



SOFTWARE FOR WATER ENVIRONMENTS

SOFTWARE CATALOGUE **2014**

OUR OFFER

What makes our offer special is that it is underpinned by great people. We are a truly global organisation with experts in water environments located in more than 30 countries.

Most of these have active research groups, all of them have local partners with whom we work and collaborate.

One of the key tasks of our local offices is to act as gateways to the top experts within any given topic, wherever these experts are located.

Our local staff provide local support, local training and local solutions - based on DHI's global knowledge of water environments.



CONTENTS

MIKE BY DHI

Our MIKE by DHI software has made knowledge of water environments accessible to water professionals around the globe for more than 25 years. After 25 years of development our MIKE product family encapsulates more knowledge and covers a wider range of water modelling needs than any similar products. The MIKE products are available in many sizes, flavours and languages - and recently also in the cloud. Getting access to DHI's global knowledge has never been easier than today!

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MIKE CUSTOMISED BY DHI

Despite the versatility of the standard MIKE tools, we fully realise that not all needs can be met by a standard product. For that reason, we have created MIKE CUSTOMISED. MIKE CUSTOMISED focuses on building decision support systems where each system is unique, but the tools to build them are generic. MIKE CUSTOMISED solutions range from small and simple applications for a single user to multinational decision support systems for hundreds of simultaneous users. Many of the systems are powered by MIKE by DHI modelling software.

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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. DHI's standard courses - run by our highly qualified trainers - provide a direct route to more knowledge about water environments and to improved skills in the use of the MIKE by DHI tools. Moreover, our user group meetings and seminars are famous for bringing professionals together for knowledge sharing in a relaxed and inspiring environment.

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RELEASE NEWS 2014

Introducing:
MIKE 21 GPU -
 the fastest 2D solver ever!

Users of MIKE 21 FM HD get a **pleasant surprise** with Release 2014. This also applies to MIKE FLOOD users with a Flexible Mesh solver. Their update package automatically includes a **brand new version of the MIKE 21 FM HD module**. The new version, MIKE 21 GPU, is 'GPU card enabled' and is thus able to use the graphics card on the PC to **speed up simulations significantly**. Depending on the model setup and the type of GPU, the speed up can be **a factor 100 or more**, when compared to running the same simulation on a single processor CPU!

HOW IT WORKS - TECHNOLOGY

The computational engine of MIKE 21 FM HD has been reprogrammed to make use of the latest graphical processing units (GPUs) - hardware that is otherwise typically used for speeding up computer games.

It is important to note that MIKE 21 GPU solves exactly the same equations on exactly the same computational mesh as MIKE 21 FM HD. No simplifications or shortcuts have been introduced.

The results from simulations using MIKE 21 GPU are also identical with results from similar simulations using MIKE 21 FM HD. The only minor exception is that small differences in the rounding error may occur for simulations with flooding and drying due to the different sequence of numerical operations.

MIKE 21 GPU behaves exactly like MIKE 21 FM HD - also when applied as the 2D solver in MIKE FLOOD - river, urban or three-way applications.

WHERE CAN I READ MORE?

We have made a detailed performance report with comparisons of the performance of MIKE 21 GPU with the non-GPU enabled MIKE 21 FM HD.

Besides, a detailed result verification report is available - comparing results from MIKE 21 GPU with results produced by MIKE 21 FM HD.

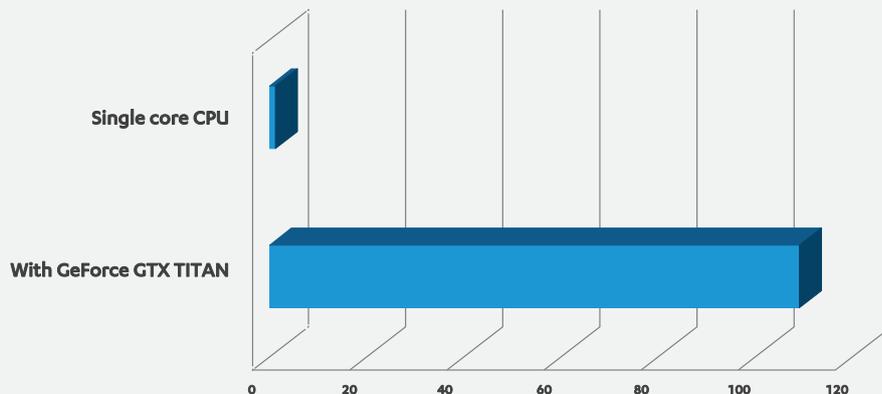
The reports can be found on our website www.mikebydhi.com

HOW DO I GET MIKE 21 GPU?

MIKE 21 GPU is available at no extra cost to all owners of corporate licences of MIKE 21 or MIKE FLOOD with valid SMA. No licence fee and no increase in SMA costs!

For users who discontinue their SMA, the GPU module will no longer be available for free but can be purchased as an upgrade.

MIKE 21 GPU is also available as an upgrade to owners of personal licences.



Upper figure: simulation speed (relative) for a high resolution Mediterranean model with and without GPU card (MIKE 21 FM running single precision, first order scheme).



DHI WaterData

A step towards data aware MIKE models

If your model results are to reflect the real world and your conclusions to be trusted, **access to quality data is a must**. At the same time, finding good data, quality assuring it and converting it to **a format useful for your modelling** is often difficult and can sometimes ruin your budget and time schedule. **DHI WaterData** and the stepwise implementation of data aware MIKE by DHI software **aims to make this part of your project work flow easier and less expensive**. The development will be continued in coming releases...

WHAT IS DHI WATERDATA?

DHI WaterData is a new web based service, which gives water professionals access to relevant water related data.

The data include:

- Remote sensing data
- On-site sensor data
- Model simulation results
- Global as well as local datasets

All datasets have been selected by DHI's domain experts, who recommend these data for your projects.

Some of the datasets are public domain data available elsewhere through other web services. However, DHI's experts have specifically selected the datasets that they consider to be the most relevant.

Furthermore, the data are available from DHI WaterData in standard DHI formats.

Some data are free of charge for MIKE users. A fee is charged for other datasets.

See more detailed information on the WaterData portal:

<http://waterdata.dhigroup.com>

HOW TO GET ACCESS

You have two options:

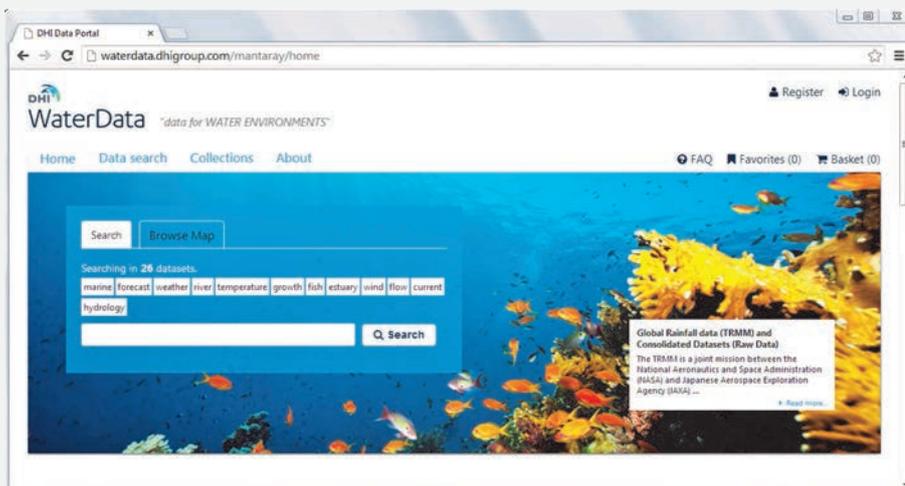
- You can either access the web service directly through the link below (MIKE users are pre-approved as data portal customers), or
- You can access some of the most relevant datasets through a MIKE by DHI WaterData application, which is provided as part of Release 2014. This application helps you access the data you need in MIKE compatible data formats.

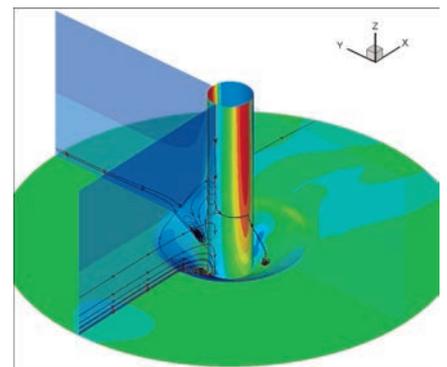
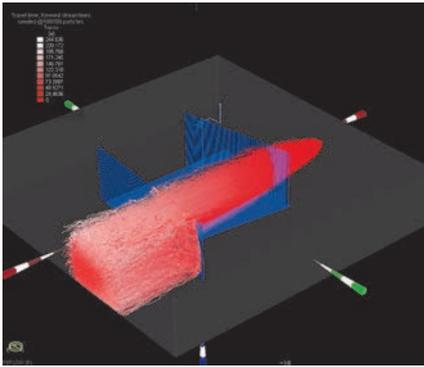
CREATE YOUR OWN DATA PORTAL

Do you need a "<YOUR COMPANY> Data Portal"?

- You can either use the DHI WaterData portal as it is for storage of your data - with access rights limited to those people whom YOU specify, or
- We can also provide you with a complete portal on your own hardware and with your staff as administrators - but with all the features similar to the DHI WaterData portal

Please ask us for details!





GROUNDWATER

FEFLOW PERFORMANCE

Release 2014 (FEFLOW 6.2) features the latest version of the algebraic multi-grid solver SAMG, providing a new level of solution performance and stability. With the introduction of Pardiso, FEFLOW now also offers a non-iterative, exact solution of sparse linear systems of equations, at an often affordable memory use and computational cost thanks to parallelisation.

PARAMETER OPTIMISATION - FEPEST

FePEST, which is now included with every FEFLOW licence, is a graphical user interface for using PEST by John Doherty with FEFLOW models. Its advantages include graphical support during the setup process and immediate graphical feedback on the simulation progress.

With FePEST parameter estimation or uncertainty analysis, tasks can be executed in parallel on many computers - requiring only one single licence seat of a corporate licence for FEFLOW!

SUBDOMAIN BUDGET, AGE SIMULATION AND MUCH MORE

FEFLOW now includes the possibility to exactly calculate all components of the water budget on the entire model domain or arbitrary subdomains. While standard in finite-difference codes and thus often asked for, such capability is rare in finite-element modelling.

Other new features include:

- Groundwater age modelling
- Random-walk particle tracking
- Temporal element and BC deactivation
- Database and Excel/Access file links
- A Scene Library to store view settings

CITIES

MIKE URBAN PERFORMANCE

Users of Release 2014 benefit from many generic developments, including:

- **Faster MIKE 1D** - with AD module
- **GPU enabled MIKE 21 FM** - also for urban flooding

In addition, MIKE URBAN's GUI has been optimised for working comfortably with much larger networks.

WEST

WEST, for modelling of wastewater treatment plants, has quickly established itself as an important product in the MIKE by DHI family with a growing number of users all over the world.

Release 2014 includes several important new features:

- **New Report Generator** - which enables the user to automatically create reports containing graphs and data pertaining to a project in a variety of formats including: project information, plant layout, plots, tables, etc
- **Integrated urban water systems (IUWS) libraries** - which make WEST a powerful tool for identifying synergies and for optimising the wastewater system performance globally on a catchment scale

COAST AND SEA

Among new features are:

SCOUR CALCULATOR

The scour calculator is a new tool for MIKE users that facilitates the evaluation of scour risk around monopiles as a result of combined wave and current motion - typically derived from simulations with MIKE 21 HD and MIKE 21 SW. Several methods are available. This tool will enhance productivity in this type of work.

