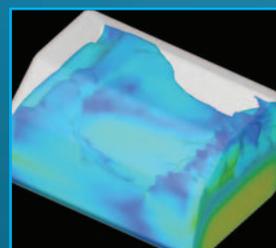
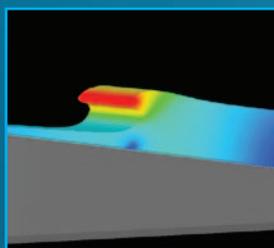
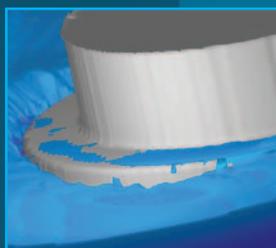




Image courtesy of
XC Engineering and Earthrace

FLOW-3D

Powerful computational fluid dynamics software for accurate flow modeling

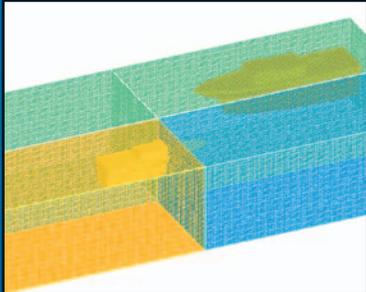


Easy-to-use CFD software to optimize the design and operation of your maritime projects

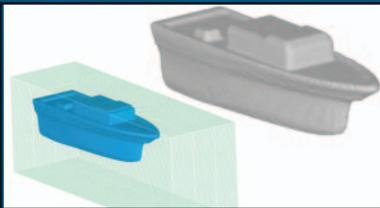
- Model a wide range of maritime engineering projects
- Accurately predict dynamic surface profiles and flow patterns
- Predict tow tank results
- Simulate ship and cargo stability
- Minimize time from design to physical modeling
- Reduce R & D and production costs

Advanced Modeling Features

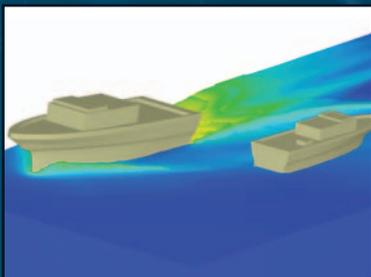
FLOW-3D's advanced features make it easy to use and provide highly-accurate results.



Multi-Block meshing adds even more flexibility and efficiency to problem setup.



FLOW-3D's FAVOR™ method makes accurate representation of complex geometries simple.



FLOW-3D's TruVOF technique precisely simulates moving liquid fronts.

FLOW-3D

from

FLOW Science

www.flow3d.com

FLOW-3D: Exceptional Accuracy

Why Choose FLOW-3D?

FLOW-3D is a powerful CFD modeling tool that gives engineers valuable insight into many physical flow processes. With special capabilities for accurately predicting free-surface flows, **FLOW-3D** is the ideal software to use for maritime applications including ship design, sloshing dynamics, coastal engineering, wave impact and ventilation.

Our strengths:

Accuracy is crucial for any simulation software. **FLOW-3D** provides meaningful results and has a proven reputation for accuracy in the many industries Flow Science supports.

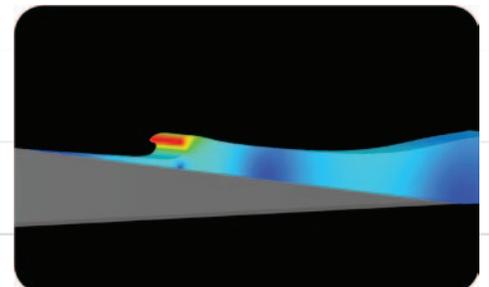
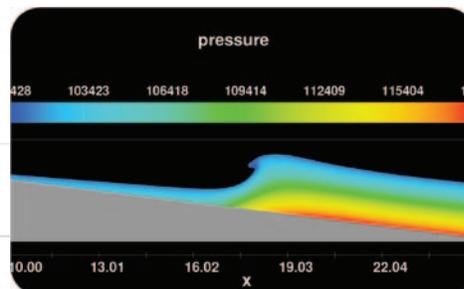
Meshing can be the most unwieldy part of setting up a simulation. The free gridding approach in **FLOW-3D** allows users to change the mesh grids independent of the geometry. **FLOW-3D's** FAVOR™ method allows users to accurately simulate flow profiles around complex geometries and save significant time in setting up a simulation.

