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Extreme precipitation and flooding in Berlin under climate change conditions

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The effect of climate change on extreme precipitation and its impacts are investigated for the city of Berlin. The study is based on regional climate scenario simulations with a convection permitting horizontal resolution of 3 km conducted with CCLM (COSMO model in CLimate Mode).
The regional model was forced with a CMIP5 global model simulation (MIROC5). Precipitation output is available at an hourly temporal resolution. We show results from simulations with historical greenhouse gas concentrations (1971-2000) and compare them to results with RCP8.5 greenhouse gas forcing.

The relationship between duration, intensity and probability of the simulated precipitation is evaluated with a duration dependent general extreme value approach. The results are presented in the form of intensity-duration-frequency (IDF) curves. The curves for the historical period fit well to the corresponding product of the German weather service based on station observations (KOSTRA). The comparison of the IDF curves between the historical and the scenario periods reveals that extreme precipitation will strongly increase in a warmer climate for all analysed accumulation times between 1 hour and 5 days. Hourly events that occurred on average every 100 years in the historical period, for example, are found to be 45% more intense in Berlin during the period 2031-2060 at RCP8.5 conditions. For events with a very low probability (return periods above 50 years) this increase is ,however, not steady in time.

If no adaptation measures are taken, the projected increase in extreme precipitation can also be expected to have an impact on the intensity and
probability of urban flooding. Risk maps for pluvial flooding are usually based on statistical precipitation events estimated from past observation, also known as design rainfall. Often the 100-year return value for an hourly accumulation time is used. To demonstrate how the anticipated changes in extreme precipitation reflect on the potential future flood risk for Berlin, risk maps for the future climate scenario are produced using the design rainfall from the climate scenario simulations as input for hydro-numerical simulations. The hydro-dynamical simulations are performed with the robust 2-D shallow water model hms++ coupled to the canal-system model of the Berlin water company (BWB). In addition to the maps, changes in flood depth for selected hot-spots and increases in sewer overflow volumes are presented.