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Hydrological-hydraulic model cascading for pan-European flood hazard mapping

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Flood hazard maps at trans-national and continental scale have potential for a large number of applications ranging from climate change studies, aid to emergency planning for major flood crisis, early damage assessment and urban development, among others. However, such maps are usually available at rather coarse resolution, which limits their applications to rough assessments. At finer resolution, maps are often limited to country boundaries, due to limited data sharing and specific cooperation programs at trans-national level. The European Floods Directive 2007/60/EC requires EU Member States to map the potential flood extent for all water courses by the end of 2013. In this work we derive a pan-European flood hazard map at 100 m resolution, covering most of the European territory. The proposed approach is based on expanding the cascade model presented by Barredo et al. (2007). First, a pan-European distributed rainfall-runoff model with a resolution of 5x5km is set up and calibrated using discharge observations at 481 gauging sites. Then, by using 21-year meteorological climatology we derived a long term discharge simulation. A generalized extreme value fitting is applied to estimate flood peaks with 100-year return period for each river pixel in the model. This data is downscaled to the river network at 100 m resolution and design flood hydrographs are derived for 100-year return period event along the entire pan-European river network. Design flood hydrographs are then used to perform small-scale floodplain hydraulic simulations every 5 km along the river network using a two-dimensional hydraulic model. Finally, output maps of more than 35000 hydraulic simulations are merged into a pan-European flood hazard map. The quality of this map is evaluated for selected areas against the flood hazard maps provided by national/regional authorities. Finally, limitations of the approach and future directions of research are discussed.