

# MIKE 3

## 3D modelling of coast and sea

**MIKE 3** provides the simulation tools you need to model **3D free surface flows** and associated sediment or water quality processes. All over the world, MIKE 3 is **widely recognised** as the platinum standard for **environmental and ecological studies**.

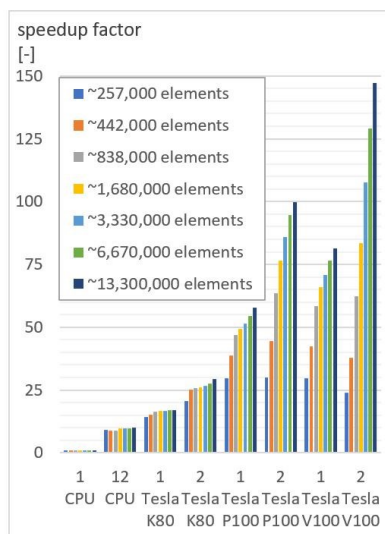
### APPLICATIONS

The following is a small subset of the almost endless list of possible MIKE 3 applications.

#### TYPICAL APPLICATIONS

MIKE 3 is the ideal software for:

- Assessment of hydrographic conditions for design, construction and operation of structures and plants in stratified waters
- Coastal and oceanographic circulation studies including fine sediment dynamics
- Optimisation of coastal, thermal or wastewater disposal outlets
- Environmental impact assessment of marine infrastructures
- Ecological modelling including optimisation of aquaculture systems
- Lake hydrodynamics and ecology
- Coastal and marine restoration projects
- Analysis and optimisation of cooling water recirculation and desalination
- Integrating vegetation into coastal defence strategies and coastal zone management planning



Example of GPU-based speedup tests

### ENGINES

MIKE 3 offers our state of the art **Flexible Mesh (FM)** simulation engine which allows maximum flexibility for adapting grid resolution of the model domain.

The core numerics of MIKE 3 are continuously improved to ensure unrivalled stability, performance and accuracy.

#### SHORT DESCRIPTION

The model solves the 3D incompressible Reynolds averaged Navier-Stokes equations. Both the full 3D Navier-Stokes equations (non-hydrostatic) and the 3D shallow water equations (hydrostatic) can be applied. Thus, the model consists of continuity, momentum, temperature, salinity and density equations and is closed by a set of turbulent closure schemes.

The spatial discretisation of the governing equations is performed using a cell-centred finite volume method on triangular, quadrangular or mixed element domains, employing a shock-capturing Riemann solver to ensure robust and stable simulation of flows.

#### PARALLEL PROCESSING (CPU)

The Flexible Mesh (FM) engines show excellent performance when parallel processing is undertaken - also on a large number of computational cores. On multicore Windows computers, parallelisation is menu-driven and straightforward.

The FM engines are also available for Linux, which gives the possibility to utilise High Performance Computing (HPC) systems.

#### GRAPHICAL PROCESSING UNITS (GPU)

For the FM engines, the use of graphical processing units (GPU) is also supported and gives easy access to spectacular increases in simulation speed.

### MODULES

MIKE 3 is modular. You buy what you need and nothing more. It includes a wide range of modules, allowing you to create your own tailored modelling framework for your environmental and ecological studies.

#### PP - PREPROCESSING AND POSTPROCESSING

This module offers an integrated work environment which provides convenient and compatible routines to ease the task of data input, analysis and presentation of simulation results. If you already have MIKE 21, you do not need another PP module for your MIKE 3 installation on the same PC.

#### HD - HYDRODYNAMICS

This module simulates the water level variations and flows in response to a variety of forcing functions. It includes a wide range of hydraulic phenomena in the simulations and it can be used for any 3D free surface flow. The Flexible Mesh engine, which uses a depth and surface adaptive vertical grid, is particularly suitable in areas with a high tidal range.

#### AD - TRANSPORT

This simulates the transport, dispersion and decay of dissolved or suspended substances. It is typically used in cooling water and sewage outfall studies.

