Engineering Risk Analysis Group
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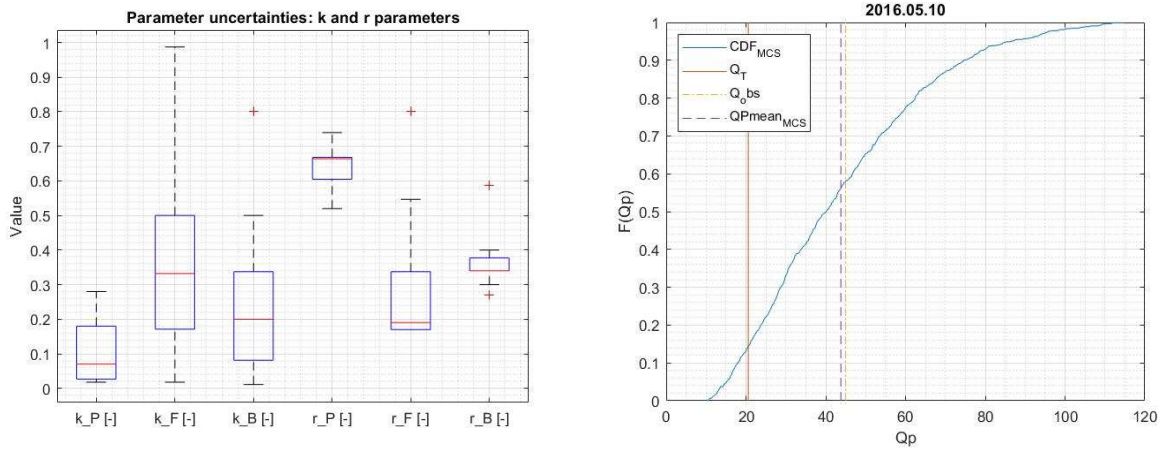
MSc thesis

Probabilistic discharge prediction for a flood warning system

Martina Raffellini, September 2018

Background

This project was developed in cooperation with *Corporación Autónoma Regional del Valle del Cauca*, and *Pontificia Universidad Javeriana Cali*, Colombia. According to the register of natural and anthropic disasters DesInventar, floods represent the hazard which, between 1950 and 2012, has affected the city of Cali the most. Early warning systems are aimed at avoiding exposure to risk and can represent an economically efficient mitigation measure. The aim of the project is to contribute to the flood warning system for the city with the discharge forecast of the upper Cali river and estimate the uncertainty associated with it.



Left: Boxplots of calibrated values for 6 selected parameters. Right: CDF and mean MCS estimate of peak discharge for one event compared with the observed peak discharge and the threshold river capacity.

Methodology

A rainfall-runoff model accounting for parameters' uncertainties was implemented based on time series of rainfall and river discharge and geographic data to predict peak discharge, runoff volume and time to peak. Semi-automatic calibration was performed for each selected time window based on graphical sensitivity analysis. Parameters' distributions and dependencies were derived and MCS was performed for each event. The exceedance probability of river capacity was then established as waning criterion. MCS results were used to estimate the forecast's reliability in terms of probability of detection and probability of false alarm and derive a Receiver-Operator Characteristic curve.

Conclusion

Due to the restricted learning dataset and uncertainties in input data, calibration data, model structure and calibration procedure, the forecast has limitations. Cross-validation revealed that the errors in the prediction of peak discharge and volume are still large, while prediction of time to peak is satisfactory. The peak discharge is the most critical variable since the warning criterion is based on it.

Due to the above-mentioned uncertainties, the optimal warning threshold for the flood forecasting system and the Receiver-Operator Characteristic curve, used to derive it, only are rough estimates, too.

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