

American Water Resources Association
2010 SUMMER SPECIALTY CONFERENCE
GIS & Water Resources VI
March 29 – 31, 2010
Orlando, FL

Wednesday, March 31

8:30 AM – 10:00 AM

SESSION 28: Hydrologic and Hydraulic Modeling I

Development of Parameter Maps of the Modified Bartlett-Lewis Rectangular Pulse Stochastic Rainfall Generator - Francisco Olivera, Texas A&M University, College Station, TX (co-author: Dongkyun Kim)

In this paper, maps of the parameters of the Modified Bartlett-Lewis Rectangular Pulse (MBLRP) stochastic rainfall simulation model were developed for the contiguous United States. The six MBLRP model parameters define the probability distributions from which variables are drawn randomly to generate rainfall time series. The parameters were calculated at a total of 3,444 National Climate Data Center (NCDC) rain gauges for each month of the year. The calibration aimed at minimizing the discrepancy between the statistics of the observed and MBLRP-generated precipitation time series. The statistics considered were the mean, variance, lag-1 autocorrelation coefficient and probability of zero rainfall at 1-, 3-, 12- and 24-hour accumulation intervals. The Ordinary Kriging interpolation technique was used to develop the 72 parameter maps (i.e., 6 parameters, 12 months.) All parameters showed a regional tendency, except for one related to the rain cell duration distribution. Parameter seasonality was not obvious and it was more apparent in some locations than in others, depending on the seasonality of the rainfall statistics. Cross-validation was used to assess the validity of the parameter maps. The results indicate that the suggested maps reproduce well the statistics of the observed rainfall for different accumulation intervals, except for the lag-1 autocorrelation coefficient. The estimated parameter values were also used to estimate storm and rain cell characteristics.

Building a Better Hydraulic Model from the Ground Up - Ajay Prasad, CDM, Cambridge, MA (co-authors: James Carolan, Constantin Banciulescu)

The Metropolitan District (MDC) is a municipal corporation providing water and wastewater services to approximately 400,000 people in Hartford, Connecticut and seven neighboring communities. MDC has a well-developed GIS using ESRI ArcSDE geodatabase technology. MDC engaged CDM to develop a USEPA SWMM hydrologic and hydraulic model of their sanitary and stormwater collection system networks. This presentation reviews key areas where GIS technology assisted in the development of the model. To develop the model, CDM and MDC leveraged the existing GIS to provide the initial pipe network but found that key pipe and structure elevations were missing. CDM used ArcSDE multi-versioned editing technology to allow multiple staff to edit the data while modeling staff reviewed and modified the pipe network to prepare it for use in the modeling software. Innovative geometric network tracing functions were used to check the network flow to verify its correct connection prior to transfer to the model, saving time and effort during the modeling. Other quality control checks to verify elevations, pipe diameters and materials were used in ArcGIS to speed the review process and correct issues prior to inserting the data into the modeling software. In the past the model applications are used to perform QC on the data once the data are inserted in the model. During this project the data were comprehensively checked prior to processing the data into the modeling format saving time and effort. To develop accurate catchment delineations for the system, modeling and GIS staff used customized ArcObjects and VBA applications in conjunction with the GIS pipe network and a digital elevation model (DEM). The MDC GIS basemap data layers developed from photogrammetry were used to form accurate impervious area calculations for each catchment. The model operates in a GIS environment to create efficient integration between MDC's GIS, facilitating management and update of the model. Several key aspects of model to GIS integration will be reviewed during the presentation.

Channel Geomorphology Characterization for Modeling with HEC-RAS - Raja Srinivasan, Michael Baker Jr Inc, Manassas, VA (co-author: Steve Jencen)

The availability of LIDAR data for many parts of the United States allows accurate and high resolution representation of overland features for water resources applications. These provide ability for more accurate

and quicker delineation of watersheds for hydrological modeling. However, challenges remain in the incorporation of accurate channel geometry data for hydraulic modeling of these watersheds. Two methods will be discussed for obtaining or improving the channel geometry data from these terrain datasets through GIS applications. The GIS information and applications will be demonstrated as they translate the information for inclusion in HEC-RAS models. The channel geometry data collected by surveyors at a few representative channel sections limit the modeler from accurately representing the cross section geometry within HEC-RAS models. To overcome this limitation, a non-linear interpolation algorithm will be discussed for integration of the channel geometry information with the high resolution ESRI terrain dataset. The method fits an interpolated curve between surveyed cross sections by maintaining the relationship of surveyed data to sampled channel overbank elevations from the LIDAR dataset. Subsequently, a new terrain dataset is built by incorporating the interpolated channel geometry with the high resolution terrain surface. This provides the modeler the ability to include additional cross sections at any desired location and is more representative of the channel geometry for building more representative HEC-RAS models. In case of non-availability of surveyed channel data, a second method will be demonstrated. This is a parametric method used to approximate a channel geometry based on regional studies linking the bankfull flow, channel width and mean depth. The estimated and further calibrated channel geometry is incorporated within the terrain to more accurately represent the channel for modeling.

Projecting Future Precipitation Pattern for Ohio - Shuang-Ye Wu, University of Dayton, Dayton, OH

Global warming has the potential to intensify hydrological cycle, hence causing more frequent extreme precipitation events. This study aims to project future changes in precipitation pattern in Ohio. We first compared the daily precipitation data output from 20th century runs of various climate models with the historical observations from climate stations within Ohio to evaluate the accuracy of the models and identify the biases. Daily precipitation data is used to establish the frequency of extreme precipitation events. We then apply the bias correction to the 21st century runs of climate models for daily precipitation to make projections on future precipitation patterns for Ohio. In order to examine the spatial variation of such changes, we use spatial disaggregation techniques to statistically downscale climate model output. We apply the techniques to both global (GCM) and regional climate model (RCM) output and compare the results to observed values in order to assess the validity of the downscaling method and the performance of climate models. In addition, multiple climate models are used to establish uncertainties in climate modeling. Initial results suggest that the bias correction and spatial disaggregation method, when applied to RCM output, is most successful in reproducing the main features of the observed hydrometeorology from the retrospective climate simulations. By applying this method to future simulations (under A2 emission scenario), we find that (a) Annual precipitation is going to increase for Ohio; such increase will be more in northeast and less in southwest of the state; (2) Seasonally, total precipitation will increase most in summer and will decrease slightly in winter; (3) Number of wet days will increase for northeast but decrease for southwest Ohio; (4) Number of days with extreme precipitation (exceeding 95% value) will increase dramatically for all Ohio.