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Data-driven modelling of morphological evolution in salt marshes: The role of morphometric system status indices exploiting high resolution spatial datasets

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Saltmarshes provide valuable ecosystem services and are protected. Nevertheless they are generally thought to be declining in extent in North West Europe and beyond. The drivers of this decline and its variability are complex and inadequately described. When considering management for future ecosystem service provision it is important to understand why, where, and to what extent areal decline is likely to occur. Physically-based morphological modelling of fine-sediment systems is in its infancy. The models and necessary expertise and facilities to run and validate them are rarely directly accessible to practitioners. This paper uses an accessible and easily applied data-driven modelling approach for the quantitative estimation of current marsh system status and likely future marsh development.
Central to this approach are monitoring datasets providing high resolution spatial data and the recognition that antecedent morphology exerts a principal control on future landform change (morphodynamic feedback). Further, current morphology can also be regarded as an integrated response of the intertidal system to the process environment . It may also, therefore, represent proxy information on historical conditions beyond the period of observational records. Novel methods are developed to extract quantitative morphological information from aerial photographic, LiDAR and satellite datasets. Morphometric indices are derived relating to the functional configuration of landform units that go beyond previous efforts and basic description of extent.
The incorporation of morphometric indices derived from existing monitoring datasets is shown to improve the performance of statistical models for predicting salt marsh evolution but wider applications and benefits are expected. The indices are useful landscape descriptors when assessing system status and may provide relatively robust measures for comparison against historical datasets. They are also valuable metrics when considering how the landscape delivers ecosystem services and are essential for the testing and validation of morphological models of salt marshes and other systems.