INTRODUCTION OF OVERTOPPING

Overtopping is an issue that has a growing relevance in many parts of the world and we are therefore improving the possibilities for modelling this phenomenon.

The dike structure was introduced in MIKE 21 HD FM and MIKE 3 HD FM in 2012 and constitutes an option to introduce dikes and similar structures at a subgrid level.

In Release 2014, we have introduced a range of possibilities including overtopping of these dike structures.

CITIES





"The import of master data into the model has **worked just as smoothly as the evaluation of results.** The clear presentation and the many opportunities for further analysis in the GIS has **greatly facilitated action planning** and **opened up the space for smart rehabilitation concepts"**

MIKE URBAN user from Germany

MIKE URBAN

Modelling & GIS for water in the city

MIKE URBAN is the urban **water modelling** software of choice when the important parameters for model selection are stability, workflow, openness, flexibility, GIS integration and physical soundness. MIKE URBAN **covers all water networks in the city**, including water distribution systems, storm water drainage systems and sewer collection in separate and combined systems.

APPLICATIONS

DRINKING WATER

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



WASTEWATER AND STORM WATER

- 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

MODEL MANAGER

The Model Manager is the core of the MIKE URBAN user interface. Using the wealth of features, the user efficiently goes through all phases of preparing the model input data as well as analysing and presenting results from the simulation engines.

The Model Manager provides:

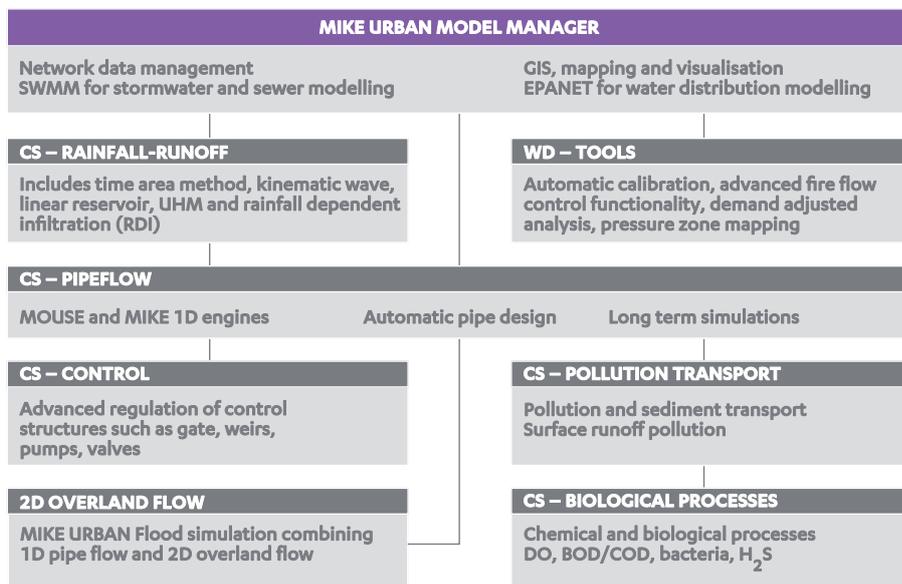
- Network data management for storm water collection systems, wastewater collection systems and water distribution systems
- Feature rich GIS functionality powered by ESRI's ArcGIS, effective time series data management features, comprehensive data processing and manipulation tools as well as powerful data visualisation capabilities for all data entities

MODEL MANAGER

- US EPA's engines SWMM5 and EPANET
- Result interpretation and presentation for an unlimited number of users with the freeware MIKE View

TOOLS INCLUDED

- Scenario manager
- Data validation, assignment and interpolation tool
- Catchment delineation tool
- Network simplification tool
- Geocoded load and demand allocation
- Model results presentation through static and animated time series, profiles, maps, tables and statistics





WATER DISTRIBUTION

The water distribution (WD) components are based on DHI extensions to the worldwide standard EPANET engine and DHI's powerful simulation engine for transient flows, and allow the following simulations for modelling WD networks: steady state simulations, extended period simulations, water quality simulations under extended period conditions and transient flow simulations.

DEMAND ALLOCATION AND DISTRIBUTION

- 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 system
- Chlorine residuals
- Growth of disinfection byproducts
- Contaminant propagation

WD TOOLS

Advanced features such as:

- Automatic calibration
- Control options for extended period simulations
- Transient flow simulation of fully pressurised systems
- Pressure dependent demands suitable for simulation of system shutdown, maintenance and intermittent water supply systems
- Advisor tools including pipe criticality, sustainability and cost analysis
- Fire flow: Analysis of improvements to meet fire flow requirements and calculation of available flow and residual pressure

COLLECTION SYSTEM

All collection system modules (CS) are based on DHI's MOUSE, MIKE 1D and/or SWMM with unrivalled numerical stability and efficiency.

CS - PIPEFLOW

The Pipeflow module simulates unsteady flow in pipe and channel networks. It has a wide range of network components and flow processes such as:

- Standard and flexible cross-sections, circular manholes, retention basins, overflow weirs, orifices, pumps, flow regulators, storm water inlets, etc
- Simulation of subcritical and supercritical flow conditions in partially full, full and pressurised pipes
- Includes a long term simulation tool for continuous simulations of long periods and a unique automatic pipe design tool

CS - CONTROL

This module features advanced real time control capabilities. It makes the definition of complex operational logic for interdependent regulators fully transparent and easy.

CS - POLLUTION TRANSPORT

This module includes pollution transport by advection and dispersion as well as sediment transport.

CS - BIOLOGICAL PROCESSES

This module includes simulation of chemical and biological processes in sanitary systems and combined systems.

CS - RAINFALL RUNOFF

This module includes multiple rainfall-runoff models such as time area method, kinematic wave, linear reservoir and UHM as well as an RDI module for the generation of continuous inflow typically applied for simulating slow response inflows (such as infiltration).

MIKE URBAN provides efficient solutions to the increasing need for combining 1D modelling of sewer and storm water drainage systems with other models.

OVERLAND RIVER AND PIPE FLOW MODELLING

With a dynamically coupled combination of 1D and 2D models, it is possible to model a flood in an urban environment - in an accurate and efficient way. For further details, see MIKE FLOOD on page 28.

GROUNDWATER AND PIPE FLOW MODELLING

Accurate modelling of the two-way interaction between pipes in the ground and the surrounding aquifer.

This allows modelling of infiltration to and leakage from pipes as well as modelling of the potential side effects of infiltration prevention.

For more information, please see MIKE SHE on page 30.

BENEFITS

MIKE URBAN is the modelling software package for all urban water modelling activities. You can maximise your productivity and fully leverage your investment in GIS and water modelling software tools.

All GIS licences and components required are embedded in the MIKE URBAN licence.

MIKE URBAN is available in many languages and users are supported locally in more than 30 countries.

Regardless of which engine you choose or which model you build, all your data is stored in one database.

WEST

Modelling and simulation of wastewater treatment plants

WEST is a **powerful and user friendly** software application 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, one may be interested in comparing different design solutions in terms of performance with respect to specific objectives (eg effluent quality, investment and operational costs). The Scenario Analysis tool and the possibility to define custom objective functions in WEST enable engineers to select the best design for their plant.

A more conventional approach to plant design can be taken by means of the Designer application, which allows for designing a WWTP according to a template, following a design protocol (eg 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 engineers to identify the combination of operational conditions that optimises 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 for engineers to efficiently calibrate a 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. It is therefore 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), to identify bottlenecks and the appropriate countermeasures, or to train the operators through the offline simulation of a variety of control actions. The Scenario and Uncertainty Analysis tools in WEST are very beneficial in understanding the complex processes taking place in a modern WWTP.

R&D

When studying novel treatment approaches, researchers require a software tool that is both sufficiently flexible to capture newly acquired knowledge (models, data) and fast enough to evaluate a large number of alternatives in a reasonable timeframe. WEST excels in both areas, which is demonstrated by its Block & 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 WWTPs, sewers and river catchments. The integrated IUWS library makes WESTforOPTIMIZATION a powerful tool to identify synergies and to globally optimise the wastewater system performance.

FEATURES

PHYSICAL MODELS

- Buffer tanks
- Activated sludge tanks
- Integrated fixed film activated sludge (IFAS)
- Settling tanks
- Sand and trickling filters
- Sequencing batch reactors (SBR)
- Membrane Bioreactors (MBR)
- Sludge dewatering units
- Anaerobic digesters
- Chemical dosing units
- Controllers and Timers

BIOCHEMICAL MODELS

- Activated sludge model (ASM) Nos 1, 2, 2d and 3
- Anaerobic digestion model (ADM) No 1
- Anaerobic ammonium oxidation (Anammox) model
- Greenhouse gas emission model
- Plantwide model
- Integrated urban water systems (IUWS)





MODULES

WESTforOPERATORS

is a simplified version of WEST limited to steady state and dynamic simulation, as well as the computation of custom objective functions. Essentially, it allows for executing WEST projects that are based on read-only models and plant layouts prepared with higher versions of WEST, and is well suited for training and for the evaluation of operational strategies on a fixed plant model.

WESTforDESIGN

is similar to WESTforOPERATORS in the sense that it allows for steady state and dynamic simulation as well as for the computation of custom objective functions. In addition, it provides for the graphical creation of plant layouts based on a read-only model library.

WESTforDESIGN is ideal for design purposes when the engineer has a limited amount of data, limited time and needs to quickly compare scenarios (for example different loads, layouts or control strategies).

MODULES

WESTforOPTIMIZATION

is the full product that allows both for the creation of basic projects (solely based on steady state and/or dynamic simulation), as well as more complex projects exploiting WEST's powerful tools for model calibration (Global Sensitivity Analysis, Parameter Estimation), reliable predictions of plant performance (Uncertainty Analysis) and process optimisation (Parameter Estimation). Next to graphical creation of plant layouts, it provides for the creation of entirely customised model libraries (by means of its Model Editor and Block Editor applications).

WESTforAUTOMATION

is a software development kit (SDK) that enables software engineers to develop custom applications that integrate the WEST engine with other software systems, such as SCADA systems and databases. It is an essential component for the development of sophisticated, tailor made decision support systems (DSS).

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
- SDK for integration with other software systems
- Very high simulation speed
- Engine installable on HPC infrastructures
- Multilanguage support

	WESTfor OPERATORS	WESTfor DESIGN	WESTfor OPTIMIZATION	WESTfor AUTOMATION
WEST Application	•	•	•	
Interactive Layout Editor		•	•	
Influent/Effluent Tool		•	•	
Executable Model Builder		•	•	
Steady-state Simulation	•	•	•	
Dynamic Simulation	•	•	•	
Objective Evaluation	•	•	•	
Local Sensitivity Analysis			•	
Global Sensitivity Analysis			•	
Parameter Estimation			•	
Scenario Analysis			•	
Uncertainty Analysis			•	
Input/Output Controls	•	•	•	
Notes & Reports	•	•	•	
Block Editor Application			•	
Model Editor Application			•	
Unit Editor Application	•	•	•	
Data Editor Application	•	•	•	
Designer Application		•	•	
WEST3 Conversion Tool		•	•	
API				•

COAST & SEA



“If the client lets us choose the modelling software, **we always choose MIKE 21** because it’s **much faster** and thereby **cheaper**”

Manager from global consulting company

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 certainly has the tools you need.

