Technische Universität München

E R A

Ingenieursfakultät Bau Geo Umwelt
Engineering Risk Analysis Group
Prof. Dr. Daniel Straub

Master's thesis proposal

# Coupling of probabilistic dike failure model with 1D hydraulic model for performing probabilistic flood risk analyses

## Background

Controlled flood polders are built as means to reduce flood damages during extreme flood events. By retaining large volumes of water, they can reduce the hydraulic load on downstream flood protection structures, e.g. dikes and walls, thereby lowering their respective failure probabilities. The failure of protection structures leads to high damages during flood events, due to the accumulation of assets behind these structures.

The probability of dike failure can be described using fragility functions that maps the probability of failure depending on one or several intensity measure of the flood event. A common measure of flood intensity is the water level at the structure at different times during the flood event, which can be modeled using 1D/2D hydraulic models. The water levels are fed into a probabilistic model to determine the state of protection structure as well as possible failure characteristics during a flood event.

A dike failure can activate large retention volumes, that can significantly impact water levels in the river downstream of the break location (much like a flood polder itself). To account for this effect, it is necessary to include the discharge through the broken structure in the hydraulic model once the failure occurs. Neglecting the subsequent effect can significantly overestimate the frequency of dike failures during a flood event as well as the water levels downstream of any failure location.

## Methodology

The suggested workflow is as follows: The student…

- will review the literature on dynamic coupling for probabilistic dike risk assessment as well as alternative approximation methods.
- will program the interface between the 1D hydraulic model SOBEK and a probabilistic dike failure model (currently implemented in MATLAB).
- will illustrate the method by quantifying the flood risk for selected flood scenarios.
- will investigate the error of neglecting the hydraulic effect of dike failure for different flood scenarios by comparing with the results of other approximation methods.

**Supervised by**:

Amelie Hoffmann (amelie.hoffmann@tum.de)

**Language**: Deutsch or English
**Starting date**: As soon as possible