Hydrologic Engineering Center

Training Course on

ADVANCED APPLICATIONS OF HEC-HMS

18 – 22 April 2016
Davis, California

Course Objectives

The course covers a variety of areas that go beyond the Basic HEC-HMS course which focuses on event-based flood hydrology. This course contains a major module on continuous simulation, including the details of modeling water content in the soil, evaporation and transpiration, and details of the components included in HEC-HMS for representing these processes. This course contains additional modules on surface erosion modeling and interior drainage projects. A major module is included for snow processes and snowmelt modeling, with particular attention paid to proper calibration techniques when using snow data. An introduction is provided to using the new uncertainty analysis tools within HEC-HMS. The week wraps up with newer forecasting features and an introduction to HEC-MetVue.

HEC Instructors

Mike Bartles
Tom Brauer
Beth Faber
Matt Fleming
Stan Gibson
Fauwaz Hanbali
Alex Sanchez
Bill Scharffenberg

Guest Instructors

Brian Skahill, ERDC
Cary Vuyovich, CRREL

Advanced HMS Training Course

Monday

8:00 – 9:00	Introductions and Opening Activities
9:00 – 10:00	**1.1 Lecture 1: Continuous Simulation Methodologies** (Scharffenberg) Explanation of differences between event and continuous simulation. Description of the soil moisture accounting and deficit constant methods that can be used for continuous simulation.
10:00 – 10:15	Break
10:15 – 11:00	**1.2 Lecture 2: Evapotranspiration** (Scharffenberg) Explanation of the physical process of plant water use and approaches to simulating evapotranspiration. Discussion of the importance of evapotranspiration in the water balance over long time periods, the methods available in HEC-HMS for modeling ET.
11:00 – 12:00	**1.3 Lecture 3: Soil Data and Parameter Estimation** (Bartles) Introduction to soil databases and the information they contain. Explanation of procedures that can be used to estimate parameters from the soil data base to populate continuous simulation models.
12:00 – 13:00	Lunch
13:00 – 14:00	**1.4 Workshop 1: Estimating Loss Model Parameters** (Bartles, Fleming) Use a soil data base to estimate parameters for the soil moisture accounting and deficit constant continuous models.
14:00 – 14:15	Review (Bartles)
14:15 – 14:30	Break
14:30 – 15:15	**1.5 Lecture 4: Calibration Procedure for Continuous Simulation Models** (Fleming) Discussion of methodology to calibrate and validate a continuous simulation model. Common metrics to use for model verification and documentation.
15:15 – 16:45	**1.6 Workshop 2: Calibrating a Continuous Simulation Model** (Fleming, Bartles) Practice calibrating continuous simulation models. Explore the effect of different methods for representing evapotranspiration.
16:45 – 17:00	Review (Fleming)

Tuesday

8:00 – 8:45	**2.1 Lecture 5: Reservoirs for Interior Ponds** (Scharffenberg) Definition of an interior pond and typical uses in flood protection projects. Features in the reservoir element that are used when modeling an interior pond. Discussion of data sources necessary when preparing a reservoir for use as an interior pond.
8:45 – 9:00	Break
9:00 – 10:00	**2.2 Lecture 6: Coincident Frequency Analysis** (Faber) Discussion of the relationship between flooding on the main channel and flooding upstream of the interior pond. Methodologies for evaluating and describing the cumulative flood risk upstream of the interior pond.
10:00 – 11:30	**2.3 Workshop 3: Coincident Interior Flooding** (Scharffenberg, Bartles) Develop a model for a watershed that drains to an interior pond adjacent to a levee. Set up a reservoir to represent the interior pond and evaluate alternatives for operating the pump station. Develop a coincident frequency curve for maximum stage.
11:30 – 12:00	Review (Scharffenberg)
12:00 – 13:00	Lunch
13:00 – 14:00	**2.4 Lecture 7: Continuous Analysis** (Faber) Discussion of the correct analysis techniques for developing frequency curves from continuous simulation results. Determining whether a coincident frequency or continuous analysis is indicated.
14:00 – 14:15	Break
14:15 – 15:45	**2.5 Workshop 4: Continuous Interior Flooding** (Bartles, Scharffenberg) Develop a model for an interior area and simulate for a period-of-record; create a frequency curve from the results.
15:45 – 16:00	Review (Bartles)
16:00 – 17:00	**2.6 Lecture 8: Case Study of a Continuous Simulation Model for the Russian River Watershed** (Brauer) Discussion of the application of HEC-HMS to the Russian River Forecast Informed Reservoir Operation study and how the HEC-HMS model was developed and calibrated.

