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Spatio-temporal patterns of daily sediment elevation changes in relation to tidal and wave actions in a macrotidal flat

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Sediment dynamics in tidal flats, ranging from daily to seasonal timescales, are especially relevant as they determine key ecological and geomorphic processes that contribute to the long-term evolution of coastal and estuarine landscapes. Yet, studies that integrate high-resolution bed level measurements over seasonal to yearly periods are relatively scarce due to limitations in current measuring equipment and methods.
An 18-month field survey involving high resolution (∼daily) measurements of bed level changes and associated external forcing—tidal hydrodynamics, wave activity, suspended sediment concentrations—was conducted along two cross-shore transects within a macrotidal flat located in the inner Scheldt estuary, Belgium.
Results revealed that daily bed level changes and intra-tidal sediment resuspension were dominated by either tidal or wave forcing, depending on the location within the intertidal zone. Furthermore, seasonal sediment deposition–erosion cycles superimposed on the daily bed level changes were associated with the seasonality of wind wave activity and benthic biology. Spatial variation in tidal flat sediment characteristics also partly explained differences of the morphological impact of tides and waves and the consequent patterns of bed level changes between the two transects.
This complex spatio-temporal variability of internal and external forcing highlights the necessity to conduct comprehensive and detailed field measurements to better understand and predict short-term bed level dynamics in tidal flats and related ecological implications.