Engineering Risk Analysis Group
Prof. Dr Daniel Straub

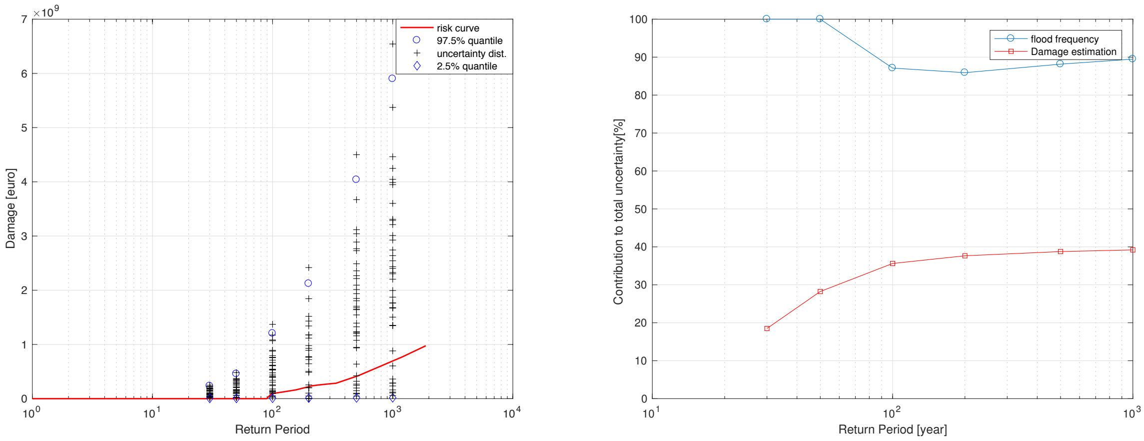
MSc thesis

Comparing sources of uncertainty in flood risk estimation - case study in Rosenheim

Negin Ebrahimian, June 2017

Background

According to the latest published report of MunichRE in 2017, floods are the most common natural hazard in 2016 with a share of 50%. Due to urbanization and globalization of industry the exposed assets at risk have increased which means the economic cost of flooding are growing as well. This fact proves that the flood risk analysis is becoming a vital factor for different sectors such as industry, insurers, governments, etc. Ideally, a robust flood risk analysis considers the relevant flooding scenarios, probability of the flood event (flood frequency), potential losses and damages as well as associated uncertainties in each steps of analysis.



Left: Uncertainty of the risk curve caused by all sources of uncertainty, the red curve shows the risk curve using posterior mean point estimator and Rhine Atlas damage model using CORINE land use without considering variation in the roughness coefficient; Right: Relative contribution of the two modules to the total maximum uncertainty range as a function of return period.

Methodology

This thesis investigates the uncertainty in flood risk assessment in three modules including flood frequency analysis (using Bayesian estimation tio get the full distribution of parameters), inundation estimation (roughness variation) and damage estimation (Rhine Atlas Model with two land use data set) in city of Rosenheim as a part of the “AdaptRisk" project. For each module, the sources of aleatory and epistemic uncertainty are identified and where it is possible these sources are quantified using Monte Carlo simulation. The flood risk analysis results in a flood risk curve that represents aleatory uncertainty, and associated uncertainty bounds, that represent epistemic uncertainty. Moreover, to quantify the contribution of each module on the total uncertainty, parallel modeling is implemented.

Conclusion

The results show that as the return interval increase, the uncertainty bounds for the flooding risk becomes larger.

Results from the parallel modelling demonstrate that the flood frequency module is the deriving sources of uncertainty in comparison with the damage estimation module. This shows that the posterior distribution that was obtained from Bayesian estimation is not quite informative which is due the simple choice of the prior distribution. On the other hand, the damage module itself has also a considerable contribution to the total uncertainty; specifically, in high return interval which is due to the fact that relative depth-damage functions that were used in the Rhine Atlas model does not explain the variation in damage comprehensively. Since the inundation depth is not the only factor that influence the potential damage, and there are other factors like contamination, inundation duration, the flow velocity, timing, and some management factor like emergency response have considerable effect on the damage estimation.

Supervised by Dr. Ing. Olga Špačková

Prof. Dr. Daniel Straub