Hydrologic Engineering Center

Training Course on

Hydrologic Modeling with HEC-HMS

Davis, CA

Course Description

The course provides an introduction to HEC-HMS for new users, focusing both on using the program and performing watershed studies. The course starts with a summary and overview of the program and the mechanics of constructing watershed models. Each component of the model is then studied in detail. Major modules include historic and synthetic precipitation approaches, and computing infiltration and excess surface runoff. Unit hydrograph procedures are explained. Channel and reservoir routing methods are also included. Parameter estimation techniques are taught throughout with supplemental use of the optimization tool for refining estimates using observed data. A multiple-subbasin model is finalized and used to compute flow frequency curves. Theoretical material is supported with workshops that illustrate the basic steps of building a model to support "without project" and "with project" alternative analysis for a watershed study.

Monday

8:00 - 9:00 a.m.	**Introduction**	
9:00 - 9:15 a.m.	Break	
9:15 - 10:00 a.m.	1.1 Lecture:	**Overview of Hydrologic Modeling for Project Studies**
	Purpose and applications of rainfall-runoff modeling to accomplish study goals, overview of rainfall-runoff processes, and description of how each technical subject relates to the overall task of model development with consideration given to the intended us of the model.	
10:00 - 11:00 a.m.	1.2 Lecture:	**Introduction to HEC-HMS**
	Introduction to modeling capabilities, the user interface, data entry and editing, simulation runs, and viewing results.	
11:00 - 12:00 noon	1.3 Workshop:	**Getting Started with HEC-HMS**
	Mechanics of the program including creating data sets, computing simulation runs, and viewing results.	
12:00 - 1:00 p.m.	**Icebreaker Lunch**	
1:00 - 1:15 p.m.	**Review**	
1:15 - 2:15 p.m.	1.4 Lecture	**Introduction to HEC-GeoHMS**
	Introduction to the HEC-GeoHMS ArcGIS extension. Demonstrate how HEC-GeoHMS can be used to generate input files for an HEC-HMS model.	
2:15 - 4:45 p.m.	1.5 Workshop:	**Applying HEC-GeoHMS**
	The workshop will show students how to use HEC-GeoHMS to build a watershed network and generate input files for an HEC-HMS model.	
4:45 - 5:00 p.m.	**Review**	

Tuesday

8:00 - 9:00 a.m. 2.1 Lecture: **Meteorologic Models - Historic Precipitation**

Overview of the types of rainfall used in runoff computations and introduction to precipitation methods available in HEC-HMS for reproducing historic storms: user-specified gage weights, inverse distance, specified hyetograph, and gridded precipitation.

9:00 - 9:15 a.m. Break

9:15 - 10:00 a.m. 2.2 Lecture: **Introduction to Loss Rate Methods**

Definition of "loss rates" and the processes involved. Introduction to loss rate methods for event simulations: initial constant, deficit constant, SCS curve number, Green Ampt. Discussion on the choice of a loss rate method and how to estimate model parameters.

10:00 - 11:45 a.m. 2.3 Workshop: **Rainfall and Loss Rate Computation**

Examination of different approaches to historic precipitation. Time will also be spent comparing different approaches to computing loss rates.

11:45 - 12:00 noon **Review**

12:00 - 1:00 p.m. Lunch

1:00 - 1:45 p.m. 2.4 Lecture: **Meteorologic Models - Hypothetical Storms**

Description of hypothetical storms and their use. Introduction to the methods available in HEC-HMS: specified hyetograph, standard project storm, SCS storm, and frequency storm.

1:45 - 2:00 p.m. Break

2:00 - 3:00 p.m. 2.5 Lecture: **Unit Hydrograph Approach to Rainfall-Runoff Modeling**

Development of the unit hydrograph theory and its application. Definition of synthetic methods and discussion of several methods: Clark, SCS, and Snyder. Discussion of the choice of a unit hydrograph method and how to estimate parameters.

3:00 - 4:45 p.m. 2.6 Workshop **Computing Synthetic Unit Hydrographs**

Students will develop unit hydrograph parameters using standard methods with comparison to observed data. Time will also be given to comparing hydrographs generated using different watershed delineations.

