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# The evolution of the barrier-island-lagoon system under rising sea levels

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We employ the model proposed by Lorenzo-Trueba and Mariotti (2017;Chasing boundaries and cascade effects in a coupled barrier-marsh-lagoon system, Geomorphology, Volume 290, pp 153-163) to study the evolution of a generalized barrier-island-marsh-lagoon-marsh system under different sea-level rise scenarios, such as RCP 4.5 (with and without Antarctic contribution) and RCP 8.5 (with and without Antarctic contribution), until the year 2100. The model is employed to perform Monte-Carlo type simulations to address uncertainties in the sea-level rise scenarios and the subsequent effects on the sediment overwash flux. To address the latter, we sample future probabilistic surge height distributions, for example from Irish and Resio (2013; Method for Estimating Future Hurricane Flood Probabilities and Associated Uncertainty, Journal of Waterway, Port, Coastal, and Ocean Engineering, 139, pp 126-134).

From the simulations, we conclude that not surprisingly the evolution of the marsh-lagoon-marsh portion of the system is governed by much shorter time scales than the development of the barrier island itself. This also leads to the conclusion that the marsh-lagoon-marsh system is much more sensitive to the sea-level scenarios, namely the timing and rate of sea level rise. The results are consistent with previous studies, showing that, reducing the overwash sediment flux artificially, for example, due to hardening of the coastline, negatively impacts the evolution of the marsh-lagoon-marsh system, but also negatively impact the barrier island.

To conclude, the barrier-island-marsh-lagoon-marsh system is a very sensitive system. If we take the marsh-lagoon-marsh system as green infrastructure to protect the mainland from the impact of hurricane surge and wave impacts, not including the evolution of the barrier island and adjacent marshes in the future hazard assessment is a mistake. Our modeling shows that the marsh-lagoon-marsh portion is dependent on the barrier island evolution, despite the fact the barrier island evolution is governed by longer time scales, and the service that the marsh-lagoon-marsh system provides degrades very quickly.