Case study about the reliability analysis of dike stability

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Motivation:

The aim of a risk analysis in flood protection is to get a systematic judgement of the flood risk under cost-benefit aspects. The flood risk is usually defined as the product of failure probability and the allocated vulnerability of the flooded area. As the input data for the risk analysis itself contains statistical uncertainties, it is inadequate to entirely rely on and communicate an absolute flood risk as a potential danger to the public. However, dike sections can be compared and those sections can be identified where flood protection should be improved first. Comparing the risk due to different failure modes to each other, one can furthermore indicate the most cost-efficient measures to increase safety.

Contents:

The project PCRiver contributes to the German national research activity RIMAX (Risk Management of Extreme Flood Events) and has the aim to extend an existing model for the determination of the failure probability mainly of sea dikes in the Netherlands to river dikes in Germany.

The probabilities of different failure modes of dike systems are calculated and combined taking into account the statistical input data for geometric, hydraulic and geotechnical parameters.

In a case study at the Elbe River, in the neighbourhood of Torgau (Germany), four different failure mechanisms of river dikes are evaluated probabilistically: Overtopping, damage of the revetment, uplift/piping, instability of the inner slope and the combina-

tion of these failure mechanisms within a dike section are compared and interpreted. The comparison of the different dike sections to each other is done with respect to the different geological and geometrical boundary conditions. These results are validated with a dike failure statistics from the severe flood at Elbe River in 2002.

This case study will be the starting point of the evaluation of the allocated vulnerability of flood areas within different dike failure scenarios. Different construction techniques to reinforce the dikes will be evaluated in a cost benefit analysis afterwards.

Conclusions:

The presented case study of the Elbe River shows very well the applicability of an evaluation of river dike systems using different failure mechanisms amidst a probabilistic framework.

Both water authorities and consulting engineers will be able to evaluated dike sections probabilistically with the program PCRiver in order to make cost benefit analysis for priorisation of dike improvements to increase safety.

Submission is part of the RIMAX initiative