Finite Element Modeling of Coastal Ocean Circulation

Research focuses on the characterization of circulation and transport dynamics in nearshore, riverine, estuarine, and coastal environments, with the objective to quantify interrelationships between numerous, complex physical processes that govern three-dimensional circulation and mixing. The approach centers on the development and application of finite element-based (unstructured grid) numerical coastal circulation models that have advanced to include the full suite of baroclinic, tidal, riverine, wind-driven, and wave-driven physics. The finite element discretization offers unequaled flexibility with respect to the representation of geometric complexities that include moving shorelines in the intertidal zone. Applications have spatial scales ranging from semi-enclosed seas, to embayments, rivers and nearshore beaches. Areas of emphasis include (1) the inter-tidal zone where development of a physically-based shoreline inundation algorithm and the inclusion of river dynamics is a priority; (2) the incorporation of advanced 4DVAR data-assimilative techniques into the modeling systems with particular interest in the utilization of remotely sensed observations from platforms such as SAR, LANDSAT, and video cameras; (3) the development of coupled dynamics linking circulation models to groundwater and overland flow regimes at the land-sea interface as well as investigating chem.-bio processes driven by coastal circulation and transport; and (4) implementation of a relocateable, real-time forecast system that includes automated mesh generation. We are also interested in new approaches that quantify model capabilities through comparisons to *in situ* and remotely sensed observations.