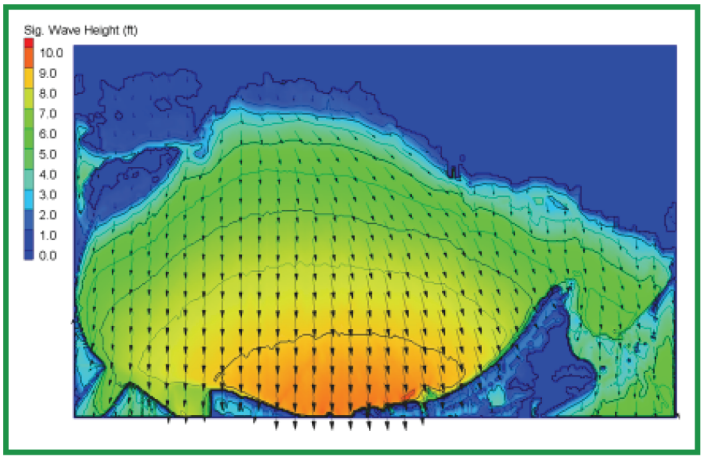
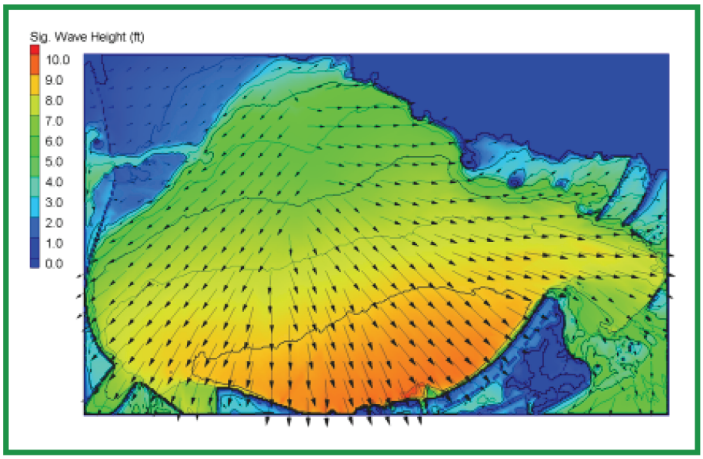
System-Wide Water Resources Program
SWWRP

Steady-State Spectral Wave Model (STWAVE)

Description: The Steady-State Spectral Wave Model (STWAVE) is an easy-to-apply, flexible, robust, numerical model that provides nearshore wind-wave growth and propagation. STWAVE simulates depth-induced wave refraction and shoaling, current-induced refraction and shoaling, depth- and steepness-induced wave breaking, diffraction, bottom friction, parametric wave growth generated by wind input, and wave-wave interaction and white capping that redistribute and dissipate energy in a growing wave field. STWAVE has been extended from a half-plane model to a full-plane model (including propagation and generation from all directions) with spatially variable wind and surge input. Ongoing work includes improvements to shallow-water growth and transformation processes.



Lake Pontchartrain modeled wave height and direction at peak of Hurricane Katrina (wave heights in feet)



Lake Pontchartrain maximum modeled significant wave height and corresponding mean direction for 0000 UTC on 29 August to 1200 UTC on 30 August 2005 (wave heights in feet) (IPET Report 2)

Application: Corps Districts and other government agencies, universities and private consultants use STWAVE. Applications of STWAVE include:

- **Hurricane Katrina, Louisiana and Mississippi.** The Interagency Performance Evaluation Task Force study is evaluating the wave and wave level impacts on the levees and flood walls in southeastern Louisiana and Lake Pontchartrain. This study requires efficient, high-resolution wave modeling of complex geometries/bathymetries over extensive areas. STWAVE is being applied for nearshore wave transformation and generation. STWAVE receives boundary conditions from a Gulf of Mexico-scale wave model, complex wind fields from detailed wind modeling/measurements, and spatially varying surge from the ADCIRC circulation model. STWAVE wave momentum fluxes are fed back into ADCIRC to calculate wave-induced setup. STWAVE is also being applied for 16 hypothetical hurricanes for the entire coasts of Louisiana, Mississippi, and input to improve the level of hurricane

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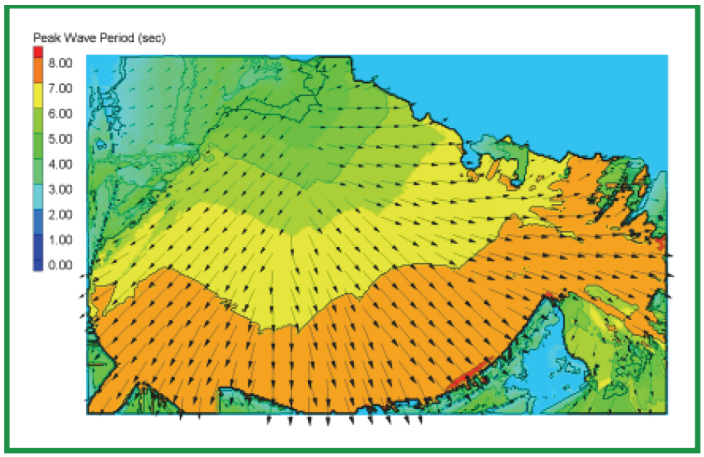

Lake Pontchartrain modeled peak wave period corresponding to the maximum wave height for 0000 UTC on 29 August to 1200 UTC on 30 August 2005 (periods in sec) (IPET Report 2)

protection in these areas. In the next phase, STWAVE will also be used to evaluate ecosystem restoration alternatives in southern Louisiana.

- **Chesapeake Bay,** Maryland**.** Constructed islands in Chesapeake Bay serve multiple purposes: disposal of dredged material, habitat enhancement, and adjacent shoreline protection. STWAVE was applied for the design of the expansion of Poplar Island, including design of the island protection and investigation of adjacent shoreline sheltering by the island expansion and was also applied to evaluate future expansion of Barren and James Islands. STWAVE was applied together with ADCIRC to evaluate sediment transport patterns around the proposed expanded islands.
- **Willapa Bay, Washington.** This location is a challenging environment to apply a wave transformation model. The inlet is subjected to high waves, strong currents, and large variations in water elevation, and the bathymetry at the Willapa entrance is complex and continually changing. As part of a study to determine navigability and estimate sediment transport for evaluating navigation-channel alternatives, STWAVE was run for Willapa Bay. The model was driven with incident spectra from the Grays Harbor Coastal Data Information Program (CDIP) buoy and water levels and current fields calculated with the circulation model ADCIRC. Wave measurements were made at three stations (M01, M02, and M03) for verification.

Benefits: Estimating nearshore wind-wave growth and transformation is a critical component of most coastal engineering projects such as predicting bathymetric and shoreline change, estimating navigation channel shoaling and migration, designing or repairing coastal structures, assessing navigation conditions, and evaluating natural evolution of coastal inlets or beaches versus consequences of engineering actions. STWAVE's numerical wave technology offers simulation of the waves that drive nearshore processes for Corps navigation, coastal flooding, and ecosystem restoration projects, allowing the Corps to choose the most cost-effective methods.

Future Capabilities:

- **FY07** - Bottom orbital velocities, wave asymmetry, xmdf conversion for output files, time-stepping, two-scale nonlinear interaction source term, statistical tools, GIS linkage
- **FY08** - Upgraded wind input and dissipation source terms
- **FY09** - Final validation, documentation, and release

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