

# SOFTWARE CATALOGUE 2022

# OUR FOCUS IS YOU

Providing you with the right tools, support and training is what matters. We understand how important it is to get your project delivered on time and we have structured our software with this in mind.

With the global reach of MIKE Powered by DHI, we offer insight from local experts in water environments located in more than 30 countries. Our local staff provide support, training and solutions - based on DHI's global knowledge of water environments - and can act as gateways to specialists from DHI within any given topic.

Our focus is empowering you to perform at your best.

MIKE Powered by DHI

# CONTENTS

## INTEGRATED PLATFORMS

---

- 06 MIKE+
- 09 MIKE Cloud

## CITIES

---

- 12 WEST
- 14 WaterNet Advisor

## COAST AND SEA

---

- 18 MIKE 21
- 20 MIKE 3
- 22 LITPACK
- 23 ABM Lab
- 24 MIKE ECO Lab
- 25 MetOcean Data Portal & Bathymetrics Data Portal

## WATER RESOURCES

---

- 28 MIKE SHE
- 30 MIKE HYDRO River
- 32 MIKE HYDRO Basin
- 33 MIKE 21C

## GROUNDWATER AND POROUS MEDIA

---

- 36 FEFLOW

## DATA AND OPERATIONS

---

- 40 MIKE OPERATIONS

## MIKE FOR DEVELOPERS

---

- 42 MIKE API

## GET ACCESS TO MIKE

---

- 44 PRICING OPTIONS

## THE ACADEMY BY DHI

---

- 48 Training and capacity development
- 50 Events, universities, publications and newsletter

## MIKE Powered by DHI

For more than 25 years, MIKE Powered by DHI software products have been used in water environments all over the world. Thousands of professionals choose MIKE software to solve tough and complex challenges in areas such as oceans and coastlines, rivers and reservoirs, ecology, groundwater, water distribution, wastewater and many more. Our data management, decision support and operational forecasting software suite traverses all our areas of applications, complementing existing MIKE technologies in the work we do for you.

## THE ACADEMY by DHI

THE ACADEMY embraces all of DHI's global training and knowledge sharing activities. Every year, thousands of water professionals participate in our training or knowledge sharing activities. Moreover, our user group meetings and seminars are famous for bringing professionals together for knowledge sharing in a relaxed and inspiring environment.

For more information and examples of how our software products have been applied to solve complex water challenges worldwide, visit our website

[www.mikepoweredbydhi.com](http://www.mikepoweredbydhi.com)

# INTEGRATED PLATFORMS

DHI is leading the way in enabling **scalability** in the water business across water domains—**linking ports to cities to global hydrology**.

On the computational scale, we are seamlessly bringing the **nearly infinite IT resources in the Cloud** to your desktop. In the area of collaboration, we are making it possible for you to **work securely** with your team and clients anytime, anywhere, on any device.

Platforms are **evolutionary and dynamic**. Over time, they will change the way we work and interact with water models and with each other.

Our platforms are young, and they will grow and evolve to meet your changing needs. Come with us on this journey and experience the **power of integrated modelling and open innovation**.



# MIKE+

## Integrated water modelling

With MIKE+ , you can **integrate, model and manage all your water systems** in one place for the most comprehensive analyses. Model **water distribution, collection systems, river networks and flooding** within a platform that is integrative, flexible and scalable to easily discover patterns, develop predictive modelling and design more resilient water systems.

### APPLICATIONS

#### Water Distribution

- Master planning
- System rehabilitation and pressure optimisation
- Leakage analysis and reduction
- Fire flow analysis
- Water quality risk analysis
- Transient flow analysis

#### Collection Systems

- Master planning
- Capacity management and operational maintenance
- Wet weather management and overflows, rainfall dependent inflows and infiltration mitigation
- Emergency response planning for urban flooding
- Evaluation of storm water best management practices and low impact development
- Design and optimisation of real-time controls
- Sulphide gas formation analysis

#### River Networks

- River engineering and flood control
- Reservoir operation and hydropower
- Water resources and watershed management
- Wetland management and restoration

#### Flooding

- Flood management and mitigation
- Flood risk analysis and flood hazard mapping
- Flood contingency planning
- Flood defence failure impact studies
- Climate change assessments

### MODEL MANAGER

The Model Manager is the core of the MIKE+ user interface. The wealth of features enable you to efficiently go through all phases of preparing the model input data as well as analyse and present results from the simulation engines. Model Manager provides:

- Network data management for storm water collection systems, wastewater collection systems, water distribution systems, rivers and 2D flooding
- Feature-rich in-built GIS functionality powered by ThinkGeo
- Effective time series data management, comprehensive data processing and manipulation tools as well as powerful data visualisation capabilities for all data entities
- Result interpretation and presentation for an unlimited number of users

#### SELECTED TOOLS

In addition to the variety of modules, MIKE+ also includes a number of tools to optimise your work. These include:

- Scenario manager
- Instant data validation
- Interpolation and assignment tool
- Catchment delineation tool
- Network simplification tool
- Results differences tool
- Geocoding catchment, wastewater load and demand allocation
- Model results presentation through static and animated time series, profiles, thematic maps, tables and statistics

MIKE+ is available in many languages and we provide local support in more than 30 countries. Regardless of which engine you choose or which model you build, most of your data is stored in one database.

### MIKE+ ARCGIS

Open the door to world-leading Esri software by combining MIKE+ with ArcGIS Pro capabilities. MIKE+ ArcGIS gives you access to sophisticated spatial processing technology to help you efficiently prepare, analyse, and visualise spatial data.

MIKE+ ArcGIS is a complete integration of water modelling and GIS. It supports model building, managing data and sharing results.

With MIKE+ ArcGIS, you can:

- Prepare and integrate data from multiple sources and in various formats
- Transform your data into maps and actionable information
- Visualise, edit and analyse your data
- Share your work online for better collaboration
- Access ArcGIS essential and field applications





## WATER DISTRIBUTION

The two Water Distribution modules, EPANET and Special Analyses, are based on DHI extensions to the worldwide standard EPANET engine.

### EPANET

These modules allow the following simulations for modelling water distribution networks:

- Steady state simulations
- Extended period simulations
- Water quality simulations

### Demand Allocation

- Junction node demands
- Geocoding and aggregating of consumption data
- Computing water demands for each node of the network system

### Water Quality

- Blending water from different sources
- Age of water throughout a network
- Chlorine residuals
- Growth of disinfection by-products
- Contaminant propagation

### SPECIAL ANALYSES

This module includes features such as:

- Pressure-dependent demands
- Network vulnerability
- Hydrant flushing
- Multi-source tracing
- Extended rule-based control, variable speed driven pumps and PID control
- Flow modulated pressure reducing valve
- Sustainability and cost analysis
- Fire flow analysis for calculation of available flow and residual pressure
- Transient flow modelling using DHI's Water Hammer engine
- Automatic optimisation of pump and valve operations

## COLLECTION SYSTEMS

The collection system modelling is based on US-EPA SWMM engine or DHI's multi-core MIKE 1D engine.

### SWMM

This module includes US-EPA SWMM5 engine for modelling stormwater and wastewater systems from primarily urban areas.

### Hydraulics

Simulates unsteady flow in pipe and channel networks including:

- Junctions, outfalls, dividers and storage units. Links, pumps, orifices, weirs, outlets, transects and regulators
- Simulation of subcritical and supercritical flow conditions in partially full, full and pressurised pipes and open channels

### Hydrology

Simulates the catchment rainfall routing and infiltration with option of modelling the effects from I/I, LIDS, snow pack and groundwater.

### MIKE1D PIPEFLOW

This module simulates unsteady flow in pipe and channel networks including:

- Circular manholes, junctions, retention basins, soakaways. Standard and flexible cross-sections, weirs, orifices, pumps, valves, flow regulators and storm water inlets
- Simulation of partially full, full and pressurised pipes and open channels
- Continuous simulations involving RDI and long term statistics
- Optimisation of network capacity
- Wet weather management to reduce CSO
- Design and optimisation of real-time controls
- Sustainable stormwater management

Connections can be made seamlessly between collection systems and river networks.

## RIVER NETWORKS

The river module is based on MIKE 1D, DHI's hydrodynamic engine for rivers, open channels and other free surface flows.

### MIKE1D RIVERS

This module simulates the flow in the natural river. It supports a wide range of structures (weirs, culverts, bridges, dam break, control structures, etc.) and is typically used with the Rainfall Runoff module to represent hydrological inflows from the catchment.

Connections can be made seamlessly between pipe network and river.

When coupled with the 2D overland module or a 3D coastal model, it provides numerous opportunities to analyse complex issues, such as:

- Conveyance problems due to improper maintenance of vegetation
- Limited upstream flood storage capacity
- Crossing infrastructures reducing flow capacity in rivers and floodplains
- Flood preventions through optimised structure operation in reservoirs
- Flood impacts from dam break or levee breach failures
- Land use changes
- Climate change flood risk impacts
- Dispersion of pollutants in coastal environments
- Estuaries hydrodynamics



## FLOODING

MIKE+ is an all-in-one flood modelling platform that is well suited for most flooding applications.

The flooding module efficiently simulates any cause of urban, pluvial or riverine flooding (heavy local rainfall, insufficient flow capacity of storm water inlets, overtopping of nearby rivers) and assesses mitigation options.

The flooding module is based on MIKE 21 FM, DHI's 2D overland flow engine.

### 2D OVERLAND

The Flexible Mesh (FM) solver offers maximum flexibility for detailed and tailored meshes. Its advanced handling of buildings, roads and rainfall is perfectly suited for urban flooding studies.

By directly using your geographical land cover data, you can easily represent the spatial variability of the roughness in your domain. The depth varying roughness feature accurately represents the impact of different land covers along the simulation.

Structures like weirs, dikes and culverts can be directly implemented in the 2D engines.

Parallelisation enables 2D model performance enhancements through use of multiple cores and GPU-cards.

## CROSS DOMAIN CAPABILITIES

MIKE+ allows you to plug and play with different modules to customise water management solutions. These add-on modules can be used across your collection systems, rivers and/or flooding challenges:

### RAINFALL RUNOFF

This module includes multiple rainfall-runoff models such as time area method, kinematic wave including infiltration and LIDS, linear reservoir and UHM.

Modelling of the rainfall dependent inflow and infiltration using the RDI/I conceptual model for simulating continuous slow response inflows due to infiltration and groundwater.

Stormwater quality modelling of the build-up and wash-off of pollutants on the sub-catchments.

### CONTROL STRUCTURES

This module features advanced real-time control capabilities allowing users to design and test real-time controls of pumps, weirs, gates and valves. It makes the definition of complex operations logical for regulators.

### TRANSPORT (AD)

This module includes pollution transport by advection and dispersion including fine sediments as well as sediment transport of coarse sediments.

### MIKE ECO LAB

MIKE+ enables powerful analysis of the flood-related environmental impacts to rivers and collection systems through water quality options in all engine components. See page 24.

## INTEGRATED MODELLING

More complex problems can also be investigated by coupling and extending MIKE+ with other MIKE software.

### CONNECTION TO MIKE HYDRO RIVER

Embedding a MIKE HYDRO River model in MIKE+ extends its river functionalities. More options and modules become available (Sediment Transport, routing branches, storages, time-varying roughness, 2D mapping, etc.).

### CONNECTION TO MIKE 21

MIKE+ 2D Overland module can be replaced by a full MIKE 21 FM model. This is useful when studying inundation of reclaimed areas and flooding of coastal cities and infrastructures. You can also investigate the effects of coastal protection, such as dikes, polders and tidal gates, or other operational structures in delta areas. Combined with one of our wave models, it offers a unique capability to address all aspects of coastal impacts.

### CONNECTION TO MIKE SHE

MIKE SHE is a distributed hydrology model that calculates local changes in catchment water balances, including runoff, infiltration and groundwater recharge. This can improve MIKE+ results related to flooding caused by climate and land use change.

### MIKE OPERATIONS

Upgrading a MIKE+ model to a real-time flood forecasting system can significantly decrease the impact of flood events. This can be easily done through MIKE OPERATIONS.

### WATERNET ADVISOR

Extend MIKE+ with a web application that enables you to make better and faster decisions involving your water network. WaterNet Advisor gives you the ability to access your hydraulic models instantly with no special expertise required, work from anywhere— from a tablet, phone, laptop— whichever you prefer, as well as allows online control (EPANET, MIKE1D and SWMM).

# MIKE CLOUD

**Open innovation platform** where people, technology, research and business come together

The **power of data**, combined with **scalable cloud computing, easy plug-in of third-party technologies, multi-user collaboration and partnerships** enable efficient and innovative ways of modelling. MIKE Cloud gives you access to a **quickly evolving ecosystem** for the water industry, helping you achieve more – in less time.

## COMPANY SUBSCRIPTION

MIKE Cloud is DHI's cloud ecosystem for water experts. Built to take advantage of the infinite compute, storage and connectivity potential of the cloud, it is clear that the MIKE Cloud will benefit your projects no matter where you are in the world. The open innovation platform offers a suite of web-based modelling applications as well as the tools you need to unlock team productivity through multi-user collaboration.

## CLOUD STORAGE

At the core of MIKE Cloud is cloud storage. Secure, scalable, API-enabled and purpose-built for the water industry, MIKE Cloud has specific support for Timeseries, GIS and Multidimensional datasets as well as regular binary files. MIKE Cloud supports and converts most popular file formats found in the water industry and connects easily with the MIKE Desktop suite and third-party software like Microsoft Power BI. It is your central hub for working with data in MIKE applications.

