



Hydra-Ring: a computational framework to combine failure probabilities

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This presentation discusses the development of a new computational framework for the safety assessment of flood defence systems: Hydra-Ring. Hydra-Ring computes the failure probability of a flood defence system, which is composed of a number of elements (e.g., dike segments, dune segments or hydraulic structures), taking all relevant uncertainties explicitly into account. This is a major step forward in comparison with the current Dutch practice in which the safety assessment is done separately per individual flood defence section. The main advantage of the new approach is that it will result in a more balanced prioritization of required mitigating measures ('more value for money').

Failure of the flood defence system occurs if any element within the system fails. Hydra-Ring thus computes and combines failure probabilities of the following elements:

- Failure mechanisms: A flood defence system can fail due to different failure mechanisms.
- Time periods: failure probabilities are first computed for relatively small time scales (<1 day) in which the temporal variation of the relevant hydraulic variables (water level, wind etc) is small enough to be assumed constant. However, the required output of Hydra-Ring is an annual failure probability, which means failure probabilities of the smaller time scales need to be combined (scaled-up) into an annual failure probability.
- Cross-sections: The probability of failure is first derived for a single location (cross-section) of the flood defence segment. This probability is subsequently scaled up to a failure probability of the entire flood defence segment.

Besides the assessment of flood defence systems, Hydra-Ring can also be used to derive fragility curves, to assess the efficiency of flood mitigating measures, and to quantify the impact of climate change and land subsidence on flood risk. Hydra-Ring is being developed in the context of the Dutch situation. However, the computational concept is generic and the model is set up in such a way that it can be applied to other areas as well.

The presentation will focus on the model concept and probabilistic computation techniques.