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A spatially-distributed eco-geomorphic model for the coevolution of landscape, vegetation and sedimentation in coastal wetlands affected by sea-level rise and man-made flow structures

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On a global scale, the sustainability and resilience of coastal wetlands to sea-level rise depends on the slope of the landscape and a balance between the rates of soil accretion (due to eco-geomorphic feedbacks) and the sea-level rise. However, local human-made flow interventions can have comparable effects. We use a spatially-distributed dynamic wetland eco-geomorphic model that not only incorporates the effects of flow modifications due to culverts, gates, drainage ditches, but also considers that vegetation changes as a consequence of changing inundation patterns. The model includes hydrodynamics, sediment and vegetation components. To realistically represent the vegetation ability capture sediment and produce accretion, we implement an advection-driven sediment transport and deposition model, so we can produce a constantly evolving landscape. Vegetation and sediment feedbacks are regularly incorporated in the hydrodynamics model component to modify the inundation patterns. We test a number of different flow control interventions on a tidal flat with conditions typical of SE Australian coastal wetlands.

The results show increased sedimentation near drainage channels, but a considerable decrease far from it, in agreement with previous observations. We compare the results with a simpler sedimentation model based on water depth and analyse the implications for vegetation dynamics during sea-level rise.