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Hydrologic Engineering Center

Hydrologic Modeling System HEC-HMS

Release Notes

Version 3.4
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Hydrologic Modeling System HEC-HMS, Release Notes

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Introduction

Version 3.3 of the Hydrologic Modeling System (HEC-HMS) was completed in November 2008 and released for general use shortly thereafter. Two new simulation features have been added to Snyder transform method in the subbasin element. Changes have been made to *Basin Map* and the *Watershed Explorer* to improve visualization of the hydrologic elements. The development team has also continued careful and systematic testing of the program since the last release. The results of that testing in combination with reports from users has allowed the identification and repair of various problems. Some of these affected simulation results and are described in detail later in this document. Some problems that did not affect results but caused problems in the program interface have been repaired without being specifically documented. The result is this Version 3.4 release. It is currently available for the Microsoft Windows® operating system, the Sun Microsystems Solaris™ operating system, and also the Linux® operating system.

The program has been designed to be easy to use. However, an understanding of how the program works is critical to producing accurate results. It is suggested that a new user read the *Quick Start Guide* (Version 3.4 August 2009). The guide briefly describes the basic features of the program in enough detail to begin using it. The guide also includes a step-by-step tutorial.

Installation

The installation program and all documentation are available on the HEC website at http://www.hec.usace.army.mil/. This new release is installed independently of any previous versions of the program so you will need to remove Version 3.3 if you do not want to use it anymore. However, you may keep different versions of the program installed for parallel use or testing if you choose to do so. This new version will automatically open projects developed with any previous version of the program. However, once a project has been opened in Version 3.4, it may not be possible to open it with older versions of the program.

The new installation package is designed to be easy to use. It will take you through the steps of selecting a directory for the program files and making other settings. Use the following steps to install the program on the Microsoft Windows® operating system:

1. Download the installation package from the HEC website to a temporary folder on the computer. If the software was provided to you on a CD-ROM or other media, insert it in the appropriate drive.

2. Run the installation program. In Windows Explorer, double-click the icon for the installation program. You must have administrator privileges to run the installer.

3. Follow the on-screen prompts to install the program.

Instructions for installing the program on the Sun Microsystems Solaris™ operating system and the Linux® operating system can be found in Chapter 2 of the User's Manual.

New Capabilities

The Snyder transform method computes a unit hydrograph on the basis of the lag and peaking coefficient parameters. The method has been expanded with two sub-methods for regional application. The "Ft Worth District" sub-method is based on a regional study by the U.S. Army Corps of Engineers Ft Worth District. Parameters are entered and an internal equation developed in the regional study is used to estimate the peaking coefficient. The lag is also entered. The estimated parameter values are used to develop a standard unit hydrograph. The "Tulsa District" sub-method is based on a similar regional study by the U.S. Army Corps of Engineers Tulsa District. In this case both the lag and peaking coefficient are replaced by new parameters and internal estimation equations. The original capability to specify the lag and peaking coefficient remains and is now called the "Standard" sub-method. The new sub-methods should only be used in the regions where they were developed. Other locations should continue to use the "Standard" sub-method and enter a lag and peaking coefficient estimated according to locally accepted practices.

Tooltips have been added to the Basin Map. You have the option of no tooltip, or the hydrologic element name, or the description of the element. When the description is selected, only the first 120 characters of the description are used. Select the desired format for tooltips by clicking the menu command **Tools ⇒ Program Settings**, and then choosing the "Basin Map" tab.

Early versions of the program automatically closed results (graphs, summaries, tables) when ever the basin or meteorologic model data changed. More recent versions of the program were able to keep some results open, and then automatically update the results after a simulation was recomputed. All results are now able to remain open after data changes. When the data changes, the results are labeled to show that data has changed and the results need to be recomputed. The results are automatically updated with new simulation results after the recomputed is completed.

Changes in Operation

All previous versions of the program listed the hydrologic elements in alphabetic order. This ordering was used in the *Watershed Explorer*, global editors, global summary table, and other places. This has been replaced by hydrologic ordering. Hydrologic ordering lists the elements in order from headwater to outlet, using the downstream flow connections and drainage area to automatically keep the elements in sorted order. The Watershed Explorer will always show elements in hydrologic order. Other displays, such as global editors or the global summary table, can be shown in either hydrologic order or alphabetic order. It is suggested that users review the appropriate section of the User's Manual, Chapter 6 for further details.

