Geophysical Research Abstracts
Vol. 21, EGU2019-10189, 2019
EGU General Assembly 2019

Sea-level rise, inland wetland migration and man-made flow controls

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At a large scale the sustainability and resilience of coastal wetlands to sea-level rise depends on the slope of the landscape, a balance between the rates of vegetation-enhanced soil accretion and the sea-level rise and their capacity to migrate inland. Coastal infrastructure controlling flow in the wetlands (culverts, gates, weirs, ditches. embankments) can pose an additional constraint on the adaptive capacity of these ecosystems, but can also present opportunities for targeted flow management to increase their resilience.
Coastal wetlands in SE Australia are heavily managed and typically present infrastructure including flow control devices. How these flow control structures are operated respond to different ecological conservation objectives (i.e. bird, frog or fish habitat, carbon sequestration) that can sometimes be mutually exclusive. For example, promoting mangrove establishment to enhance fish habitat results in saltmarsh decline thus affecting bird habitat. Moreover, sea-level rise will change hydraulic conditions in wetlands and may result in some flow control structures and strategies becoming obsolete or even counterproductive. In order to address these problems and in support of future management, we have developed a spatially-distributed predictive tool for long-term wetland evolution (including vegetation and carbon capture) that incorporates the effects of infrastructure and other perturbations to the tidal flow within the wetland (i.e. vegetation resistance) and determines how these flow conditions affect vegetation establishment, migration and survival. We use the model to support management and analyse different scenarios of sea-level rise and flow control measures aimed at preserving habitat and capture carbon. Our results show the potential of targeted flow management to moderate the effects of sea-level rise. They also show that sea-level rise can affect the efficiency of some management measures and in some cases may completely override their effect.