MIKE+

Integrated water modelling

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

APPLICATIONS

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

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

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

Flooding
- Flood management and mitigation
- Flood risk analysis and flood hazard mapping
- Flood contingency planning
- Flood defence failure impact studies
- Climate change assessments
- System-wide water quality evaluations

MODEL MANAGER

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

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

SELECTED TOOLS

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

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

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

MIKE+ ARCGIS

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

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

With MIKE+ ArcGIS, you can:

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

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WATER DISTRIBUTION

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

EPANET

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

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

Demand Allocation

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

Water Quality

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

SPECIAL ANALYSES

This module includes features such as:

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

COLLECTION SYSTEMS

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

SWMM

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

Hydraulics

Simulates unsteady flow in pipe and channel networks including:

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

Hydrology

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

MIKE1D PIPEFLOW

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

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

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

RIVER NETWORKS

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

MIKE1D RIVERS

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

Connections can be made seamlessly between pipe network and river.

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

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

DATA ASSIMILATION

This module includes continuous model state updating during simulation, Kalman filter and uncertainty assessments.
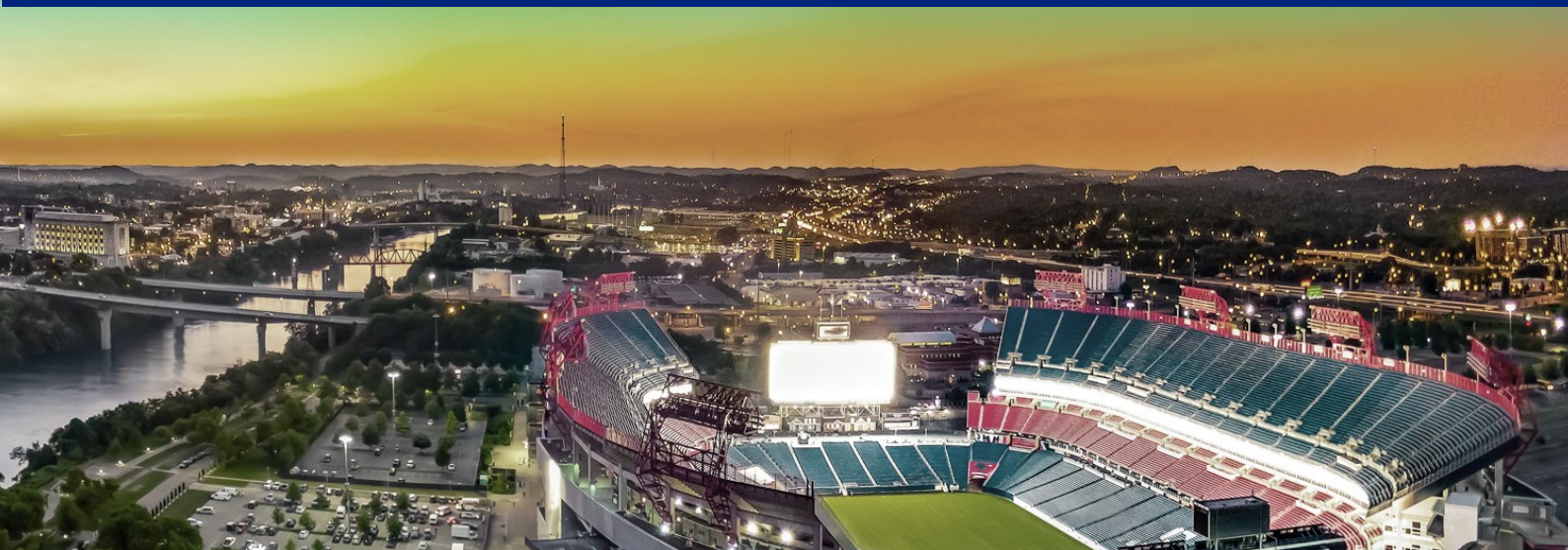
FLOODING

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

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

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

2D OVERLAND
The Flexible Mesh (FM) solver offers maximum flexibility for detailed and tailored meshes. Its advanced handling of buildings, roads and rainfall is perfectly suited for urban flooding studies.

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

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

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

INTEGRATED COUPLING
The MIKE 21 FM engine can also be coupled to Collection Systems and Rivers for an efficient user experience when modelling stormwater runoff to flow in pipes, channels and rivers and 2D surface. This also includes modelling the transport of surface pollutants and fine sediments (AD) as well as water quality (MIKE ECO Lab).

CROSS DOMAIN CAPABILITIES

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

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

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

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

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

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

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

COUPLING CAPABILITIES

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

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

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

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

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