Future flood risk in the Rhine basin

Due to the impact of climate change, the probability of flooding in the Rhine basin in 2050 is expected to be two to five times as high as it is today[1]. That isa, in case no additional flood management measures are implemented. Population growth and increase in property values in flood prone areas further enhance future flood risk.

Many uncertainties exist in flood risk projections. For example, extreme value analysis on flood probabilities in 2050 are difficult to make and different methods are currently under debate. Furthermore, projections on the basin-wide potential damage are not available. The central aim of this research is to focus on extreme flood events, on their probability, and to simulate the effect of climate change on future flood peaks in the Rhine basin. Based on this information, cross-boundary flood management strategies can be developed and evaluated. Recent scientific literature describes the necessity to move away from traditional flood frequency analysis, since climate change undermines the basic assumption of stationarity[2]. Therefore, we adopted a process-based approach including different climate change projections, a rainfall generator, and hydrological models, to estimate changes in low-probability flood peaks and the impact of measures.

The embankments along the Lower Rhine and in the Netherlands have very high safety norms of 1/ 500 and 1/1250 years, respectively. Our results displayed that in the most extreme climate change scenario, associated design discharges increase by 17% (Figure 1). Due to variation in safety levels, however, upstream flooding in Germany might occur, which lowers peak discharges downstream in The Netherlands up to 15%. The only effective measure at the basin-wide scale to reduce flood probability is drastic dike heightening, while measures such as extra retention basins, reforestation and by-passes can be beneficial at the local scale[3]. However, in a risk-based approach, more could be gained by damage reduction than through flood defense measures to reduce flood risk. Calculations to estimate (future) potential damage in the Rhine basin are in progress.

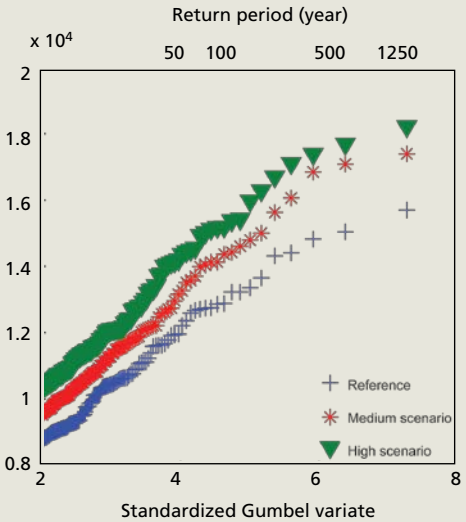

FIGURE 1.
Extreme value plots of yearly maximum discharges of the Rhine at the German Dutch border. As input for the rainfall-runoff model served 1000 years of daily meteorological input data that were obtained by a weather generator. Displayed are 1000 years of simulated yearly maximum discharges for the reference situation and two climate change scenarios for the year 2050.

ALINE TE LINDE is a PhD researcher on climate change and water management issues. She is convinced that more interaction is required between the scientific and market communities, which explains why she works both at a university (IVM-VU) and an independent institute on applied research and specialist advice (Deltares). In her work, she links scientific research, decision support and practical solutions in the fields of hydrology, river basin management and risk assessment, with a focus on cross-boundary river basins.
+ 31 20 59 89564 / aline.te.linde@ivm.vu.nl

PROJECT A07 Adaptive Capacity to Extreme events in the Rhine basin (ACER).

PARTNERS: Alterra / Deltares / VU University Amsterdam / Future Water / Royal Dutch Meteorological Institute (KNMI) / Seecon GmbH / Delft University of Technology / Universität Osnabrück / Wageningen University and Research Centre / Water Service, Ministry of Transport, Public Works and Water Management

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