APPLICATIONS

MIKE 21 APPLICATIONS

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

- Design data 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 flooding and overland flow modelling

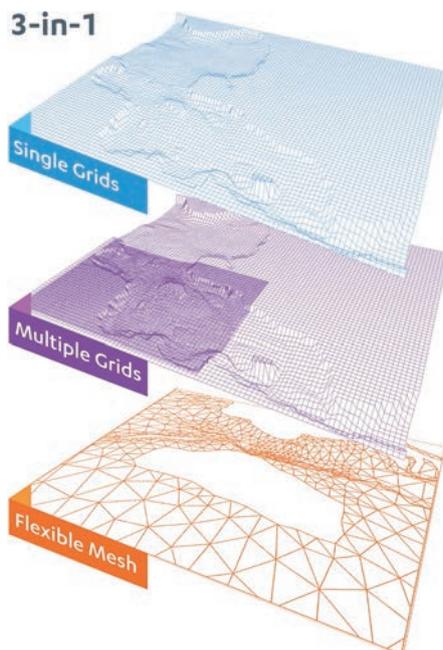


ENGINES

MIKE 21 comprises the following simulation engines:

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

All Flexible Mesh and Single Grid engines support parallel processing. Since Release 2012, high performance computing on multicore computers, also under Linux, has been available for the FM engines. From Release 2014, MIKE 21 FM is also able to use GPU cards for increased simulation speed.



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

MODULES

MIKE 21 is modular. You buy what you need and no more. You can see the module overview and the application areas of each module below:

PP - PREPROCESSING AND POSTPROCESSING

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

HD - HYDRODYNAMICS

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

AD - ADVECTION-DISPERSION

Simulates the transport, dispersion and decay of dissolved or suspended substances. It is typically used in cooling water and tracer studies.

ST - SAND TRANSPORT

Advanced sand transport model with several formulations for current and 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

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



MODULES

COUPLED MODELLING

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

PT - PARTICLE TRACKING

Describes transport and fate of dissolved and suspended substances, including sediments.

OS - OIL SPILL

Simulates the spreading and weathering of suspended substances and is used for oil spill modelling.

ECO LAB - ECOLOGICAL MODELLING

Please see page 23.

ABM LAB - AGENT BASED MODELLING

Please see page 22.

SW - SPECTRAL WAVES

Spectral wind-wave model that simulates the growth, decay and transformation of wind generated waves and swell.

MODULES

PMS - PARABOLIC MILD SLOPE WAVES

A linear refraction-diffraction model for studying wave disturbance in open coastal areas.

EMS - ELLIPTIC MILD SLOPE WAVES

Efficient model for studying wave dynamics in coastal areas and, for instance, harbour resonance in response to linear and monochromatic wave forcing.

BW - BOUSSINESQ WAVES

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

WS WAT - WAVE ANALYSIS TOOL

Detailed wave analysis: linear spectral analysis, digital filtering analysis, directional wave analysis and crossing analysis. Postprocessing of MIKE 21 BW output.

BENEFITS

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

The recipe for the unique success of MIKE 21 is simple: it gives its users maximum flexibility, higher productivity and full confidence in the results.

And MIKE 21 is much more than just the right tool for your project. Being a MIKE product, it also brings along the other benefits of MIKE software:

- Solid technical support
- Regular training courses
- Access to DHI know-how wherever you are

MIKE 21 comes with a wealth of first class tools that enhance and ease modelling possibilities.

A FEW EXAMPLES OF TOOLS

- Global tide data and tools for tidal analysis and prediction
- MIKE by DHI'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.

	Flooding	Marine and hydraulic structures	Cooling water, desalination, outfalls	Ports, terminals, navigation channels	Coastal, estuarine and shoreline management	Sediments and morphology	Water quality and ecology	Environmental impact assessment	Water forecasting	Single grid	Multiple grids	Flexible mesh
HD - hydrodynamics	•	•	•	•	•	•	•	•	•	•	•	•
AD - advection-dispersion			•							•	•	•
ST - sediment transport				•	•	•				•	•	•
MT - mud transport				•		•	•			•	•	•
Coastal morphology					•	•						•
PT - particle tracking						•		•		•	•	•
OS - oil spill								•		•	•	•
ECO Lab - ecological modelling			•					•		•	•	•
ABM Lab - agent based modelling			•					•		•	•	•
SW - spectral waves		•		•	•	•		•				•
PMS - parabolic mild slope waves		•		•	•	•				•		
EMS - elliptic mild slope waves		•		•	•	•				•		
BW - Boussinesq waves		•		•	•	•				•		

MIKE 21 module overview.

MIKE 3

3D modelling of coast and sea

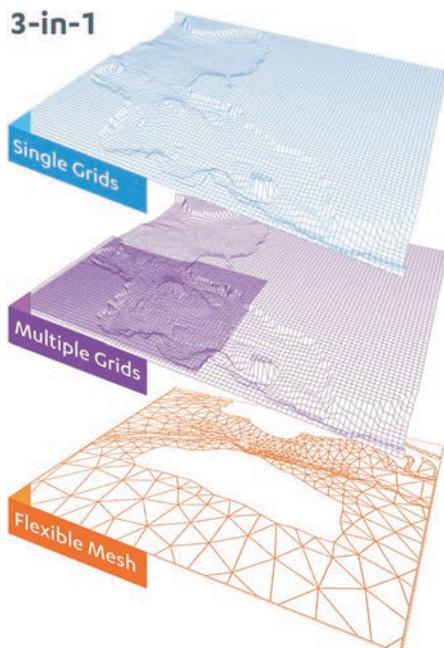
MIKE 3 provides the simulation tools you need to model **3D free surface flows** and associated sediment or water quality processes. All over the world, MIKE 3 is **widely recognised** as the platinum standard for environmental and ecological studies.

APPLICATIONS

TYPICAL EXAMPLES OF APPLICATIONS

- 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

3-in-1



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

ENGINES

MIKE 3 offers the following simulation engines:

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

SINGLE GRID AND MULTIPLE GRID VERSIONS

For the Single Grid and Multiple Grid versions, the fully time dependent nonlinear equations of continuity and conservation of momentum in three dimensions are solved by finite difference techniques with the variables defined on a rectangular staggered grid in x, y and z space.

Two different hydrodynamic engines are included: a hydrostatic version and a nonhydrostatic version, which applies an artificial compressibility.

THE FLEXIBLE MESH VERSION

The Flexible Mesh version uses a cell-centred, finite volume method for discretisation of the flow and transport equations. In the horizontal plane (Cartesian or spherical coordinates) an unstructured grid, consisting of triangular and quadrilateral elements, is used. In the vertical domain, a combined sigma and z level vertical grid giving an improved description of, for example, complex stratified environments, is used.

All FM and Single Grid engines support parallel processing. Since Release 2012, high performance computing on multicore computers, also under Linux, has been available for the FM engines.

MODULES

MIKE 3 is modular. You buy what you need and no more. You can see the module overview for application areas of each module below:

PP - PREPROCESSING AND POSTPROCESSING

The PP module offers an integrated work environment providing 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

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



MODULES

AD - ADVECTION-DISPERSION

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

ECO LAB - ECOLOGICAL MODELLING

Please see page 23.

ABM LAB - AGENT BASED MODELLING

Please see page 22.

MT - MUD TRANSPORT

A combined multifraction and multilayer 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.

MODULES

PT - PARTICLE TRACKING

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

OS - OIL SPILL

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

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.

BENEFITS

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

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

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

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

A FEW EXAMPLES OF TOOLS

- Global tide data and tools for tidal analysis and prediction
- MIKE by DHI'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

	Aquaculture	Marine and hydraulic structures	Cooling water, desalination, outfalls	Ports, terminals, navigation channels	Coastal, estuarine and shoreline management	Sediments and morphology	Water quality and ecology	Environmental impact assessment	Water forecasting	Single grid	Multiple grids	Flexible mesh
HD - hydrodynamics	•	•	•	•	•	•	•	•	•	•	•	•
AD - advection-dispersion	•		•				•	•	•	•	•	•
ST - sediment transport				•	•	•						•
MT - mud transport				•	•	•	•	•		•	•	•
Coastal morphology						•						•
PT - particle tracking	•					•		•	•	•	•	•
OS - oil spill								•	•	•	•	•
ECO Lab - ecological modelling	•		•				•	•	•	•	•	•
ABM Lab - agent based modelling	•		•				•	•	•			•
MIKE 21 Waves		•		•		•		•	•	•		•

MIKE 3 module overview.

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 applies a **unique deterministic approach** to give you a powerful tool for a wide range of coastal zone management applications.

APPLICATIONS

TYPICAL EXAMPLES OF APPLICATIONS

- Impact assessment of coastal works
- Optimisation of beach redevelopment schemes
- Design and evaluation of coastal protection
- Execution of morphological baseline studies

MODULES

LITPACK Release 2014 contains a revised interface in line with the well proven GUI for the FM versions of MIKE 21 and MIKE 3.

LITPACK utilises the same preprocessing and postprocessing 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.

MAIN CONTENTS

The core of LITPACK is the STPQ3 sediment transport model - a deterministic description of noncohesive sediment transport in a single point. For decades, this model has been used and improved and has proven very reliable.

Applying STPQ3 in a series of points in a profile and using the actual wave and current climate permits the calculation of the littoral drift and annual net and gross sediment transport.

The combination of these data permits the modelling and analysis of the 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 simulates a wide range of wave and current scenarios along straight or nearly straight coastlines.

LITPACK combines these simulations into predictions of coastal profiles and long term coastline evolution.



MIKE ANIMATOR PLUS AND MIKE C-MAP

Animated presentations of model results

MIKE Animator Plus is a **digital video production studio**, which enables you to turn MIKE 21, MIKE 3, MIKE FLOOD and MIKE SHE model results into **amazing 3D video presentations**.

Model bathymetries made fast and easy

MIKE C-MAP provides access to an **abundance of bathymetric data** and, combined with an electronic chart database, it can make the **setup of model bathymetries easy and consistent**.

MIKE ANIMATOR PLUS

ENHANCED COMMUNICATION

MIKE Animator Plus is the result of a complete reengineering of the previous MIKE Animator. One of the important news is that it now supports MIKE 3 files.

FEATURES

MIKE Animator Plus includes tools that allow you to:

- Create realistic 3D scenes including solids
- View model areas and simulation results in 3D
- Produce professional fly through animations
- Save the presentation in AVI, PNG, FLC or Frame Format for easy dissemination

MIKE C-MAP

ENHANCED PRODUCTIVITY

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.

FEATURES

Jeppesen Norway is the provider of sea chart information in digital form. This is the data, which is turned into your model bathymetries.

C-MAP data are available in a number of packages. Prices vary depending on the size and location of the geographical area.

MIKE C-MAP is the MIKE by DHI application, which is used for turning C-MAP data into model bathymetries for your MIKE models.

In order to produce your model bathymetries, you need MIKE C-MAP and the relevant data from Jeppesen Norway.

Apart from bathymetric data, Jeppesen Norway also provides tidal data.

MIKE C-MAP extracts these tidal data and can turn them into the formats needed, for example for tidal boundary conditions for MIKE 21.

BENEFITS

MIKE ANIMATOR PLUS BENEFITS

Enhanced communication:

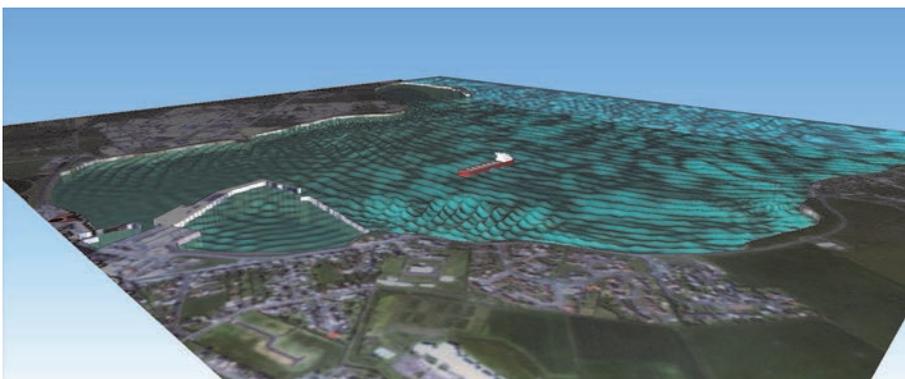
- **Bridges the gap between specialists and nonspecialists**
- **Communicates model studies and ideas efficiently within your team**
- **Provides professional client presentations**
- **Facilitates consensus making and the dialogue with stakeholders**
- **Demonstrates your modelling skills better than any printed material**

MIKE C-MAP BENEFITS

If you are a professional MIKE 21 or a MIKE 3 modeller facing tight budgets and deadlines, MIKE C-MAP is an almost indispensable tool in your toolbox.