#### UAS - UNDERWATER ACOUSTIC SIMULATOR

This module offers modelling of the propagation of underwater noise from a variety of man-made activities at sea. It is the ideal tool for managing noise impacts.



## MODULES

MIKE 3 includes the following modules specifically for sediment transport and water quality modelling.

### ST - SAND TRANSPORT

The advanced sand transport model in MIKE 21 has been ported to MIKE 3, dynamically coupled to the 3D hydrodynamic flow model, and extended to perform sand transport calculations using a 3D flow field. MIKE 3 ST includes two options for extracting 2D information from the 3D flow: mean and derivation or bed shear stress. Using a 3D flow field, a 3D transport equation for the suspended sediment concentration is used. This extends the use further into, for example, river morphology and to areas with current circulation such as confined bays.

### MT - MUD TRANSPORT

This is a combined multi-fraction and multi-layer model that describes erosion, transport and deposition of mud (cohesive sediments). A dredging module has been added to the versatile features of the MT module, allowing dynamic simulation of all stages of the dredging process, including suspended and near-bed load transport.

### PT - PARTICLE TRACKING

This simulates transport and fate of dissolved and suspended substances. It is, for example, used for risk analyses, accidental spillage and monitoring of dredging works.

### OS - OIL SPILL

This module simulates the spreading and weathering of suspended substances and is used for forecasting of oil spills, spill scenarios for contingency plans and so on.

### M3W - MIKE 3 WAVE MODEL FM

The state-of-the-art flexible mesh based model for simulating fully non-linear and fully dispersive 3D wave kinematics with no depth restrictions in the model domain. Featuring excellent flood & dry capabilities, the tool handles run-up and overtopping events in coastal flooding studies exceptionally well.

## MODULES

### M3WST - MIKE 3 WAVE MODEL FM SAND TRANSPORT

This is a state of the art calculation of sand transport using a 3D flow field. This approach uses a 3D transport equation for the suspended sediment concentration.

### MIKE ECO LAB - ECOLOGICAL MODELLING

This is a complete numerical laboratory for water quality and ecological modelling. See page 24.

### ABM LAB - AGENT-BASED MODELLING

This is a flexible numerical laboratory used to define agents, their behaviour and states. See page 23.

### SELECTED TOOLS IN MIKE 3

In addition to its variety of modules, MIKE 3 also includes a number of tools to optimise your work. Here is a subset of tools:

- Global tide data and tools for tidal analysis and prediction
- Cyclone wind generation and wind generation from pressure maps
- Advanced mesh and grid generators and editors
- Advanced tools for generation of graphical output
- An interface (API) for reading and modifying files in MIKE 3's internal, binary format

### MIKE MESH BUILDER

This cloud application streamlines the mesh creation process. See page 9.

### MIKE DATA LINK

This cloud application is designed to handle all important marine model data for you. See page 9.

## BENEFITS

MIKE 3 builds on the same solid technology as MIKE 21 and is the obvious choice when your project requires 3D modelling.

If you are familiar with MIKE 21, you will immediately feel at home with MIKE 3. With the combination of the two in your toolbox, hardly any coastal or marine modelling job will exceed your capabilities.

If you are not yet an expert in 3D modelling, you do not have to go far for assistance. Expert support is available from any of our more than 30 offices around the world.

MIKE 3 comes with a wealth of first class tools that enhance and ease modelling possibilities.

### MIKE C-MAP and MIKE ANIMATOR PLUS

Setting up the basic model bathymetries is normally a tedious and expensive part of coastal and marine modelling projects. MIKE C-MAP can reduce this task to minutes, offering model bathymetries generated fast and easy from an electronic chart database. With MIKE C-Map, you no longer need to manually digitise your model bathymetries.

Regardless of how well you undertake your modelling work, clear communication of results is crucial to its value and recognition. MIKE ANIMATOR PLUS turns model results into amazing 3D video presentations, facilitates communication between specialists and non-specialists, and demonstrates your modelling insights better than any printed material.