HEC-HMS: Hydraulic Engineering Center Hydrologic Modeling System

Contact Information

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Download Information

Availability: Nonproprietary
Cost: N/A

HEC-HMS was developed for the U.S. Army Corps of Engineers, but the model program files, executables, and documentation are available for free download by the public at the website above. However, the Hydrologic Engineering Center (HEC) of the U.S. Army Corps of Engineers will not provide user support to non-Corps users. In addition, public distribution of the model source code is generally discouraged by HEC.

Model Overview/Abstract

The Hydrologic Engineering Center (HEC) of the U.S. Army Corps of Engineers released the Hydrologic Modeling System (HEC-HMS) (HEC, 2001a) for rainfall-runoff simulation as a successor to HEC-1 (HEC, 1998). This model includes many of the watershed runoff and routing computation methods of HEC-1 but also includes many additional capabilities, including continuous hydrograph simulation over longer periods of time, distributed runoff computation using a grid cell representation of the watershed, a GUI, integrated hydrograph analysis tools, data storage and management tools, and graphics and reporting packages. HEC (2001b) reports specific differences between HEC-HMS and HEC-1.

HEC-HMS is specifically designed for simulation of rainfall-runoff processes of networking watershed systems. The modeling system includes many modernized and expanded algorithms from previous HEC models, including HEC-1, HEC-1F (HEC, 1989), PRECIP (HEC, 1989), and HEC-IFH (HEC, 1992).

Model Features

Modeling components

- Losses
- Runoff transform
- Open-channel routing
- Analysis of meteorologic data
- Rainfall-runoff simulation
- Parameter estimation
- Reservoir system simulations

User interface includes

- File management

- Data entry and editing
- Basin mapping for model configuration and data input and access
- Tabular and graphical display of input and output data

Model Areas Supported

Watershed	Low
Receiving Water	Low
Ecological	None
Air	None
Groundwater	Low

Model Capabilities

Conceptual basis

HEC-HMS is designed to simulate the rainfall-runoff processes of networked watershed systems. This model serves as the successor to HEC-1, providing a user interface and improvements and additional capabilities for distributed modeling and continuous simulation. It is designed to be applicable in a wide range of geographic areas for solving the widest possible range of problems.

Scientific detail

The physical representation of watersheds or basins and rivers is configured in the model based on representation of general hydrologic elements, including subbasins, reaches, junctions, reservoirs, diversions, sources, and sinks. The system encompasses losses, runoff transform, open-channel routing, analysis of meteorological data, rainfall-runoff simulation, and parameter estimation. A wide array of options is available to simulate losses, including initial and constant rates, the SCS curve number method, and the Green-Ampt method. Runoff transform methods include the Clark, Snyder, and SCS unit hydrograph techniques. User-specified unit hydrograph ordinates can also be used. Open-channel routing methods include the lag method, Muskingum method, the modified Puls method, the kinematic wave method, and the Muskingum-Cunge method. Meteorological data analysis can also be performed in the model for precipitation and evapotranspiration and includes various historical and synthetic methods (HEC, 2001).

Model Framework

Each model run combines a basin model, meteorologic model, and control specifications with run options to obtain results. The system connectivity and physical data describing the watershed are stored in the basin model. The precipitation and evapotranspiration data necessary to simulate watershed processes are stored in the meteorologic model (HEC, 2001).

Scale

Spatial Scale

- One-dimensional

Temporal Scale

- User-defined

Assumptions

Multiple assumptions are made that reduce the watershed to three separate processes—loss, transform, and baseflow. The number of assumptions is controlled by the hydrologic methods selected by the user for simulation. HEC (2000) reports specific assumptions for each method and algorithm used in HEC-HMS.

Model Strengths

- Simplified methods of hydrologic simulation encourage reduced number of parameters for model calibration.
- Capable of modeling common types of hydraulic control structures with appropriate on and off features.
- Includes a GUI with pre- and post-processing capabilities.

Model Limitations

- Cannot simulate water quality processes
- Relatively difficult to use in conjunction with other water quality models
- Cannot simulate groundwater levels

Application History

Multiple example model applications are reported by HEC (2001a and 2002). Many algorithms from HEC-1, HEC-1F, PRECIP, and HEC-IFH have been modernized and combined with new algorithms to form a comprehensive library of simulation routines in HEC-HMS.

Model Evaluation

See available references.

Model Inputs

- Initial conditions and attributes
- Inputs from watershed sources and discharges
- Element data
- Physical coefficients
- Time sequences of hydrometeorological conditions

Users' Guide

Hydrologic Modeling System, HEC-HMS: User's Manual (HEC, 2001a). Available online: http://www.hec.usace.army.mil/software/hec-hms/documentation/hms_user.pdf

Technical Hardware/Software Requirements

Computer hardware:

The minimum hardware requirements for a Microsoft Windows installation includes

- Intel 80486 compatible processor
- 16-MB memory to run the program individually
- 15-MB available hard-disk space
- 15-inch VGA monitor
- Microsoft compatible mouse

The minimum hardware requirements for a Unix installation includes

- 64-MB memory to run the program individually
- SuperSPARC processor
- 28-MB available hard-disk space
- 10-MB available hard-disk space per user
- 17-inch color monitor

Operating system:

- Microsoft Windows 2000, 98, and 95

- Microsoft Windows NT 4.0
- Unix 2.5 or higher

Programming language:
FORTRAN

Runtime estimates:
Available intervals range from 1 minute to 24 hours

Linkages Supported
HEC-DSS

Related Systems
HEC-1, HEC-1F, PRECIP, HEC-IFH, HEC-RAS, HEC-DSS

Sensitivity/Uncertainty/Calibration
Not available

Model Interface Capabilities
The program features a completely integrated work environment including a database, data entry utilities, computation engine, and results reporting tools. A GUI is also included.

References
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