance of marsh islands and linearization of scarps, both indicative of higher hydrodynamic stress, along with a structuration of channel networks and the increase of levee volume, suggesting higher sediment input on the platform. Future research will lead to observing and modelling the evolution of saltmarshes under various tidal forcing in order to assess their resilience to environmental change.