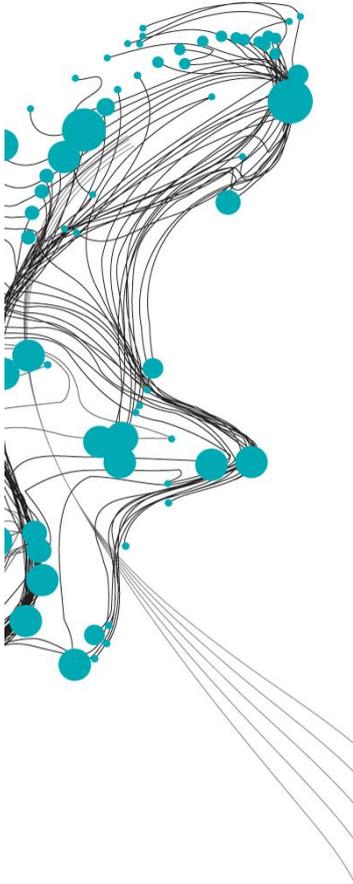


THE OPTIMAL CAPACITY FOR TEMPORAL CONTROL MEASURES FOR DIKES IN THE IJSSEL-VECHT DELTA



In the IJssel-Vecht delta, and other parts of The Netherlands, there is a gap between the current safety and the required safety against floods. This is caused by the fact that dikes are not reinforced instantly, but that the dike reinforcements are spread out over a timespan of several decades, up to 2050. Temporal control measures can be taken in order to fill this gap. The goal of this research is to determine the optimal capacity for temporal control measures for dikes in case of extreme water levels by quantifying the coincidence probabilities of extreme water levels and performing a cost-benefit analysis. The term capacity is used to denote the required amount of material, equipment, and manpower.

A copula-based assessment is applied on the water systems of the IJssel-Vecht delta to derive the coincidence probabilities. Copulas are a flexible technique for describe the dependence between two or more random variables. They allow to build joint distributions from two or more variables while maintaining the statistical properties of their marginal distributions. The results show that the coincidence probability of high water level events is highest in the month January and February, and that the probability of simultaneous occurrence of extreme water levels is relatively low.

A cost-benefit analysis based on a risk approach is performed to provide more insight in the consequences of flooding and possibilities of decreasing the consequences by the deployment of temporal control measures. Deployment of measures will decrease the (failure) probability but measures also bring costs. For the total costs there is an optimum point at which the summation of the damage and the investment is minimal. For the IJssel a lot of measures can be taken before the optimum is reached, but for the Vecht and Zwarte Meer the optimum is reached at lower capacities.

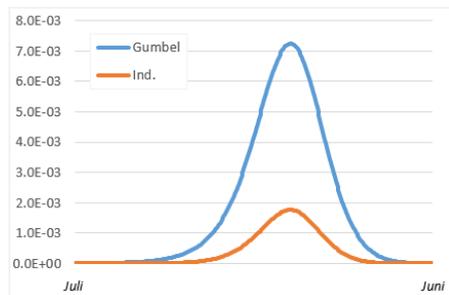


Figure 1 Coincidence probability IJssel-Vecht

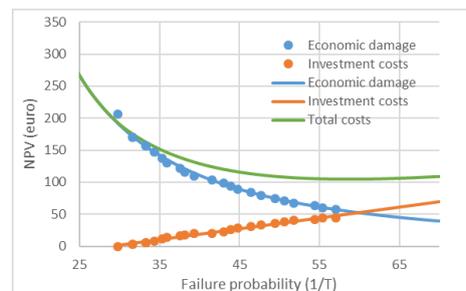


Figure 2 Cost-benefit relations Vecht

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This research distinguishes itself from other studies by being helpful for the operational issues instead of the norms for dike reinforcements. The copula-based assessment provides insight into the coincidence probabilities of extreme water levels in multiple systems, and the cost-benefit model provides the possibility to quantify the required capacities and the duty of care ('zorgplicht') for the water boards for a single system. Especially the latter can prove to be helpful for the water boards in specifying the grey area between meeting the norms and doing whatever is possible to increase the safety for their inhabitants.