Engineering Risk Analysis Group
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MSc thesis

Probabilistic Modeling Of Design Floods Including Parameter Uncertainties

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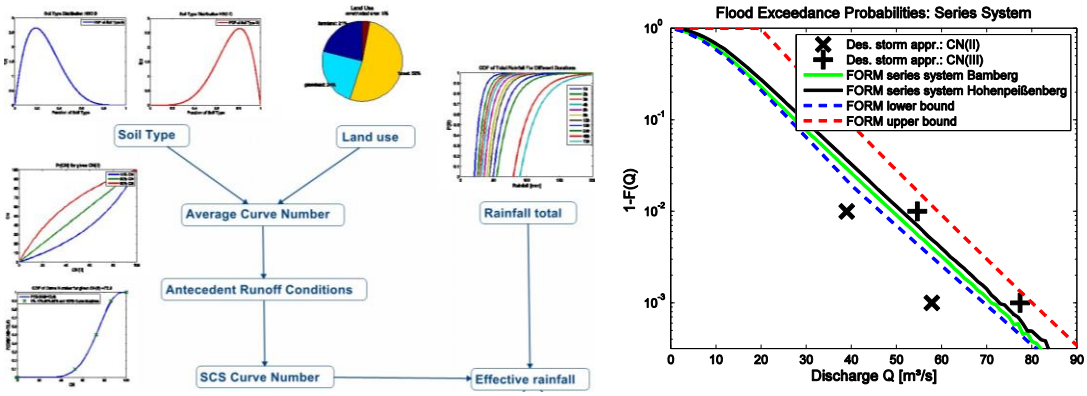
Background

One of the most common ways of estimating design floods in ungauged basins is the design storm concept with event based rainfall-runoff models. This concept however leads to flawed design flood estimations due to the negligence of parameter uncertainties through the incorrect assumption of average recurrence interval (ARI) neutrality between rainfall and runoff and due to the selection of a representative critical storm duration. The aim was to develop a probabilistic framework based on methods of structural reliability that allows to incorporate parameter uncertainties and improves the current design storm practice.



Effective rainfall modeling with relevant uncertainties (left); flood exceedance probabilities estimated with different methods (right)

Methodology

A methodology is presented using the First Order Reliability Method (FORM) that effectively improves the current design storm practice by incorporating the probabilistic nature of the parameters involved. Formulation of the problem as a series system allows to take the effect of different rainfall durations on flood probabilities into account. The method is applicable to any event based rainfall-runoff model, in this Thesis a case study at the Trauchgauer Ach in southern Bavaria with a SCS Curve Number plus Unit Hydrograph model is performed.

Results

The case study identifies the rainfall and the runoff coefficient here in form of the SCS Curve Number as the most important uncertain parameters and demonstrates how neglecting parameter uncertainties and utilizing a critical storm duration leads to under prediction of design floods. The application of the proposed methodology illustrates its utility. Moreover design diagrams for ungauged catchments are developed that specify the inputs to the traditional design storm concept such that the results of the more accurate series system approach using FORM are reproduced.

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