



USGS NSF GRIP, GSP Opportunity

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USGS Center:	Illinois-Iowa Water Science Center
Project Title:	Assessing the uncertainty in model estimated streamflows: A case study using watersheds and rain gage network in Chicago metropolitan area
Summary:	The intern will benefit through professional growth gained by academic training in hydrologic science, statistical analysis, and numerical modeling. The intern will also benefit from mentoring opportunities with the PIs and other USGS scientists; with academic professionals at University of Illinois–Urbana, and potential co-authorship on one or more scientific publications.
Project Hypothesis or Objectives:	<p>The intern will join a research team and work on a component or components of an on-going study that aims to develop methodology for estimating uncertainty in rainfall-runoff modeling and determine uncertainty of simulated annual runoff volumes from an ungaged area—about 673 square miles—in the Chicago metropolitan area. The Principal Investigators (PIs) selected 9 gaged watersheds with relatively long-term streamflow records in the vicinity of the ungaged area, developed Hydrological Simulation Program—FORTRAN (HSPF) hydrologic models for the watersheds, and determined a representative regional parameter set using Parameter Estimation (PEST) algorithms in prior studies. The following is a list of objectives the intern can choose to focus on.</p> <ul style="list-style-type: none">• Errors in simulated streamflows due to uncertainty in precipitation. Uncertainty in precipitation loading due to spatial variability will be the primary focus, and we will use NEXRAD data as the auxiliary data in assessing the spatial variability,• Effects of errors in discharge records on parameter calibration. Uncertainty in discharge records is analyzed, primarily due to rating curve uncertainty.• Parameter variability due to errors in data. Analytical methods and criteria are needed for comparing relative errors in simulated records due to discrepancies in parameters that are induced by errors in the data. Do different parameters respond to errors in

different types of data?

- Development of a method for integrating source uncertainties and parameter uncertainty.

Simplification of the complex natural processes is necessary in order to describe them through applying or developing a theoretical framework; aggregation the mosaic compositions of nature is necessary for users to systematically quantify the features in a model. While simplification and aggregation contribute to imprecision in environmental modeling, inaccuracy in input data, including meteorological, precipitation, and data-series for calibration, lead to errors and uncertainty in using models to estimate past records or predict future events. To tackle the uncertainty in input data, the study will use information from a well-established 25-raingage network and several long-term streamflow gages mentioned above. The PIs have developed representative regional parameter set for starting the uncertainty analysis.

 Duration:	Up to 12 months
 Internship Location:	Urbana, Illinois
 Field(s) of Study:	Engineering
 Applicable NSF Division:	EAR Earth Sciences
 Intern Type Preference:	NSF Graduate Research Fellow (GRF) via the Graduate Research Intern Program (GRIP)
 Keywords:	Sensitivity and uncertainty analysis, rainfall-runoff modeling, HSPF, NEXRAD, rating curves
 Expected Outcome:	The project is expected to advance our understanding of uncertainty analysis and the development of a generalized approach to estimate the total uncertainty of streamflow predictions in ungaged basins for practical applications. As a general problem of great importance to practical hydrologic prediction, these results will benefit the intern in their future career, the Lake Michigan diversion system, including the USACE and the State of Illinois. Peer-reviewed publication is anticipated. Working in a USGS Water Science Center with the hydrologists and technicians who make streamflow measurements will also provide an important experience on the properties of these data which form the basis of most studies of watershed hydrology in the US.
 Special skills/training Required:	The intern is expected to have training in watershed hydrology, hydrologic model calibration, and statistical hydrology. Computer programming (R, Python are currently used) is desirable.
 Duties/Responsibilities:	The intern will select, in consultation with the Principal Investigators, one or two of the elements as matches his/her interests and background.

- Reviewing and documenting errors in model inputs, developing methodologies for analyzing the errors, and estimating errors in modeling results due to errors in various components of the model system,
 - Conducting error analysis of streamflow measurements and defining an error function for describing the streamflow measurement errors,
 - Conducting error analysis of precipitation assignments at each subbasin-Thiessen level, in this case, Thiessen polygons are determined through the 25-gage network system,
 - Conducting error analysis in annual streamflow volumes due to errors in model inputs, including: precipitation, streamflow record, and model parameters,
 - Conducting predictive uncertainty analysis of the HSPF model predictions with existing regional parameter sets, and
 - Synthesizing a methodology for determining the total uncertainty in the rainfall-runoff model predictions.
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