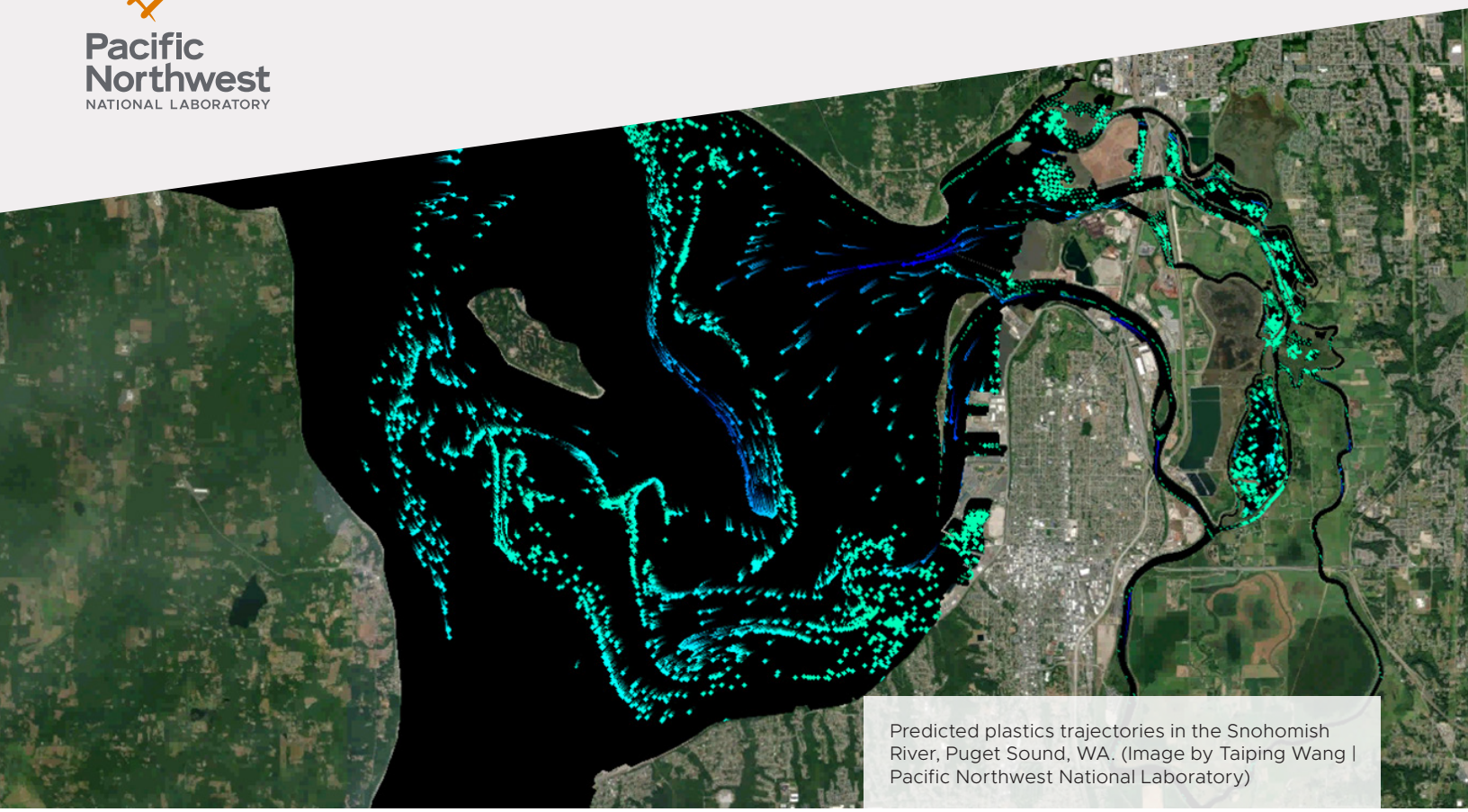
Pacific Northwest
NATIONAL LABORATORY



Predicted plastics trajectories in the Snohomish River, Puget Sound, WA. (Image by Taiping Wang | Pacific Northwest National Laboratory)

Modeling Ocean Dynamics

Supporting coastal ecosystems, climate-ready communities, and marine energy site selection

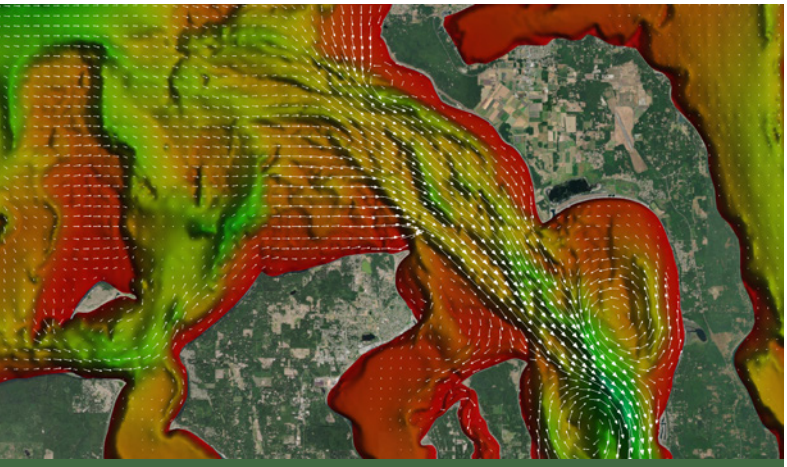
For the past decade, Pacific Northwest National Laboratory (PNNL) has developed and applied ocean models to inform marine management and policy. From estimating tidal power and wave energy to predicting hurricane storm surge and tracking plastic pollution, PNNL's modeling capabilities provide critical insights that support the nation's coastal resilience in the face of climate change.