Meshing controls allow users to optimize their mesh for the best combination of accuracy and speed. Multi-block meshing provides this ability. Multiple mesh blocks of varying degrees of resolution enable users to capture regions requiring detail with a high degree of accuracy and keep other regions more coarse for a faster calculation time.

Speed is critical in going from design to production. **FLOW-3D's** unstructured memory allocation and implicit advection scheme gives users faster computational times.

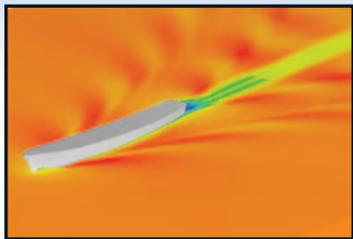
Capturing Non-linear Waves

Wave generation and propagation are key to understanding and predicting loads on sea or coastal structures. **FLOW-3D's** unique TruVOF technique maintains wave amplitude and energy throughout the computational domain.

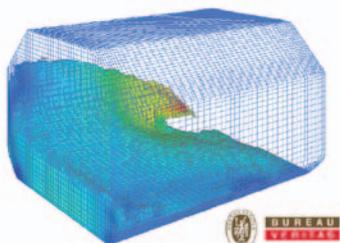


FLOW-3D simulates the introduction of a true Stokes wave at the boundary producing the correct wave profile as the wave breaks on the beach. Maintaining the correct profile accurately captures wave run up and breaking distances so that accurate force distributions on coastal structures can be determined.

Vessel Design



Seakeeping: Hull design considerations include the resistance (drag), stern boundary layer, streamwise vortices, and velocity field at the propeller plane. **FLOW-3D** is an essential design tool for predicting vessel dynamics.



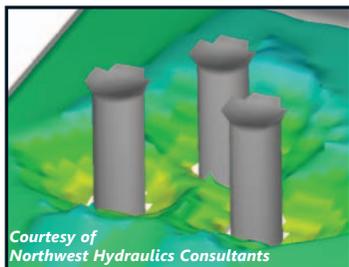
Sloshing: Liquid cargo and propellant motion in fuel tanks is essential to understanding vessel performance. **FLOW-3D** accurately captures the transient fluid mass predicting the correct forces exerted on a container, critical when the liquid mass is a significant portion of the total vessel mass.



Wave Impact: Load predictions on marine structures such as oil production platforms in random storm waves are critical. Physical mechanisms leading to water on deck and bow flare slamming, and the resulting responses, must also be analyzed. **FLOW-3D** provides

predictions of water presence on the deck, impact load on structures, and large-scale wave propagation.

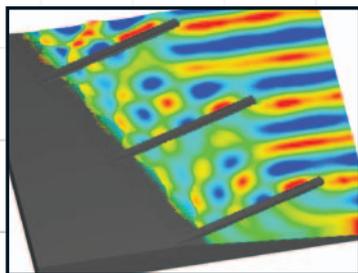
Coastal Engineering



Beach Erosion & Developed Surf:

Coastal erosion is very complex, involving three-dimensional flow fields created by the breaking waves, unsteady turbulent sediment transport in both the water column and on the bottom of a moving shoreline. **FLOW-3D** can simulate the three main types of breaking

waves: spilling or rolling, plunging or dumping, and surging.



Shoreline Structures: Structures along a shoreline can accelerate the deterioration of the beach or foundation. Physical modeling cannot capture the true turbulent effects due to Reynolds scaling. **FLOW-3D** simulations provide an accurate picture of the structural strength needed to resist various sea conditions.

Modeling Fluid/Structure Interaction with FLOW-3D



Simulation of a moored ship using the strings & ropes capability in **FLOW-3D**'s GMO model.

