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Efficient pan-European flood hazard modelling through a combination of statistical and physical models

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Low-resolution hydrological models are often applied to calculate extreme river discharges and delimitate flood zones on continental and global scale. Still, the computational expense is very large and often limits the extent and depth of such studies. Here, we present a quick yet similarly accurate procedure for flood hazard assessment in Europe. Firstly, a statistical model based on Bayesian Networks is used. It describes the joint distribution of annual maxima of daily discharges of European rivers with variables describing the geographical characteristics of their catchments. It was quantified with 75,000 station-years of river discharge, as well as climate, terrain and land use data. The model's predictions of average annual maxima or discharges with certain return periods are of similar performance to physical rainfall-runoff models applied at continental scale. A database of discharge scenarios—return periods under present and future climate—was prepared for the majority of European rivers. Secondly, those scenarios were used as boundary conditions for one-dimensional (1D) hydrodynamic model SOBEK. Utilizing 1D instead of 2D modelling conserved computational time, yet gave satisfactory results. The resulting pan-European flood map was contrasted with some local high-resolution studies. Indeed, the comparison shows that, in overall, the methods presented here gave similar or better alignment with local studies than previously released pan-European flood map.