Many MIKE 21 and MIKE 3 modellers claim that the time saved on just one project has more than paid their MIKE C-MAP licence.

Manual digitisation of model bathymetries is no longer required.



ABM LAB

Agent based modelling

ABM Lab offers **a 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.

INTRODUCTION

ABM Lab is a flexible, numerical laboratory where the user can define agents, their behaviour and their states.

ABM Lab was introduced in version 2012 of MIKE by DHI and 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 ECO Lab in order to make the agents react to water quality parameters.

EXAMPLES OF APPLICATIONS

- Coral spawn modelling. Numerical modelling of the impacts of dredging plumes on coral spawning and recruitment
- Modelling eelgrass succession patterns. Determining the recolonisation of eelgrass
- Modelling the migration of salmonide 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 the user to define agents, including their internal state and processes, movement, interaction with the environment and interaction with other agents of the same or different types.

Features that can be modelled with ABM Lab:

- **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** - 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
- Swarming
- Foraging
- Breeding
- Growth, death, prey/predator relations, etc

BENEFITS

Combined with the hydrodynamic MIKE models and ECO Lab (see page 23), 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 kind of technique in the context of real engineering projects.



ECO LAB

Ecological modelling made simple

With 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 ECO Lab. Furthermore, there is **no time consuming programming** involved.

APPLICATIONS

With ECO Lab you simply define the process using standard templates as a basis.

ECO Lab thereby lets you transform any aquatic ecosystem into a reliable numerical model for accurate predictions.

Typical applications of ECO Lab include:

- 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. ECO Lab integrates seamlessly with the MIKE by DHI suite of flow simulation models covering all aspects - ranging from 1D, 2D and 3D free surface modelling to integrated hydrology:

- MIKE 11 (1D)
- MIKE 21 (2D)
- MIKE 3 (3D)
- MIKE SHE (Hydrology)

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

ECO Lab combines the best of two worlds:

- **you get access to our well proven and widely used standard water quality models**
- **you get complete freedom to include your own know-how or research ideas and test them against your field data**

ECO Lab models work across the range of 1D, 2D and 3D MIKE modelling packages. Your own templates will do that too.

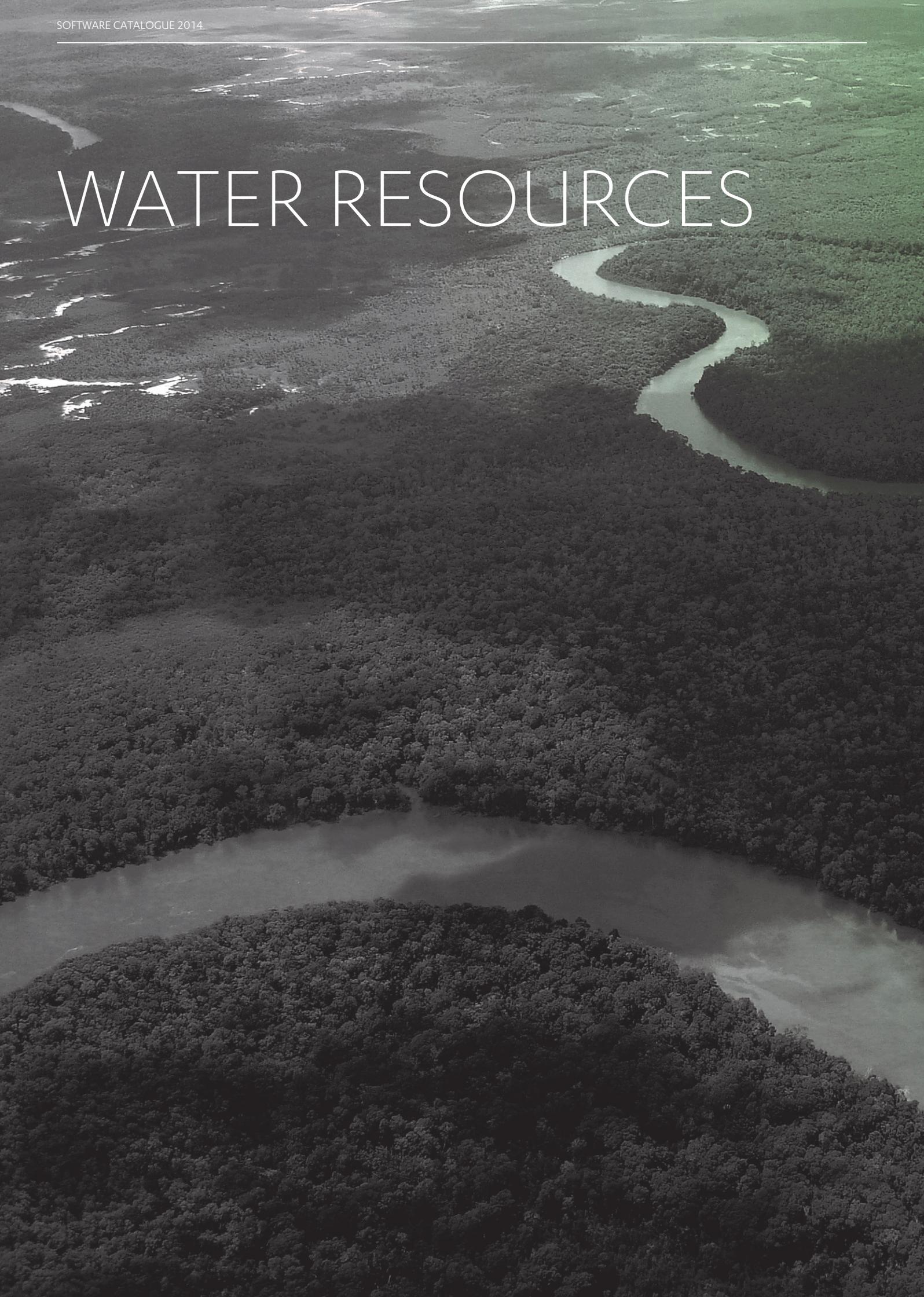
You can focus on the processes and forget about programming.

You can exchange ideas and models with colleagues around the world. Simply send them a copy of your templates.

Since ECO Lab contains a generic equation solver, it can also be used for generic postprocessing of hydrodynamic results, for example calculations of flood risk indices or scour risk formula.



WATER RESOURCES

An aerial photograph of a river system flowing through a vast, dense forest. The river starts in the upper right, curves to the left, and then flows towards the bottom center. The surrounding forest is a deep, dark green, and the water in the river is a lighter, greyish-green color. The overall scene is a natural, undisturbed landscape.

“Through our projects, **MIKE 11 and MIKE 21 FM** have proved their capabilities in **detailed flood planning**. MIKE 11 and MIKE 21 FM are **friendly and supportive software for the decision makers**”

Project Engineer of Vietnam Academy for
Water Resources

MIKE 11

River modelling unlimited

MIKE 11 is synonymous with **top quality** river modelling covering **more application areas than any other river modelling package available.**

Whether your project deals with flooding, navigation, water quality, forecasting, sediment transport, a combination of these or other aspects of river engineering, MIKE 11 handles it. MIKE 11 also includes **options for investigating river bank overflow and catchment hydrology.**

APPLICATIONS

TYPICAL MIKE 11 APPLICATIONS

- Flood analysis and flood alleviation design studies
- Real time flood or drought forecasting
- Dam break analysis
- Optimisation of reservoir and canal gate and structure operations
- Ecological and water quality assessments in rivers and wetlands
- Water quality forecasting
- Sediment transport and long term assessment of river morphology changes
- Salinity intrusion in rivers and estuaries
- Wetland restoration studies
- Integrated modelling of river and groundwater interaction



ENGINES

MIKE 11 offers a variety of hydraulic and hydrological simulation engines:

HD - HYDRODYNAMICS

Our classic 1D hydrodynamic engine for rivers and open channels. Unsurpassed in flexibility, robustness and features, including:

- Fully dynamic solution to the complete nonlinear St. Venant equations for open channel flow
- Muskingum and Muskingum-Cunge routing method options for simplified channel routing
- Automatic adaptation to subcritical and supercritical flow
- A large suite of standard hydraulic structures, such as weirs, culverts, bridges, pumps, energy loss and tabulated structures
- Extremely flexible control module for movable gates, pumps, turbines, etc
- Choice of fixed, tabulated or adaptive simulation time step

DISTRIBUTED HYDROLOGY

- **Overland flow** - using a simplified, semidistributed method or a 2D diffusive wave method. This allows you to do simplified 1D/2D flood modelling with MIKE 11.
- **Unsaturated infiltration** - using a two-layer water balance method for infiltration losses.
- **Evapotranspiration** - from intercepted storage, ponded water, the root zone and groundwater.
- **Groundwater** - using linear reservoir groundwater calculations for basin-wide water balance and river inflow calculations.

MODULES

MIKE 11 includes a wide range of add-on modules allowing you to create your own tailored river modelling framework for specific river modelling projects:

RR - RAINFALL-RUNOFF

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.

SO - STRUCTURE OPERATION

Simulates operational structures such as sluices, overflow and radial gates as well as pumps and reservoir releases from user defined operating strategies.

DB - DAM BREAK

Provides options for definition of initial dam geometry and dam breach development methods. Options available are either a time and space definition or a soil erosion failure mode. DB includes NWS DAMBRK and energy equation breach calculation methods.

AUTOCAL- AUTOMATIC CALIBRATION

Automatic calibration process for a wide range of parameters, including RR parameters, Manning numbers, head loss coefficients and WQ parameters.

STRATIFIED - MULTILAYERED RIVER FLOW

Modelling of vertical density differences, such as salinity or temperature in two-layered or multilayered stratified water bodies.



MODULES

FF - FLOOD FORECASTING

Modelling of real time flood forecasting, including state updating and data assimilation features.

ST/GST - NONCOHESIVE SEDIMENT

Transport, erosion and deposition of uniform and graded noncohesive sediments, including morphological changes of river bed bathymetry.

AD - ADVECTION-DISPERSION

Transport and spreading of conservative pollutants and constituents, including a linear decay option (includes heat modelling).

ACS - COHESIVE SEDIMENT

Cohesive sediment modelling applying an advanced three-layer bed description with quasi-2D erosion dynamics as well as settling and deposition dynamics.

ECO LAB - ECOLOGICAL MODELLING

ECO Lab is applied for all water quality related applications with MIKE 11, using predefined or user defined water quality model templates. See page 23 for details.

PACKAGES

In order to make it easier to configure your MIKE 11 toolbox, two value added packages are available:

MIKE 11 STUDIO

Ideal for small to medium sized river modelling applications with the HD solution limited to 250 calculation points (HD-250).

In addition, MIKE 11 Studio includes the structure operations (SO) and the dam break (DB) modules as well as the distributed hydrology component.

MIKE 11 ENTERPRISE

Ideal for professionals working with detailed river modelling. It has no limits in size and detail of the HD solution and includes the SO, DB, rainfall-runoff (RR), AD and AUTOCAL modules. Furthermore, it includes distributed hydrology.

Specific enterprise packages are also available for real time, sediment transport or water quality applications.

All packages can be extended with extra add-on modules as required.

BENEFITS

With MIKE 11 you get one of the world's most well proven and widely applied 1D river modelling packages.