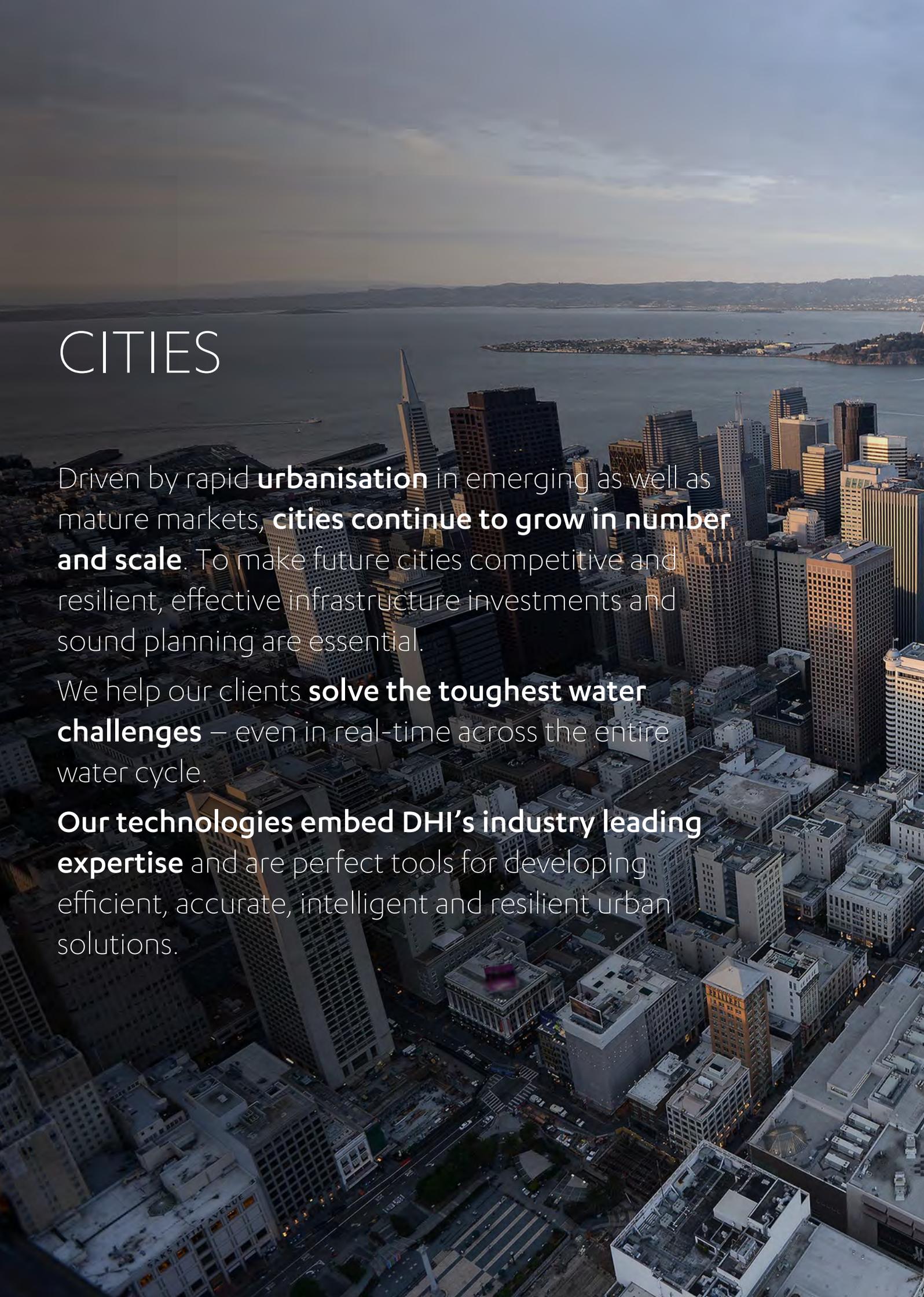
## MESH BUILDER

Building high-quality meshes can require a great deal of time. Automate the most time-consuming step in the model building process with the Mesh Builder, and quickly create high-quality 2D meshes for river and flood applications in record time.

### BENEFITS

Mesh Builder offers a new workflow to streamline the mesh creation process. The Mesh Builder offers you:

- Smart control of mesh operations, including full flexibility to control variable mesh density
- Comprehensive toolbox to prepare your data
- 3D visualisation to investigate the quality of the dataset and meshes
- Extraction of GIS vector data from Open Street Map for use in the meshing process
- A multi-user workspace to support users working in parallel to modify, document and review the mesh
- A mesh generation process centred on mesh quality driven by interactive feedback
- Mesh scenarios tied back to the original data and embedded in a project framework
- Significant time savings in terms of data management and mesh generation allowing you to respond quickly to changing project needs

An aerial photograph of San Francisco, California, taken at dusk. The city's dense skyline of skyscrapers is visible, with the Transamerica Pyramid being a prominent feature. The city is situated on a peninsula, with the San Francisco Bay and the Golden Gate Bridge visible in the background. The sky is a mix of soft blues and oranges, indicating the time is either early morning or late evening. The overall scene is a high-angle, wide shot of the city and its surrounding water.

# CITIES

Driven by rapid **urbanisation** in emerging as well as mature markets, **cities continue to grow in number and scale**. To make future cities competitive and resilient, effective infrastructure investments and sound planning are essential.

We help our clients **solve the toughest water challenges** – even in real-time across the entire water cycle.

**Our technologies embed DHI's industry leading expertise** and are perfect tools for developing efficient, accurate, intelligent and resilient urban solutions.



# WEST

## Modelling and simulation of wastewater treatment plants

WEST is a **powerful and user-friendly** software package for **dynamic modelling and simulation of wastewater treatment plants** (WWTP) and other types of water quality related systems. It is designed for operators, engineers and researchers interested in studying **physical, biological or chemical processes** in WWTPs, sewer systems and rivers.

### APPLICATIONS

#### EVALUATION OF DESIGN OPTIONS

When designing or upgrading a WWTP, WEST enables you to compare different design solutions in terms of performance with respect to specific objectives, such as effluent quality, investments and operational costs. The Scenario Analysis tool and the possibility to define custom objective functions in WEST allow you to select the best design for your plant.

You can also take a more conventional approach to plant design by means of the Designer Application. This allows you to design a WWTP according to a template and following a design protocol, such as ATV.

#### PROCESS OPTIMISATION

Improvements to the operations of a WWTP may lead to considerable benefits in terms of process performance, effluent quality as well as operational costs, for example for aeration. The Parameter Estimation tool enables you to identify the combination of operational conditions that optimise a given objective.

#### MODEL CALIBRATION

Model calibration is an essential part of the model development process. The local and global Sensitivity Analysis and Parameter Estimation tools in WEST are invaluable to efficiently calibrate your model.

#### DEVELOPMENT OF ADVANCED CONTROL STRATEGIES

To assess different control strategies by experimenting is typically a cumbersome exercise. WEST provides flexible control models as well as automated conversion of MATLAB fuzzy logic controllers. This makes it the tool of choice for evaluating control strategies prior to their actual implementation.

### APPLICATIONS

#### MONITORING OF PLANT OPERATION AND TROUBLESHOOTING

A calibrated model of a WWTP can be used to predict the dynamic response to different types of variations, for example in the influent composition, in order to identify bottlenecks and the appropriate countermeasures. It can also be used for training operators through the offline simulation of a variety of control actions. The Scenario and Uncertainty Analysis tools in WEST are instrumental to understanding the complex processes in a modern WWTP.

#### RESEARCH AND DEVELOPMENT

When studying novel treatment approaches, you require a software tool that is both sufficiently flexible to capture newly acquired knowledge, such as models and data, and fast enough to evaluate a large number of alternatives within a reasonable timeframe. WEST excels in both areas, demonstrated by its Block Editor and Model Editor applications (for developing custom model libraries) and the availability of the WEST engine on a number of high performance computing (HPC) infrastructures and supercomputers.

#### MODELLING INTEGRATED URBAN WATER SYSTEMS

The water quality in integrated urban water systems (IUWS) is simulated taking into account the catchment, the sewer, the treatment plant(s), and the receiving water body. The integrated IUWS library makes WEST a powerful tool to identify synergies and to globally optimise the wastewater system performance.



### FEATURES

#### PHYSICAL MODELS

- Screening and grit removal
- Equalisation, storm and settling tanks (with reactions)
- Activated sludge tanks and oxidation ditches (raceway)
- Granular sludge
- Integrated fixed film activated sludge and moving bed bioreactor (IFAS, MBBR)
- Sand and trickling filters
- Sequencing batch reactors (SBR), incl. moving- and fixed bed biofilm
- Membrane- (MBR) and membrane-aerated biofilm reactors (MABR)
- Upflow anaerobic sludge blanket (UASB)
- Sludge treatment (dewatering, aerobic and anaerobic digestion)
- Heat exchanger and gas turbine
- Chemical dosing units
- Disinfection
- Pumps and blowers
- Controllers and timers
- Nutrient recovery

#### BIOCHEMICAL PROCESS MODEL

- Activated sludge model (ASM) no. 1, 2d (with inorganic solids) and 3
- Anaerobic digestion model no. 1 (ADM1) with extension for sulphur
- Anaerobic ammonium oxidation (Anammox) model
- Activated sludge models for greenhouse gases (ASMG)
- Comprehensive C-N-P-S model
- Plant-wide model (PWM\_SA)
- Wastewater Aerobic/Anaerobic Transformation in Sewers (WATS) model
- Integrated urban water systems (IUWS)



## MODULES

### WEST Basic

This is an entry-level license that allows for the construction of a plant layout and the execution of simulations. The layout is limited in size and only a sub-set of all unit processes can be used. All advanced features (tools and experiment types) are not enabled. It is the ideal starting point to acquire familiarity with the software and get a feeling for its huge potential.

### WEST Player

This module is limited to steady state and dynamic simulation and the computation of custom objective functions. Essentially, it allows you to execute projects that are based on read-only models and plant layouts prepared with higher versions of the software. It is well-suited for training and for evaluation of operational strategies on a fixed or pre-constructed plant model.

### WEST

Based on a read-only model library, this module enables the construction and modification of plant layouts with no limitations in terms of process units. For any plant layout, it allows for the performance of steady state and dynamic simulation as well as computing custom objective functions. In addition, you can exploit powerful tools for model calibration (Global Sensitivity Analysis and Parameter Estimation) and what-if scenario evaluation (Scenario Analysis).

WEST is ideal for projects with limited amount of data, limited time and need to compare scenarios such as different loads, layout configurations or control strategies.

## MODULES

### WEST+

This is the full product that allows you to create both basic projects, which are solely based on steady state or dynamic simulation, as well as more complex projects exploiting powerful tools for model calibration (Global Sensitivity Analysis and Parameter Estimation), reliable predictions of plant performance (Uncertainty Analysis) and process optimisation (Parameter Estimation). In addition, it enables you to create entirely customised model libraries by using the Model Editor and Block Editor applications.

### WEST SDK

This is a software development kit (SDK) that enables you to develop custom applications through integration of WEST engine with other software systems, such as SCADA systems and databases. It is an essential component for developing sophisticated, tailor-made decision support systems.

## BENEFITS

- User-friendly and intuitive graphical tools
- Extensive and transparent default model library
- Limitless flexibility for developing customised model libraries
- Easy implementation of control strategies
- Customisable project documentation through inclusion of rich text notes and automated report generation
- Fully customisable objective functions
- Wide range of statistical criteria
- Advanced tools for scenario analysis, sensitivity analysis, uncertainty analysis and parameter estimation
- Software development kit (SDK) for integration with other software systems
- Very high simulation speed
- Engine installable on high performance computing (HPC) infrastructures
- Multi-language support

	WEST Basic	WEST Player	WEST	WEST+	WEST SDK
<b>WEST Application</b>	✓	✓	✓	✓	
<i>Steady-state simulation</i>	✓	✓	✓	✓	
<i>Dynamic simulation</i>	✓	✓	✓	✓	
<i>Objective Evaluation</i>		✓	✓	✓	
<i>Custom Dashboards</i>	✓	✓	✓	✓	
<i>Layout Animation</i>		✓	✓	✓	
<i>Notes, Reports and Workbook</i>	With limitations	✓	✓	✓	
<i>Interactive Layout Editor</i>	✓		✓	✓	
<i>Influent / Effluent Tool</i>	✓		✓	✓	
<i>Executable Model Builder</i>			✓	✓	
<i>Advanced Experiments</i>			✓	✓	
<i>Extensions</i>				✓	
<b>Data Editor Application</b>				✓	
<b>Unit Editor Application</b>				✓	
<b>Designer Application</b>				✓	
<b>Block Editor Application</b>				✓	
<b>Model Editor Application</b>				✓	
<b>Command-line Executor</b>				✓	
<b>MEX Executor for MATLAB</b>				✓	
<b>.NET / COM API</b>					✓

# WATERNET ADVISOR

## Modelling and result presentation **through the web browser**

WaterNet Advisor is a **powerful and user-friendly web-based application** for displaying EPANET, MIKE1D, SWMM model layers, editing model data, setting up scenarios, as well as running and displaying model results. You can **access it using a web browser on any device**, such as a desktop or laptop (running on Microsoft Windows, Apple or other operating systems), and smartphones or tablets.

### SOFTWARE USAGE AND APPLICATIONS

Get answers at your fingertips with the WaterNet Advisor web application.

If you work with a water supply network, you may find these daily operational challenges familiar:

- Where is the source of the leaking pipe?
- Can the network provide sufficient pressure for a new housing area?
- How much water can a particular fire hydrant supply?