4:45 - 5:00 p.m. **Review**

Wednesday

8:00 - 9:00 a.m. 3.1 Lecture: **Introduction to HEC-DSS and HEC-DSSVue**

Introduction to the HEC-DSS data files and its role in HEC-HMS. Introduction the the HEC-DSSVue program for creating and managing data in support of hydrology studies.

9:00 - 9:15 a.m. Break

9:15 -11:00 a.m. 3.2 Workshop: **Using HEC-DSSVue**

Use HEC-DSSVue to plot and tabulate data. Manually enter time-series and paired data in a HEC-DSS file and use the automatic import tool to import precipitation data. Overview and use of the HEC-DSSVue graphical editor.

11:00 - 11:15 a.m. **Review**

11:15 - 12:00 noon 3.3 Lecture: **Automatic Optimization Tools in HEC-HMS**

Use of the optimization tool to estimate unit hydrograph and loss rate model parameters using observed rainfall and flow data.

12:00 -1:00 p.m. Lunch

1:00 - 2:30 p.m. 3.4 Workshop **Parameter Estimation with Optimization**

Use of the optimization tool to estimate unit hydrograph and loss parameters using rainfall and flow data developed in an earlier workshop. Comparison of the results by analyzing multiple storm events.

2:30 - 2:45 p.m. **Review**

2:45 - 3:30 p.m. 3.5 Lecture **Reservoir Modeling Capabilities**

Description of the reservoir element and the three methods for routing water through the reservoir pool. Representation of outflow structures of the dam. Discussion of data requirements.

3:30 - 3:45 p.m. Break

3:45 - 5:00 p.m. 3.6 Lecture **Overview of Channel Routing Techniques**

Concepts of flood wave routing and discussion of the channel routing methods available in HEC-HMS: lag, Muskingum, kinematic wave, Muskingum-Cunge, and modified Puls.

Thursday

8:00 - 8:30 a.m.	4.1 Lecture:	**Selecting the Appropriate Routing Technique**
	Discussion on the choice of a routing method and how to estimate model parameters.	
8:30 - 10:00 a.m.	4.2 Workshop:	**Stream Flow Routing**
	Development of routing parameters using Muskingum-Cunge and modified Puls methods, with comparison of results between methods and to observed flow data.	
10:00 - 10:15 a.m.	**Review**	
10:15 - 10:30 a.m.	Break	
10:30 - 11:30 a.m.	4.3 Lecture:	**Model Calibration Strategies**
	Discussion of the model calibration process. Methods for selecting initial parameter values, calibration versus validation, and metrics for determining model adequacy. Requirements for report documentation.	
11:30 – 12:00 noon	4.4 Workshop:	**Multiple Subbasin Modeling**
	Finalize the multiple-subbasin model using parameters developed during previous workshops. Verify the completed model using observed storm events. Make final adjustments and calibrate loss rates to a computed frequency flow curve.	
12:00 -1:00 p.m.	Lunch	
1:00 - 2:30 p.m.	4.4 Workshop - continued	
2:30 - 2:45 p.m.	**Review**	
2:45 - 3:45 p.m.	4.5 Lecture:	**Advanced Capabilities**
	Introduction to advanced modeling tools in HEC-HMS including: gridded precipitation and loss rates, snowmelt, evapo-transpiration, erosion and sediment transport, and water quality.	
3:45 - 4:00 p.m.	Break	
4:00 - 5:00 p.m.	4.6 Lecture:	**Frequency Curve Determination for Planning Studies**
	Watershed modeling for planning studies with emphasis on frequency curve determination for "with project" and "without project" conditions.	

Friday

8:00 - 10:30 a.m.	5.1 Workshop: **Frequency Curve Determination** Determination of frequency curves for "without project" and multiple "with project" alternatives, considering current and future conditions in the watershed.
10:30 - 10:45 a.m.	**Review**
10:45 -12:00 noon	Conclusion and Closing Activ**ities**