SUSTAINING COASTAL ECOSYSTEMS

PNNL researchers have developed and applied models to assess marine ecosystem concerns, including pollutants, harmful algal blooms, and hypoxia, to support healthy coasts. They have simulated the complex interaction of ocean currents, nutrients, and weather on **macroalgal growth** to inform macroalgal harvests along the U.S. West Coast, Florida, and Puerto Rico. They are also tackling the growing coastal issue of plastic pollution. Through the Waterborne Plastics Assessment and Collection Technologies (WaterPACT) project, PNNL's modeling capabilities are being used to understand the extent of plastic pollution in U.S. waterways and prioritize areas for cleanup and plastic reclamation.

CLIMATE-READY COMMUNITIES

For coastal communities, the combined effect of **sea-level rise**, storm surge, and river flooding pose complex risks. PNNL researchers have developed high-resolution models to simulate realistic coastal

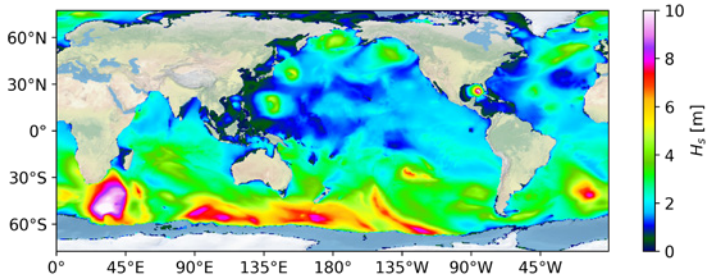


Simulated tidal current in Admiralty Inlet, Puget Sound, WA. (Image by Taiping Wang | Pacific Northwest National Laboratory)

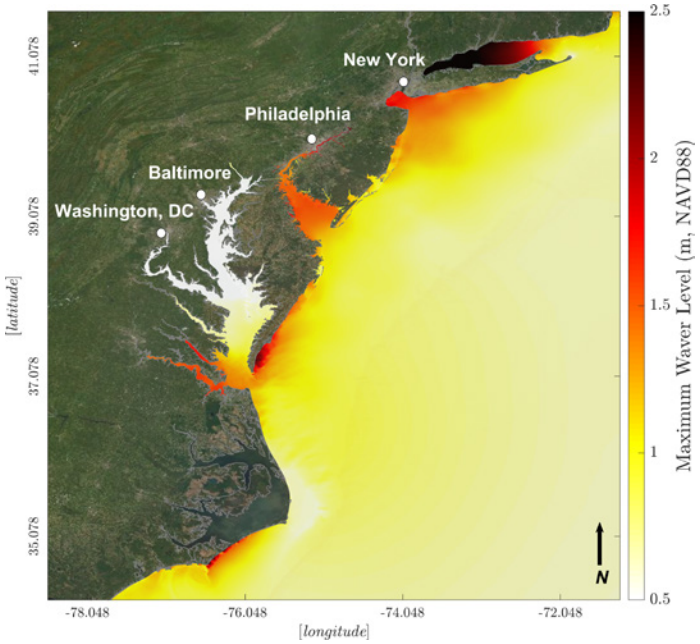
inundation under future climate scenarios to inform coastal communities preparing for climate change and extreme events. To support coastal resilience and flood mitigation, PNNL has developed hydrologic and coastal ocean models that simulate the combined **risk of river flooding and storm surge** on urban infrastructure in the Delaware Bay Estuary. They have also simulated hurricane-induced storm surge in the Gulf of Mexico, Salish Sea, and mid-Atlantic coast, and predicted coastal inundation fueled by sea level rise along the Louisiana coast by the end of the century.

MARINE ENERGY SITING

Marine energy will play an important role in a clean energy future. At PNNL, researchers are modeling ocean currents, tides, and waves to help decision makers assess locations for marine energy installations that can maximize energy potential and limit hazards. Using state-of-the-art, high-fidelity models, PNNL researchers have assessed optimal **tidal energy** sites in the United States, including Cook Inlet in Alaska, Western Passage in Maine, and the Salish Sea, as well as available **wave energy** resource characterization along the U.S. West Coast, Alaska, and Hawaii. PNNL researchers have also developed ocean-atmosphere-wave models that simulate air-sea interactions and improve **offshore wind energy** resource assessments along the northeastern and western U.S. coasts. They are also modeling the Gulf Stream to assess energy resources and the potential effect of energy extraction on ocean circulation and regional climate.



Simulated global wave height during Hurricane Katrina. (Image by Gabriel Garcia-Medina | Pacific Northwest National Laboratory)



Simulated maximum water level along the mid-Atlantic coast from the combined effects of tides, hurricane-induced storm surge, and river flooding during Hurricane Irene. (Image by Mithun Deb | Pacific Northwest National Laboratory)

To learn more, visit https://www.pnnl.gov/projects/ocean-dynamics-modeling.

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