If you work with collection systems, you may find these daily operational challenges familiar:

- Where may I experience flooding in the network?
- Are there any bottlenecks or insufficient capacity in the network?
- In the event of pump failure, where in the system will I experience sewer overflows?

These challenges – and many more – often need a quick response. What if you could have the information you need at your fingertips wherever you are?

With WaterNet Advisor, you can access your hydraulic models and get immediate answers with just a few clicks on your tablet, smartphone, laptop or desktop.

### APPLICATIONS

#### WATER DISTRIBUTION

Typical applications within water distribution are:

- Master planning and system rehabilitation
- Pressure optimisation
- Leakage analysis and reduction
- Fire flow analysis
- Shut-down planning
- Flushing programmes
- Contaminant event analysis
- Water quality risk analysis
- Multi-source trace analysis
- Water age analysis
- Online analysis based on SCADA data

#### COLLECTION SYSTEMS

Typical applications within collection systems are:

- Master planning and system rehabilitation
- Optimise network capacity and maintenance work
- Wet weather management planning to reduce SSOs/CSOs
- Design and optimise real-time controls
- Manage rainfall dependent inflow and infiltration (RDI) & LTS
- Control of sulphide gas (H<sub>2</sub>S) formation
- Assessments of stormwater quality and green solutions

### FEATURES

Many water utility operators or emergency response teams depend on experts to get data from the hydraulic models of the water network. This process slows down decision-making, delays tasks and impacts your bottom line.

Imagine a web application that enables you to make better and faster decisions – and which doesn't require any special knowledge to operate. Here are its core features:

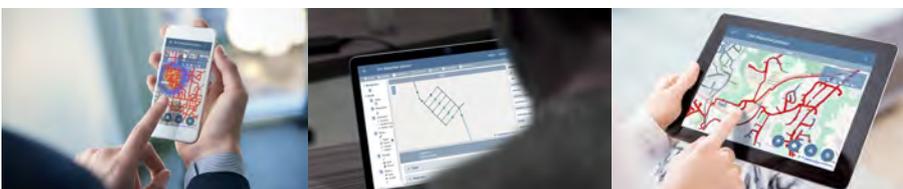
- Instantly access your hydraulic models
- No special expertise required
- Work anywhere
- Online control

WaterNet Advisor allows you to work with any MIKE+ Water Distribution (EPANET) or MIKE+ Collection Systems (MIKE1D, SWMM) or EPANET, SWMM model within Internet Explorer.

It is possible to open any MIKE+ model database, display the contents of the model using predefined layers and edit the model data using any of edit tools running on the simulations based on:

- EPANET
- MIKE1D
- SWMM

You can also load the simulation results and display them in the Map view, create thematic maps, display time series, browse and animate the results in accordance with the focus of the application.





## WATER DISTRIBUTION

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### MODEL MANAGEMENT

- Create, edit and delete a model
- Register any MIKE+ EPANET or EPANET file
- Register GIS layers
- Share the model with other users or keep it private

### SCENARIO MANAGEMENT

- Create, edit and delete a scenario
- Share the scenario with other users or keep it private

### HYDRAULIC MODELLING - EPANET

- Editing (tanks, reservoirs, pipes, pumps, valves, node demands)
- Hydraulic analysis (steady state, extended period analysis)
- Fire flow analysis
- Network capacity analysis
- Water age analysis
- Multi-source trace analysis
- Contaminant event analysis
- Flow trace analysis
- Online analysis (may require additional software)

### RESULTS PRESENTATION

- Map views
- Information browser
- Time series
- Scatter plots
- Profile plots
- Animations

## COLLECTON SYSTEMS

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### MODEL MANAGEMENT

- Create, edit and delete a model
- Register any MIKE+ MIKE1D file
- Register any MIKE+ SWMM or SWMM file
- Register GIS layers
- Share the model with other users or keep it private

### SCENARIO MANAGEMENT

- Create, edit and delete a scenario
- Share the scenario with other users or keep it private

### HYDRAULIC MODELLING - MIKE1D

- Editing (manholes, basins, soakaways, pipes, pumps, valves, orifices, weirs and gates, wastewater loads)
- Hydrology and Hydraulic analysis
- Flow trace analysis

### RESULTS PRESENTATION

- Map views
- Information browser
- Time series
- Scatter plots
- Profile plots
- Animations

## BENEFITS

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### SERVER HOSTING

- The application can be hosted by Microsoft Azure or other Cloud service providers
- The applicaion can be hosted on-premise
- There is no need for any software installation on end-user devices as the application runs from within the web browser

### MODEL SHARING

- Hydraulic models are shared by multiple users across the organisation
- Models can be accessed by multiple users at the same time
- Various users roles (administrator, modeller, reviewer, manager, etc) are available

### EASY-TO-USE

- Use case-driven interface
- The user selects a predefined task from the list and the application displays all relevant entries on a single screen
- No special expertise required when the application is used for information browsing
- You can access it using a web browser on any device, such as a desktop or laptop (running on Microsoft Windows, Apple or other operating systems), and smartphones or tablets

# COAST AND SEA

Human activities at sea are growing and becoming ever more complex in sectors such as **transport, energy and aquaculture**.

With increasing demands for coastal resources, advanced expertise and technologies are necessary to **analyse these complex challenges** and find optimal solutions.

Our numerical modelling **software embeds DHI's industry leading expertise** and provides **maximum versatility and quality** in coastal and marine modelling. Our technologies help clients develop efficient, reliable and sustainable solutions.



# MIKE 21

## 2D modelling of coast and sea

MIKE 21 is by far **the most versatile tool for coastal modelling**. If you need to **simulate physical, chemical or biological processes** in coastal or marine areas, MIKE 21 has the tools you need.

### APPLICATIONS

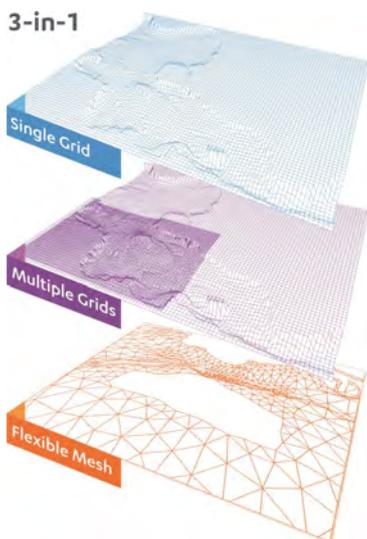
The following is a small subset of the almost endless list of possible MIKE 21 applications.

#### TYPICAL APPLICATIONS

MIKE 21 is the ideal software for:

- Design assessment for coastal and offshore structures
- Optimisation of port layouts and coastal protection measures
- Cooling water, desalination and recirculation analysis
- Optimisation of coastal outfalls
- Environmental impact assessment of marine infrastructures
- Ecological modelling including optimisation of aquaculture systems
- Optimisation of renewable energy systems
- Water forecast for safe marine operations and navigation
- Coastal flooding and storm surge warnings
- Inland river, flooding and overland flow modelling

#### 3-in-1



The unique 3-in-1 package includes all three engines in one great package deal.

### ENGINES

MIKE 21 comprises the following simulation engines:

- **Single Grid**, which is a classic rectilinear model that is easy to set up and with easy I/O exchange
- **Multiple Grids**, which is a dynamically nested rectilinear model with the ability to focus the grid resolution
- **Flexible Mesh**, which allows maximum flexibility for adapting grid resolution of the model domain

#### PARALLEL PROCESSING (CPU)

All Flexible Mesh and Single Grid engines support parallel processing. 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 21 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 coastal and marine studies.

#### PP - PREPROCESSING AND POSTPROCESSING

This module offers an integrated work environment which provides convenient and compatible routines to ease the tasks of data input, analysis and presentation of simulation results.

#### HD - HYDRODYNAMICS

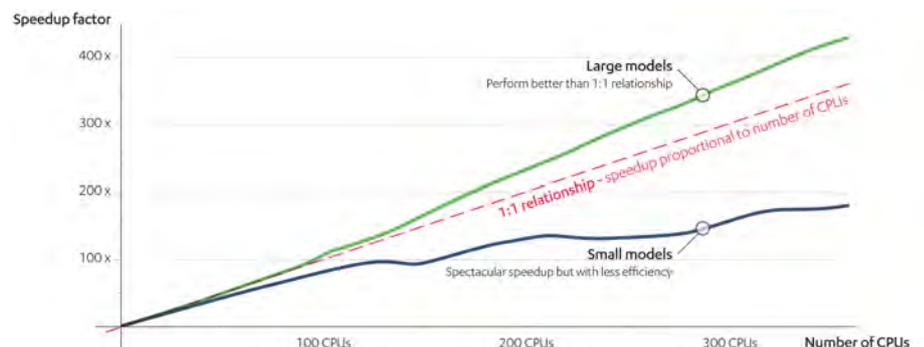
This module simulates water level variations and flows in response to a variety of forcing functions.

#### AD - TRANSPORT

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

#### COUPLED MODELLING

The FM series include a powerful, integrated system which, in a surprisingly easy manner, combines wave, flow and sediment transport models into a fully dynamic morphological model.



Example of CPU-based speedup tests.



## MODULES

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MIKE 21 includes the following modules specifically for sediment transport and water quality modelling.

### ST - SAND TRANSPORT

This is an advanced sand transport model with several formulations for current as well as current-wave generated transport, including 3D description of sediment transport rates. It is, for example, used for morphological optimisation of port layouts, impact of shore protection schemes and stability of tidal inlets.

### MT - MUD TRANSPORT

This is a combined multi-fraction and multi-layered model that describes erosion, transport and deposition of mud (cohesive sediment) or mixtures of sand and mud.

### PT - PARTICLE TRACKING

This module simulates transport and fate of dissolved and suspended substances, including sediments.

### SM - SHORELINE MORPHOLOGY

This module combines detailed 2D modelling of currents and waves with a constrained morphological model, making it possible to undertake fast, stable and robust modelling of shoreline evolution in 2D environments.

### OS - OIL SPILL

This module simulates the spreading and weathering of hydrocarbons and is used for oil spill modelling.

### 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.

## MODULES

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MIKE 21 includes the following modules specifically for wave modelling.

### SW - SPECTRAL WAVES

This is a spectral wind-wave model that simulates the growth, decay and transformation of wind-generated waves and swell.

### BW - BOUSSINESQ WAVES

The state-of-the-art tool for studies and analyses of wave disturbance in ports, harbours and coastal areas. It includes full surf and swash zone dynamics.

### MA – MOORING ANALYSIS

This module simulates the motions of single or multiple vessels subject to winds, waves and currents. It also calculates the forces in the mooring equipment such as fenders and mooring lines and can directly use results from MIKE 21 BW, MIKE 3 Wave FM and MIKE 21 HD as input.

### SELECTED TOOLS IN MIKE 21

In addition to its variety of modules, MIKE 21 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
- MIKE's Climate Change Editor
- 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 21's internal, binary format

## BENEFITS

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MIKE 21 is proven technology. No other modelling package has been used for as many coastal and marine engineering projects around the world as MIKE 21.

The recipe for the unique success of MIKE 21 is simple. It gives you maximum flexibility, higher productivity and full confidence in the results.

Also, MIKE 21 is much more than just the right tool for your project. It also gives access to other benefits of MIKE software products, including unparalleled technical support, training courses and access to DHI's expertise and know-how regardless of where you are in the world.

MIKE 21 also 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.

# 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**.

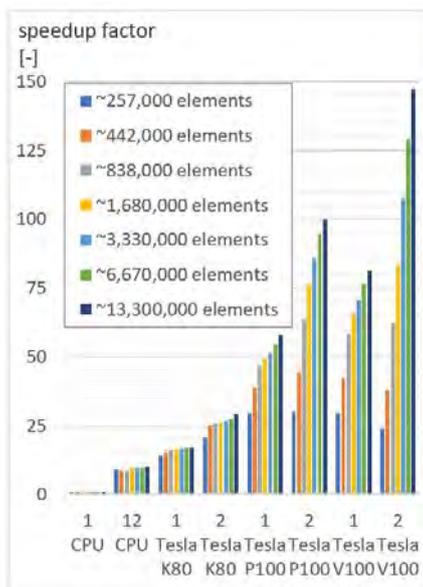
### APPLICATIONS

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



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

#### 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

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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 and dynamically coupled to the 3D hydrodynamic flow model. MIKE 3 ST includes two options for extracting 2D information from the 3D flow: mean and derivation or bed shear stress. 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.

### WFM - WAVES

The state-of-the-art flexible mesh tool 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

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### BOUNDARY CONDITIONS GENERATOR

Create high quality MIKE 3 HD boundary conditions automatically in a matter of minutes. This advanced online tool is a free premium feature for our SMA customers – Try it out today:

<https://boundary-generator.dhigroup.com>

### 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.

### 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
- MIKE's Climate Change Editor
- 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

## BENEFITS

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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.

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# LITPACK

## Littoral processes and coastline kinetics

Design and implementation of **efficient coastline management strategies**, locally as well as regionally, require detailed knowledge of the physical processes controlling the transport and sedimentation of beach materials. LITPACK models apply a **unique deterministic approach** to give you a powerful tool for a wide range of coastal zone management applications.

### APPLICATIONS

LITPACK is applicable for a wide range of coastal management and optimisation projects.

