Flood & Coastal Simulation Software
Accurate, efficient numerical engines for application to urban drainage, floodplains, estuaries, coastlines and beyond
Our Commitment

TUFLOW Products are developed through collaborative efforts with universities and research organizations, to ensure they are scientifically of a high standard and are thoroughly benchmarked.

TUFLOW Products are designed for the rigorous demands of consulting, are extremely workflow efficient, and customizable. They are the modeler’s model.

Training and support are key services we offer, with personal support and customized training that focuses on your needs.

Markets

Catchments
Fast computing via GPU for distributed hydrologic applications and basin scale modeling.

Estuaries and river entrances
Where rivers and the sea meet: a complex interaction of tides, inflows and ocean currents combined with sediments and environmental issues.

Urban drainage and stormwater
Superior 1D solver for simulating pipes, manholes, pits and lined channels. 1D links and operable structures provide the solution for complex urban drainage, pipe networks and river systems.
For nearfield analysis of structures, as an alternative to CFD and physical modeling.

Floodplains and rivers
TUFLOW’s heritage and strength, providing the benchmark modeling tool for floodplain management.
New alternatives and options with logic controls and advance gate operations leading to flood warning and emergency response.
Flexible mesh and fast computing alternatives.

Coastal and nearshore
Winds and waves, hurricanes, wave setup and current generation.
Longshore transport of sediments and morphological change.
Tsunami propagation and inundation.

Offshore and metocean
Providing a link between oceanography and coastal engineering with high resolution nesting and advanced 3D boundary transfers.
Supporting the oil and gas industry; oil spill response and drill mud dispersion.
TUFLOW “Classic”

Flooding, storms and coastal surges cause extensive damage, stress, loss of life-and-limb and disruption. To understand and manage these risks requires software that quickly and accurately models the inundation of rivers, urban areas and coastal floodplains.

TUFLOW is the most fully featured software for modeling:
- Flooding in major rivers
- Complex overland and piped urban flows
- Storm tide inundation of coastal plains
- Estuarine and coastal tidal hydraulics

New for 2013

Pumps; sluice gates; radial gates; crump, ogee, rectangular, sharp-crested, trapezoidal, V-notch and user-defined weirs; spillways; hQh channels. Operational controls of structures.

Ahead of the pack

TUFLOW is a fully featured modeling platform that has been continuously enhanced, based on users’ needs, since the 1990s. Key features are:

- Layered data approach - no data duplication
- Layers independent of 2D cell size, grid extent and orientation
- Modify data easily for “what-if” scenarios
- Powerful topography manipulation tools
- Hydraulic structures in 1D and 2D
- Supercritical, weir and subcritical flow switching in 1D and 2D
- The best 1D/2D linking available
- Boundaries and 1D/2D links at any orientation and location
- Vary the 2D cell size and orientation using the multiple 2D domains module
- Easily manage events and scenarios
- Fast and reliable for real-world models
- Extensive range of outputs
- Advanced flood risk management analyses
- Extensive QA and healthy model checks
- Comprehensively detailed manual
- Seamless integration with GIS platforms and third party graphical user interfaces
- 32 and 64-bit; single and double precision; regular releases
- Customize TUFLOW – create your own USER_DEFINED.dll
- TUFLOW Tutorial/Demo models
- Active on-line TUFLOW Forum and Wiki
Background
TUFLOW originated from a joint R&D project between WBM Pty Ltd and The University of Queensland in 1989/90 to develop a 2D modeling system with dynamic links to a 1D system, and has since gone from strength to strength.

Work Flow Efficiency
The simple logical scripts, GIS data layering, powerful topographic modification functions and clever event and scenario management, make TUFLOW the modeler’s model. For those who wish to model quickly and efficiently, TUFLOW is the preferred option.

This is the primary reason TUFLOW has become the dominant 1D/2D flood modeling software in Australia and the UK, and is seeing a significant uptake in the USA and elsewhere. TUFLOW makes modeling easy, flexible, customizable and extremely efficient for detailed flood assessments and modeling numerous what-if scenarios.

