

# **HEC-HMS Uncertainty**



## Need



Spillway adequacy and dam failure analyses require uncertainty in the hydrologic loading on the structure.

The Corps of Engineers is currently working to transform the planning and design of flood risk management projects by adopting a complete risk informed analysis process. It is no longer sufficient for a hydrologic analysis to provide flow, stage, and volume estimates based on an analysis of the mean behavior of the watershed. A broader sampling of possible behaviors must be made in order to estimate the probability of outcomes for events such as inundation, dam failure, and levee overtopping. These behaviors must be evaluated using a systems approach that considers the whole watershed.

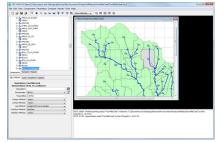
Civil Works flood risk management projects are a major business line within the Corps of Engineers. Current guidance calls for the use of uncertainty assessments in the process of planning and designing flood risk management projects. This work unit seeks to expand the uncertainty assessment capabilities of hydrologic simulation tools currently used to plan and design these key projects.

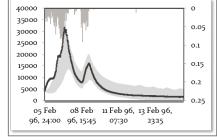
# **Approach**

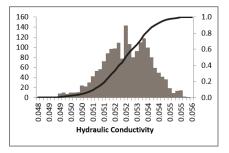
The Hydrologic Modeling System (HEC-HMS) is mature and established hydrologic simulation software used for many flood risk management projects. This work unit is implementing the Markov Chain Monte Carlo (MCMC) simulation technique for uncertainty quantification, and integrating it as a new simulation capability within HEC-HMS. The strength of MCMC is its reliance on Bayesian statistics. It provides a proven scientific framework for taking initial assumptions about model parameter uncertainty, combining that with observations such as stream flow, and producing updated estimates of parameter uncertainty. This capability essentially transforms HEC-HMS into a robust probabilistic hydrologic simulator. The results can be used to calculate assurance and other key hydrologic statistics in a way that holistically incorporates the uncertainty inherent across all hydrologic processes.

#### Outcomes

The new MCMC simulation techniques developed in this work unit will be fielded as fully integrated features within HEC-HMS, which is a preferred hydrologic simulation model of the HH&C CoP.







**HEC-HMS** 

Hydrograph Uncertainty

Parameter Uncertainty

### More Information

For more on HEC-HMS, including software download and documentation, see the HEC website: https://www.hec.usace.army.mil/software/hec-hms

For more information on FRM R&D, see the ERDC FRM wiki: https://wiki.erdc.dren.mil/Flood\_and\_Coastal\_Storm\_Damage\_Reduction\_Research\_Program