All previous versions of the program created a reach by clicking once with the mouse. This was followed by specifying the name in a small window that appeared over the location of the mouse click. The reach had an "upstream" and "downstream" end but they could not be visually distinguished unless the viewing option was turned on to show flow direction arrows. It was not hard to connect a reach into the flow network incorrectly with flow going the wrong way. The process of creating a reach has been changed to require two mouse clicks. The first click defines the upstream end of the reach. A line then connects from that point to the mouse crosshair as it moves around the *Basin Map*. Clicking the

second time fixes the downstream end of the reach. The process completes similar to before by specifying the name of the reach. The revised process for creating a reach should make it easier to have the correct flow direction in a reach when it is connected into the flow network.

All of the *Component Editors* in the program have been enhanced to show which data is required and which data is optional. Required data fields are indicated with a red asterisk just before the parameter label. Any data that is shown with the red asterisk must be entered before a simulation can be computed. Any data that is not marked is optional and usually represents additional processing options that may be selected by the user.

The *Program Settings* have been expanded with new options. Global editors can be optionally positioned outside the *Desktop*, to take advantage of multiple monitors. Tooltips can be configured for the *Basin Map*. Additional file and memory management options are now available for results. The settings can be accessed by clicking on the **Tools ⇒ Program Settings** menu command.

Basin element names and simulation names could not include special characters. For example, a reach element could be created with the name "Sarandí-Ressaca". A simulation run would appear to complete normally but no results would be available for that reach. Changing the name to use only simple characters would allow results for that element to be visualized. No results could be visualized for any element in a simulation run where the name of the run included special characters. This happened because the HEC-DSS output file cannot use special characters for identifying time-series data. A system is now implemented to allow special characters in element and simulation names, and still be able to store results for visualization. Any special characters are substituted in the HEC-DSS file when storing and retrieving results. Accessing results within the program interface now functions normally regardless of the use of special characters. The substitution system should work well for languages with a sparse use of special characters. However, some languages such as Arabic, Hindi, or Japanese are essentially entirely composed of special characters. The substitution system will be overly restrictive in these languages. In these cases, an English transliteration is recommended for naming elements and simulations.

Problems Repaired

A simulation run would abort with Error 41200 but only under certain conditions: temperature index snowmelt included in the meteorologic model, and temperature gage reading irregular data from a Data Storage System (DSS) file. The problem has been solved so that irregular data can be used correctly and successfully from a DSS file.

The Smith Parlange loss rate method would compute infinite infiltration for an entire simulation run if the initial water content was set less than the residual water content. From a physical standpoint, it is impossible for the water content to be less than the residual water content under general environmental conditions. The initial water content must be greater or equal to the residual water content. A parameter check was added to verify that the initial water content is valid. When the initial water content is not valid, the simulation will abort and display an informational error message.

The soil moisture accounting loss rate method did not work correctly with the kinematic wave transform method. All other non-gridded loss rate methods

functioned correctly with the kinematic wave transform method. The problem was caused by an interaction between the soil moisture accounting method and the second loss plane within the kinematic wave transform. The problem has been resolved so that all non-gridded loss rate methods can work correctly and successfully with the kinematic wave transform.

The Component Editor for the soil moisture accounting loss rate method did not synchronize correctly with the corresponding global editor. Canopy and surface layer data did not remain synchronized. Both editors have been corrected to remain synchronized regardless of which editor is used to enter data.

The computed evapotranspiration was incorrectly shifted one time interval when the monthly average evapotranspiration method was selected in combination with a basin model using the ModClark transform method. The calculated values were numerically correct, but shifted forward one time interval. This shift caused the evapotranspiration to be incorrect only for the first time interval of each month. The time shift has been corrected so that the evapotranspiration is correct at all time intervals during a simulation.

The combined inflow to an element was not calculated correctly if there was more than one upstream element and the system international unit system was used. The values of combined inflow were correctly but they were labeled in cubic feet per second (CFS) instead of cubic meters per second (CMS). This calculation has been corrected so that both the values and units label are correct for both unit systems.

The reservoir did not properly process tailwater stage under some circumstances when using the outflow structures routing method. The problem would appear with the fixed tailwater method, if the stage was outside the range 0 to 100 meters (0 to 328 feet). The simulation would stop with an error message that the specified stage was outside the acceptable range. The only solution was to use a different option for specifying the tailwater condition. The fixed tailwater method has now been fixed so that it operates over the same range of values used for elevation in the reservoir storage curve. Stages may now be specified between -500 and 10,000 meters (-1640 and 32,808 feet).