Solution Schemes
TUFLOW’s 2D solution is the leading alternating direction implicit (ADI) scheme on the market. The 1D scheme is a very stable and accurate second-order, Runge-Kutta solution. TUFLOW was a top performer in the 2012 UK EA Benchmark Study, and achieved speeds on single cores faster than the multi-core solvers.

The 2D scheme automatically handles upstream controlled flow regimes (supercritical flow down steep slopes and weir flow over levees), bridge decks, box culverts, excellent wetting and drying, and other key features. The 1D solution includes detailed representation of rivers, floodplains, extensive pipe network systems, pits and manholes, and as of 2013, a wide range of structure types, and highly flexible structure operational controls.

TUFLOW 1D/2D Dynamic Linking
TUFLOW’s 1D/2D dynamic linking is the best in the industry.

- 1D/2D links can be at any orientation to the 2D grid, start completely dry, and wet and dry during the simulation.
- Operate as simple source/sink links (e.g. connections to pipe network pits) through to momentum preservation links across major waterways, large 1D structures and along river banks.
- 1D/2D links do not force a reduction of the 2D timestep
- Apply the full 2D solution for momentum preservation
- Switch automatically to the weir equation when upstream controlled (e.g. free flow over a levee)
- Do not need to be reworked if the 2D cell size or grid orientation changes.
TUFLOW FV

A 2D / 3D flexible mesh finite volume numerical model that simulates hydrodynamic, sediment transport and water quality processes in oceans, coastal waters, estuaries and rivers. A powerful engine proven at all scales.

FV Solution Scheme
The finite volume numerical scheme solves the conservative integral form of the non linear shallow water equations (NLSWE).

The equations can be solved in 2D (vertically averaged) and 3D.

Features
Flexible controls / interfacing
TUFLOW FV inputs are controlled via a macro style text-file interface. This allows the user to flexibly and efficiently control model configuration, boundary condition specification and output requirements.

Open boundaries
- Fully open (non-reflective)
- Specified water level
- Specified discharge
- 3D linkages to ocean circulation models

Additional forcings
- Global cell inflows and outflows (e.g. rainfall, evaporation)
- Cell inflows/outflows (e.g. pollutant source/sinks)
- Wind and wave stresses, atmospheric pressure
- Holland parametric cyclone wind and pressure model

Structures
- Weirs, culverts
- Adjustable beds, levee failure, etc
- hQh matrix specification at selected cells
- Logical controls
- Auto weir function

Key FV Scheme Features
- Intrinsically handles shocks
- Subcritical, supercritical and transitional flows
- Locally (and globally) conservative to numerical precision
- Robust wetting/drying
- Parallelized explicit scheme (varying Courant dependent timestep)
- 2D and 3D with 1st and 2nd order schemes

Speed
TUFLOW FV code is optimized and parallelized for multi-processor machines, using the OpenMP implementation of shared memory parallelism.

Engines

A combined 2D/3D flood model
TUFLOW FV has an option to insert 3D within a 2D model. This feature, which allows simulation of overland inundation plus complex 3D flow patterns in the main river channel, was successfully applied to the design of riverbank infrastructure.
Complex problems require clever solutions

A nested modeling approach around Trinidad and Tobago to establish design parameters for infrastructure:

- 3D currents and vortex shedding from the HYCOM global model
- Hurricane activity, generating high currents on local and regional scales
- Rapidly shallowing bathymetry, with tidal and wind driven currents becoming influential close to the coastline

Tsunami

To accurately capture steep tsunami wave gradients, the higher order spatial solution scheme available for TUFLOW FV was applied to simulate the Great East Japan Earthquake in 2011.

UK EA Benchmark Testing:

TUFLOW FV performs well against all alternative products, including dambreak tests with sub-supercritical transitions.
TUFLOW GPU

A 2D fixed grid hydrodynamic numerical model that uses the computational performance of GPUs to deliver a 10 to 100 times speed increase.

