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FORMATION AND PERSISTENCE OF RIP CURRENTS EXAMINED WITH A COASTAL ENGINEERING NUMERICAL MODEL, THE COASTAL MODELING SYSTEM (CMS)

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The literature on rip currents identifies many factors controlling the formation and persistence of rip currents. The presence of rips has been variously attributed to antecedent bathymetry, incident wave angle, infragravity waves, and hydrodynamic instability, among other mechanisms. The roles of many deterministic factors can be examined systematically by engineering numerical models. The present work demonstrates the utility of these models through variation of initial bathymetry, incident wave angle, longshore variation in wave height, and stage of tide. The Coastal Modeling System readily represents these processes in a depth-averaged approach including non-linear terms such as advection and quadratic bottom friction, as well as the wave-current interaction for spectral waves. In addition to the complex hydrodynamics, morphology change at rips is calculated with unified sediment transport formulas that smoothly match zones of non-breaking, breaking, and broken waves.

Idealized bathymetries have been established representing equilibrium beach profiles with and without longshore bars. Consequences for rip formation are examined through perturbations in the beach and bar for different wave and tide conditions. The incident waves include those that may have generated the bar and waves with different (greater or lesser) height. Transitions among horizontal circulation patterns are calculated such as those identified by Harris (1969) and Sonu (1972) as symmetrical and cellular (rip), meandering, and longshore current systems, and animations reveal the dynamic circulation pattern and morphology change. We are also examining the conditions causing either accretion or erosion at the roots of rip currents, as well as rip current deltaic formations offshore of the surf zone. Such modeling can be done efficiently and is applicable to surf zone condition forecasting for beach safety alerts.