MIKE 11 is the preferred choice of professional river engineers when reliability, versatility, productivity and quality are the keywords.

MIKE 11 is a powerful river modelling toolbox with more features than any other river modelling package.

MIKE 11 is the software product, which made the MIKE brand name synonymous with top quality modelling software from DHI and it remains one of the most widely used MIKE by DHI products.



MIKE 11 is accepted by US Federal Emergency Management Agency, FEMA, for use in the National Flood Insurance Program (NFIP)



MIKE FLOOD

Urban, coastal and riverine flooding

MIKE FLOOD is the **most complete toolbox for flood modelling** available. It includes a wide selection of 1D and 2D flood simulation engines, which enable you to **model virtually any flood problem** - whether it involves rivers, floodplains, floods in streets, drainage networks, coastal areas, dam, levee and dike breaches or **any combination** of these. Where other tools give up, **MIKE FLOOD gives results!**

APPLICATIONS

MIKE FLOOD is applicable at any scale from a single parking lot to regional models. Independent studies show that you can save months of efforts and create more reliable models by upgrading from standard 1D modelling to MIKE FLOOD!

TYPICAL MIKE FLOOD APPLICATIONS

- Flood management
- Rapid flood risk assessments
- Flood risk and flood hazard mapping
- Flood risk analysis for industrial, residential or cultural heritage areas
- Flood contingency planning such as planning of evacuation routes and rescue priorities
- Climate change impact assessments
- Dam breach and flood defence failure impact studies
- Integrated urban, river and coastal flood modelling

FEATURES

MIKE FLOOD SIMULATION FEATURES

1D engines:

- **1D River** - based on DHI's classic, hydrodynamic engine for rivers and open channels. See MIKE 11 on page 26 for more details
- **1D Urban** - based on DHI's equally classic engine for sewer and drainage networks. See MIKE URBAN on page 10 for more details

2D engines:

- **Flexible Mesh** - maximum flexibility for tailoring grid resolution within the model. The FM engine supports parallel processing using OpenMP or MPI as well as GPU for simulations. See MIKE 21 on page 16 for more details
- **Single Grid** - the classic rectilinear grid based model. Easy to set up and easy input/output exchange, including parallel processing
- **Multi-Cell Overland Flow Solver** utilising higher resolution DEM information on a coarser simulation grid for increased computational performance

STRUCTURES

A large variety of hydraulic structures are available in both 1D and 2D engines. Amongst these are culverts, weirs, dikes and operating structures.

THREE-WAY COUPLING

MIKE FLOOD offers a fully dynamic and integrated coupling between urban and river 1D engines and the 2D overland flow engine. This solution provides the full flexibility and capability of investigating complex problems.

ADVECTION-DISPERSION MODELLING

Each MIKE FLOOD related engine includes advection-dispersion modelling capability, and MIKE FLOOD offers a fully dynamic coupling of AD components between all 1D and 2D engines.

URBAN FLOODING

ACCURACY DEMAND

Today's demand for accuracy often calls for using a 1D pipe flow model combined with a 2D overland flow model. MIKE FLOOD offers such a model combination through the coupling of MIKE URBAN CS and MIKE 21.

MIKE FLOOD efficiently simulates any cause of urban flooding, including heavy local rainfall, insufficient flow capacity of storm water inlets or the drainage network, and flooding caused by overtopping of nearby river or coastal flood defences.

Urban flooding in MIKE FLOOD is simulated through model couplings at the location of nodes, pumps, weirs or outlets. Water is exchanged between the pipe flow model and the overland flow model through these couplings in a dynamic two-way process.

Defining the couplings between pipe and overland flow model as well as launching simulations and visualising results are supported in the GUI of both MIKE FLOOD and MIKE URBAN.





COASTAL FLOODING

THE IDEAL PACKAGE

MIKE FLOOD is ideal for efficient and accurate coastal flood risk assessments, whether they relate to flooding of coastal cities and infrastructures, or to inundation of reclaimed or low lying areas.

The flexibility of MIKE FLOOD components enables professional modelling of complex and dynamic events due to ocean storm surges, and the impacts in estuaries, rivers and drainage canals as well as sewer systems.

MIKE FLOOD offers the possibility to investigate the effects of coastal protection, such as dikes/polders and tidal gates or other operational structures in delta areas.

Combined with one of the MIKE wave models (MIKE 21 Spectral Wave or MIKE 21 Boussinesq Wave), MIKE FLOOD can address all aspects of coastal impacts of storm surge and inundation.

RIVERINE FLOODING

EFFICIENT AND FLEXIBLE

MIKE FLOOD is an efficient and flexible tool for river flood modelling when investigating flood risk and flood hazard from rising water levels in the river system or from high rainfall intensity in the catchment area.

Flooding can be investigated on multiple scales ranging from large scale basin areas to local impacts in flood prone areas along the river.

When simulating river flooding, the combination of a 1D open channel model using MIKE 11 and a 2D overland flow model using MIKE 21 is generally preferred.

The flexibility of the combined 1D/2D engines provides numerous opportunities for analysing complex issues such as:

- River conveyance problems due to improper maintenance of vegetation
- Limited flood storage capacity
- Infrastructures crossing the river and the floodplain
- Operation of hydraulic structures and reservoirs
- Dam breaks or levee breaches
- Land use changes
- Climate change flood risk impact

MIKE FLOOD offers the highest flexibility in options for coupling 1D and 2D engines. These include coupling at specific points, coupling at internal or external boundaries or coupling being distributed along entire river stretches on either side of the main river channel.

BENEFITS

MIKE FLOOD builds on well proven technology and simulation engines, which have been applied successfully in numerous important engineering projects all over the world.

MIKE FLOOD IS FAST

With the parallel 2D engines and the capability of using GPU, MIKE FLOOD provides options for fast simulation execution.

MIKE FLOOD SAVES TIME

Create transparent models using 2D representations for the relevant areas, rather than spending time on simplifying the models.

MIKE FLOOD IS VERSATILE

Enhanced range of applications through the three-way coupling for both hydrodynamic and advection-dispersion modelling.

MIKE FLOOD IS MORE THAN JUST SOFTWARE - it is also access to DHI flood modelling expertise in more than 30 countries around the world.

MIKE FLOOD is accepted by US Federal Emergency Management Agency, FEMA, for use in the National Flood Insurance Program (NFIP)

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 EXCELS AT

- 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, including 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.

The hydrological processes and numerical methods can be combined, 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 includes both a simple, semidistributed overland flow method for rainfall-runoff modelling and a 2D, diffusive wave, finite difference method for detailed runoff and flood modelling.

MIKE SHE can simulate detailed flooding based on fine scale topography in a coarser numerical grid, as well as detailed two-way exchange with rivers.

RIVER FLOW

Channel flow can be simulated 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.

FEATURES

UNSATURATED ZONE

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

Alternatively, a two-layer root zone model can be used for simple water balance calculations in the unsaturated zone.

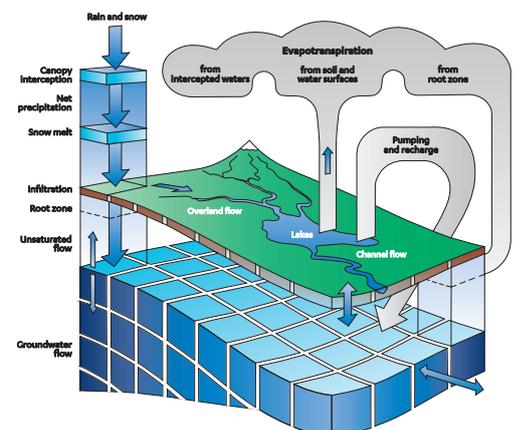
The Green and Ampt infiltration model for dry soil is available, as is bypass flow for soil macropores and subgrid variability of infiltration.

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 to 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, which discharges groundwater drainage directly to surface water (Enterprise version only).

A linear reservoir groundwater method is also available for basin wide water balance and management, as well as 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.

More complex, multispecies, kinetic reactions - comprising all aspects of ecohydrology - can be included using ECO Lab.

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

WATER BALANCE

A comprehensive, flexible water balance utility for complete local and model wide water balances for any time period is included in MIKE SHE.

ADDITIONAL FEATURES

- Deficit-driven irrigation from multiple sources (eg rivers and groundwater) subject to control and licence limits
- AUTOCAL - a generalised tool for parameter estimation and sensitivity analysis that automatically utilises available multicore resources
- Particle tracking for abstraction well capture zones, groundwater age and solute transport time presentation

PACKAGES

MIKE SHE CONFIGURATIONS AVAILABLE

MIKE SHE Studio

MIKE SHE Studio is the ideal tool for distributed rainfall-runoff modelling or basin wide water balance and water management studies.

Furthermore, it is a powerful 1D-2D surface water tool for flood modelling when evapotranspiration, infiltration and groundwater are relevant.

MIKE 11 studio is included in the MIKE SHE Studio package.

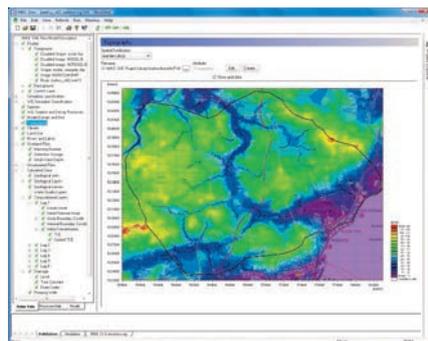
MIKE SHE Enterprise

MIKE SHE Enterprise is the ideal tool for advanced fully integrated groundwater and surface water modelling, including water quality. MIKE SHE Enterprise includes MIKE SHE Studio and all other features described in these pages.

MIKE 11 studio is included in the MIKE SHE Enterprise package.

MIKE 11-MIKE SHE Enterprise

The combination of MIKE SHE Enterprise and MIKE 11 Enterprise packages ensures a completely unlimited, fully integrated groundwater and surface water modelling package.



BENEFITS

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

It is this experience that is embedded in MIKE SHE and is available to you in DHI's superior technical support and training.

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

With MIKE SHE you can tailor the complexity of your model and truly explore the impact of any changes to the hydrological regime within your project area.



MIKE HYDRO BASIN

River basin planning

The basin module of MIKE HYDRO is a **multipurpose, map based decision support tool** for integrated river basin analysis, planning and management. MIKE HYDRO Basin is **designed for analysing water sharing issues** at international, national or local river basin level. A comprehensive, yet simple, product for those who solve problems at local project and basin wide scales. A learning tool for investigating options and **making reliable decisions**.

APPLICATIONS

TYPICAL MIKE HYDRO BASIN APPLICATIONS

- Integrated water resources management (IWRM) studies
- Provision of multisector solution alternatives to water allocation and water shortage problems
- Improvements and optimisation of reservoir and hydropower operations
- Exploration of conjunctive use of groundwater and surface water
- Evaluation and improvement of irrigation scheme performance

FEATURES

MIKE HYDRO is the common framework for DHI's water resources products, offering the latest generation of a map based, easy to use graphical user interface.

The basin module of MIKE HYDRO includes tools and procedures for:

- Water allocation and sharing algorithms
- Advanced reservoir operation options
- Detailed hydropower simulation
- River routing options
- Irrigation water demand and crop yield estimation
- Catchment hydrological modelling
- Result presentation
- Catchment and River delineation tools
- Reservoir sedimentation from sediment loads
- Scripting options for tailored optimisation and scenario simulations
- Water quality simulations using ECO Lab
- Global ranking of water users

BENEFITS

You can design model layouts exactly as you require using embedded GIS features and functionalities.

You can create a unique overview of the spatial and temporal data in the river basin.

You can develop inspiring workshops for learning, trouble shooting or consensus building discussions with live scenario modelling.

