U.S. Defense Modeling and Simulation Office

Success Stories

June 2004

DMSO Supports Integration of Ocean Predictors

The Defense Modeling and Simulation Office (DMSO) has set its sights on providing wave, tide and surf data for after-action research and lessons learned, war games and strategic planning. The Distributed Integrated Ocean Prediction System (DIOPS) is a complete wave, tide and surf prediction system capable of running on Unix, Windows and Linux platforms. It was designed to provide worldwide wave forecasts from basin-to-beach scale. The maritime strategy for the future is emphasizing joint and combined littoral operations, including shallow water anti-submarine warfare, theater and ship self-defense, strike and landward assault. Commanders at all levels must know how the environment will impact their operations as well as the operations of their adversary and use this knowledge for military advantage. Sensor and weapon system developers must also understand the environment's effects on system performance to optimize design effectiveness.

As a subset of the littoral, the surf zone is the operating area for special operations teams and landing craft. Surf zone missions include mine and obstacle clearing, reconnaissance, building floating docks and landing the Marines on shore. Wave action, sea spray, bottom composition and beach slope are only a few of the issues surf models have to address.

The Department of Defense Modeling & Simulation Master Plan (DoD 5000.59-P, October 1995) states as one of its actions for the Modeling & Simulation Executive Agent (MSEA) for Ocean Representation, "Develop authoritative oceanographic process representations to include the interface with associated terrain and atmospheric effects (e.g., littoral region shoreline, bottom and wind conditions) for selected M&S functional areas." In 1997, the MSEA (Ocean), with DMSO support, initiated the Joint Surf Zone Environmental Representation System (JSZERS) project to provide a dynamic representation of the surf zone including environmental parameters such as currents, tides, waves, sea surface height and the water level changes induced by breaking waves and bottom sediment transport. That system was the first step in providing improved natural environmental representations to DoD programs such as the Joint Countermine Operational Simulation (JCOS) and Joint Logistics Over the Shore (JLOTS). In 1999, JSZERS was renamed as DIOPS.

DIOPS technology is a successful collaboration of model developers and standard models

It incorporates four operational Navy models: The Wave Action Model (WAM), a spectral wave prediction model that produces a directional spectrum of energy density from which significant wave height, average wave period and average wave direction can be computed; the shallow-water Simulating Waves Nearshore (SWAN) model, a third generation wave model that computes random, short-crested wind-generated waves in coastal regions and inland waters; the Navy Relocatable Tide and Surge Model (PCTIDES), a globally relocatable tidal prediction model consisting of a 2-dimensional barotropic ocean model; and the Navy Standard Surf Model (SURF), a surf forecasting model also used to generate surf climate descriptions.

Model outputs include a forecast summary which lists the surf zone width, the maximum wave height and long-shore current, direction of breakers, breaker type, breaker period, percent of breaking waves, breaker height, breaker angle, water depth, wave height and the Modified Surf Index, a dimensionless number that characterizes overall surf conditions used for operational planning.

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For more information contact Public Affairs
U.S. DEFENSE MODELING and SIMULATION OFFICE (DMSO)
1901 North Beauregard Street, Suite 500, Alexandria, Virginia 22311-1705 USA
PHONE 1-703-824-3437 or -998-0660 FAX 1-703-998-0667 E-MAIL *pao@dmso.mil* *www.dmso.mil*

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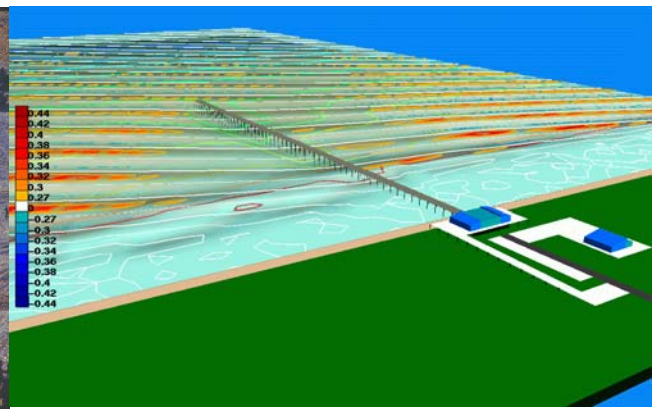
DIOPS uses Navy Operational Global Atmospheric Prediction System (NOGAPS) and Coupled Ocean Atmosphere Prediction System (COAMPS) field data for its wind field inputs. The NOGAPS forecasts are used primarily for basin scale WAM predictions, or in areas where COAMPS fields are not available. COAMPS is a higher resolution mesoscale model and its fields are used for higher resolution model runs, such as regional WAM areas, SWAN, PCTIDES and SURF models.

With DMSO support, the Argonne National Laboratory employed its Dynamic Information Architecture System (DIAS) to assemble a software object framework that allows these models to work together in various context-dependent combinations within the same simulation. The DIAS software architecture underlying DIOPS mandates that the models communicate only through domain objects. The modular approach allows individual components to be replaced or upgraded as model improvements become available. As a result, the DIOPS virtual maritime environment can be modified and extended far more easily than other "model federations."



DIOPS is available today

A DIOPS beta-test site was established at the Naval Pacific Meteorology and Oceanography Center (NPMOC-SD), San Diego, CA in 2001 and transitioned to operations in 2004. NPMOC-SD is an operational Meteorology and Oceanography Center (METOC) responsible for the prediction of environmental effects on major fleet training exercises and evolutions. DIOPS will also be one of the core capabilities of an ocean center of excellence (currently being planned) to support M&S. DIOPS has been successfully demonstrated as an effective tool in numerous U.S. and NATO exercises and has received positive feedback from METOC assets for supporting amphibious and special warfare operations. Distribution to the warfighter and visualization on the Defense Information Infrastructure - Common Operating Environment (DII-COE) command and control viewer called the Common Operating Picture (COP) have also been a keystone of DIOPS development.

Future plans call for the addition of the Delft3D model to DIOPS, which will provide a capability to generate 2-D surf predictions using very high-resolution bathymetry collected from Autonomous Underwater Vehicles.

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