#### TYPICAL APPLICATIONS

LITPACK is the ideal software for:

- Impact assessment of coastal works on coastline dynamics
- Evaluation of different designs and types of coastal constructions, including groynes, revetments, harbours and breakwaters
- Optimisation of beach redevelopment plans, including artificial nourishment
- Design and evaluation of coastal protection
- Execution of morphological baseline studies. These studies often lead to the definition of more detailed studies undertaken with other tools

### MODULES

LITPACK includes the same well-proven graphical user interface (GUI) as our MIKE 21 and MIKE 3 products.

#### PP - PREPROCESSING AND POSTPROCESSING

LITPACK also utilises the same pre-processing and post-processing (PP) module as MIKE 21 and MIKE 3. This module provides an integrated work environment with convenient and compatible routines. It simplifies the tasks of data input, analysis and presentation of simulation results.

If you already have a MIKE 21 or a MIKE 3 on the same installation, you do not need an additional PP module for LITPACK.

#### THE CORE OF LITPACK: SEDIMENT TRANSPORT MODEL

The core of LITPACK is the sediment transport model - a deterministic description of non-cohesive sediment transport in a single point. For decades, this model has been used and improved and has proven very reliable.

Applying the model in a series of points in a profile and using the actual wave and current climate permit the calculation of the littoral drift and annual net and gross sediment transport. The combination of these data enables modelling and analysis of coastline evolution, including the effects of constructions and other measures on the coastline.

### BENEFITS

LITPACK is proven science turned into a productive tool for coastal engineers.

It combines unique expert knowledge about physical processes within waves, currents and sediment transport with efficient numerical simulation and an efficient user interface. The professional user is able to undertake complex studies in a productive and safe manner.

To facilitate this, LITPACK also contains a series of productivity tools, such as graphical editors and animated presentation of results.

LITPACK simulates a wide range of wave and current scenarios along straight or nearly straight coastlines. It combines these simulations into predictions of coastal profiles and long-term coastline evolution.

#### 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.

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# ABM LAB

## Agent based modelling

ABM Lab offers **unique integration of agent based modelling** with classical water quality and hydrodynamic modelling. It is possible to address questions **beyond the scope of more traditional water quality and ecological models**. ABM Lab is a **flexible numerical laboratory** used to define agents, their behaviour and states.

### APPLICATIONS

ABM Lab is a flexible numerical laboratory where the user can define agents, their behaviour and states. It integrates with our hydrodynamic models in two and three dimensions (MIKE 21 and MIKE 3).

The Lagrangian ABM Lab can work with the hydrodynamics alone, or it can be combined with the Eulerian MIKE ECO Lab in order to make the agents react to water quality parameters.

#### TYPICAL APPLICATIONS

ABM Lab is the ideal software for:

- Numerical modelling of the impacts of dredging plumes on coral spawning and recruitment
- Modelling eelgrass succession patterns and determining the recolonisation of eelgrass
- Modelling the migration of salmonid fish larvae through different wetland construction designs
- Modelling of bull shark migration patterns in a semi-enclosed ecosystem

### FEATURES

ABM Lab is a general tool which permits you to define agents, including their internal state and processes, movement, interaction with the environment as well as interaction with other agents of the same or different types.

With ABM Lab, you can model:

- **Movement**, which can be passive (drift) or active (depending on other model parameters). The resulting movement can be the sum of several independent movement vectors
- **Sensing**, where the individual's sensing of the environment and of other agents is done through 'Restricted Area Search Functions'
- **Interaction** with other elements, including functions such as create, split, remove, eliminate and transfer

The use of these functions permits modelling of complicated behaviours such as:

- Complicated horizontal and vertical movement
- Migration and swarming
- Foraging and breeding
- Growth, death and predator-prey relations

### BENEFITS

Combined with the hydrodynamic MIKE models and MIKE ECO Lab, ABM Lab is unique for undertaking agent based modelling.

It is possible to establish a user-friendly tool that makes it feasible to apply this type of technique in the context of real engineering projects.

#### 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.

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# MIKE ECO LAB

## Ecological modelling made simple

With MIKE ECO Lab you get a **complete numerical laboratory** for water quality and ecological modelling. You can **develop exactly the model you need** and describe the processes you wish. No ecological problem is too simple or too complicated for MIKE ECO Lab and there is **no time-consuming programming** involved.

### APPLICATIONS

With MIKE ECO Lab, you simply define the process using standard templates as a basis. It lets you transform any aquatic ecosystem into a reliable numerical model for accurate predictions.

#### TYPICAL APPLICATIONS

MIKE ECO Lab is the ideal software for:

- Water quality and ecological studies related to subsurface and groundwater, rivers, wetlands, lakes, reservoirs, estuaries, coastal waters and the sea
- Spatial predictions of any ecosystem response
- Simple and complex water quality studies
- Impact and remediation studies
- Planning and permitting studies
- Water quality forecasts

### FEATURES

One of the preconditions of ecological modelling is an accurate flow model for the area of interest. MIKE ECO Lab integrates seamlessly with the MIKE suite of flow simulation models covering all aspects - ranging from 1D, 2D and 3D free surface modelling to integrated hydrology:

- MIKE HYDRO River (1D)
- MIKE 21 (2D)
- MIKE 3 (3D)
- MIKE SHE (Hydrology)
- MIKE+ Collection Systems (MIKE 1D)

MIKE ECO Lab works out of the box, using predefined templates covering standard water quality issues.

The predefined templates can be used as the basis for user-defined ecosystem models.

You may also start from a blank template making use of the wide range of libraries of constants and functions, which make it easy to generate and edit your own templates.

### BENEFITS

MIKE ECO Lab combines the best of two worlds - you get access to our well-proven and widely used standard water quality models and you get complete freedom to include your own know-how or research ideas and test them against your field data. MIKE ECO Lab models work across the range of 1D, 2D and 3D MIKE modelling packages - as will your own templates.

You can focus on the processes and forget about programming. You can exchange ideas and models with colleagues around the world. Simply send them a copy of your templates.

As MIKE ECO Lab contains a generic equation solver, it can also be used for generic post-processing of hydrodynamic results, for example, in calculating flood risk indices or scour risk formula.

#### 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.

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# DHI METOCEAN DATA PORTAL

Speed up your marine projects by instant access to validated metocean data and analytics

The MetOcean Data Portal enables you to download and validate metocean data, including wind, wave, water level and current data – faster than ever before.

Imagine getting immediate access to nearly 40 years of global metocean data, along with quick validation reports and interactive analytics on-demand.

Here is what you will get:

- Instant access to worldwide metocean data
- Data from high-resolution local or regional models, to global coverage datasets
- On-demand calculations of commonly requested analytics
- Continuously-improving metocean data

[www.metocean-on-demand.com](http://www.metocean-on-demand.com)  
(Best viewed using Google Chrome)



# BATHYMETRICS DATA PORTAL

Now you can get high quality water depth data online - and only pay for what you need!

The Bathymetrics Data Portal enables you to search, purchase and automatically download the best available water depths information for your area of interest in three simple steps. For many parts of global coastal waters, reliable and readily available information about water depths has been insufficient. Imagine gaining online access to high quality water depth data, and only paying for what you need.

Here is what you will get:

- Search, purchase and download online
- Access data ranging from 2m to 90m
- Reduce costs by only paying for your project area
- Stay up-to-date with the best bathymetric information

<https://bathymetrics.shop>



An aerial photograph showing a wide river meandering through a vast, dense green forest. The river's path is irregular, with several sharp turns and smaller tributaries branching off. The water appears dark, contrasting with the bright green of the trees. The overall scene is a natural, undisturbed landscape.

# WATER RESOURCES

Successful water resources management is becoming an **increasingly complex and challenging task** with issues ranging from drought and water scarcity to severe flood incidents.

Our unique software suite **embeds DHI's industry leading expertise** in a range of highly specialised products covering all aspects of **inland water dynamics** and **water resources availability and quality**.

Our products work individually or in combination to assist our clients to make **optimal and well-balanced decisions** when solving today's water resources challenges.



# MIKE SHE

## Integrated catchment modelling

MIKE SHE delivers **truly integrated modelling** of groundwater, surface water, recharge and evapotranspiration. MIKE SHE includes **all important aspects of hydrology** when your project requires a fully integrated model. **No other tool or combination of tools can match MIKE SHE** in terms of seamless integration of all the important processes of the hydrological cycle.

### APPLICATIONS

MIKE SHE is ideal when surface processes affect subsurface conditions and vice versa. MIKE SHE internalises traditional boundaries and effectively partitions rainfall into Evapotranspiration, Runoff and Groundwater Recharge.

#### TYPICAL APPLICATIONS

The list of potential MIKE SHE applications is huge including, for example:

- Integrated catchment hydrology
- Conjunctive use and management of surface water and groundwater
- Irrigation and drought management
- Wetland management and restoration
- Environmental river flows
- Floodplain management
- Groundwater-induced flooding
- Land use and climate change impacts on groundwater and surface water
- Nutrient fate and management
- Integrated mine water management

### FEATURES

MIKE SHE is a flexible modelling framework that includes a range of numerical methods for each hydrological process. It has an advanced, conceptual, model-independent user interface with full water balance accounting for all hydrological processes.

It is possible to combine the hydrological processes and numerical methods depending on the requirements of your application and the availability of data.

All numerical engines in MIKE SHE are parallelised to make efficient use of available multicore resources.

#### OVERLAND FLOW

MIKE SHE uses a 2D, diffusive wave, finite difference method for detailed runoff and flood modelling, with two-way dynamic exchange between the floodplain and the river.

In parallel, MIKE SHE can route rainfall to nearby streams and channels via a conceptual drainage network.

### FEATURES

#### RIVER FLOW

You can simulate channel flow using full, 1D hydrodynamics, including operation of hydraulic structures such as gates, pumps and weirs. For larger networks, a faster and less data intensive flow routing method is also available.

#### UNSATURATED ZONE

For detailed, vertical unsaturated flow, you can use the 1D, finite difference multilayer method based on either Richards' equation or gravity flow.

Alternatively, you can use a two-layer root zone model for simple water balance accounting in the unsaturated zone.

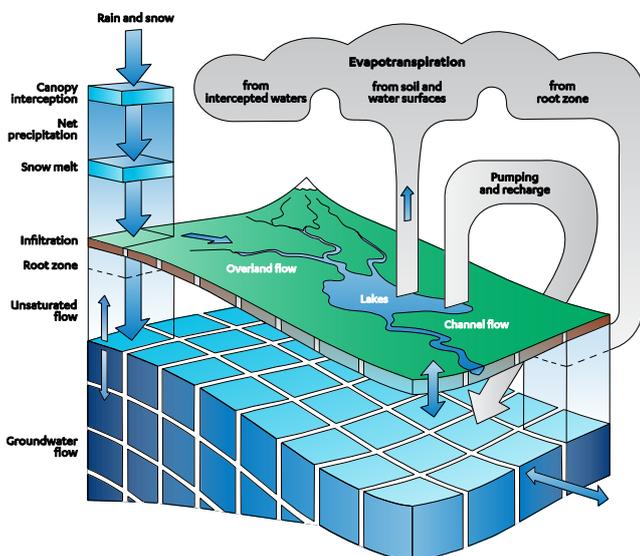
Green and Ampt infiltration can be used in dry soils when capillarity is ignored. Bypass flow can be used to account for soil macropores and sub-grid variability of infiltration.

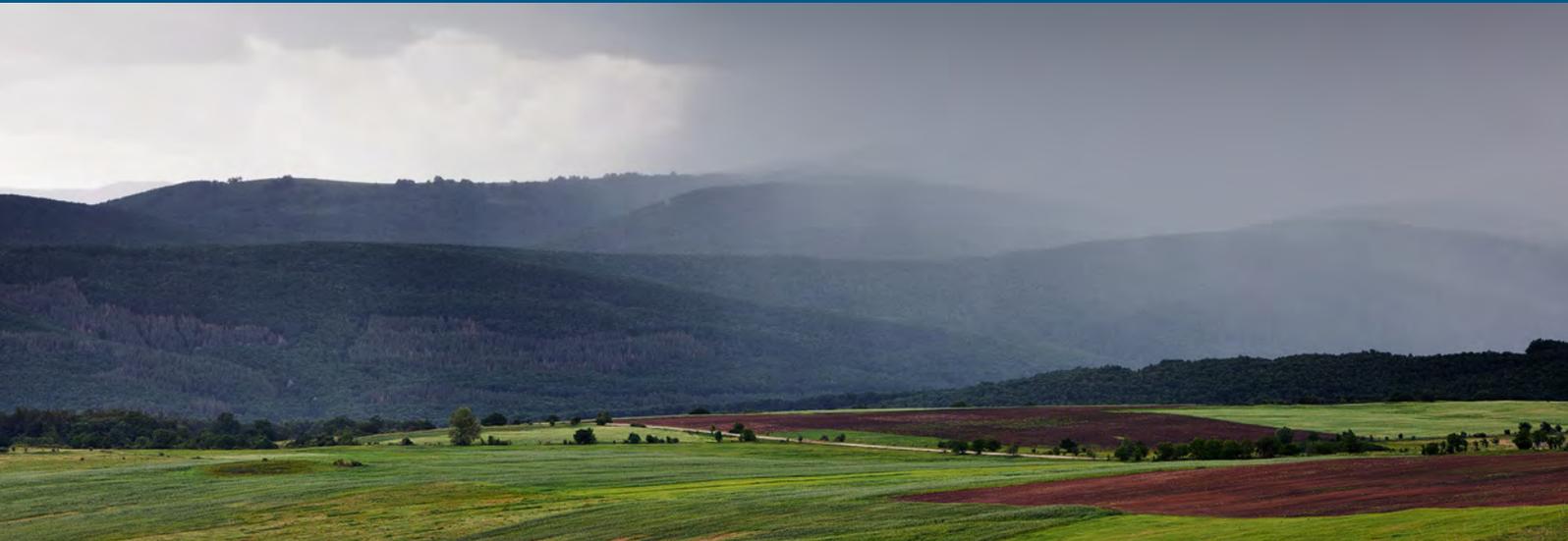
#### EVAPOTRANSPIRATION

Rainfall and evapotranspiration are the largest parts of the water balance. In MIKE SHE, vegetation-based actual evapotranspiration is calculated from interception, soil, ponded water, the root zone and groundwater.

