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## Understanding salt marsh resilience to changes in external disturbance

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Salt marshes are valuable ecosystems that provide numerous services and act as natural coastal defences by buffering storm waves and stabilising sediments. However, it is not clear whether they will be able to retain their resilience with accelerating rate in sea-level rise, possible increases in storm intensity, increasing land reclamation and changes in sediment supply. The current paradigm is that a positive sediment budget supports the survival and accretion of salt marshes while a negative sediment budget causes marsh degradation. Here we present the results of two studies (Pannozzo et al., 2021a,b; Pannozzo et al., 2021c) that used an integration of modelling and paleoenvironmental analysis and a sediment budget approach to investigate the resilience of estuaries and salt marshes to projected rise in sea-level, possible increases in storm activity, existing anthropogenic disturbance and natural sediment supply. The studies were conducted using the Ribble Estuary - North-West England - as a test case, the hydrodynamic model Delft3D to simulate the estuary morpho-dynamics under selected scenarios, and optically stimulated luminescence (OSL), geochemistry and particle size distribution analysis to reconstruct the past evolution and adaptation of the estuary morphology. Pannozzo et al. (2021a,b) showed that sea-level rise threatens estuary and marsh stability by promoting ebb dominance and triggering a net export of sediment. Conversely, storm surges aid the resilience of the system by promoting flood dominance and triggering a net import of sediment and have the potential to counteract the negative impact of sea-level rise by masking its effects on the sediment budget. Pannozzo et al. (2021c) showed that the addition of embankments can further promote ebb dominance in the system and intensify sediment export, further threatening marsh stability. This latest effect, however, becomes negligible with high natural sediment supply to the system.

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