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# A stochastic storm surge generator for the German North Sea and the multivariate statistical assessment of the simulation results

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Storm surges along the German North Sea coastline led to major damages in the past and the risk of inundation is expected to increase in the course of an ongoing climate change. The knowledge of the characteristics of possible storm surges is essential for the performance of integrated risk analyses, e.g. based on the source-pathway-receptor concept. The latter includes the storm surge simulation/analyses (source), modelling of dike/dune breach scenarios (pathway) and the quantification of potential losses (receptor). In subproject 1b of the German joint research project XtremRisK (www.xtremrisk.de), a stochastic storm surge generator for the south-eastern North Sea area is developed. The input data for the multivariate model are high resolution sea level observations from tide gauges during extreme events. Based on 25 parameters (19 sea level parameters and 6 time parameters) observed storm surge hydrographs consisting of three tides are parameterised. Followed by the adaption of common parametric probability distributions and a large number of Monte-Carlo-Simulations, the final reconstruction leads to a set of 100.000 (default) synthetic storm surge events with a one-minute resolution. Such a data set can potentially serve as the basis for a large number of applications. For risk analyses, storm surges with peak water levels exceeding the design water levels are of special interest. The occurrence probabilities of the simulated extreme events are estimated based on multivariate statistics, considering the parameters “peak water level” and “fullness/intensity”. In the past, most studies considered only the peak water levels during extreme events, which might not be the most important parameter in any cases. Here, a 2D-Archimedian copula model is used for the estimation of the joint probabilities of the selected parameters, accounting for the structures of dependence overlooking the margins. In coordination with subproject 1a, the results will be used as the input for the XtremRisK subprojects 2 to 4.

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