

## Probability analysis of compound extreme events based on the example of heavy rainfall and floods

Felix Simon<sup>1</sup> and Christoph Mudersbach<sup>1</sup>

(1) *Hydraulic Engineering and Hydromechanics Section, Department of Civil and Environmental Engineering, Bochum University of Applied Sciences, Bochum, Germany*

Heavy rainfall and flooding events pose a high risk to people and the environment when they occur as a single event. If these events occur at the same time, so-called compound events, the potential damage can overlap and a higher risk can be expected. Due to anthropogenic climate change, the probability of occurrence of combined extreme events is expected to increase (Bevacqua et al, 2019). Within the framework of the research project climXtreme - ProComE, funded by the Federal Ministry of Education and Research (BMBF), analyses for various compound extreme events are carried out, with a focus on the combination of heavy rainfall and river floods. Using this combination as an example, analyses for the determination of probabilities of occurrence of compound extreme events are presented.

For these investigations, data for discharge gauges in Germany were evaluated, which were obtained from both the Global Runoff Data Centre and the State Office for Nature, Environment and Consumer Protection in North Rhine-Westphalia (LANUV NRW). Based on the gauging station locations, the corresponding precipitation was determined using radar data from the German Weather Service. First, annual maximum values (AMAX) were determined for both data sets (precipitation and runoff time series). Associated with the respective AMAX events, the simultaneously occurring value of the second parameter was used to define the samples of the compound events. Trend corrections were carried out by using the Mann-Kendall test with a significance level of 5 %. Subsequently, the marginal distributions of the individual parameters were determined and the correlation between heavy rainfall and river flooding was calculated using Kendall's correlation. Finally, the occurrence probabilities of the compound extreme events were determined with the help of Copula functions.

### References

Bevacqua E., D. Maraun, M. I. Vousdoukas, E. Voukouvalas, M. Vrac, L. Mentaschi and M. Widmann (2019): Higher probability of compound flooding from precipitation and storm surge in Europe under anthropogenic climate change, *Science advances*, **5(9)**. doi:10.1126/sciadv.aaw5531