



A coupled weather generator – rainfall-runoff approach on hourly time steps for flood risk analysis

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The evaluation of potential monetary damage of flooding is an essential part of flood risk management. One possibility to estimate the monetary risk is to analyze long time series of observed flood events and their corresponding damages. In reality, however, only few flood events are documented. This limitation can be overcome by the generation of a set of synthetic, physically and spatially plausible flood events and subsequently the estimation of the resulting monetary damages.

In the present work, a set of synthetic flood events is generated by a continuous rainfall-runoff simulation in combination with a coupled weather generator and temporal disaggregation procedure for the study area of Vorarlberg (Austria). Most flood risk studies focus on daily time steps, however, the mesoscale alpine study area is characterized by short concentration times, leading to large differences between daily mean and daily maximum discharge. Accordingly, an hourly time step is needed for the simulations. The hourly meteorological input for the rainfall-runoff model is generated in a two-step approach. A synthetic daily dataset is generated by a multivariate and multisite weather generator and subsequently disaggregated to hourly time steps with a k-Nearest-Neighbor model.

Following the event generation procedure, the negative consequences of flooding are analyzed. The corresponding flood damage for each synthetic event is estimated by combining the synthetic discharge at representative points of the river network with a loss probability relation for each community in the study area. The loss probability relation is based on exposure and susceptibility analyses on a single object basis (residential buildings) for certain return periods. For these impact analyses official inundation maps of the study area are used. Finally, by analyzing the total event time series of damages, the expected annual damage or losses associated with a certain probability of occurrence can be estimated for the entire study area.