Forecasting long-term shoreline evolution in highly anthropized coastal areas

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A new numerical model for addressing long-term coastline evolution on a local to regional scale on highly anthropized coasts is presented. The model, named IH-LANS (Long-term ANthropized coastlines Simulation tool), is validated over the period 1990-2020 and applied to obtain an ensemble of end-of-century shoreline evolutions. IH-LANS combines a hybrid (statistical-numerical) deep-water propagation module and a shoreline evolution model. Longshore and cross-shore processes are integrated together with the effects of man-made interventions. For the ease of calibration, an automated technique is implemented to assimilate observations. The model is applied to a highly anthropized 40 km stretch located along the Spanish Mediterranean coast. High space-time resolution climate data and satellite-derived shorelines are used to drive IH-LANS. Observed shoreline evolution (<10 meters of root mean square error, RMSE) is successfully represented while accounting for the effects of nourishments and the construction and removal of groynes, seawalls and breakwaters over time. Then, in order to drive the ensemble of end-of-century shoreline evolutions, wave and water level projections downscaled from different climate models for various emissions scenarios are employed to force the calibrated model. From the forecasted shoreline time-series, information from multiple time-scales is unraveled yielding valuable information for coastal planners. The efficiency and accuracy of the model make IH-LANS a powerful tool for management and climate change adaptation in coastal zones.