

Capabilities & Applications

➤ Hydrodynamics

- 3-D free surface flows
- Stratified flow
- Coastal circulation
- Rivers, lakes, & estuaries

➤ Computational Fluid Dynamics (CFD)

- 3-D flows near structures
- Complex model grids
- Jet plume mixing & dilution

➤ Water Quality/Ecology

- Effluent mixing & dilution
- Toxics fate and transport
- Salinity, DO, pH, & T
- NPDES and TMD
- Primary productivity

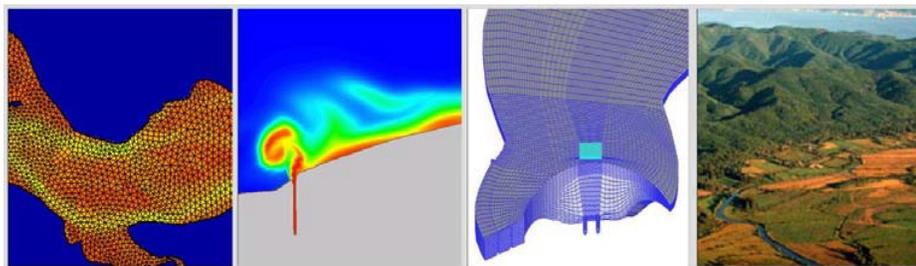
➤ Sediment Transport

- Dredged material transport
- Sediment impact zones
- Sedimentation basins
- Natural recovery

➤ Hydrology

- Watershed behavior
- Flooding
- Storm events
- Climate-driven impacts
- Interactions with structures

PNNL's Integrated Coastal Ocean Modeling (ICOM) group is a part of the Coastal Sciences Division at the Marine Sciences Laboratory (MSL), specializing in the development and application of state-of-the-art oceanographic, hydrodynamic, water quality, and ecosystem models to solve water and natural resources issues in watersheds, river systems, estuaries, and coastal regions. We use comprehensive numerical modeling to build scientific understanding and support decision making for all aspects of the water hydrologic cycle ranging from rainfall and runoff from watersheds to flows in small streams to distributed flows in larger river systems to circulation in wetlands, estuaries, and coastal waters. Our investigations include hydrodynamics, water quality and quantity, sediment transport, and ecosystem modeling that support the diversity of science and decision needs. Our modeling capabilities ranges from simple one-dimensional (1-D) flow and effluent dilution models to state-of-the-art, complex three-dimensional (3-D), computational fluid dynamic (CFD), hydrodynamic, fate and transport, and comprehensive water quality models.

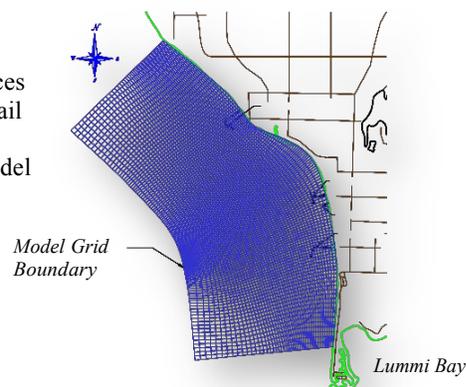


The ICOM group mission is to

- Provide state of the art oceanographic modeling of the coastal regions in support of multi-disciplinary research related to nearshore restoration and resource recovery.
- Respond to the growing need for predictive planning tools (hydrodynamics, hydrology, water quality, and sediment transport) for climate change, sea level rise, and carbon issues.
- Deliver novel operational and integrated modeling systems to optimize design and siting of ocean power technologies.

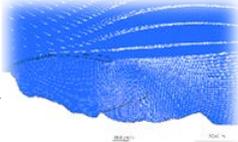
The ICOM Group's Approach to Modeling

- Our phased approach to complex water resources modeling provides the appropriate level of detail for systems analysis and interpretation.
- We emphasize effective communication of model development and results to stakeholders and decision-makers.



