

**Texas A & M University and U.S. Bureau of Reclamation  
Hydrologic Modeling Inventory  
Model Description Form**

**JUNE 18, 1999**

**Name of Model:** Two-Dimensional Floodplain Model (MIKE21 HD)

**Model Type:**

MIKE 21 HD is a comprehensive modeling system for two-dimensional free surface flood flows.

**Model Objective(s):**

MIKE21 HD simulates spatial variations in flood water levels, depths, flows and velocities in two dimensions. MIKE21 HD can be used for the prediction of flood inundation areas, depth maps, velocity maps, flood hazard maps and flood flow distributions.

**Agency and Office:**

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**Technical Contact and Address:**

Mr. Jesper T. Kjelds  
Mr. Andy Driscoll

**Model Structure or Mathematical Basis:**

MIKE21 HD simulates water level and flow variations in river channels, on river floodplains (both urban and rural) and in lakes, estuaries and coastal areas in response to various forcing functions. The water levels and flows are resolved on a rectangular grid covering the area of interest using the river channel and floodplain topography, bed resistance coefficients and hydrographic boundary conditions.

MIKE21 HD solves the vertically integrated, fully dynamic equations of continuity and conservation of momentum in two horizontal directions using implicit finite difference methods. The following effects are included in the equations:

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- Convective and cross momentum
- Momentum dispersion
- Floodplain flooding and drying
- Evaporation
- Wind shear stress

MIKE21 HD forms the basis for calculations in additional MIKE21 modules describing advection dispersion, water quality and sediment transport.

#### **Model Parameters:**

MIKE21 HD solves the vertically integrated, fully dynamic equations of continuity and conservation of momentum in two horizontal directions. Model parameters for MIKE21 are:

- Bed resistance
- Momentum dispersion (eddy) coefficient
- Wind friction factor (optional)

#### **Spatial Scale Employed in the Model:**

In MIKE21 HD, the floodplain and channel topography is described by a rectangular grid. The grid size is specified by the user and should be based on the level of topographical detail required to be represented. MIKE21 HD can be used to simulate two dimensional flooding over a wide spatial range from small scale urban situations with channels only metres wide to broad scale river floodplains of several kilometres width.

#### **Temporal Scale Employed in the Model:**

The temporal scale of MIKE21 HD is characterized by its flexibility and is based on the boundary time series defined by the user. MIKE21 HD has the flexibility to run short scale, event based time series or time series covering months or years of flow simulation. Boundary time series are entered into a database by the user, who also defines the length and time step of the series.

#### **Input Data Requirements:**

MIKE21 HD requires the following data:

- Basic Model Parameters
  - Model grid size and extent
  - Times step and length of simulation
  - Type of output required and its frequency
- River channel and floodplain topography
- Calibration factors
  - Bed resistance coefficients

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- Momentum Dispersion coefficients
- Wind friction factor (optional)
- Boundary Conditions
  - Water levels or flow magnitudes
  - Flow direction

MIKE21 HD utilizes the powerful and flexible MIKEZero graphical interface for the input and pre-processing of data.

### **Computer Requirements:**

MIKE21 HD is available in the Microsoft Windows (Win95, Win98, WinNT) environment. Minimum computer requirements are Pentium processor, 16MB RAM, 100MB hard disk space.

### **Model Output:**

MIKE21 HD provides output as time varying maps of water surface level and water flux in two dimensions with values defined on the model grid specified by the user. MIKE21 HD utilizes the MIKEZero Graphical interface, which allows powerful and flexible graphical interpretation of the model results including:

- Color presentation of plans of water surface, water depth, flow distribution and flow speed
- Vector representation of flow velocity
- Plots of time series of water surface, water depth, flow flux, flow velocity at any point on the model grid
- Plots of the variation in space along any line of the water surface, water depth, flow flux, flow velocity.
- Discharge calculations, accumulated volume calculations across any line
- Statistical calculations on model output
- Digital video animation of model outputs

### **Parameter Estimation / Model Calibration:**

MIKE21 HD has three calibration parameters, namely bed resistance factor, momentum dispersion (eddy) coefficient, and wind friction factor (optional). Calibration of the model can be achieved easily by adjustment of these factors. In practice, the calibration of a model depends more on the accuracy of the available data e.g. topography and boundary time series definition than the model parameters. Model calibration parameters are chosen by the user. Instruction and guidelines for parameter selection are provided in the model documentation and on-line help. Further information on parameter selection is available from a wide selection of published references and case studies.

**Model Testing and Verification:**

MIKE21 HD has been extensively tested on a wide range of flood projects worldwide, and has a proven record of accomplishment within the wider consulting community. A list of applications and case studies is available on the DHI website or by contacting DHI direct.

**Model Sensitivity:**

The sensitivity of MIKE21 HD to calibration parameters is largely case dependent e.g. in areas where the floodplain topography is uniform and the flood slope gentle, little sensitivity to parameters is observed. However, on floodplains with rapidly varying topographies or steep floodwater slopes model outputs may be more sensitive to the parameter values chosen.

**Model Reliability:**

MIKE21 HD has a reliability proven over many years on numerous projects worldwide. When properly calibrated, MIKE21 HD can predict flood levels to within 0.1m and flood flows and velocities to within 10% of observed data.

**Model Application / Case Studies:**

MIKE21 HD has been utilized in a wide range of flooding related studies worldwide including:

- flood studies
- floodplain management studies
- flood protection studies, especially where a detailed description of the impact on flood flow patterns is required
- Urban flooding
- Dam break studies

A list of specific case studies is available on the DHI website or directly from DHI on request

**Documentation:**

MIKE21 HD is supported by a thorough on-line help system and user manual and technical reference documentation.

In addition, DHI offers a comprehensive system of technical support through its dedicated Software Support Centre. 24 hour assistance from DHI's highly trained technical staff can be obtained through our Software Support Centre via telephone hotline, fax or the Internet ([software@dhigroup.com](mailto:software@dhigroup.com)). As a part of License Service Agreements DHI software users are updated regularly with software developments via newsletters and Internet broadcasts.

**Other Comments:**

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Since its establishment in 1964, DHI has provided a continuing, long-term commitment to the research and development of reliable and useable modeling software. DHI offers a broad range of software tools and services, which support investigation, design, operation and maintenance tasks ranging from urban drainage hydraulics, to broad scale flood studies to offshore and coastal hydraulics.

As an independent research and consulting organisation, DHI supplies knowledge, technology and advisory services for the provision of safe and reliable infrastructure with sustainable and environmentally sound development.