Basin scale modeling

Direct rainfall over the Condamine-Balonne catchment and surrounds, an area of over 400,000 km², was modeled on a 30 m resolution grid using TUFLOW GPU. A total of 486 million elements over a rectangular area of 810 km x 540 km.

The simulation, performed on a standard desktop computer plus four additional nVidia GTX 680 cards, simulated a 5 day flood event over a period of 5 days.
Supercomputer performance on a desktop

The GPU solver seamlessly slots into TUFLOW “Classic”.

All the power and flexibility of TUFLOW’s superior GIS functionality, scripting and scenario/event management is at your fingertips when using the GPU Module.

The explicit finite volume 1st order space, 1st or 4th order time solution is 100% stable.

Solves the full 2D free-surface equations including inertia and sub-grid turbulence (eddy viscosity) – a superior solution at all levels compared with other GPU solvers.

Successfully benchmarked and a top performer of the 2012 UK EA 2D Benchmarking.

Soil infiltration using IL/CL, Green-Ampt and Horton methods.

Multiple water level boundaries, rainfall distributions and catchment inflows.

Vary Manning’s n with depth.

The GPU Module requires CUDA enabled NVidia cards. The substantial speed gains are achieved on high performance cards.

Multiple GPU cards supported.
TUFLOW Modules

Modules are additional components of TUFLOW Products providing expanded functionality and capability.

Sediment Transport and Morphology

TUFLOW FV ST has cohesive and non-cohesive sediment transport capabilities, linked to hydrodynamic response via a morphological update routine to simulate evolution of bed features.

TUFLOW Classic provides non-cohesive sediment transport specifically for morphological analyses during flooding events.

Applications

- Sediment plumes
- River, estuarine and coastal morphology
- Shoreline processes
- Scouring and bank stability
AD and Heat Balance

The AD (advection dispersion) module provides capability to simulate constituent fate and transport in receiving waters. It is applicable to:

- Mixing in inland waterways
- Fate of plumes
- Flushing assessments
- Advanced atmospheric heat exchange routines simulate thermal mixing and plumes
- For 3D applications the AD scheme is coupled to salinity, temperature and sediment concentrations to simulate density driven currents
- The AD scheme is at the core of subsequent sediment and water quality capabilities

Sediment plumes using TUFLOW FV ST Module, Gladstone

The water and environment of the Port of Gladstone (Australia) has been studied using TUFLOW for two decades. Recently, TUFLOW FV played a key role in managing excess suspended sediments from dredging activities.

Water Quality

Water quality modeling is currently available in-house using TUFLOW FV in combination with AED, developed by the University of Western Australia.

A commercial version is currently being finalized; please contact sales@tuflow.com for more information.
We focus on accurate and work efficient numerical engines and choose interfaces that best suit our modeling requirements.

3rd Party Links and Interfaces

TUFLOW “Classic” is utilized by other software vendors. It’s 1D and 2D solutions have been dynamically linked to other 1D schemes, and Graphical User Interfaces (GUI) have been developed for TUFLOW, further spreading its appeal and functionality.

Interfaces

ISIS

ISIS 1D, historically the mainstay of 1D modeling in the UK, was linked with TUFLOW’s 2D scheme in 2004 and to its 1D scheme in 2010. TUFLOW’s 2D and excellent 1D pipe network modeling capabilities have allowed ISIS 1D models to be substantially value-added through replacing overbank areas as 2D and inclusion of urban pipe networks linked to ISIS in-bank river networks. Today, TUFLOW is the predominant 1D/2D flood modeling software in the UK.