#### SNOW

In cold climates, MIKE SHE converts elevation corrected precipitation into wet and dry snow storage. Snow is converted to surface water using an extended degree-day method, including elevation corrected temperature, radiation and rain-on-snow.





## FEATURES

### GROUNDWATER

For detailed groundwater-surface water interaction, MIKE SHE includes 3D, finite difference groundwater flow that discharges groundwater drainage directly to surface water.

A linear reservoir groundwater method is also available for basin-wide water balance and management, or fully distributed rainfall-runoff modelling.

### WATER QUALITY

With MIKE SHE, you can simulate fully integrated solute transport between surface water and the subsurface, including decay, sorption, precipitation and selective uptake.

You can also include more complex, multispecies, kinetic reactions, comprising all aspects of eco-hydrology, with MIKE ECO Lab. See more on page 24.

For source water protection and groundwater age analysis, fully dynamic random walk particle tracking is available in the saturated zone.

### WATER BALANCE

MIKE SHE includes a comprehensive and flexible water balance utility for complete local and model wide water balances - for any time period.

### ADDITIONAL FEATURES

**Deficit-driven irrigation** from multiple sources, such as rivers and groundwater subject to control and license limits.

**AUTOCAL** is a general tool for parameter estimation and sensitivity analysis that automatically uses available CPU cores.

**Python scripting** is available in MIKE SHE for users to integrate MIKE SHE into decision support systems, or to build their own plugins to modify or create additional processes.

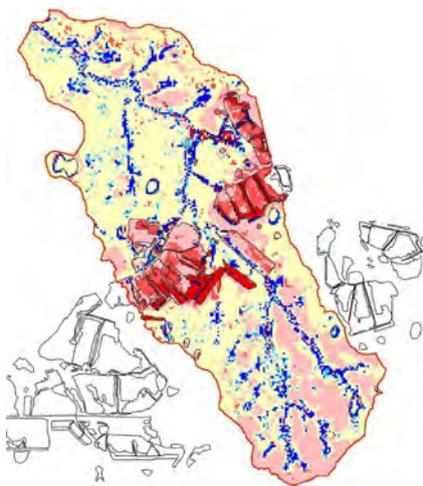
## BENEFITS

DHI has more than 30 years of experience in integrated hydrological modelling — more than any other organisation in the world.

It is this experience that is embedded in MIKE SHE and is available to you in our unparalleled technical support and training.

If you need to accurately partition rainfall into runoff, evapotranspiration and groundwater recharge, MIKE SHE is the fastest, most dependable way to produce accurate integrated models.

With MIKE SHE, you can tailor the complexity of your model and truly explore the impact of hydrologic change.



*Fully distributed map of groundwater recharge (in red) and discharge (in blue).*



# MIKE HYDRO RIVER

## Comprehensive river network modelling

MIKE HYDRO River is our **new generation river modelling** package—successor of the world-known MIKE 11 river modelling system. MIKE HYDRO River is **top quality river modelling**, covering **more application areas than any other river modelling package** available. It enables you to model a variety of tasks related to river hydraulics, water quality, flooding, forecasting, navigation as well as catchment dynamics and runoff.

### APPLICATIONS

Our 1D river modelling package is developed over decades and applied in a large range of complex applications, guaranteeing that MIKE HYDRO River is a perfect and safe choice for your river modelling projects.

#### TYPICAL APPLICATIONS

MIKE HYDRO River is the ideal software for:

- Real-time flood forecasting
- Dam break analysis
- Reservoir optimisation including complex structure operations
- Ecology and water quality assessments in rivers and wetlands
- Flood analysis and flood alleviation design studies
- Water quality forecasting
- Sediment transport and long term assessment of river morphology changes
- Salinity intrusion in rivers and estuaries

Additionally, optimal river modelling solutions often require integrated modelling, in which the river model interacts with surrounding flood areas or groundwater. MIKE HYDRO River is perfectly suited for fully integrated applications by seamless model couplings with MIKE+ and MIKE SHE.



### ENGINES

MIKE HYDRO River offers a variety of hydraulic and hydrological simulation engines.

#### HYDROLOGY

The MIKE HYDRO River packages also include options to further improve the solution through inclusion of distributed hydrology in river modelling. Hydrology features include:

- **Overland flow** using a 2D diffusive wave approach or more simplified methods to include long term exchange across floodplains
- **Unsaturated infiltration** using Richards Equation or more simplified methods to calculate infiltration losses in floodplains
- **Evapotranspiration** from leaf interception, ponding, the root zone and groundwater, to assess catchment water balances and riparian ET
- **Groundwater** using a 3D finite difference or linear reservoir approach for river bed exchange in gaining and losing rivers

#### HD - HYDRODYNAMICS

This is a powerful, parallelised 1D hydrodynamic engine for rivers and open channels. It is unsurpassed in flexibility, robustness and features. Key features include:

- Fully dynamic solution to the 1D St. Venant equations
- Hydraulic routing options for simplified channel routing
- Automatic adaptation to subcritical and supercritical flow
- Comprehensive hydraulic structures library
- Extremely flexible control module for operational gates, pumps and turbines

### MODULES

MIKE HYDRO River includes a wide range of add-on modules, enabling you to tailor the river model framework specifically to the requirements of your projects.

#### DA - DATA ASSIMILATION/FLOOD FORECASTING

Data assimilation and real-time flood forecasting, including continuous model state updating during simulation, Kalman filter and uncertainty assessments.

#### ONLINE OPERATION AND FORECASTING

Online, real-time data management and forecasting with MIKE HYDRO River is possible – through integration of river models in the modelling framework, for water forecasting and operational control using MIKE OPERATIONS. See more on page 40.

#### AUTOCAL - AUTOMATIC CALIBRATION

This is an automatic calibration process for a wide range of parameters, including RR parameters, Manning numbers, head loss coefficients and water quality parameters.



## MODULES

### RAINFALL RUNOFF

This includes a variety of RR models, amongst others, a lumped conceptual and continuous hydrological model, urban runoff models as well as the standard unit hydrograph SCS method.

### CONTROL STRUCTURES

This simulates operational structures such as sluices, overflow and radial gates as well as pumps and turbines from user-defined operation strategies.

This provides different methods for simulation of dam breaches from an initial dam geometry. The options available are modes for soil erosion failures or user-defined breaches. DB includes NWS DAMBRK and energy equation breach calculation methods.

### TRANSPORT

Transport and spreading of conservative pollutants and constituents, including a linear decay option.

Modelling of cohesive and non-cohesive sediment dynamics including transport, erosion and deposition of uniform and mixed sediments. Includes calculation of morphological changes of river bed bathymetry and bed sediment composition.

### MIKE ECO LAB - ECOLOGICAL MODELLING

MIKE ECO Lab is applied for all water quality related and heat balance applications with MIKE HYDRO River, using predefined or user defined water quality model templates. See more on page 24.

## BENEFITS

MIKE HYDRO River is a powerful river modelling software with more features than any other river modelling package.

With MIKE HYDRO River, you get the successor of MIKE 11 — one of the world's most well-proven and widely applied 1D river modelling packages.

Our 1D river modelling package is the preferred choice of professional river engineers when reliability, versatility, productivity and quality are the keywords.

MIKE HYDRO River facilitates efficient and accurate integrated modelling applications for e.g. flooding and integrated hydrology through seamless coupling to other MIKE models.

MIKE HYDRO River continues the successful era of MIKE 11 — the product that made the MIKE brand name synonymous with top quality modelling software from DHI and which remains one of the most widely-used MIKE products.



## INTEGRATED MODELLING

MIKE HYDRO River can be coupled to a 2D overland flow model and/or a collection system network using MIKE+ or alternatively using MIKE FLOOD.

### CONNECTION TO MIKE+

New coupling models should be made with MIKE+, DHI's new integrated modelling platform. MIKE+ comes with a River module that provides new user-friendly river modelling workflows. MIKE+ also supports the use of existing MIKE HYDRO River models.

### CONNECTION TO MIKE FLOOD

MIKE HYDRO River can be coupled with MIKE FLOOD, DHI's historical coupling software. This is relevant when coupling to MIKE 21 (classic version using rectangular grids only) and/or MIKE URBAN models.

### CONNECTION TO MIKE SHE

MIKE SHE is a distributed hydrological model that can improve the accuracy of MIKE HYDRO River results drastically in some instances. Investigating the overall water basin hydrology, groundwater recharge, seasonal variation, land use impact can be crucial in a flooding context.

### MIKE OPERATIONS

Upgrading a MIKE HYDRO River model to a real-time flood forecasting system can significantly decrease the impact of flood events. This can be easily done through MIKE OPERATIONS.

# MIKE HYDRO BASIN

## River basin management and planning

MIKE HYDRO Basin is a **multipurpose, map-based decision support tool** for integrated water resources analysis, planning and management of river basins. MIKE HYDRO Basin is **designed for analysing water sharing issues** at international, national or local river basin scale. It's a comprehensive yet simple product for investigating options and **making reliable decisions**.

### APPLICATIONS

The conceptual modelling approach for water resource evaluations as implemented in MIKE HYDRO Basin allows you to conduct a diversity of management and planning related applications.

#### TYPICAL APPLICATIONS

MIKE HYDRO Basin is the ideal software for:

- Multisector solution alternatives to water allocation and water shortage problems
- Climate change impact assessments on water resources availability and quality
- Exploration of conjunctive groundwater and surface water usage
- Optimisation of reservoir and hydropower operations
- Evaluation and improvement of irrigation scheme performance
- Integrated water resources management (IWRM) studies

### MODULES

MIKE HYDRO Basin includes multiple calculation modules and model components for effective water resources modelling.

Key modules and model components include:

- A model framework with a map-based graphical user interface that is comprehensive, intuitive and easy to use
- Catchment and river delineation tools
- Water movement calculations
- Catchments rainfall and runoff calculations
- Water usage calculation from multiple types of water users
- An advanced irrigation module
- Global ranking of water users
- Reservoir and hydropower calculations
- Reservoir sedimentation
- Data assimilation
- Scripting and programming
- Water quality modelling using MIKE ECO Lab
- Results presentation

### STAKEHOLDER ENGAGEMENT

Stakeholder engagement is crucial when preparing management plans for water resources usage in river basins.

MIKE HYDRO Basin can be integrated as a key model component in decision support systems like MIKE OPERATIONS. Data collection and processing together with dissemination of model simulation results ensure the most objective and optimal decisions.

### BENEFITS

MIKE HYDRO Basin provides an easy-to-use, map-based modelling framework for water resources management and planning in river basins.

It includes all model features required in most projects for efficient and accurate water resources modelling.

Mature and reliable river basin simulations capability obtained from more than a decade long record of project applications.

Comprehensive and effective model components for IWRM applications and decision support systems.

Water resource planning without limits.



# MIKE 21C

## River hydraulics and morphology

MIKE 21C is one of the most comprehensive and well established tools for **simulating river bed and channel plan form development** caused by changes in the hydraulic regime. **Simulated processes include alluvial resistance, bank erosion as well as scouring and shoaling** caused by activities such as construction and dredging, and seasonal flow fluctuations.

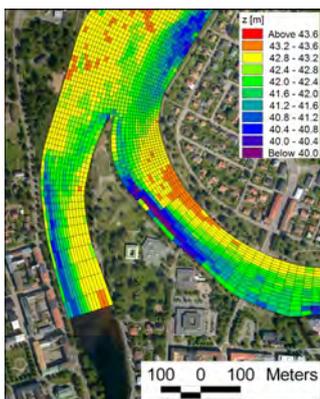
### APPLICATIONS

MIKE 21C is applied in complex river dynamics with a primary focus on sediment transport and river morphology.

#### TYPICAL APPLICATIONS

MIKE 21C is the ideal software for:

- Analysing flow fields and flood dynamics in rivers and adjacent floodplains
- Forecasting morphological changes in combination with planning and execution of river training works
- Reservoir sedimentation
- Designing protection schemes against bank erosion
- Evaluating measures to reduce or manage shoaling
- Analysing alignments and dimensions of navigation channels in order to minimise capital and maintenance dredging
- Predicting sedimentation of water intakes, outlets, locks and harbours
- Forecasting the impact of bridge, tunnel and pipeline crossings on river channel hydraulics and morphology
- Optimising restoration plans for habitat environment in channel floodplain systems
- Designing monitoring networks based on morphological forecasting



*Curvilinear grid example for a river with a bifurcation (Klarälven, Sweden).*

### MODULES

MIKE 21C is modular with options for standalone hydrodynamics or combined hydrodynamic and sediment transport simulations.

#### PP - PREPROCESSING AND POSTPROCESSING

This module offers an integrated work environment, providing convenient and compatible routines to ease the task of data input, analysis and presentation of simulation results.

#### HD - HYDRODYNAMICS

MIKE 21C is a special module of the MIKE 21 software package based on a curvilinear grid. Flow hydrodynamics are computed over a curvilinear or rectangular computational grid by solving the vertically integrated St. Venant equations. Areas of special interest can be resolved using locally varying density of gridlines.