You can create the exact maps, graphs and tables you need for public presentations.



MIKE 21C

River hydraulics and morphology

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

APPLICATIONS

MIKE 21C is developed from the 2D surface water flow model, MIKE 21, and is specifically tailored for river morphology applications.

TYPICAL MIKE 21C APPLICATIONS

- Designing protection schemes against bank erosion
- Evaluating measures to reduce or manage shoaling
- Analysing alignments and dimensions of navigation channels for minimising capital and maintenance dredging
- Predicting sedimentation of water intakes, outlets, locks, harbours and reservoirs
- 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

FEATURES

MIKE 21C features include:

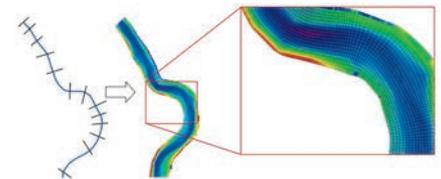
- Curvilinear numerical grid
- Two-dimensional hydrodynamic model based on fast, parallel line implicit solver making long term simulations feasible
- Hydraulic structures formulation
- Helical flow model of the 3D secondary currents, including time and phase lag
- Advection-dispersion model, fully dynamic or quasi-steady
- Bank erosion with movable grid
- Sediment transport equations for sand and gravel with separate descriptions of bed load and suspended load
- Cohesive sediment model for silt and clay
- Graded sediment model that combines a range of sediment particle sizes
- Alluvial resistance model
- Bed scour and deposition model with feedback

BENEFITS

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

Highly flexible, numerical solutions specifically tailored for sediment dynamics in river systems.

MIKE 21C encapsulates DHI's collective knowledge and experience - packaged and made available to river engineers all over the world.



Easy transition/interpolation from MIKE 11 cross-section data to MIKE 21C grid and bathymetry.

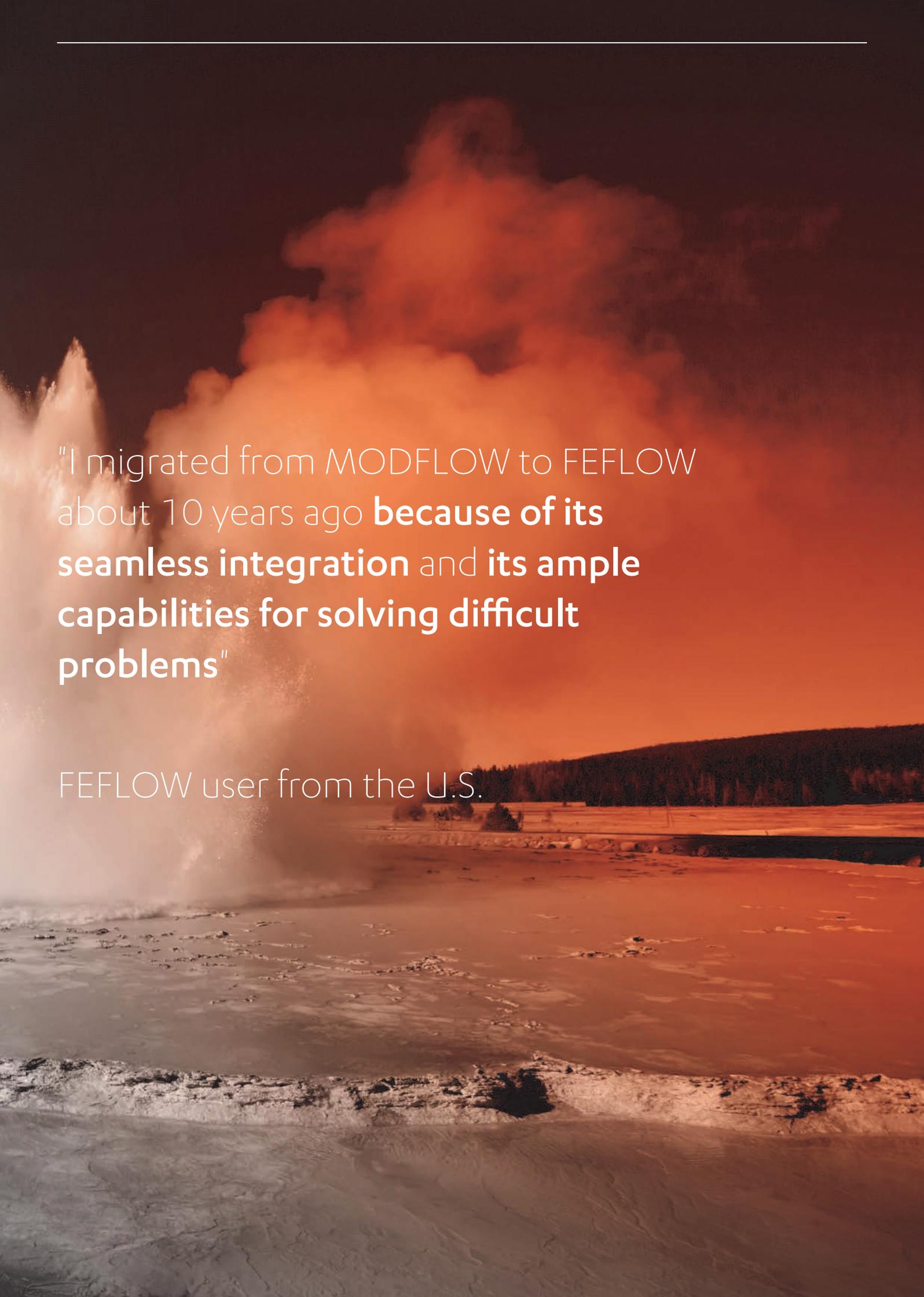


GROUNDWATER & POROUS MEDIA



"I migrated from MODFLOW to FEFLOW about 10 years ago **because of its seamless integration and its ample capabilities for solving difficult problems**"

FEFLOW user from the U.S.

A geothermal landscape featuring a large, billowing plume of white steam or smoke rising from a rocky, mineral-rich ground. The foreground is a snow-covered field with some dark, rocky patches. In the background, there is a line of dark evergreen trees under a clear sky. The overall scene is brightly lit, suggesting a sunny day.

FEFLOW

Advanced groundwater modelling

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**, FEFLOW has become a standard in **premium groundwater modelling** over the last 35 years.

APPLICATIONS

APPLICATIONS FOR WHICH FEFLOW EXCELS

- 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
- Seepage through dams and levees
- Land use and climate change scenarios
- Groundwater remediation, natural attenuation
- Geothermal energy (deep and near surface, both open-loop and closed-loop systems)
- Groundwater-surface water interaction
- Simulation of industrial porous media

FINITE ELEMENTS

FEFLOW uses finite element solution techniques to handle a broad variety of physical processes for subsurface flow and transport modelling.

The advantages of the finite element method include:

- Flexible meshing strategies allowing for detailed models of complex geological structures
- Precise spatial representation of features such as rivers, fractures, tunnels and well locations
- Accurate representation of sloping layers and anisotropy

FEFLOW supports deactivation and reactivation of mesh elements to account for geometry changes in the model domain over time.

3D groundwater models are computationally demanding. Thus, FEFLOW employs optimised numerical solvers - for example by making use of parallel computing on multiprocessor and/or multicore machines.

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 flow

MASS TRANSPORT MODELLING

- Advection-diffusion/dispersion solute transport
- Single species solute transport
- Multispecies solute transport
- Equilibrium sorption
- User defined kinetic reactions
- Double or multidiffusive convection
- Free, forced and mixed convection
- Fracture mass transport

GROUNDWATER AGE MODELLING

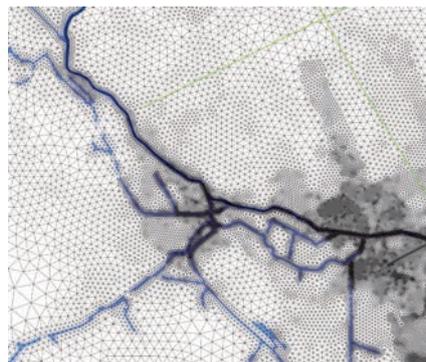
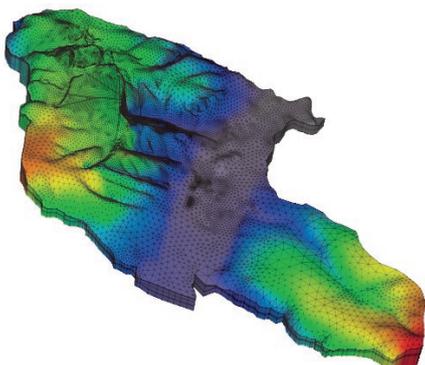
- Capture zone analysis
- Exit probability calculation

HEAT TRANSPORT MODELLING

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

GROUNDWATER-SURFACE WATER INTERACTION

- FEFLOW links with MIKE 11 for modelling of river flow





FEATURES

ONE FOR ALL

No matter whether the simulation task at hand is regional groundwater flow in the capture zone of a water supply well, or the formation of temperature and salinity induced convection cells in a large basin, FEFLOW provides you with all the support you would ask from a software product. FEFLOW covers everything from the first preprocessing steps to helping with presenting results to your clients or to the public, even after postprocessing and reporting.

UP-TO-DATE VISUALISATION TOOLS

FEFLOW provides excellent planar, cross-sectional and 3D visualisation features. Present your modelling results as high quality snapshots or in video sequences, for example, for moving plumes of contaminants!

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

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. A number of plug-ins for specific needs are readily available.

GET THE FREE VIEWER

In viewer mode, FEFLOW's advanced visualisation and postprocessing capabilities are available free of charge. Model reviewers and clients no longer need a software licence to evaluate input data and simulation results.

RELIABILITY

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.

OUTSTANDING TRADITION

Since 1979, FEFLOW has been constantly developed and applied to different kinds of groundwater and porous media simulation projects, providing a convenient graphical user interface since the late 1980s. It has been the trusted choice of leading groundwater modellers for decades all around the globe.



BENEFITS

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 by DHI Web Forum and other online groups. Use these platforms - even if you are not a FEFLOW user yet!

Regular user meetings and FEFLOW conferences provide good opportunities for physical community gatherings.

The FEFLOW package features FePEST, a graphical user interface for using PEST by John Doherty with your FEFLOW models. 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.

FEFLOW includes a licence for WGEO, an excellent tool for georeferencing and processing of spatially related raster data as well as for transformation of raster and vector data. WGEO enables quick and efficient rectification and georeferencing of data sets for use in simulations.

MIKE CUSTOMISED



“The CARM project will make **control of water flows more responsive and more precise**”

State Water Corporation, New South Wales
(NSW), Australia

MIKE CUSTOMISED

DIMS.CORE

Data integration
and business processes

For water environments, DIMS.CORE provides the **perfect data repository for your management and real time operation data** and **turns data into invaluable information** concerning the performance. DIMS.CORE can **link to all data sources, share and provide data to users worldwide**. DIMS.CORE has an impressive track record of combining multiple data sources into one platform and providing tailored reports on your water related business processes.

APPLICATIONS

OPERATION OPTIMISATION

DIMS.CORE is designed for building solutions that transform data into information for operations and management of utilities.

TYPICAL APPLICATION AREAS

- Wastewater treatment plants
- Water supply and distribution
- Collection systems

DIMS.CORE is a generic and flexible tool, which is also applicable within other domains such as:

- Monitoring, reporting and real time control (RTC) for industries
- Real time monitoring of catchment areas integrating surveillance data from deployed automatic equipment
- Real time monitoring and control of water intakes for early warning systems
- Integration with decision support systems (DSS) and information management systems (IMS)

FEATURES

DATA INTEGRATION

DIMS.CORE is used for linking SCADA system data and models in projects that implement monitoring and/or model based RT control systems.

