



**US Army Corps  
of Engineers®**  
Engineer Research and  
Development Center

# Coastal Inlets Research Program (CIRP)



**Humboldt Bay jetties protecting deep-draft entrance channel, California**

### Description of Research

The [Coastal Inlets Research Program \(CIRP\)](#) advances knowledge and develops predictive technology to reduce the cost of dredging, promote navigation channel reliability, and improve means to maintain the sediment-sharing interactions among inlets, adjacent beaches, and estuaries. The research is conducted at the Engineer Research and Development Center's (ERDC's) [Coastal and Hydraulics Laboratory \(CHL\)](#) where studies range from physical processes from the watershed, through rivers and estuaries, and beyond the shore to deep water. CIRP research and development covers numerical modeling, physical modeling, lessons learned, and basic research on hydrodynamics (waves, currents, water level), sediment transport, and morphology change.

### Problem

Navigation projects at coastal inlets must be designed, operated, and maintained in a complex hydrodynamic and morphologic environment. Inlet morphology responds to engineering actions on several time scales ranging from short-term, as in response to storms, to slow, gradual change caused by waves and currents acting over decades. Because the hydrodynamics, inlet morphology, navigation channel, and longshore sediment transport are connected, navigation project maintenance and natural processes must be estimated to minimize channel dredging and to promote sediment bypassing, either by natural processes or through dredging-related activities. To meet the challenges of channel deepening nationwide and creation of new channels, quantitative predictive models and analysis tools are being developed in the CIRP that can calculate navigation channel and morphology change and connect the processes to the adjacent beaches.

### Expected Products

CIRP comprises six work areas generating major products such as follows:

- **Coastal Modeling System (CMS):** Integrated modeling system for tide, wind, and wave-induced circulation, random waves, sediment transport, and morphology change, including interactions with channels and jetties. Typical process-based CMS simula-

tions cover morphology change from storms (days) to decades. Documentation of CMS is provided by the CIRP wiki pages, [http://cirp.usace.army.mil/wiki/Main\\_Page](http://cirp.usace.army.mil/wiki/Main_Page).

- **Geomorphic Evolution:** Empirical and mathematical models of long-term morphology change at inlets, including sediment bypassing; channel infilling and migration, barrier island breaching, all developed based on theory, analytical solutions, and data analysis.
- **Inlet Engineering Toolbox:** Online and PC-based toolboxes to provide rapid calculations to Districts. Toolboxes include Tidal Analysis and Prediction, Section 111 Navigation Project Impact Toolbox, Channel Shoaling, Inlet Reservoir Model, updated Tidal Hydrodynamics model.
- **Waves at Jetties and Breakwaters:** Numerical model of non-linear wave-wave interactions, wave run-up on and transmission through structures, overtopping of jetties and breakwaters, nearshore berm bypassing, and particle tracking.
- **Coastal Navigation Portfolio Management:** Channel Prioritization Tool (CPT) and Coastal Structures Management, Analysis, and Ranking Tool (CSMART) for channel and structure economic evaluation and prioritization. Decision-support systems for transparent, consistent methodology for maintenance of channels and modification of structures.
- **Program Management and Technology Transfer:** Coordinates with the CIRP and with other R&D programs and leveraging opportunities. Responsible for workshops, CIRP web site, CIRP eNewsletter (quarterly distribution), and interfaces for models.

**Potential Users**

CIRP is producing information and tools to support the U.S. Army Corps of Engineers, private industry, and academia in addressing engineering and science problems at coastal inlets nationwide. All models and empirical tools are developed for running on desk-top computers in the office environment.

**Projected Benefits**

The program is focused on reducing the cost of design, operation, and maintenance of Federal inlet navigation projects in a systems approach that includes the adjacent beaches and estuary. CIRP products have yielded substantial cost savings and improvements for several Federal navigation projects, including study efficiency and reliability of results, and the technology is applicable to inlets nationwide.

**ERDC Program Manager(s)**

Julie Dean Rosati, CEERD-HF-CI, 109 St. Joseph St., Mobile, AL; phone, (251) 694-3719, e-mail [Julie.D.Rosati@usace.army.mil](mailto:Julie.D.Rosati@usace.army.mil). For further information, consult the CIRP website at <http://cirp.usace.army.mil> and the CIRP wiki documentation at [http://cirp.usace.army.mil/wiki/Main\\_Page](http://cirp.usace.army.mil/wiki/Main_Page).

**Participating ERDC Laboratories**

Coastal and Hydraulics Laboratory (CHL)