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Hydrologic Engineering Center

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# **Hydrologic Modeling System HEC-HMS**

## **Release Notes**

Version 2.2.2  
May 2003



## Introduction

Version 2.2.1 of the Hydrologic Modeling System (HEC-HMS) was completed in October 2002 and released for general use shortly thereafter. A number of major problems were found and fixed since release of Version 2.2.1. Version 2.2.2 is available for computers running the Microsoft Windows 2000/NT/98/95 operating systems or the Sun Microsystems Solaris operating system. Special advice on the Microsoft Windows Me and XP operating systems is available from the HEC website at <http://www.hec.usace.army.mil/>.

Development of the software is ongoing. The entire program is currently being converted from the C++ programming language to the Java language. Details about upcoming releases of HMS can be found in the Future Plans section of this document.

The Technical Reference Manual for Version 2.0 continues to accurately describe the mathematical models included in the program. The User's Manual labeled Version 2.1 continues to accurately describe the use and application of the program. A supplemental description of the new reservoir features added at Version 2.2.0 can be found in the release notes for that version. The Applications Guide has been completed and joins the documentation set.

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 Chapter 3 of the User's Manual and Chapters 2 and 3 in the Technical Reference Manual before attempting to start and use the program. These chapters provide the fundamental instruction necessary to effectively use the program. Subsequently, start the program and construct the example application contained in Chapter 10 of the User's Manual.

## Installation

The installation program and all documentation are available on the HEC website at <http://www.hec.usace.army.mil/>. The installation package is designed to be easy to use. If you have never installed the HEC-HMS program before, the installation package will take you through the steps of selecting a directory for the program files, a directory for the sample project files, and making other settings. If you have installed the HEC-HMS program before, the installation package will automatically detect the previous version and upgrade to the new release. Use the following steps to install or upgrade the program:

1. Download the installation package from the HEC website to a temporary folder on the computer. Alternately, insert the provided CD-ROM or other media in the appropriate drive.
2. Run the installation program. In Windows Explorer, double-click the icon for the installation program.
3. Follow the on-screen prompts to install or upgrade the program. Be sure to reboot the computer before using the HEC-HMS program if this is the first installation of the program.

## Closed Defects

A total of 17 defects have been repaired since the release of Version 2.2.1. A brief description of each repaired defect follows:

1. An incorrect value in the circular cross section kinematic wave routing equation resulted in calculated flow errors of approximately 2-5 percent. The model now correctly routes stream flow in a circular channel using the kinematic wave method.
2. The program would crash if an external unit-hydrograph record was not a unit hydrograph, i.e. a flow record. Now, a critical error message is given when a record that has a "C-part" other than "flow-unit graph" is selected for a user specified unit hydrograph or "s-graph" for a user specified s-graph. Similar checks are made for all types of paired data and time-series data.
3. When only one SMA unit is defined in the SMA unit editor, that unit seemed to be selected in the loss method (the user did not have to select a unit from a list, it already appeared to be selected). However, when a run was executed, it would fail because an SMA unit was not defined for the subbasin. Now, the subbasin editor selects the first SMA unit and it is up to the user to change the selected SMA unit if a different one is desired.
4. The program would crash in some instances when opening an SMA graph. Now, the SMA graph can always be opened without the program crashing.
5. The scroll bar on the Monthly Evaporation - Evapotranspiration Coefficient table was not visible. The scroll bar is now visible.
6. There was no input box to enter a percent impervious for the SMA loss method in Overland Flow Plane 2. A percent impervious can now be entered for the second overland flow plane.
7. No baseflow was calculated when the Linear Reservoir baseflow method and the Kinematic Wave transform method were selected in the same subbasin. Now, baseflow is correctly calculated when these two methods are selected in the same subbasin.
8. Specifying the Muskingum-Cunge 8-Point routing method for the main channel in the kinematic wave transform method would cause the program to stop computing during a run. This method now works properly.
9. Loss Rate parameter values were required for Overland Flow Plane 2 even if no plane 2 data was entered in the kinematic wave transform method. Loss data is now only required if the second plane is used in the transform.
10. Baseflow from the SMA loss method was incorrectly calculated when a percent imperviousness was entered for the subbasin. The outflow from the groundwater layers did not take into account the percent impervious. Now, outflow from the groundwater layers is correct.