DIMS.CORE has flexible and automated reporting capabilities including integration with Google Maps and MS Excel.

Key components include:

- **Hosts** - modules, which execute tasks and collect data, are distributed to different computers (load balancing)
- **Clients** - the interactive user interface is for configuration and presentation. It supports user accounts and logins, thus enabling different access levels
- **Service** - include modules executing basic functions such as aggregation of time series
- **Plugins** - scalable through software extensions via user or third party configured plugins (.NET)
- **Data validation** - includes quality labels and confidence values assigned to the monitoring and/or calculated data input
- **Guard** - for system wide surveillance

SOLUTION EXAMPLE

REDUCING COSTS FOR AARHUS WATER

Challenge

Aarhus water is responsible for the operation of wastewater treatment plants (WWTP) equivalent to 500.000 PE. The population growth in the area is creating a need for additional treatment capacity. This need may be met either by building new infrastructures, such as aerations or settlement tanks, or by process optimisation within the existing physical configuration.

Solution

By installing ammonium, nitrate and phosphate sensors and feeding the data into DIMS.CORE, operational data are established and used to make the treatment process more efficient. As a result, the power consumption has dropped substantially and so has the use of expensive chemicals, while effluent quality has improved.

Value

By introducing DIMS.CORE and additional online sensors with operational control at four of their largest WWTPs, Aarhus Water has reduced yearly operational costs by EUR 250,000. Moreover, by improving the effluent quality, Aarhus Water has saved EUR 150,000 per year in effluent taxes.



MIKE CUSTOMISED

IMS

Information

Management System

IMS supports management, analysis, presentation and publication of historical and online data and information to facilitate decision making.

APPLICATIONS

MANAGE, USE AND SHARE ENVIRONMENTAL DATA AND INFORMATION

MIKE CUSTOMISED IMS is a data oriented information management system designed for local, national and international authorities, who require an efficient IT system for establishing knowledge to support decision making.

It provides a range of powerful tools to support management, analyses and publishing of data, with the capability to encapsulate accumulated knowledge about water and environment within the water resources, urban and marine sectors.

With a minimum of effort, MIKE CUSTOMISED IMS can be adapted to preferred workflow processes.

For international, transboundary organisations, MIKE CUSTOMISED IMS provides an excellent framework promoting common methodologies and procedures, and it complements and integrates with national systems.

It establishes user friendly access to data and information for both practitioners and the public.

FEATURES

OPEN IT PLATFORM WITH A WEALTH OF OUT OF THE BOX FUNCTIONALITIES

MIKE CUSTOMISED IMS is an MS Windows based, scalable client server solution.

Key components include:

- Time series analyses and visualisation, including numerous data interfaces to external data providers
- GIS processing and visualisation
- Scripting tools based on Python to develop user defined tools
- Spreadsheets to establish user defined analyses and reports
- Web publishing to share information such as data, maps, reports, etc
- Document storage to keep track of mission critical files and documents
- Data auditing, including data quality checks and logging of data changes
- Meta data to qualify your data with descriptive information
- Jobs for task automation
- Alarms and notifications
- Integration with DIMS.CORE for online data acquisition

SOLUTION EXAMPLE

SUPPORTING SUSTAINABLE MANAGEMENT IN LAKE VICTORIA BASIN Challenge

The Lake Victoria Basin Commission (LVBC) requires an IT system to assist in the monitoring of the conditions in the basin and enhance and share knowledge to promote a sustainable utilisation of natural resources for the benefit of the population.

Solution

A solution specifically designed for LVBC to serve as a repository with transboundary data and information, and tailored tools for publishing relevant information about the conditions within the Lake Victoria Basin and the lake.

Value

The solution will allow LVBC and member countries to easily capture, share and utilise data for good quality studies and help create best practice decisions.



MIKE CUSTOMISED

PLANNING

Investment planning
and decision support

Supports **comparative scenario assessment** and **objective and wise decision making** based on data and models.

APPLICATIONS

COMBINES DATA AND MODELS TO MAKE OBJECTIVE DECISIONS

MIKE CUSTOMISED PLANNING extends MIKE CUSTOMISED IMS with mathematical modelling capabilities, climate change impact and adaptation tools as well as methods for objective decision making.

The system is designed for engineers to produce a decision basis for managers and decision makers.

It supports simple or complex comparative assessments based on available modelling tools, defined development scenarios and associated key performance indicators.

Sample applications include mitigation and prevention analyses, uncertainty analyses, optimisation with multiple competing objectives as well as climate change impact and adaptation studies.

FEATURES

A MODELLING AND DECISION MAKING PLATFORM

MIKE CUSTOMISED PLANNING integrates data and modelling tools and provides a range of tools for analyses, visualisation and decision making.

In addition to the capabilities of MIKE CUSTOMISED IMS, the key components comprise:

- Scenarios for comparative assessments based on MIKE by DHI or other models
- Indicators, such as social, environmental and economic indicators for use in comparative scenario assessments
- Multicriteria analyses for objective comparison, ranking and selection of strategy for implementation
- Cost benefit analyses
- Optimisation based on multiple competing objectives
- Ensembles to assess uncertainty and make more robust decisions
- Climate change impact - and adaptation scenarios using climate data from global and regional climate models

SOLUTION EXAMPLE

THE NILE BASIN DECISION SUPPORT SYSTEM

Challenge

To reduce poverty, facilitate socio-economic development and ensure regional peace and security, the Nile Basin countries have agreed to develop the water resources of the basin in a cooperative and shared manner.

Solution

Building on MIKE CUSTOMISED PLANNING, the Nile Basin DSS was developed and configured with climatic, hydrological, hydraulic and environmental data, water simulation models, sector economic production models as well as cost-benefit and multicriteria analysis tools.

Value

The solution enables the countries of the basin to collaborate and share information in a transparent and objective way, and prioritise water resources management strategies in the Nile Basin.



MIKE CUSTOMISED

REAL TIME

Operational control
and early warning

Supports operational forecasting and early warning services using real time field data and forecasting models.

APPLICATIONS

MAKE FORECASTS AND WARNINGS TO IMPROVE DECISION MAKING

MIKE CUSTOMISED REAL TIME extends MIKE CUSTOMISED PLANNING with features for real time forecasting and warning dissemination and emergency management.

REAL TIME represents today's best practise within online river operations and forecasting services, and it supports efficient and accurate decision making.

TYPICAL APPLICATION AREAS

- Forecasting and early warning systems for cities, rivers, lakes and the sea
- Low flow forecasting
- Reservoir inflow forecasting and reservoir optimisation for both hydropower production, flood protection, irrigation and environmental flows
- During emergencies, the system is useful for risk assessment and identification of mitigation strategies

FEATURES

A LIVE MANAGEMENT AND FORECASTING SYSTEM

MIKE CUSTOMISED REAL TIME provides a range of tools for real time forecasting and warning.

In addition to the MIKE CUSTOMISED PLANNING features, key components include:

- **Data broker** - to import, validate, process and use external data for forecast modelling purposes, such as telemetry time series, radar and satellite images and numerical weather model predictions
- **Job definition and scheduling** - to automate common work flows, for example data brokering activities, forecast modelling, report generation and information dissemination
- **Events and alarms** - to detect and respond to different types of states
- **Emergency management** - to identify risk or mitigation strategies given the current system state

SOLUTION EXAMPLE

FLOOD FORECASTING FOR SAVA AND SOCA RIVER BASINS, SLOVENIA

Challenge

The Sava and Soca river basins often suffer from flooding as a result of torrential rain or melting snow. The floods have caused loss of lives and significant damages.

Solution

DHI was commissioned to provide an operational flow forecasting and warning system based on MIKE 11 and MIKE CUSTOMISED REAL TIME.

Once established, the solution was deployed on site and tested for accuracy, speed and robustness.

Value

The solution allows authorities to initiate early evacuation to save lives and property. Moreover, the system makes it possible to enhance hydropower production.



MIKE CUSTOMISED

GeoFES and Flood Toolbox

ArcGIS based disaster risk management

GeoFES supports decision makers at fire brigades and **disaster management** organisations in the event of fires, disasters and man-made occurrences. The Flood Toolbox is a modular system that helps **predict, manage and assess damage of flood events**.

APPLICATIONS

BE PREPARED FOR DISASTERS AND UNDERSTAND THEIR IMPACTS

Natural disasters across the globe appear with increasing frequency and magnitude, causing severe damage to properties and infrastructure and loss of human lives.

The GeoFES and Flood Toolbox offer powerful tools supporting different aspects of disaster management, including mitigation, preparedness, prediction, warning, response and recovery.

GeoFES is a disaster management system that supports public safety managers in operations planning and training, normal day-to-day operations - and during major emergency situations such as floods, fires or spill accidents.

The Flood Toolbox is tailored for flood preparedness planning, including impact assessment and investment planning.

The Flood Toolbox includes modules for flood estimation, risk and damage assessment, including generation of associated spatial maps.

The Flood Toolbox is frequently used to support activities related to the EU Floods Directive.

FEATURES

ALL YOU NEED FOR DISASTER RISK MANAGEMENT

GeoFES key components:

- **Operational tasks** - definition and organisation of operational tasks with detailed activity log for tracking and auditing purposes
- **Localisation tasks** - easy and fast identification of locations affected by an emergency
- **Operation overview** - situational maps with associated info tables provide an overview of key operational aspects such as site status and resource allocations
- **Information and workflows** - digital exploration of operation site and built-in standard workflows and check lists for a variety of different incidents
- **Analysis task** - for producing different types of statistics and contact information (such as population and infrastructure) within affected areas

Flood Toolbox key components:

- **Preliminary flood risk assessment tool** - for a quick initial estimation of the potential flood risk
- **MIKE by DHI tool** - for importing MIKE by DHI modelling results
- **Flood estimation tools** - for preprocessing and postprocessing of flood relevant data, including estimation of water depth, volume, flow velocity and direction
- **Flood damage assessment tool** - for calculating flood damage and for comparing different flood mitigation scenarios
- **Flood map generation tool** - for creating flood risk maps and flood hazard maps

SOLUTION EXAMPLE

MANAGING FLOODS FOR THE PORT OF HAMBURG

Challenge

The City of Hamburg is located on the Elbe river and is often affected by floods created by heavy rainfall in upstream catchments as well as by storm surges from the North Sea. During flood events, the Hamburg Port Authority cooperates with other city authorities to make operational decisions.

Solution

A comprehensive information management system was created based on GeoFES. The system includes a large spatial database holding information required for operational decision making during floods. The systems also contains a close integration between GeoFES and a flood simulation system.

Value

The established system enables fast and reliable prediction of flood levels and analysis of flood impacts. This is crucial for making timely operational decisions and thereby reducing flood impacts.



MIKE CUSTOMISED

WISYS

ArcGIS based water information system

WISYS provides a **powerful and comprehensive** ArcGIS based information system for **river basin management** that includes capabilities to ensure the compliance to the European Water Framework Directive.

APPLICATIONS

KNOWLEDGE FROM RIVER SOURCE TO MOUTH

WISYS is an ArcGIS based water information system designed to support river basin management and the implementation of the EU Water Framework Directive (EU WFD).

It supports the management of temporal and spatial data in a multiuser information management system and is ideal for sharing information among stakeholders.

WISYS includes a spatial data model enriched with information required to support the EU WFD data processing and reporting requirements.

WISYS supports water management authorities in creating and maintaining an overview of river basin features such as river networks, lakes, wetlands, protected areas, waste disposal sites, well fields and different types of administrative and infrastructural data.

FEATURES

MANAGEMENT OF COMPLEX DATA TO MAKE BETTER DECISIONS

WISYS is equipped with a number of tools and features designed to support river basin management and EU WFD data processing and reporting requirements.

