



## Coastal Inlets Research Program

# Boussinesq Modeling for Inlets, Harbors, and Structures (Bouss-2D)

### Description

The Boussinesq Modeling Technology (BMT) comprises of one- and two- dimensional (BOUSS-2D) numerical wave models for simulating nearshore waves and wave-induced circulation. It is applicable to a wide variety of coastal and ocean engineering and naval architecture problems, including: transformation of waves over small to medium spatial scale regions (1-15 km); planning and design of ports/harbors/ marinas; investigation of wave agitation and harbor resonance; risk analysis of ship transit, ship mooring and ship motion studies; wave breaking over submerged obstacles; wave-structure interaction including runup/overtopping of coastal structures, levees, groins, beaches, dunes and barrier islands; breaking-induced nearshore circulation; wave-current interaction at channels and inlets (Figure 1); infra-gravity wave generation by groups of short waves in ports and harbors; wave transformation over reefs, shoals/berms and around artificial islands; and impacts of vessel-generated waves on coastal shorelines and river banks. BMT can represent wave reflection/diffraction near structures, energy dissipation due to wave breaking and bottom friction, cross-spectral energy transfer due to nonlinear wave-wave interactions, breaking-induced longshore and rip currents, wave-current and wave interaction with porous media, vegetated areas, wetlands and marshes, and vessel wakes and ship-channel-shore-bank interactions. A user-friendly interface of BMT is available in the Surface-water Modeling System (SMS) that allows users to generate model grids, input files, and post-process model results.

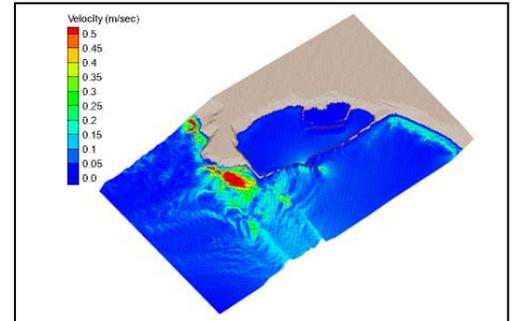


Figure 1. BOUSS-2D wave modeling at Pillar Point Harbor, CA

### Issue Addressed

The Corps Operation and Maintenance (O&M) budget spent for dredging navigation channels will increase with calls for deeper and wider channels to accommodate future fleets having larger vessels and drafts (Figure 2). BMT provides key engineering estimates for storms and non-storm waves, wave setup and wave-induced currents necessary for a risk-based design approach to evaluate the performance of navigation and flooding projects to advance coastal and hydraulic engineering practice and guidance. This decision support technology maybe used in design/repair of ports/harbors and costal infrastructures, flood levees, flooding and inundation of vulnerable coastal areas, assessment of operational risk problems in ports and harbors, and quantification of impacts of vessel-generated waves on erosion of shores and banks. BMT provides reliable and cost-effective engineering solutions for coastal and hydraulic problems, helps USACE to evaluate and

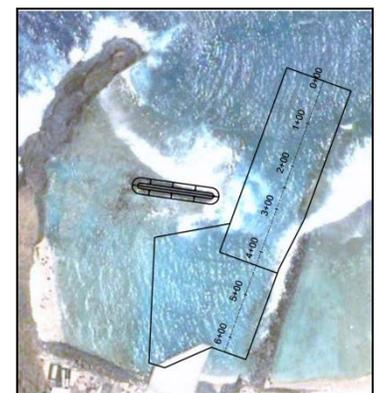


Figure 2. Channel deepening/widening at Faleasao Harbor, American Samoa

improve O&M design criteria and methods, construction, maintenance and operations practices, and identifies where present technology is inadequate or where research is required.

**Products** The primary product is BOUSS-2D, a multi-purpose advanced numerical wave model. It was developed for PC and super-computers and has a comprehensive and user-friendly interface in the SMS for grid generation, viewing and processing model inputs and outputs, and GIS data used in modeling.

**Application of Products** Recent applications include: Pillar Point Harbor, Oyster Point Marina, CA; Mouth of Columbia River, WA/OR; Grays Harbor, WA; Barbers Point Harbor, Kikiaola Harbor, Hilo Harbor, HI; Cleveland Harbor, OH; Pt Judith Harbor, RI; Diversey Harbor, IL; Mississippi River Gulf Outlet, New Orleans Flood Control Gates, LA; Buffalo Harbor, NY; Tau Harbor, and Faleasao Harbor, American Samoa.

**Projected Benefits** BMT helps USACE to evaluate challenging wave related issues in navigation and flooding projects to reduce the O&M costs by developing more accurate and cost-effective engineering solutions. BMT is used in optimization of integrated navigation system to improve performance, realignment, safety, reliability and operations of channels; improvement of navigation operations by advanced dredging practices and modifications for ports, harbors and marinas with innovative infrastructures design; probabilistic engineering design and rehabilitation estimates for jetties, breakwaters for coastal protection; evaluation of the impacts of engineering activities affecting safety of coastal navigation (e.g., channel deepening, and jetty modifications) in port access and utilization; and quantifying ship transit effects on erosion of coastal shorelines and river banks.

**Documentation** Model documentation includes a technical report and series of technical notes describing model theory, numerics, examples, and step-by-step user's guidance on model interface and applications. More than a dozen journal and conference papers provide additional information about BMT capabilities.

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**Websites**

- Please see the CIRP website to download documentation: <http://www.erdc.usace.army.mil/Missions/WaterResources/CIRP/Publications.aspx>
- View archived webinars: <http://www.erdc.usace.army.mil/Missions/WaterResources/CIRP/TechTransfer.aspx>
- Review guidance documented on the CIRP wiki: [http://cirpwiki.info/wiki/Main\\_Page](http://cirpwiki.info/wiki/Main_Page)