SMS

Aquaveo released a customized GUI for TUFLOW “Classic” 1D and 2D within their SMS Surfacewater Modeling System in 2006. SMS is popular with TUFLOW GIS based modelers for viewing and animating results and increasingly for developing TUFLOW models. The ability to move TUFLOW GIS layers between SMS and GIS provides the modeler with even more functionality. SMS’s powerful flexible mesh capabilities and generic interface is popular with TUFLOW FV users.
**XP-2D**

XP-Solutions 1D scheme was dynamically linked to TUFLOW’s 2D solution in 2004, and in 2006 they released the XP-2D GUI. Today, XP-Solutions has an extensive 1D/2D modeling user base throughout the world. XP-SWMM 1D users can now easily add 2D domains to their 1D models within an intuitive and easy to use GUI to more accurately model urban and river flooding. XP-2D (TUFLOW) was granted National FEMA approval in 2010.

**waterRIDE**

waterRIDE FLOOD Manager provides a unique, highly visual environment in which to integrate time-varying 1D and 2D model results with GIS capabilities. It is a dedicated floodplain management tool that allows you to review and integrate your TUFLOW and TUFLOW FV results and communicate “what the flooding means”. TUFLOW’s 2013 release supports direct output in waterRIDE format.

**12D**

12D Solutions Dynamic Drainage Analysis (DDA) 1D solver has been dynamically linked with TUFLOW’s 2D scheme, and the 12D GUI adapted for 1D/2D modeling. The TUFLOW integration allows modelers to easily interchange with GIS and offers an intuitive interface for working with TUFLOW’s powerful scripting capabilities.

**GIS**

Using GIS as your TUFLOW modeling environment gives you maximum flexibility and efficiency, especially for detailed, complex models or modeling investigations with numerous events and scenarios. The GIS approach is for modelers who want to “get their hands dirty” and push the barriers. Through using GIS you can access TUFLOW’s unmatched capabilities for layering and intelligently processing GIS layers to rapidly build, and easily modify simple to highly complex models.

Any GIS or CAD package can be used provided they save or export in supported formats. The most commonly used GIS software are ArcGIS, MapInfo and QGIS. TUFLOW models are independent of the GIS and can be readily moved between GIS platforms. Power users will even use a mixture of GIS and CAD packages to maximize their modeling efficiency!

**miTools**

The MapInfo and TUFLOW Productivity Utilities (miTools) is a TUFLOW Software Product that has been developed to specifically improve the efficiency of setting up and reviewing TUFLOW models, as well as improving the day to day ease of using MapInfo Professional (MI Pro).

The suite of utilities enables ‘automation’ of many of the common repetitive tasks, saving valuable time and therefore money. The utilities also enable efficient creation and visualization of key TUFLOW model inputs/outputs within the MapInfo environment. Other tools provide data checking and quality assurance functionality, thus helping to minimize modeling errors.
Our priority is to make the TUFLOW modeling experience an enjoyable one.

Our products are useful, efficient, flexible and suited to your workplace.

The TUFLOW Community
There is a large and enthusiastic community of TUFLOW users. The TUFLOW forum has over 1000 members and is a great source of knowledge, support and advice. The TUFLOW wiki provides online help and support.

We are established. TUFLOW Products have been available since 2001 and the number of users steadily grows. User’s feedback is taken seriously, and our products grow based almost entirely on user’s needs and recommendations.

Training and Support

Training
Several organizations around the world provide generic and customized project-based training courses in TUFLOW Products.

Contact training@tuflow.com to have us design an in-house or web-based course that suits your needs.
Customized TUFLOW

We are constantly developing products to satisfy demands from modelers; this is the key to TUFLOW’s success.

If your organization has specific requirements, we can develop specific features. Please contact us at support@tuflow.com.

Customized modeling application

CFD was applied to establish complex hydrodynamics around bridge piers, driven by boundary conditions provided by a TUFLOW FV simulation.

Support

Support is provided by the experts that develop and use the software. There is a strong support network through our company and our 3rd party partners.

Contact support@tuflow.com.

Model Reviews

Model reviews are an excellent way to ensure that you are using the best and latest features, modeling efficiently and producing quality models. Reviews include constructive feedback so that the modeler benefits from the review process.
TUFLOW is developed by BMT WBM; a member of the worldwide BMT group of companies. We offer more than just TUFLOW; we are a global organization with a heritage and reputation for innovation and technical excellence. See www.bmt.org.