11. Under some circumstances, calculated baseflow using the Linear Reservoir baseflow method was not updated when parameter values affecting how much water becomes baseflow were changed or if transform or loss methods were changed. Baseflow is now correctly updated when a change is made to any method parameter.
12. Evapotranspiration was not calculated for gridded subbasin (when the ModClark transform method was selected). Evapotranspiration is now calculated for gridded subbasins.
13. The source element incorrectly calculated flow when the simulation time interval was different than the time interval of the specified flow record. Now, the source element correctly calculates flow independent of the computational time increment.
14. The program would shut down after editing the name of a basin element in the Element List and then selecting Save Basin Model from the File menu. Now, a user cannot edit a basin name from the Element List and the File menu is no longer accessible.
15. The program no longer crashes when importing a Basin or Meteorologic model.
16. The SCS Hypothetical Storm method could be set as the default precipitation method for new projects, but when a new HMS project was created this precipitation method would not be the default. This has been fixed.
17. The program would not allow an SMA unit to be selected and saved for the second overland flow plane loss method other than the one selected for plane 1. Now, a different SMA unit can be selected for the second overland flow plane than the one selected for plane 1.

## Open Defects

A total of 7 major and minor defects are currently open. Version 3.0 of the program should solve most of these issues. The following defects are open:

1. The program can only print using a PostScript language print driver. Attempts to use other print driver languages, for example Printer Control Language (PCL), will result in many pages of output containing seemingly random text characters. PostScript print drivers are available for almost all laser printers. Contact the printer manufacturer for the latest PostScript print driver, or download it from their website.
2. Connecting the diverted flow from a diversion element to another element can cause the program to crash when graphing the results from an element or moving elements in the basin model screen. The crash does not occur if the diversion flow *is not* connected downstream. The exact cause of the problem is unknown at this time.
3. Optimization results will be lost if any of the hydrologic elements used in an optimization trial are renamed in the supporting basin model. Additional problems will occur if the loss, transform, or baseflow method is changed in a subbasin after it has been added to an optimization trial. Generally speaking, the basin model used in an optimization run and trials should not have elements added, renamed, or removed, and the

methods selected for the elements should not be changed. The exact cause of the problem is unknown at this time.

4. The program will crash if the parameters in an optimization trial are reordered after a new trial is created and before it is computed for the first time. The exact cause of the problem is unknown at this time.
5. The program may become unresponsive or crash under some conditions when using the mouse to very quickly open and close screens other than the basin model screen. The instability becomes more intense if selections are made or parameters entered on the screen when quickly opening and closing the screens. The problems disappear when the program is used at a normal pace.
6. Subbasin results for soil moisture accounting may not appear exactly as anticipated. The soil moisture accounting time-series table always shows results for the "first" subbasin regardless of the subbasin selected when the results were requested. The selection list in the upper right corner of the time-series table can be used to switch to any subbasin using the soil moisture accounting loss method.
7. The optimization manager will not perform well when attempting to optimize the number of routing steps in the linear reservoir baseflow method. The trial may give poor results or the program may crash while the trial is optimizing. The optimization manager continues to function correctly when the number of steps is not selected for optimization.

## Future Plans

In terms of look and feel, the current version of the program has changed little from the original Version 1.0 release in March 1998. The design of the interface was implemented by using the C++ programming language and the Galaxy development library. The library allowed nearly identical versions of the program to run on both Microsoft Windows and Sun Solaris operating systems even though they use conflicting methods for rendering images on the computer display. At the time, the library represented state-of-the-art development techniques for deploying software to multiple operating systems.

The software development industry has changed radically since the HEC-HMS project began in 1992. At that time it was very difficult to create software designed to operate on multiple operating systems if a graphical user interface was required. The intervening years between then and now have brought about the Java programming language. Contrary to earlier languages or development systems, the Java language is specifically designed to look and operate the same on a wide variety of operating systems without any additional work by software developers. The advantages of the Java language are so great that in 2000 the decision was made to adopt Java for future development work in replacement of C++ and the Galaxy library.

