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Quantification of uncertainty in flood risk assessment for flood protection planning: a Bayesian approach

Beatrice Dittes (1), Olga Špačková (1), Negin Ebrahimian (1), Maria Kaiser (2), Wolfgang Rieger (2), Markus Disse (2), and Daniel Straub (1)

(1) Engineering Risk Analysis Group, Faculty of Civil, Geo and Environmental Engineering, Technische Universität München, Arcisstrasse 21, 80333 Munich, Germany (beatrice.dittes@tum.de), (2) Chair of Hydrology and River Basin Management, Faculty of Civil, Geo and Environmental Engineering, Technische Universität München, Arcisstrasse 21, 80333 Munich, Germany

Flood risk estimates are subject to significant uncertainties, e.g. due to limited records of historic flood events, uncertainty in flood modeling, uncertain impact of climate change or uncertainty in the exposure and loss estimates. In traditional design of flood protection systems, these uncertainties are typically just accounted for implicitly, based on engineering judgment. In the AdaptRisk project, we develop a fully quantitative framework for planning of flood protection systems under current and future uncertainties using quantitative pre-posterior Bayesian decision analysis.

In this contribution, we focus on the quantification of the uncertainties and study their relative influence on the flood risk estimate and on the planning of flood protection systems. The following uncertainty components are included using a Bayesian approach: 1) inherent and statistical (i.e. limited record length) uncertainty; 2) climate uncertainty that can be learned from an ensemble of GCM-RCM models; 3) estimates of climate uncertainty components not covered in 2), such as bias correction, incomplete ensemble, local specifics not captured by the GCM-RCM models; 4) uncertainty in the inundation modelling; 5) uncertainty in damage estimation. We also investigate how these uncertainties are possibly reduced in the future when new evidence – such as new climate models, observed extreme events, and socio-economic data – becomes available. Finally, we look into how this new evidence influences the risk assessment and effectivity of flood protection systems. We demonstrate our methodology for a pre-alpine catchment in southern Germany: the Mangfall catchment in Bavaria that includes the city of Rosenheim, which suffered significant losses during the 2013 flood event.