Flood risk analysis and uncertainty considerations

B. Merz, A. Thieken

GeoForschungsZentrum Potsdam, Telegrafenberg, 14473 Potsdam, Germany
(bmerz@gfz-potsdam.de)

Flood risk assessments are frequently associated with significant uncertainty. Uncertainty analyses have to consider two fundamentally different types of uncertainty: aleatory and epistemic uncertainty. Aleatory uncertainty refers to quantities that are inherently variable over time, space or populations of individuals or objects. Epistemic uncertainty results from incomplete knowledge and is related to our inability to understand, measure and describe the system under investigation. In this paper we propose to separate aleatory and epistemic uncertainty in flood risk analyses. The separation between aleatory and epistemic uncertainty is exemplified for the flood risk analysis of the City of Cologne. This flood risk assessment consists of three modules, (1) flood frequency analysis, (2) inundation estimation, and (3) damage estimation. We quantify the aleatory and epistemic uncertainty of each module. Probability distributions, intervals and p-boxes are used as uncertainty descriptions, depending on the character of the uncertainty and on the available information. In a further step, the epistemic uncertainty associated with the risk assessment is reduced by introducing additional information in the risk analysis. In this way, the separation reveals the uncertainty (epistemic) that can be reduced by more knowledge and the uncertainty (aleatory) that is not reducible. The flood risk analysis results in a flood risk curve, representing natural variability, and an associated uncertainty bound, representing incomplete knowledge.