Key features include:

- A user friendly graphical interface, which provides easy access to the functionality
- Advanced theme management, which brings all relevant information into a spatial context
- Information explorers for powerful navigation, information query and analyses
- Tools for managing monitoring networks and functionality to analyse water quality data along rivers and in wetlands
- Visualisation of monitoring data, including interactive visualisation tools and predefined style templates
- Data import tools for data integration and harmonisation
- Links to modelling software for working with modelling data and results

SOLUTION EXAMPLE

EU WFD IMPLEMENTATION IN GERMANY

Challenge

The EU Water Framework Directive sets new standards for river basin management in Europe. German authorities, such as the federal states of Berlin, Hamburg and Brandenburg, are required to monitor and improve the water quality and quantity in rivers and groundwater systems. Large amounts of field and modelling data are available and needed to meet the EU WFD reporting requirements.

Solution

WISYS is used as a centralised IT platform for the administration of WFD baseline scenario data.

Value

- Centralised repository for efficient dissemination and sharing of WFD data
- Improved interdisciplinary and cross-institutional cooperation
- Effective analysis of data, specifically targeted towards the EU WFD reporting requirements

Other solutions

- WISYS is used by a number of German authorities as an investment planning and reporting instrument for improving wastewater systems
- GEWISS, Switzerland's national water information system, is driven by WISYS. It contains key information on all water bodies in Switzerland in one central repository



THE ACADEMY



“This course should be **essential for people new to modelling** or people working directly with models/outputs. The time and money spent on the courses are easily justified by the **time saved by avoiding basic mistakes** in the future, which is costly to a project”

Auckland Council, New Zealand.

THE ACADEMY

Make a difference -
enhance your knowledge
and skills

THE ACADEMY by DHI **embraces all 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 building programme as well as MIKE by DHI user group meetings, seminars and conferences. The activities are **run by our experienced trainers and facilitators.** Improve your skills in the use of our MIKE by DHI and MIKE CUSTOMISED by DHI tools and **facilitate your project work!**

THE ACADEMY BY DHI

THE ACADEMY by DHI is all about knowledge building and sharing experiences with our partners in order to make a difference in the world's water environments.

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

Through THE ACADEMY, we invite you to take part in our activities.

Enjoy!

GLOBAL TRAINING & CAPACITY BUILDING

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

Our training packages are designed in many forms, ranging from a few days to months. Some of our capacity building projects include large training components and training-on-the-job schemes. Special training packages are arranged for universities and research institutions.

Our training offers include standard as well as tailored training courses.

MIKE by DHI courses focus on practical skills, hands-on exercises and how to get the most out of your software. As a new user, our MIKE by DHI courses help you to a flying start.

Thematic courses embrace a range of current topics in all our areas of expertise, such as climate change adaptation or integrated water resources management. They allow you to apply concepts, applications and decision support principles to the entire business process.

MIKE CUSTOMISED by DHI courses help you understand the power of the MIKE CUSTOMISED tools for building decision support systems.

TRAINERS & FACILITATORS

We have more than 200 trainers and facilitators worldwide - experienced professionals, many of whom are recognised international experts in their individual fields.

Our trainers have a thorough knowledge of local markets and regulations. They provide training tailored to your needs and help you develop skills and build expertise in your language whenever and wherever you need it.

Our trainers advise you on which training scheme to adopt in order to meet your specific needs and preferences.

You always have a trusted advisor at hand.





PARTICIPANTS

Thousands of water professionals attend THE ACADEMY courses every year. Our courses are designed to fit your needs and challenges - whether you are a water manager, a professional engineer or a technician.

Our attendees include governmental agencies, regional and local water bodies, research institutions and universities, professional bodies and engineering companies, urban water utilities, coastal and harbour authorities.

OUR PARTICIPANTS SAY

"A training course is a must if one wants to fully understand and utilise a MIKE package to its full potential"

ADK Consulting Engineers S.A., Greece

"It was very impressive and I would like to get information about future courses too (mainly WEST, wastewater)"

Lecturer, Budapest University of technology and Economics, Department of Applied Biotechnology and Sciences

"This course was a great way to start using MIKE FLOOD software"

TPF Planege, Portugal

"I strongly recommend this course (in littoral processes) to any coastal engineer who wants to improve his/her skills in beach evolution/sediment transport modeling"

Sogreah Gulf (Artelia Group), Dubai

"After completing this course I will have a better understanding to build the model correctly and in a faster way"

Norconsult, Sweden

CONTACT US

THE ACADEMY offers a palette of training courses and capacity building packages.

Every year, we schedule a large number of public enrolment courses worldwide.

Consult our online courses and events calendar on our website for a complete listing of courses and events planned - in your region and in your language:

www.theacademybydhi.com

For questions and further information, you are welcome to contact our International Course Secretariat:

courses@dhigroup.com



THE ACADEMY

Global knowledge sharing and network building

DHI is based **on global knowledge of water environments** gained from projects and research activities and is embedded in our software tools. It is our key priority to **make knowledge accessible and share it with you** through our events, publications and guidelines, MSc/PhD co-supervision engagements, university partnering and support as well as Serious Games.

EVENTS

Large numbers of MIKE by DHI users, research partners, decision makers and stakeholders in general meet around the globe at our local, regional or national events.

OUR EVENTS

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.

The events include MIKE by DHI user group meetings, regional or national conferences, seminars, thematic workshops and expert fora.

OUR USER GROUP MEETINGS

MIKE by DHI user group meetings offer you a unique opportunity to learn about real world applications, the latest software updates, and the new software tool development and technology. In addition, you have the opportunity to share knowledge and experiences with fellow users, DHI modellers and colleagues.

OUR THEMATIC WORKSHOPS, SEMINARS, ROUND TABLES AND CONFERENCES

take up cross cutting views of how to combine decision support principles and concepts across current themes in our areas of expertise. A number of training sessions are typically offered in conjunction with our events.

When joining our events, you enjoy the warm and informal atmosphere of THE ACADEMY by DHI!



OUR PARTICIPANTS SAY

“A valuable networking and up-skilling opportunity with added value from interaction with all levels of DHI”

HPC Wales, Bangor University, Wales

“The Conferences proved to be a neutral melting pot where a huge number of representatives from academia and the business world met and shared knowledge, thus contributing to the promotion of dialogue, trust and partnerships”

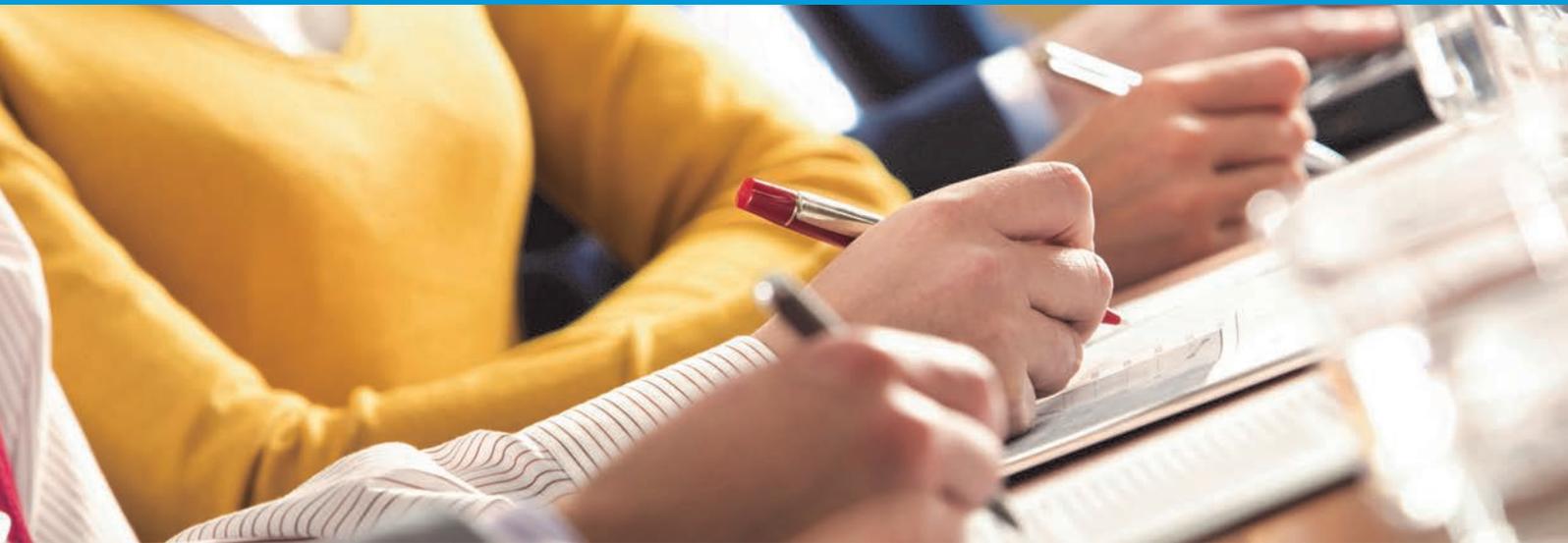
Sandro Carniel, CNR - ISMAR, Italy

“It is a chance to know about MIKE products and advancements and new techniques”

Research Scholar, Anna University, Chennai, India

“As DHI also performs consultancy, presenting case studies of practical projects during the UGM beginning from data gathering, model set-up, calibration and production runs enables users to appreciate the capability of the software”

Ir. Iwan Tan Sofan Tan, Senior Manager, Coastal Section, Dr. Nik & Associates Sdn Bhd, Malaysia



PUBLICATIONS

Through direct access to knowledge, know-how and research results, you are enabled to solve your specific challenges in water environments.

Our publications, scientific articles and guidelines are important tools in disseminating the results from our research and development activities.

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



UNIVERSITIES

We work in close collaboration with our partners worldwide. THE ACADEMY by DHI cooperates with universities and other knowledge institutions to establish an extensive network of knowledge partners.

Each year, DHI provides supervision to many Master and PhD students. The students selected for supervision must have top grades and the supervision of students is agreed upon through a written agreement between the responsible university professor and DHI. It is a prerequisite that the professor at the university has agreed before DHI is contacted.

Students, who want to use MIKE by DHI software as part of their master or PhD theses, may contact us for a licence.

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



Each year DHI provides supervision for many MSc and PhD students from all over the world.

SERIOUS GAMES

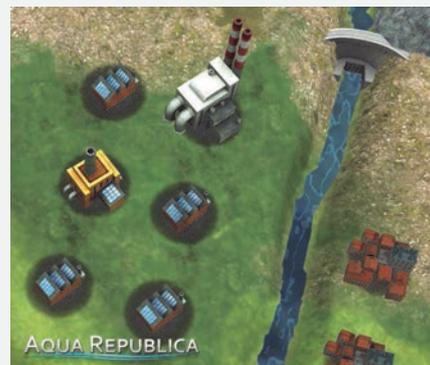
We develop Serious Games, which are ideal for creating awareness and sharing knowledge in order to engage stakeholders in understanding the complex interconnectivity of water.

Our games are effective, flexible, engaging and offer continuous learning by experiencing decision making in a realistic, virtual environment.

Our Serious Games are empowered by MIKE by DHI software.

Do you want to play our free version of Aqua Republica, develop a river basin and see the consequences of your actions? Then visit our website:

www.theacademybydhi.com/seriousgames



Aqua Republica - a collaborative project between United Nations Environment Programme (UNEP) and DHI.

ABOUT DHI



MIKE by DHI software has been the preferred choice of water professionals around the world for more than 25 years. Our product family encapsulates more knowledge and covers the widest range of water modelling needs - making it truly unique.



Make a difference in the world's water environments - enhance your knowledge and skills. Join our global training and knowledge sharing activities.



Tailored solutions for water environments. Integrate data and models in a decision making environment.

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The expert in **WATER ENVIRONMENTS**