FLOW-3D's ability to accurately capture free-surface flow dynamics enables engineers to develop new and improved designs in a reasonable amount of time and at an attractive cost versus physical testing. **FLOW-3D**'s General Moving Object (GMO) model is a fully coupled, six degree of freedom, fluid/structure interaction model with an extensive number of features including:

- Applied forces and torques
- Tethering with springs and ropes
- Fixed axis translation, rotation and fixed points
- Heat transfer (convection, conduction)
- Collisions

FLOW-3D uses a fixed (non-moving) mesh and moves the objects through the domain providing highly efficient calculations with a high degree of accuracy.

FLOW-3D

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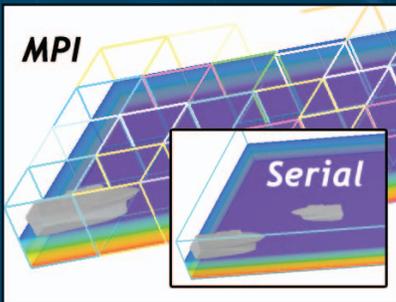
FLOW-3D MP

FLOW-3D/MP v4.1: High Performance Computing

FLOW-3D/MP v4.1 is the latest distributed-memory version of FLOW-3D and allows for larger simulations to be run and results obtained more quickly than with the serial version. Simulation speed-up of up to 21x on 32 cores can be achieved. FLOW-3D/MP is available on both Linux (RHEL 4 and 5, SUSE 10 and 11) and Windows Server 2008 systems.

Customization using FLOW-3D/MP v4.1:

The FLOW-3D/MP v4.1 distribution includes a variety of subroutines in FORTRAN source form that allow users to customize FLOW-3D. Users may customize boundary conditions or add their own models to meet their unique requirements.



The Automatic Decomposition Tool (ADT) decomposes the domain for balanced processor loads.

FLOW-3D
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FLOW Science
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An All-Inclusive Application

From Model Setup to Simulation to Detailed Results Analysis

FLOW-3D includes all the functionality you need in one simple-to-use application, driven by an intuitive graphical user interface. Users can easily set up a model and quickly mesh it through its graphical model builder, screen out model incompatibilities and configuration errors, and perform detailed analysis through extensive post-processing capabilities.

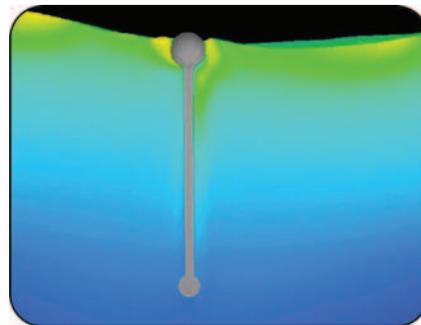
Dedicated Support

The professionals at Flow Science work closely with customers to understand their needs and ensure the software continuously meets their real-world challenges. Flow Science offers valuable training to help customers maximize their use of **FLOW-3D**. Most importantly, Flow Science engineers provide accessible, responsive technical support.

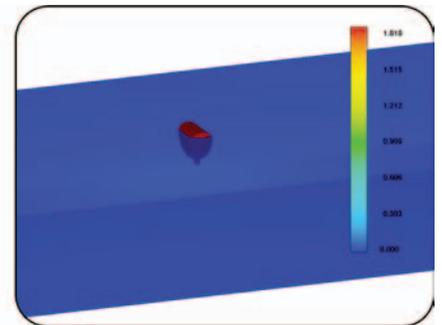
Call **505-982-0088** or email sales@flow3d.com for more information about how **FLOW-3D** can enhance the reliability and quality of your maritime designs and help you reduce overall costs.

Harness Wave Energy with FLOW-3D

In predicting the performance of Wave Energy Devices, engineers need to model device motion coupled with fluid dynamics. **FLOW-3D's** free gridding approach to meshing enable design variations to be set up quickly. This same methodology combined with the General Moving Object (GMO) model means simulation times are fast while maintaining a high degree of accuracy.



Simulation of a wave energy device hinged at a fixed point, colored by velocity. Courtesy of XC Engineering.



Numerical modeling of the Wave-driven Resonant, Arcuate-action, Surging Power Absorber (WRASPA). Courtesy of Manchester Metropolitan University & Lancaster University



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