#### ST - SEDIMENT TRANSPORT

Advanced sediment transport modelling capability including mud (cohesive), sand (non-cohesive) and mixed sediments. This includes bed load and suspended sediment transport dynamics in combination with continuous update of morphological changes to the river bed.

### BENEFITS

MIKE 21C is a specialised tool for the serious river morphology modeller.

It provides highly flexible, numerical solutions specifically tailored for sediment dynamics in river systems.

It encompasses mixed sediments ranging from silt and clay to sand and gravel.

MIKE 21C encapsulates DHI's collective knowledge and experience in river sediment dynamics - embedded into our technology and made available to river engineers all over the world.

### FEATURES

#### GRID GENERATOR

Create and edit curvilinear model grids for model simulations in MIKE 21C.

#### HYDRODYNAMICS

Features a large number of hydrodynamic processes required for complex sediment transport simulations.

- Curvilinear numerical grid
- Highly efficient model solver making long term simulations feasible
- Hydraulic structures and choice of dynamic or quasi-steady solutions

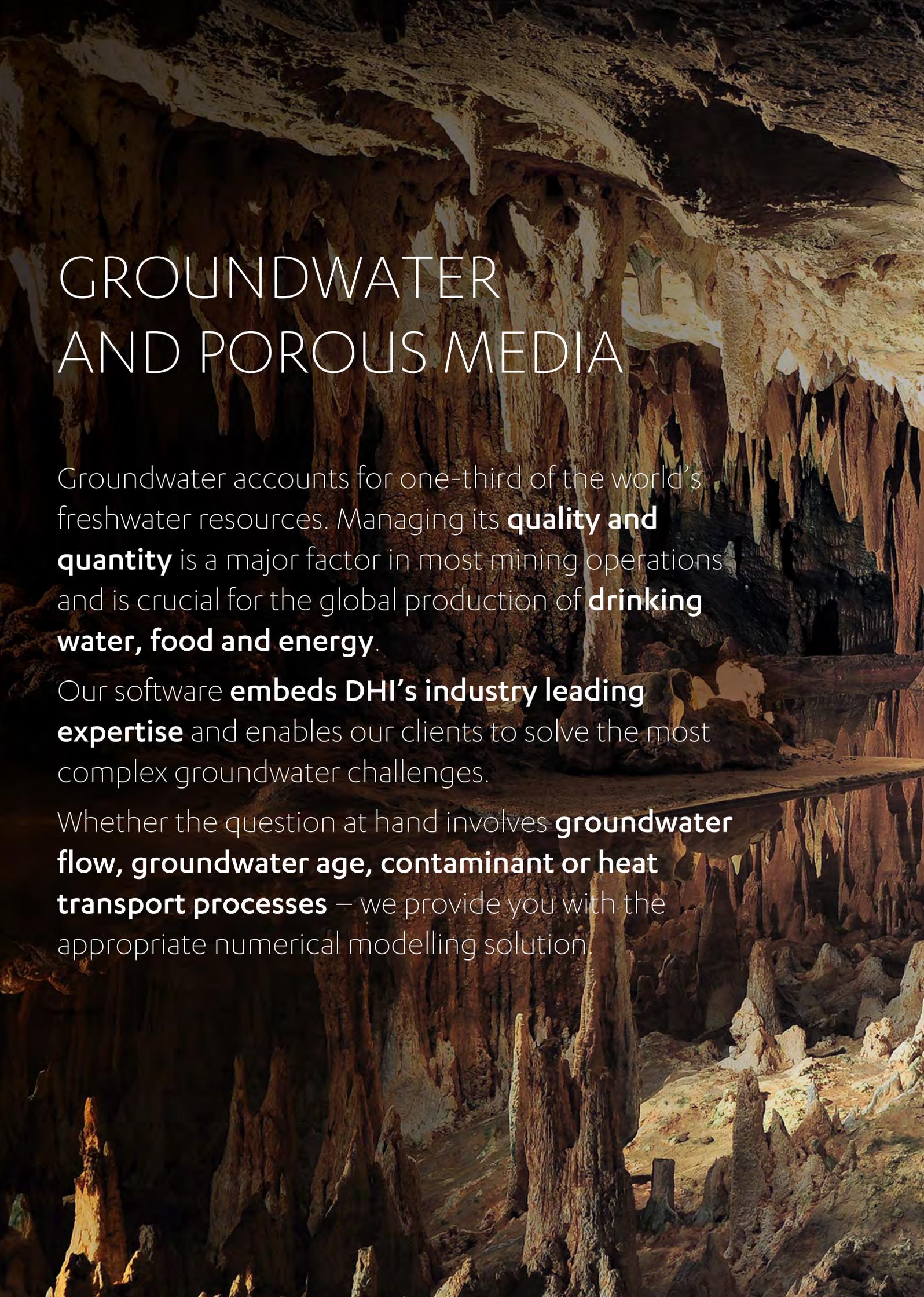
#### ADVECTION DISPERSION

The sediment transport module includes a fully implicit advection-dispersion model.

#### SEDIMENT TRANSPORT

Comprehensive sediment transport module for sediment transport and river morphology dynamics, including:

- Helical flow, bank erosion, bed scour
- Sediment transport for sand and gravel
- Bed load and suspended load
- Cohesive and non-cohesive sediment models for multiple sediment fractions



# GROUNDWATER AND POROUS MEDIA

Groundwater accounts for one-third of the world's freshwater resources. Managing its **quality and quantity** is a major factor in most mining operations and is crucial for the global production of **drinking water, food and energy**.

Our software **embeds DHI's industry leading expertise** and enables our clients to solve the most complex groundwater challenges.

Whether the question at hand involves **groundwater flow, groundwater age, contaminant or heat transport processes** – we provide you with the appropriate numerical modelling solution.



# FEFLOW

## All-in-one groundwater modelling solution

Groundwater projects are becoming more and more demanding - requiring modelling software with more sophisticated capabilities than ever before. FEFLOW provides **best-in-class technology** for groundwater flow, contaminant, groundwater age and heat transport simulations. With its **efficient user interface** and its yet **unmatched range of functionality and flexibility**, FEFLOW has become a standard in **premium groundwater modelling** over the last 35 years.

### APPLICATIONS

FEFLOW is applicable for a multitude of groundwater, porous media and heat transport projects - from local to regional scale.

#### TYPICAL APPLICATIONS

FEFLOW is the ideal software for:

- Regional groundwater management
- Groundwater management in construction and tunnelling
- Capture zone and risk assessment via groundwater-age calculation
- Mine water management
- Simulation of open-pit progress
- Saltwater intrusion
- Brine water management
- Seepage through dams and levees
- Land use and climate change scenarios
- Groundwater remediation and natural attenuation
- Geothermal energy (deep and near surface, both open-loop and closed-loop systems)
- Groundwater-surface water interaction
- Groundwater induced subsidence
- Simulation of industrial porous media

### FINITE ELEMENTS

FEFLOW uses the finite element method to handle a broad variety of physical processes for subsurface flow and transport modelling. The advantages of the finite element method include:

- Flexible meshing for detailed models of complex geological structures
- Layer-based, partially unstructured or fully unstructured (tetrahedral) meshes in 3D
- Precise spatial representation of features, such as rivers, fractures, pipes, tunnels and well locations
- Accurate representation of sloping layers and anisotropy

FEFLOW supports dynamic deactivation and reactivation of mesh elements to account for geometry changes in the model domain over time, e.g. a mining plan.

3D groundwater models are computationally demanding. FEFLOW employs optimised numerical solvers that use parallel computing on multiprocessor and multicore machines.

The highly nonlinear Richards equation is further stabilised using the Control-Volume Finite Element method.

### FEATURES

FEFLOW supports a wide range of physical processes.

#### GENERAL

- Transient conditions
- Steady state conditions

#### FLOW MODELLING

- Darcy flow in porous media
- 2D/3D unsaturated flow
- Free surface (phreatic) flow
- Density dependent flow
- Fracture and pipe flow

#### MASS TRANSPORT MODELLING

- Advection-diffusion/dispersion solute transport
- Single and multispecies solute transport
- Equilibrium sorption
- User-defined kinetic reactions
- Fracture mass transport
- Geochemical and equilibrium reactions with PHREEQC-RM

#### GROUNDWATER AGE MODELLING

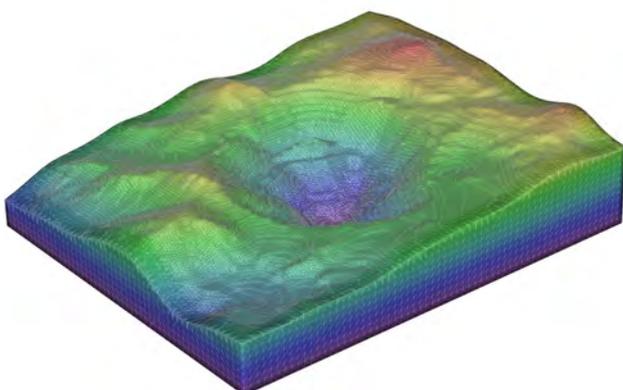
- Capture zone analysis
- Exit probability calculation

#### HEAT TRANSPORT MODELLING

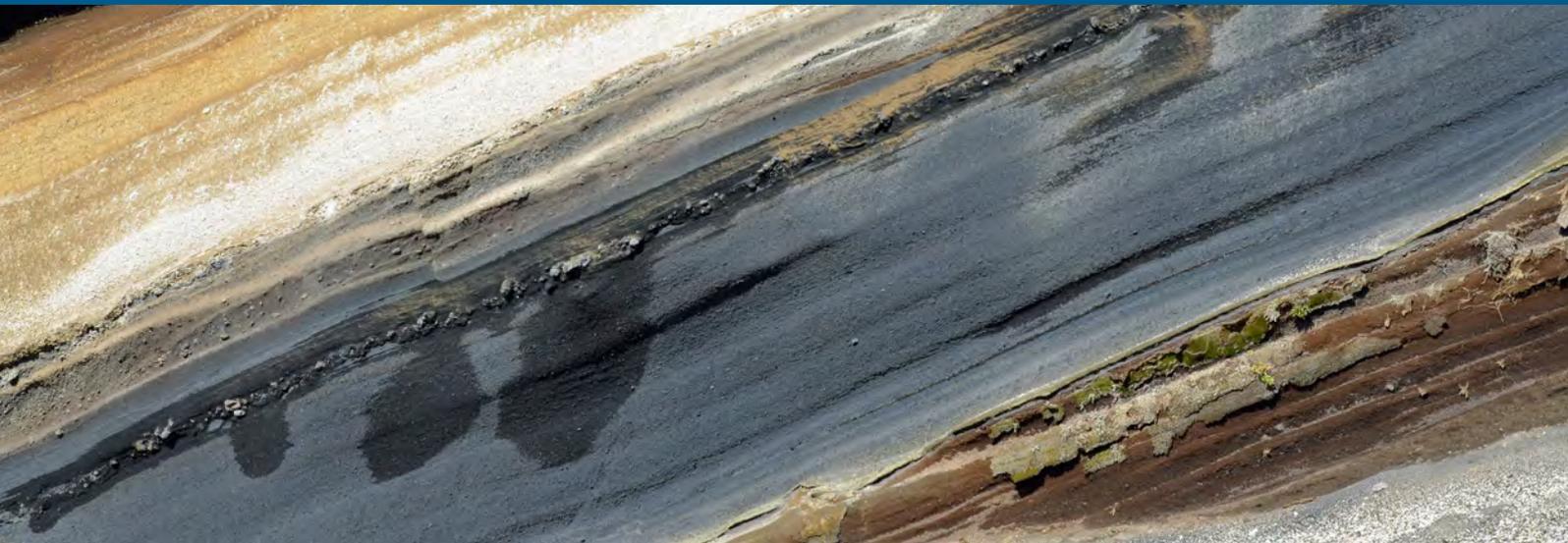
- Advection-conduction/dispersion heat transport
- Fracture heat transport
- Thermohaline convection
- 1D borehole heat exchanger elements and heat exchanger arrays

#### GROUNDWATER-SURFACE WATER INTERACTION

- Integrated dynamic river flow modelling linked to DHI's MIKE 1D surface water engine.
- Integrated fully dynamic 2D surface water overland modelling linked to DHI's MIKE 21 Flexible-Mesh engine



Open-pit mine



## FEATURES

### ONE FOR ALL

Whether you are interested in regional groundwater flow around a water supply well or formation of temperature and salinity induced convection in a coastal aquifer, FEFLOW provides everything you need.

FEFLOW covers everything from the first pre-processing steps, to helping you present results to clients or to the public.

### UP-TO-DATE VISUALISATION TOOLS

FEFLOW dramatically visualises planar, cross-sectional and 3D structures. You can present your modelling results as high quality snapshots or in video sequences.

Stereoscopic visualisation and image/video export provide a level of insight into complex simulation models that has never been reached before.

FEFLOW even exploits 3D Virtual Reality technology so you can dive inside your mesh to access its secret regions!

### OPEN PROGRAMMING INTERFACE

FEFLOW is designed to handle plug-ins for extended functionality. A convenient programming interface makes plug-in development a manageable task - even for less experienced programmers. Many plug-ins are readily available on GitHub, along with extensive documentation to help you get started.

### GET THE FREE VIEWER

In viewer mode, FEFLOW's advanced visualisation and post-processing capabilities are available free of charge. Model reviewers and clients do not need a software licence to evaluate input data and simulation results.