Wednesday

8:00 – 8:45	**3.1 Lecture 9: Applications of Erosion Modeling** (Gibson) Discussion of the ways surface erosion modeling is used in studies, including post-fire assessments, source to hydraulic channel models, watershed management, and TMDL.
08:45 – 09:00	Break
09:00 – 9:45	**3.2 Lecture 10: Surface Erosion** (Sanchez) Explanation of the MUSLE model for erosion in agricultural and natural watersheds. Discussion of appropriate use and parameter estimation.
9:45 – 10:45	**3.3 Workshop 5: Surface Erosion and Wash-off** (Sanchez, Brauer) Estimate the parameters for both the build-up wash-off and MUSLE erosion methods. Calibrate and compare results to measured sample data.
10:45 – 11:00	Review (Sanchez)
11:00 – 12:00	**3.4 Lecture 11: Sediment Transport** (Gibson) Introduction to erosion and deposition processes in the channel, and transport of suspended and bed materials.
12:00 – 13:00	Lunch
13:00 – 13:30	**3.5 Lecture 12: Sediment Reservoir Routing** (Sanchez) Explanation of the physical processes at reservoir. The reservoir sediment trap efficiency is affected by the detention time of storm runoff and by factors governing sediment particle size.
13:30 – 15:00	**3.6 Workshop 6: HMS Erosion Model: Watershed, Channel and Reservoir** (Sanchez, Gibson) Finalize HMS erosion model using the watershed, reservoir and channel routing methods. Calibrate and compare results to measured sample data.
15:00 – 15:30	Review (Sanchez)
15:30 – 15:45	Break
15:45 – 17:00	**3.7 Lecture 13: Temperature Index Modeling** (Vuyovich) Explanation of the physical processes at work during snow fall and pack accumulation. Discussion of the role of ripening and pack melt. The temperature index approach to modeling with guidance on parameter estimation.

Thursday

8:00 – 9:00	**4.1 Lecture 14: Data Needs for Snow Modeling** (Vuyovich) Introduction to the types of atmospheric data required for snow modeling. Discussion of methodologies used to collection information about the snow pack. Sources of data and appropriate processing procedures.
09:00 – 09:15	Break
9:15 – 10:45	**4.2 Workshop 7: Introduction to Snow Modeling** (Vuyovich, Scharffenberg) Review atmospheric data and prepare a temperature index snow melt model. Become familiar with the temperature index snowmelt model.
10:45 – 11:00	Review (Vuyovich)
11:00 – 12:00	**4.3 Lecture 15: Uncertainty Analysis** (Scharffenberg) Discussion of the new Uncertainty Analysis capabilities in HEC-HMS version 4.1.
12:00 – 13:00	Lunch
13:00 – 14:00	**4.4 Lecture 16: New Optimization and Uncertainty Analysis Capabilities** (Skahill) Introduction to the Markov Chain Monte Carlo Optimization and Uncertainty Analysis capabilities under development for HEC-HMS version 4.3.
14:00 – 14:15	Break
14:15 – 15:15	**4.5 Lecture 17: Demonstration of MCMC Capabilities** (Skahill) Demonstration of the Markov Chain Monte Carlo Optimization and Uncertainty Analysis using HEC-HMS version 4.1and discussion of results to example application.
15:15 – 15:45	**4.6 Workshop 8: Application of the HEC-HMS Uncertainty Analysis Compute Option** (Scharffenberg, Skahill) Using the Uncertainty Analysis to better understand uncertainty in model results.
15:45 – 16:00	Review (Scharffenberg)
16:00 – 17:00	**4.7 Lecture 18: Application of HEC-HMS for Flood Forecasting** (Bartles) Introduction to forecasting features within HEC-HMS and their application for standalone use and use within the Corps Water Management System (CWMS).

Friday

8:00 – 9:00	**5.1 Workshop 9: Flood Forecasting** (Bartles, Fleming) Application of the forecast alternative simulation, zonal editors, and slider bar adjustment tool for application of HEC-HMS to flood forecasting.
9:00 – 9:15	Break
9:15 – 9:45	**5.2 Lecture 19: Introduction to HEC-MetVue** (Hanbali) Introduction to the HEC-MetVue program and its application for developing precipitation from historical events and hypothetical storms that could be input into HEC-HMS.
9:45 – 10:45	**5.3 Workshop 10: Application of HEC-MetVue** (Hanbali, Bartles) Application of HEC-MetVue for developing precipitation for HEC-HMS simulations.
10:45 – 11:00	Review (Hanbali)
11:00 – 11:30	Conclusion and Closing Activities (Fleming)