HEC-HMS Lab 6 – Manual Calibration of HEC-HMS

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Manual Calibration of Fish Creek Model

Calibration of hydrologic model is a process of establishing model parameters such they the model is able to simulate the physical environment as real as possible. This is typically done by first comparing the model output (total flow hydrograph) with observed streamflow or direct runoff hydrograph. If these two match perfectly, then the model is assumed to be good at representing the hydrology of the watershed. If there are discrepancies between the two hydrographs, then one or more model parameters are changed until the two hydrographs match satisfactorily. How well the two hydrographs match can be determined by just comparing them visually or by computing some error statistics between them. Multiple errors statistics such as sum of squared errors (SSE), Mean Squared Error (MSE) and Nash Sutcliffe Efficiency Coefficient (NSE) are used. Expressions for these are given below:

$$SSE = \sum_{i=1}^{N} (Q_i - M_i)^2$$

$$MSE = \frac{1}{N} \sum_{i=1}^{N} (Q_i - M_i)^2$$

$$NSE = 1 - \frac{\sum_{i=1}^{N} (Q_i - M_i)^2}{\sum_{i=1}^{N} (Q_i - \bar{Q})^2}$$

Where, Qi is observed discharge as time I, Mi is the simulated discharge (model output) at time I, and Qbar is the average value of the observed discharge series. While both SSE and MSE measure the difference in the two series, the NSE determines the relative magnitude of the residual variance compared to the measured data variance. For both SSE and MSE, the value should be as close to zero as possible. For NSE, value of 1 corresponds to a perfect match of the two series (observed and model output). A value of NSE=0 indicates the model predictions are as good as the mean values of the observed data. A negative value for NSE indicates that the mean of the observed data is better predictor than the model output.

The goal of calibration is then to change the parameter values until we get SSE or MSE close to zero, or NSE close to 1.

In this exercise, your job is to calibrate the Fish Creek model from Lab 5 (previous lab), and report SSE, MSE and NSE of the final result.

First, copy the default values of CN and lag time for all sub-basins so you can use them when needed. Next, change the CN number for all sub-basins in the model to 65 and compute one of the errors statistics. Repeat the same process for a CN of 70, 80 and 85. Create a plot of CN (on x axis) and error statistic on y axis. Write few lines on how the error statistic is changing with CN, and what is the effect of CN on the hydrograph.

Next keep the CN constant to 75 for all sub-basins, and create a plot of lag time (on x axis) versus error statistic by using the following lag times in minutes: 2000, 2250, 2750, and 3000. Write few lines on how the error statistic is changing with CN, and what is the effect of lag time on the hydrograph.

Now that you know how model hydrograph reacts to CN and lag time, play with these values to calibrate the model (bring the model hydrograph as close as possible to the observed hydrograph, don't just focus on minimizing the error statistic, but also give equal importance to the peak value and the time to peak), and report the calibrated parameter values, a plot of observed and simulated hydrograph created using calibrated parameters and the final error statistics. Feel free to use different values of CN and Lag time for each sub-basin. This will give you better fit than using a single value for all of them.

Turn-in

1. A plot of CN (on x axis) and your choice of error statistic on y axis. Write few lines on how the error statistic is changing with CN, and what is the effect of CN on the hydrograph.
2. A plot of lag time (on x axis) and your choice of error statistic on y axis. Write few lines on how the error statistic is changing with lag time, and what is the effect of lag time on the hydrograph.
3. A plot of calibrated model output and observed hydrograph on the same plot. Report the final parameter values and corresponding error statistics.

Due date: March 06, 2020 by 1:30 PM