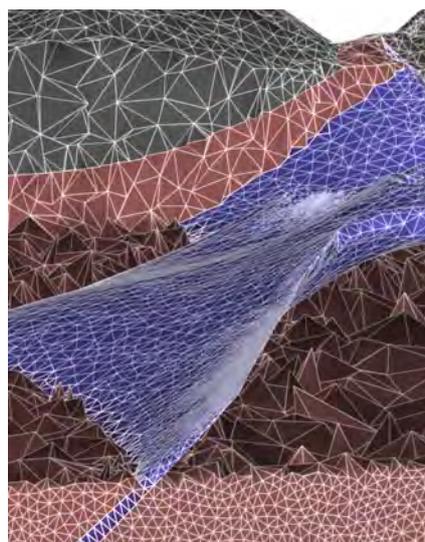
## FEATURES

### FEPEST FOR PEST

FePEST is FEFLOW's graphical user interface for PEST (Watermark Numerical Computing, John Doherty) and PEST++ (USGS). The convenient graphical interface of FePEST guides you through all steps of parameter estimation and uncertainty analysis. For increased efficiency, these tasks can be executed in parallel on multiple computers - with just one single corporate licence.

### WGEO

WGEO is an outstanding tool for georeferencing and processing of spatially related raster data, as well as for transforming raster and vector data. WGEO enables quick and efficient rectification and georeferencing of data sets for use in simulations.



*Fault system*

## RELIABILITY

### OUTSTANDING TRADITION

Since 1979, FEFLOW has been constantly developed and applied to different types of groundwater and porous media simulation projects. Through these developments, we have provided a convenient graphical user interface since the late 1980s. For decades, it has been the trusted choice of leading groundwater modellers worldwide.

### BENCHMARK SIMULATIONS

Users of complex simulation software, such as FEFLOW, expect reliability, accuracy and efficiency.

All parts of the FEFLOW simulation engine have passed extensive benchmark testing against analytical solutions, physical laboratory test results and results from other well-known simulation systems.

If your project requires accurate representation of the geology through flexible mesh modelling - even with time varying geometries - FEFLOW is the answer.

Thousands of users around the world know that highly-qualified support for complex groundwater modelling is only an email or a phone call away.

The very active FEFLOW user community shares application experience via the MIKE User Forum and other online groups. Use these platforms - even if you are not a FEFLOW user yet.

Regular user group meetings and FEFLOW conferences provide opportunities to share knowledge and connect to the global community of FEFLOW users.

# DATA MANAGEMENT, INVESTMENT PLANNING, REAL-TIME FORECASTING AND OPERATIONAL CONTROL

Taking on the world's biggest water challenges requires the most **advanced, reliable and innovative technology**.

**Our unified software suite** optimises your data handling workflow, supports scenario analysis and decision making, as well as offers real-time forecasting and operational control capabilities.

Our technologies **embed DHI's industry leading expertise** and integrate with MIKE products as well as your existing technologies to solve the toughest water challenges **across disciplines and industries**.



# MIKE OPERATIONS

Transform your data, models and knowledge into **better operational decisions**

MIKE OPERATIONS empowers water professionals with technology for building data management systems, water forecast systems and ultimately establish **real-time operational control systems that connect to the internet-of-things** and control pumps, weirs, gates and dams in the physical system.

## EMPOWERING WATER PROFESSIONALS

Whether working with water in river basins, cities or marine environments, water professionals are facing the same difficulties when dealing with diverse data sources and a variety of different modelling applications and outputs.

MIKE OPERATIONS is a generalised software product designed to build manual or automated workflows for data acquisition, data validation, model execution and information publishing.

It supports organisations in building the capacity needed for configuring and maintaining sophisticated information systems that make essential information readily available to operators and decision-makers.

## BENEFITS

Water professionals use MIKE OPERATIONS to deal with a complex range of water challenges. Key benefits include:

### INCREASED EFFICIENCY

- Do more with less and get the full benefit of data and models
- Improve operations with existing knowledge and infrastructure
- Provide better service to partners, clients, stakeholders and to the public

### REDUCED COSTS

- Develop less labour intensive processes
- Reduce operational costs (energy, chemicals, downtime)
- Make better long term investments
- Reduce emergency damages

### REGULATORY COMPLIANCE

- Emergencies response and public safety
- Environmental Impact Assessments
- Managing Combined Sewer Overflows (CSOs)
- Understand risks and avoid penalties

## APPLICATIONS

### WATER RESOURCES AND RIVER BASINS

Water authorities use MIKE OPERATIONS as a hydrological data management system that provides access to quality assured data for water management purposes.

Basin managers use MIKE OPERATIONS to promote transparency and objectivity in water resources management and planning decisions.

River operators and emergency managers use MIKE OPERATIONS to collect and process real-time data and to build flood forecasting system or optimise river operations.

### WATER UTILITIES

Water utilities use MIKE OPERATIONS to:

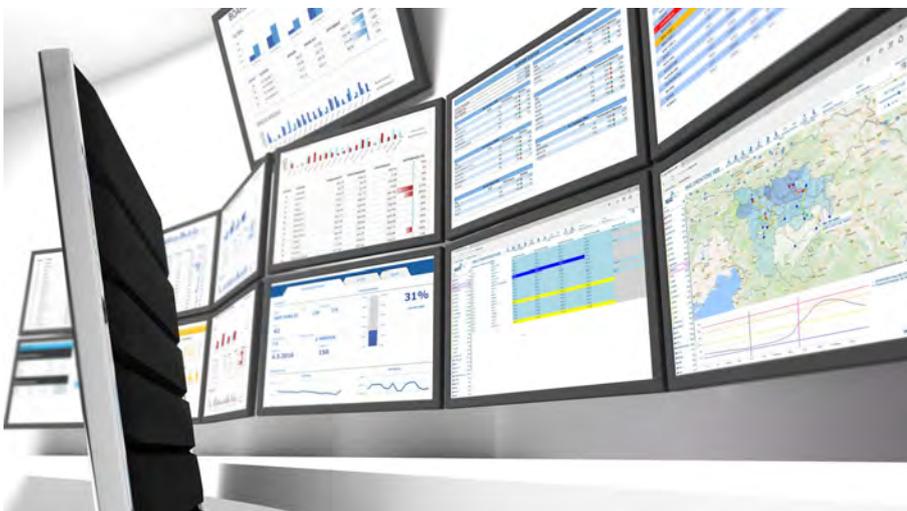
- Establish real-time data management including data and compliance reporting
- Establish real-time forecast systems and for control and optimisation of storm- and wastewater collection systems
- Monitor leaking water distribution systems and minimise non-revenue-water

### HARBOUR AUTHORITIES AND MARINE OPERATORS

Marine operators use MIKE OPERATIONS to create data management systems providing metocean data.

Oil companies and dredging companies use MIKE OPERATIONS to make environmental risk and impact assessments for operational planning.

Emergency management authorities use MIKE OPERATIONS to create forecast systems targeting coastal flooding, pollution spills and bathing water quality.





## MODULES

### DATA AND TOOLS

The Data module manages the basic storage and processing of data. The functionality is organised in a number of components, including:

- Time series, which includes a variety of tools for data processing and quality assurance
- GIS tools for analysis and processing of vector and raster data
- Document management system (images, MS Word, PDF and so on)
- Spreadsheet component for data reporting and spreadsheet calculations
- Python Scripting with editor and debugger
- Indicators calculated based on field data or model outputs
- Report generator for automated reporting with MS Word

### SCENARIO

Extends the Data module with scenario management functionality. It provides a number of model adapters that links MIKE OPERATIONS to a particular model and enables scenario comparison, model optimisation, sensitivity analysis, linking multiple models in one model as well as Multi Criteria Analysis and Cost Benefit Analysis.

### REALTIME

Extends the Data module with built-in job tasks and workflow designer for automation of data import, data processing and model execution tasks.

## FEATURES

MIKE OPERATIONS combines the strengths of an out-of-the-box configurable software product with the flexibility of an open software development framework. Key features include:

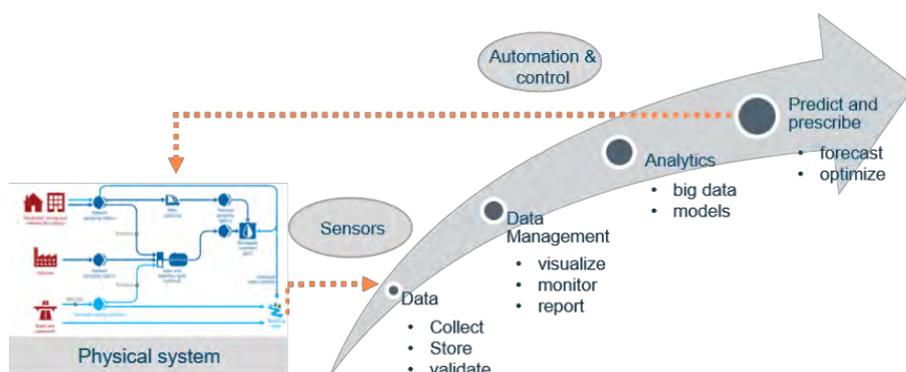
- Configurable desktop and web application designed to provide necessary information to system operators and decision makers
- Workbench application with user interface designed for effective and system configuration and maintenance
- Tools for interfacing to a variety of data formats and data sources
- Data storage in relational database.
- Expandable through built-in Python scripting component
- API for developing custom applications
- Multi-user with different user access levels and associated privileges

## DIMS.CORE

DIMS.CORE complements MIKE OPERATIONS by providing advanced time series management capabilities.

DIMS.CORE can link to all data sources, combine multiple data sources into one platform, as well as share and provide data to users anywhere.

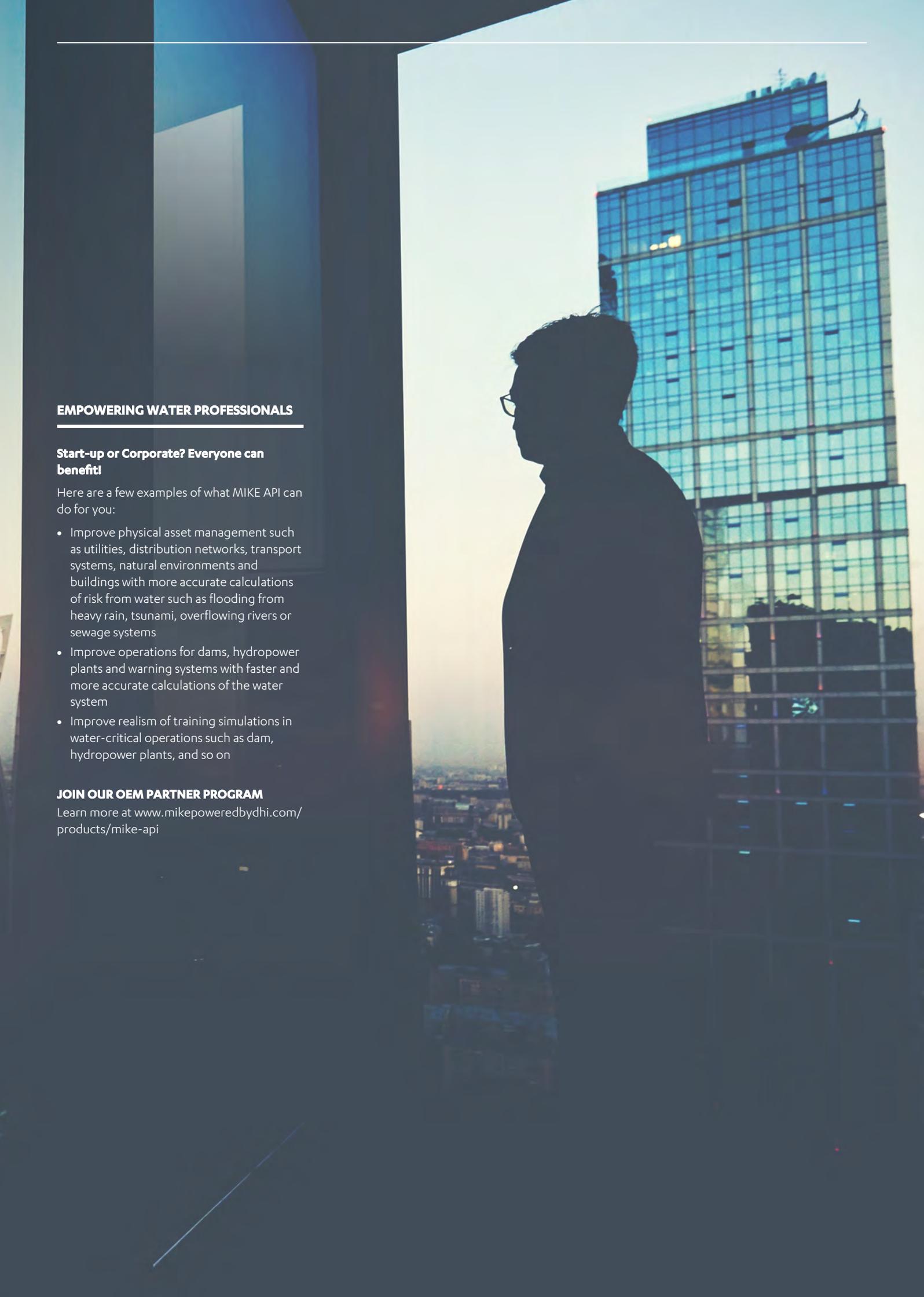
It is designed for building solutions that transform data into information for the operation and management of utilities. DIMS.CORE is used for linking the Supervisory Control and Data Acquisition (SCADA) system data and models in projects that implement monitoring and/or model-based real-time control systems, and it comes with flexible and automated reporting capabilities.