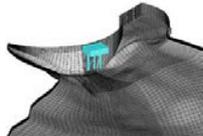
HYDRODYNAMICS

We have the expert capability to provide services in the areas of 1-D, 2-D, and 3-D surface water model development, modification, and application. We routinely use 1-D and 2-D models, such as HEC-2, UNET, SWMM, RMA-1/-2, and FEQ, for hydraulic evaluations, channel design, and screening-level flood analyses. Our group conducts detailed 3-D hydrodynamic circulation modeling in estuarine and coastal settings where currents are affected by the dynamics of salinity and temperature-induced gradients and coastal geometry using models such as FVCOM, RMA-10/-11, DELFT3D, and EFDC.



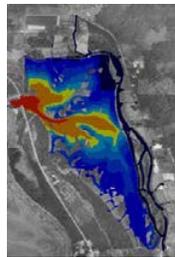
COMPUTATIONAL FLUID DYNAMICS (CFD)

The ICOM group is experienced in high-resolution 3-D simulation of flow fields using CFD models. CFD codes, such as PHOENICS, STAR-CD, and U²RANS, are applied by our staff for hydropower dam forebay hydrodynamic analyses, pump-station studies, and clarifier and sedimentation basin design. We have expert capability in generating and modifying complex high-resolution model grids for CFD modeling.



WATER QUALITY

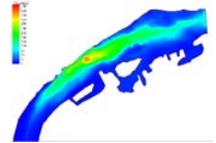
The ICOM group applies state-of-the-art water quality modeling technology to ecological restoration, environmental impact assessment, and permitting projects of all sizes. We are experienced in the application of a variety of water quality models, such as CE-QUAL-W2, EFDC, RMA-, and CE-QUAL-ICM, for near- and far-field mixing studies for the National Pollutant Discharge Elimination System (NPDES) permit process, simulation



of eutrophication processes, dissolved oxygen, and pH for total maximum daily load (TMDL) evaluations, and modeling the effects of tidal, wave, and conventional hydropower operations, cooling water discharges, and diversions on water quality parameters supporting siting, operations, design, and licensing.

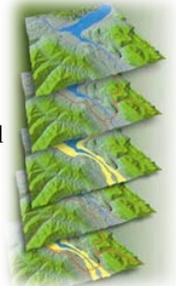
SEDIMENT TRANSPORT

The ICOM staff has considerable experience in conducting sediment quality and transport modeling. The impacts of dredging on circulation, sediment transport, and salinity are evaluated by our staff in connection with ports and harbors projects using the RMA-2 and SED-2D models. We routinely apply 2-D and 3-D models to simulate the transport and dispersion of suspended solids, turbidity, and contaminated sediments for evaluation of potential habitat impacts and delineation of sediment impact zones.



HYDROLOGY

We have collaborated on hundreds of interdisciplinary modeling projects to assess water quantity and quality impacts on aquatic, riparian, and wetland ecosystems and urban areas. We are experienced in application of the HSPF, BASINS, HEC-HMS, MODFLOW, CFEST, and PNNL's Distributed Hydrology-Soil-Vegetation Model (DHSVM) hydrologic models to integrated surface and groundwater modeling projects, regional and inter-state watershed analyses, and rainfall runoff modeling through complex drainage networks, and land-use planning and stormwater management.



About Pacific Northwest National Laboratory

The Pacific Northwest National Laboratory, located in southeastern Washington State, is a U.S. Department of Energy Office of Science laboratory that solves complex problems in energy, national security and the environment, and advances scientific frontiers in the chemical, biological, materials, environmental and computational sciences. PNNL currently has approximately 4,900 staff members and a business volume of more than \$1.1 billion. The Laboratory has been managed by Ohio-based Battelle since 1965.

For more information about the science you see here, please contact:

Tarang Khangaonkar
Pacific Northwest National Laboratory
1100 Dexter Ave. N
Seattle, WA 98109
(206) 528-3053
Tarang.khangaonkar@pnl.gov



U.S. DEPARTMENT OF
ENERGY

www.pnl.gov