BMT WBM

"Where will our knowledge take you?"

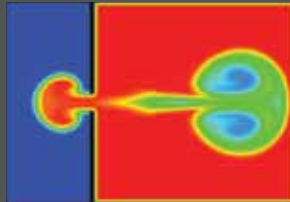# TU**FLOW**-*AD*

Advection Dispersion

TUFLOW AD (Advection Dispersion) is a module for simulating depth-averaged, two and one-dimensional constituent fate and transport. Both dissolved and particulate constituents can be simulated. TUFLOW AD takes depth and velocity fields computed by the TUFLOW and ESTRY engines and uses this information, together with initial and boundary conditions, to simulate the advection and dispersion of constituents. TUFLOW AD is specifically oriented towards such analyses in systems including coastal waters, estuaries, rivers, floodplains and urban areas.

Background

The BMT WBM experience of using AD models over the last 20 or so years has clearly shown the value that such models can add to understanding and managing natural systems. For example, simulation of pollutant transport can assist with defining spatially variant flushing and residence timescales within tidal systems, the fate of diffuser or other outfall derived pollutants, or the impact that catchment loads might have on receiving environments and their healthy functioning. TUFLOW, through the AD module, now offers the capability to examine these, and other, processes.


Solution Scheme

The TUFLOW AD 2D advection solution algorithm is based on the third order ULTIMATE QUICKEST method. It solves the full two-dimensional, depth averaged, constituent conservation equation, including sink terms such as settling (for particulate species) and decay. The continuity equation is used to ensure conservation of mass.

The scheme also includes representation of mixing due to sub-grid-scale turbulence and vertical shear via a well known dispersion formulation. The scheme implements automatic sub-stepping to maintain stability, and has the capability to adaptively expand its computational stencil from third to ninth order if strong constituent gradients are identified.

Existing TUFLOW-AD Models:

- Gold Coast Broadwater and upstream estuaries (sustainable pollutant loads assessment)
- Moneys Creek Lagoon (flushing timescale and options analysis)
- Square box tidal harbour (hypothetical)
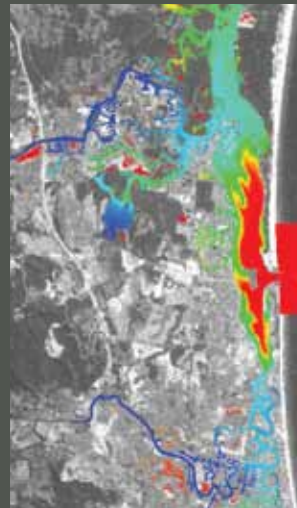
Capabilities

Similar to TUFLOW, the AD module is controlled via a fully-featured text file interface. This allows the user to flexibly and efficiently control model configuration, constituent properties, boundary and initial condition specification and output requirements.

Specific capabilities include:

- Support for all height and flow TUFLOW boundaries
- Support for for internal inflow boundaries (i.e. SA polygons)
- Simulation of constituent decay (first order scheme)
- Simulation of constituent settling for simulation of particulate matter
- Simultaneous simulation of up to twenty constituents
- Automatic sub-stepping in time to enforce stability of the scheme in terms of advective (CFL) and diffusive (Peclet) constraints
- Automatic computational stencil expansion to maintain sharp constituent gradients where detected and reduce numerical diffusion
- Simultation of simple 1D components (SX lines)

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