MORPHODYNAMICS OF OYSTER REEFS IN TIDAL FLATS UNDER VARIOUS SEA-LEVEL RISE AND WAVE SCENARIOS

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Oyster reefs are self-organized structures, that establish and grow through feedbacks between internal population dynamics and external factors. Reef self-organization depends on the balance of production and occupancy of the local substrate. The physical environment and mortality constrain reefs spatially by reducing production but expose substrate for recruits, which depend on spat deposition and growth. In estuarine environments, spat deposition is modulated by hydrodynamic and topographic parameters, such as waves, tides, and water depth. Here we couple an oyster population model with a simple wave model to take into account the feedback between hydrodynamics and reef evolution. In the model, spats deposition is modulated by the shear stress acting on the reef surface. Simulations are run for different combinations of tidal-flat geometries and hydrodynamic forcings. Model results show that reefs preferentially survive and reach a morphodynamic equilibrium for lower tidal-flat depths, narrower tidal flats, and lower wind intensities. Given the wind climate, lower water depths prevent the formation of high waves, even with high wind intensities, thus limiting the value of the shear stress, and facilitating spats deposition. Wider tidal flats allow for longer fetches and larger shear stresses, thus favoring reef collapse. With higher rates of sea-level rise, the parameter space that guarantees oyster growth drastically reduces. To our knowledge, this is the first attempt to couple hydrodynamics and population dynamics to predict the evolution of oyster reefs in intertidal environments at different climates. Our model results can be used by local managers to maximize the likelihood of success of oyster-reef restoration.

PRESENTER BIO: Daniele is a Ph.D. student at the Department of Civil and Coastal Engineering at the University of Florida. He got his bachelor’s and master’s degrees in Civil and Hydraulic Engineering at the University of Padova. In Spring 2019, Daniele joined Dr. Canestrelli’s lab, to improve numerical models in coastal environments.