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Estimating extreme river discharge at European scale under present and future climate conditions

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Global warming is generally expected to increase the intensity and frequency of extreme precipitation events across Europe, and therefore also the probability of river flooding. For the purpose of analysing changes in flood hazard at European scale, we used simulations from the regional climate model HIRHAM at 12-km resolution to drive the hydrological model LISFLOOD running at 5-km grid scale. The probability of extreme discharge levels was estimated by fitting an extreme value distribution to the simulated river discharges in every grid cell. The performance of the model was furthermore tested by comparing the simulations with observation-based estimates of extreme discharge at 209 gauging stations throughout Europe. Contrary to what may be expected from the literature, we did not find conclusive evidence for the generalised extreme value distribution (GEV) being heavy-tailed. At most (over 80%) of the gauging stations the shape parameter of the distribution fitted to the observations was close to 0 or even negative. We also found that in the majority (about 85%) of the rivers cells the three-parameter GEV does not yield a significant improvement over the two-parameter Gumbel distribution. This implies that in these rivers the use of a GEV fitted to the simulated discharges is not justified and that a Gumbel distribution should be used instead. We conclude that the choice for a particular extreme value distribution to estimate discharge extremes has a significant influence on the results, especially when looking events with a return period of more than 50 years.