Version 2.2.2 should be the terminal release using the C++ programming language and the Galaxy library. All future releases, beginning with Version 3.0, will be developed using the Java language. A significant amount of work has already been completed to convert the existing computation engine to Java. Instead of replacing the existing interface with one written in Java using a similar look and feel, the development team has taken this opportunity to critically examine the interface and redesign it as necessary. The final design is complete

and compares nicely with other engineering and scientific software programs from commercial companies. Work is under way to implement the new design for the interface and an approximate date for the beta release of Version 3.0 is fall 2003.

Version 3.0 will contain all of the capability present in Version 2.2.2 and will also add snowmelt simulation to the meteorologic model. Algorithms originally developed for the Distributed Snow Process Model (DSPM) are being adapted for use in HEC-HMS. DSPM is a temperature index method that has already been successfully applied in a number of projects (Daly *et al.*, 1999). The algorithms represent a reasonable advancement over snow melt algorithms included in HEC-1 and will support both lumped subbasins using unit hydrograph or kinematic wave methods, and gridded subbasins using the ModClark method. Unfortunately, the advancements in algorithm design will preclude importing HEC-1 files set up for snow melt simulation.

As time allows, features in addition to snowmelt simulation will also be added to Version 3.0 before its first release. These features may include customizable reports for basin model, meteorologic model data, and run results, or automatic depth-area reduction analysis. The first priority is to release Version 3.0 in a timely manner with the temperature index snowmelt simulation. Extensive beta testing will be undertaken prior to release of the new interface system.

Additional features are being planned for inclusion after Version 3.0 is released. These may include: additional reservoir capabilities for modeling interior flood zones, energy budget snowmelt simulation, user scripting to automate simple tasks, frequency curve generation, animated graphs of gridded precipitation and runoff results, additional optimization features, and user extensions for adding new methods such as reach routing.

A comprehensive program validation guide is currently under development and will be published when complete. The guide gives detailed information about the tests used to determine the accuracy of the mathematical models included in the program, for example, the SCS curve number loss method. The section for precipitation methods is currently complete in draft form. Sections for junctions, sinks, diversions, reservoirs, and some reach routing and loss rate methods are also complete in draft form. It was found that HEC-HMS accurately implements all features in the tested methods.

## Documentation

The *Hydrologic Modeling System HEC-HMS: User's Manual* contains extensive information on installing and using the program. An example application is included to illustrate the steps necessary to produce results.

The *Hydrologic Modeling System HEC-HMS: Technical Reference Manual* contains information on how to use the various methods included in the program. The scientific origin and equation derivations are presented for each method. Specific solution algorithms for a method are discussed when necessary for a complete understanding. Application and parameter estimation for each method is also included.

The *Hydrologic Modeling System HEC-HMS: Applications Guide* illustrates application of program HEC-HMS to studies typical of those undertaken by Corps' offices, including (1) urban flooding studies; (2) flood-frequency studies;

(3) flood-loss reduction studies; (4) flood-warning system planning studies; (5) reservoir design studies; and (6) environmental studies.

The online help system within the program contains topics describing each screen of the graphical user interface.

## 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. Domestic and foreign vendors are available that provide 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 do contact HEC on behalf of their users when unusual problems or errors are encountered. A list of vendors can be found at <http://www.hec.usace.army.mil/>.

Reporting of suspected program errors is unrestricted. 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. We will reply to all correspondence concerning program errors.

Request support or report program errors through the following channels:

- Call +1-530-756-1104, 7:30 am to 4:30 pm PT Monday through Friday.
- Fax +1-530-756-8250 any time.
- Write to U.S. Army Corps of Engineers, Institute for Water Resources, Hydrologic Engineering Center, 609 Second Street, Davis, CA 95616-4687 USA.
- Send email to [hec.hms@usace.army.mil](mailto:hec.hms@usace.army.mil) on the internet.
- Visit our web site at <http://www.hec.usace.army.mil>.