# MIKE API

**Unlock more business opportunities with MIKE API.** By integrating MIKE API into your own development projects, you will be sure to get the most accurate modelling engine to support your business goals – and to differentiate you from the competition.



A silhouette of a man in a suit and glasses stands on a high-rise building, looking out over a city skyline at sunset. The sky is a mix of orange and blue, and the city lights are visible in the distance. A large glass skyscraper is prominent on the right side of the frame.

## EMPOWERING WATER PROFESSIONALS

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### **Start-up or Corporate? Everyone can benefit!**

Here are a few examples of what MIKE API can do for you:

- Improve physical asset management such as utilities, distribution networks, transport systems, natural environments and buildings with more accurate calculations of risk from water such as flooding from heavy rain, tsunami, overflowing rivers or sewage systems
- Improve operations for dams, hydropower plants and warning systems with faster and more accurate calculations of the water system
- Improve realism of training simulations in water-critical operations such as dam, hydropower plants, and so on

### **JOIN OUR OEM PARTNER PROGRAM**

Learn more at [www.mikepoweredbydhi.com/products/mike-api](http://www.mikepoweredbydhi.com/products/mike-api)

# PRICING OPTIONS

**Getting access to MIKE has never been easier.**

With a wide variety of licenses and access options available, there is sure to be one that is right for your projects. Whether you need access for a single user, small businesses, large corporations or universities, we have the pricing option that fits your budget and modelling needs.

A person is surfing on a large, curling wave. The scene is captured at sunset, with the sky transitioning from a bright orange near the horizon to a pale blue at the top. The water is a deep, dark blue, and the wave's crest is white with foam. The surfer is positioned on the right side of the frame, riding the face of the wave. The overall mood is dynamic and energetic.

## CHOOSE YOUR ACCESS

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Experience MIKE through one of these options:

- **Subscription Packages** to enjoy multiple applications in one bundle
- **Perpetual Licenses** to build your own software portfolio
- **Academic License** for academic staff and students at all tertiary levels
- **MS Azure Marketplace** to model in the Cloud with your own Internet License
- **MIKE Software as a Service** to access MIKE software for one simple hourly fee

### GET STARTED

Learn more at [www.mikepoweredbydhi.com/pricing](http://www.mikepoweredbydhi.com/pricing)



# THE ACADEMY BY DHI

THE ACADEMY by DHI is all about **knowledge building and sharing**. With our skills development and capacity building activities, **we make sure you're equipped** to find and apply the appropriate solutions to your unique challenges.

Our **global knowledge** is delivered **online, in physical classrooms and project sites**, or through a **combination** of these—all depending on your needs and requirements.

We have **nearly 200 highly skilled trainers and facilitators** located at our offices worldwide. They are all **experienced professionals**, many of whom are recognised international experts in their individual fields. With THE ACADEMY, you'll always have a **trusted advisor**.



# THE ACADEMY BY DHI

**Make a difference** – enhance your knowledge and skills

THE ACADEMY by DHI embraces all of DHI’s global **training and knowledge sharing activities**. Through THE ACADEMY, we invite you to join the thousands of **water professionals**, who every year participate in our global training and capacity development programmes, as well as MIKE Powered by DHI seminars, workshops and conferences. You may join the activities **online** or **physically**—all depending on your needs, requirements and availability.

## ABOUT THE ACADEMY BY DHI

THE ACADEMY by DHI is all about developing skills and sharing knowledge with our clients and partners in order to make a difference in the world’s water environments.

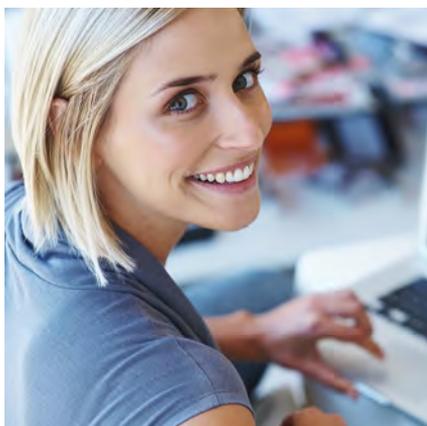
THE ACADEMY designs and arranges training packages and facilitates access to research results, expert forums, networks, partnerships and technology.

In addition to our traditional classroom courses, we also provide online courses, training seminars and presentations.

See the courses and events calendar on our website for a complete list of activities we have planned for you.

For questions and more information, you are welcome to contact our International THE ACADEMY Support Team at:

[www.theacademybydhi.com](http://www.theacademybydhi.com)  
[theacademybydhi@dhigroup.com](mailto:theacademybydhi@dhigroup.com)



## TRAINING & CAPACITY DEVELOPMENT

With our skills and capacity development activities, we make sure that you are equipped to find and apply the appropriate solutions to your unique challenges.

We offer training online and in the physical classroom—or through a blend of these, all depending on your needs and requirements.

We design many types of training packages ranging from a few hours, days or even months. Many of our projects include large training components and training-on-the-job schemes. We also organise special training packages for universities and research institutions as well as corporates and global companies.

A large proportion of our courses cover training in MIKE software where you will learn how to get the most out of them, as well as understand how they can improve the decision-making process for your projects.

Our courses are offered as standard or as tailored courses where you use your own project data.

Our trainers provide training tailored to your needs and help you develop skills and build expertise in your language — whenever and wherever you need it.

They will be able to advise you on the training scheme to adopt in order to meet your specific needs and preferences. With THE ACADEMY, you’ll always have a trusted advisor.

## ONLINE COURSES & ACTIVITIES

Training is important in building and maintaining your career and projects, but can be a challenge to schedule in your busy workweek.

Our online courses, seminars and presentations offer you a cost-effective and flexible method to enhance your skills and knowledge. The online activities can be arranged as standard or as tailored — or a blend of the two.

### ONLINE SELF-PACED COURSES

Our self-paced courses are ideal for the water professional who wants to learn to set up a simple MIKE model in a quick and cost-effective way—at a time and place that is convenient for you. These courses are free and all you need is a reliable internet connection of sufficient bandwidth and an investment of time of approximately 2-5 hours depending on the complexity of the model/theme.

The self-paced courses combine a number of sessions including online video lectures, demonstration videos, quizzes, hands-on exercises and reading materials.





**ONLINE COURSES & ACTIVITIES**

**ONLINE INSTRUCTOR-LED COURSES**

Our online instructor-led courses are ideal for the water professional who wants to learn in interaction or dialogue with fellow trainees and a trainer. The instructor-led courses typically combine lectures, demonstration videos and quizzes, hands-on exercises and reading materials. A major part of the online sessions is allocated to group work, which is based on home assignments.

These courses are modular-built, typically including four modules, each module of two hours duration. As an estimation, two hours are needed for home assignments per module. The instructor-led courses include a course fee.

**BLENDED LEARNING & COURSES**

An increasing number of our customers opt for 'blended learning' combining online courses with face-to-face tutoring. The face-to-face tutoring can also be replaced by your own online tutor, for example combining a self-paced course with tailored and personal online tutoring.



**OUR WEBINARS**



THE ACADEMY offers online and on-demand webinars.

Our 45- or 60-minute webinars feature a theme within a short duration, which can be a software feature and/or a more thematic subject. Our webinars are ideal to help you identify what our MIKE software can do to match your requirements. If you want to learn more, you can attend our software training courses, which are suitable for both potential, new and experienced users.

**OUR CLIENTS SAY**

Thousands of water professionals attend THE ACADEMY courses every year. Participants span governmental agencies, regional and local water bodies, research institutions and universities, professional bodies and engineering companies, urban water utilities as well as coastal and harbour authorities.

'Completed the advanced WWTP modelling and simulation online course on WEST. So thankful to the DHI instructors' enthusiasm and positive attitude. The course exercises were very interesting and I am amazed by the variety of functions that can be performed by WEST. [...] I performed more than 400 sequential simulations in WEST by using advanced functions with the aim to optimise UWWTP. Simply amazing!'

~ Utkarsh Sethia, India

'I really liked the course work provided and received valuable feedback from the trainer. The breakout session during the course assisted me with different approaches and logic that other participants used in solving the same problem in better ways.'

~ Shujaathussian Soudagar, India

'The trainer is great, he explains everything clearly and leads you through the full operation of MIKE Zero. Very knowledgeable! Will highly recommend if you plan to work on mooring analysis.'

Tim Zhou, ARUP USA

'The course was of high standard and really interactive in nature.'

~ Manek N. Pillai, Byrne Looby

# THE ACADEMY BY DHI

## Global knowledge sharing and network building

DHI is founded on **global knowledge of water environments** gained from projects and research activities. This knowledge is embedded in our software tools. It is our priority to **make knowledge accessible and share it with you**. We do this through our events, publications and guidelines, student co-supervision engagements, university partnering and support as well as our newsletter.

### EVENTS—ONLINE AND PHYSICAL

THE ACADEMY by DHI events include MIKE Powered by DHI software seminars, national and international conferences, workshops and expert forums. Typically, we offer training sessions and field trips in conjunction with our events.

We offer our events online and in physical venues.

Our events give you the opportunity to share your knowledge, ideas, experiences and research results with other water professionals across a large number of technical areas.

Numerous MIKE users, research partners, decision makers and stakeholders meet around the world at our events.

MIKE User Group Meetings offer you a unique opportunity to learn about real world applications, the latest software updates, and new software developments and technologies. In addition, you have the opportunity to share knowledge and experiences with fellow users, colleagues and DHI modellers.

Overall, our events take up cross-cutting views on how to combine decision support principles and concepts across current themes within our areas of expertise.

### EVENTS PARTICIPANTS SAY

‘Very good and complete product for each of the simulation and analysis needs. It is a good idea to carry out seminars online, since it gives the opportunity to attend when you don’t have the chance to do so physically. Congratulations and thank you!’

~ Antonio Rosas Pomposo  
Sistema de Aguas de la Ciudad de México

‘It was a great experience to get to know the application of the different tools in complex problems, with high quality speakers.’

~ Jesús Arenas Romero  
Instituto Mexicano del Petróleo

‘It was an excellent seminar where I discovered the capacity of DHI’s commercial software through professional practices in each subject.’

~ Rafael Andrés Borobio Castillo  
Universidad de las Américas Puebla

‘This geothermal workshop depicted the high variety of user presentations related to geothermal simulations, underlining the importance of knowledge sharing in this field and highlighting the future challenges for geothermal simulation software.’

~ Kai Zosseder, Head of Geothermal Work Group, Technische Universität München (TUM), Germany

‘DHI created an ambience that made participants comfortable to exchange ideas and information about their work. The seminar was really well organised. Lunch and refreshments were really good. The boat trip was more than welcome. This FEFLOW Conference was perfect - nothing more I could ask for!’

~ Morgan le Lous, Senior Researcher, ENSEGID, Bordeaux Institute of Technology, France

‘Excellent seminar. High scientific and academic level. It would be very interesting to maintain the virtual option in future seminars organised by DHI post-pandemic.’

~ Marcelo Sarubi DPH Buenos Aires



### UNIVERSITY COLLABORATION

We cooperate with universities and other knowledge institutions around the world to further strengthen our extensive network of knowledge partners. The collaboration takes place in many different forms and on different levels. Examples include collaborative research projects related to national and international research programmes, supervision of Master and PhD students, and development of joint training packages.

We wish to contribute to shaping the future generation of professionals in water environments. For this reason, we have designed a careful selection process for student supervision. Supervision is agreed upon through a written agreement between the responsible university and DHI.

#### MIKE POWERED BY DHI THESIS PROGRAMME

Our MIKE Powered by DHI thesis programme provides free time-limited licenses for thesis work. Students who would like to use MIKE Powered by DHI software as part of their Master or PhD theses may contact us - in agreement with their university - to join the programme.

You can also meet our trainers as lecturers at universities around the world.



### PUBLICATIONS

Direct access to knowledge, know-how and research results enable you to solve your specific challenges in water environments.

Our publications, scientific articles and guidelines are important tools to disseminate results from our research and development activities. For more information, visit our website at:

[www.theacademybydhi.com/research-and-publications](http://www.theacademybydhi.com/research-and-publications)

#### KNOWLEDGE-SHARING FORUMS

Our knowledge-sharing forums and institutions, such as MIKE User Forum and the UNEP-DHI Centre for Water and Environment, are invaluable for the development of expertise, exchange of ideas and sharing of know-how.

### THE ACADEMY NEWSLETTER

Enroll for the next THE ACADEMY Newsletter here:

<https://ocean.dhigroup.com/sign-up-for-dhi-group-newsletters/>



Another supreme way of keeping yourself updated on our activities is connecting with us via LinkedIn:

[www.linkedin.com/company/dhi/](http://www.linkedin.com/company/dhi/)

# ABOUT DHI

DHI are the first people you should call when you have a tough challenge to solve in a water environment – be it a river, a reservoir, an ocean, a coastline, within a city or a factory.

Our knowledge of water environments is second-to-none. It represents over 50 years of dedicated research and real-life experience from more than 140 countries. We strive to make this knowledge globally accessible to clients and partners by channelling it through our local teams and unique software.

Our world is water. So whether you need to save water, share it fairly, improve its quality, quantify its impact or manage its flow, we can help. Our knowledge, combined with our team's expertise and the power of our technology, holds the key to unlocking the right solution.



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Powering **WATER DECISIONS**