The reservoir did not correctly save states during a simulation run if the specified release routing option was used. The reservoir would simulate correctly up to the time the states were saved. Then the reservoir would reset to the storage at the beginning of the simulation run before completing the simulation. This has been fixed so that the reservoir storage simulates continuously up to the time states are saved, and then continues correctly to the end of the simulation.

Saved states did not work correctly when combined with the ModClark transform method. Any direct runoff that should have been included in the saved state was missing. Therefore, subbasin outflow was underestimated from the beginning of a simulation run starting with a saved state, up to at least the time of concentration. There were no problems with saved states and direct runoff for other transform methods. Direct runoff is now correctly included in saved states with the ModClark transform.

Future Plans

Land surface erosion and channel sediment transport is under development. Initially two simple methods will be provided for simulating land surface erosion as part of subbasin calculations. Eventually more complex methods will be

added to the subbasin. A simplified channel transport capability will be added to reach elements. It will handle erosion and deposition within the channel in addition to transport down the channel, all in a simplified approach appropriate for hydrologic simulation. It is not anticipated to include a movable bed. Additional components will also be provided at source, diversion, and reservoir elements to include the movement of sediment throughout the element network.

Several features will be added to the reservoir element. Methods for simulating direct precipitation are being considered, along with percolation. Capability will be developed to specify a new type of spillway gate using a family of elevation-discharge curves. Plans are also underway to provide additional options for controlling the opening and closing of spillway gates. Finally, we are investigating ways to simulate the infiltration-runoff response of exposed ground when the pool is drawn down.

Significant upgrades to the basin map are also in the planning stage. An option is being developed to represent subbasins and reservoirs with polygons instead of a simple icon. Similarly, the reach would be represented with a line that follows the actual stream location. This will increase the spatial context of the basin model and create opportunities for visualizing parameter data or simulation results directly in the map through color-coded animations of the polygons.

Documentation

The *Hydrologic Modeling System HEC-HMS: Quick Start Guide* (Version 3.4 August 2009) provides a brief description of the program for new users. It describes the different parts of the interface and the basic steps necessary to obtain simulation results. A tutorial takes the user through the creation of a new project and shows how to obtain results. The guide has been updated to reflect changes in the interface.

The *Hydrologic Modeling System HEC-HMS: User's Manual* (Version 3.4 August 2009) contains extensive information on installing and using the program. Details on the use of each of the features and capabilities in the program are included. The manual has been updated with information describing new features added to the program for this Version 3.3 release. The updates are generally confined to Chapter 6 in select locations describing the SCS unit hydrograph transform method and the reservoir element.

The *Hydrologic Modeling System HEC-HMS: Technical Reference Manual* (March 2000) continues to accurately describe the mathematical models included in the program. New simulation capabilities have been added to the program and are not included in the manual. The manual is currently undergoing a major revision to expand documentation of existing mathematical models and fully describe the newly added models.

The *Hydrologic Modeling System HEC-HMS: Applications Guide* (March 2008) also continues to accurately describe how to apply the program to various engineering problems. However, the guide is undergoing revision to add guidance on how to use new features of the program to more efficiently solve problems.

Support Policy

Technical support for program users within the Corps of Engineers is provided through an annual subscription service. Subscribing offices can expect full

support from HEC staff in the routine application of the program. Users are strongly urged to consult with HEC staff on the technical feasibility of using the program before beginning a project with unique requirements such as grid cell hydrology, snow melt, or continuous simulation. Extended support for large or complex projects can be arranged under a separate reimbursable project agreement.

Support can not be provided to users outside the Corps of Engineers. Several companies and organizations offer varying levels of support, some through a fee-for-service support similar to the support provided to subscribing Corps offices. Such service agreements are between the user and the vendor and do not include HEC staff. Vendors can be located through internet searches.

Reporting of suspected program errors is unrestricted and we will reply to all correspondence concerning such errors. We are continuously working to improve the program and possible bugs should always be reported. Reports should include a written description of the steps that lead to the problem and the effects that result from it. If we cannot reproduce the reported problem, we may ask you to send a copy of your project.

Request support or report program errors through the following channels:

- Call 530.756.1104, 7:30 am to 4:30 pm PT Monday through Friday.

- Fax 530.756.8250 any time.

- Write to U.S. Army Corps of Engineers, Institute for Water Resources, Hydrologic Engineering Center, 609 Second Street, Davis, CA 95616 USA.

- Send email to *hec.hms@usace.army.mil* on the internet.

- Visit our web site at http://www.hec.usace.army.mil.