EGU21-14069
https://doi.org/10.5194/egusphere-egu21-14069
EGU General Assembly 2021

Coastal wetland substrate elevation is dynamically related to accommodation space and influenced by sea-level rise

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The resilience of coastal wetlands in the fate of sea-level rise is proposed to be related to the combined influence of changes in substrate organic matter volume, mineral sediment volume, auto-compaction of accumulating material and deep subsidence; however, relatively few studies have measured all of these variables. In addition, there is ongoing debate about the suitability of this data for modelling the behaviour of coastal wetlands under anticipated sea-level rise projections as temporal discrepancies in the elevation response of coastal wetlands derived from observational and stratigraphic records exist. To resolve these issues, data derived from a range of techniques sensitive to changes occurring at annual, decadal and century timescales, is presented in the context of available accommodation space, that is, the space in which tidally-borne material can accumulate. Focussing on an embayment in Victoria, Australia, analyses confirm that at annual-decadal timescales, organic matter behaves like a sponge, compressing as the overburden of material accumulates, resulting in auto-compaction that modulates the degree of surface elevation change that occurs as tidally-borne material accumulates. These processes operate concurrently and are influenced by sediment availability, yet vary on the basis of available accommodation space. At longer timescales, the influence of auto-compaction diminishes as organic matter has undergone significant compression and decomposition, yet accumulated material remains proportional to available accommodation space. These analyses confirm that temporal discrepancies in rates of substrate elevation change can be resolved by accounting for the timescale over which processes operate and the influence of sea-level rise on available accommodation space. Accordingly, models should dynamically consider rates of surface elevation change relative to available accommodation space.