



The future of global coastal wetlands in response to sea level rise

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Globally, coastal wetlands and their associated ecosystem services are at risk from sea level rise (SLR). A wide range of models exist that seek to quantify the potential magnitude of this loss. However, whilst local-scale models commonly find coastal wetlands to be relatively resilient to SLR due to increased sediment accretion, many regional and global scale models suggest a dramatic decrease in global wetland area by the end of the century. One possible reason for the discrepancy is the failure to account for bio-physical feedback mechanisms, which govern the sediment accretion processes and play an important role in the capacity of coastal wetlands to adapt to SLR. Existing regional and global scale models thus likely overestimate expected losses.

Here we present an integrated global model which accounts for the vertical adaptability of coastal wetlands, via bio-physical feedbacks between wetland accretion and SLR, as well as horizontal adaptability via interactions between inland wetland migration and accommodation space – defined as the available space for lateral wetland expansion given the current position of the wetland, the tidal frame and erosive forces. In doing so, we present robust projections of changes to coastal wetlands and their resilience due to SLR during the 21st century. We also quantify the extent to which resilience is constrained by vertical and horizontal resilience mechanisms.

The results of the model show that coastal wetlands in many regions of the world are more resilient to SLR than previously thought due to their ability to accumulate sediments and grow vertically with rising sea levels. However, resilience was found to be even more dependent upon the availability of accommodation space, which varies in relation to factors such as the extent and degree of anthropogenic occupation and the associated development of coastal infrastructure (e.g. seawalls, roads, railways, etc.). Given an estimated 10% of the global population is currently living in coastal areas below 10 meters and the current projections that this percentage will significantly increase in the future, our results suggest a large-scale reduction in accommodation space will be a major contributing factor to coastal wetland resilience and loss into the future. Under a business-as-usual scenario, up to 31% of the present-day global coastal wetland area may be lost.

Climate change and SLR necessitate adaptation strategies for coastal areas. The results presented here demonstrate a clear need for policy makers and coastal managers to appreciate and account for the importance of accommodation space when developing adaptation strategies seeking to minimise the impact of SLR on coastal areas. We show that large-scale loss of coastal wetlands is avoidable if new accommodation space can be created through innovative “nature-based adaptation” schemes, currently implemented as local-scale projects only. A strategic upscaling of such approaches would allow coastal wetlands to adapt to SLR and help better protect the rapidly increasing global coastal population.