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Pluvial flooding in urban areas: potential and limitations of DEM-based hazard assessment

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Reported economic losses from weather and climate-related extremes over 1980-2016 exceeded €50 bn in Europe alone. Floods are responsible for 40% of these losses and together with storms denote the major natural hazard type in terms of economic damage. A sound, evidence-based flood hazard and risk assessment should underpin public policies. On the one hand, binary classifiers based on DEM-retrieved geomorphological indices, such as HAND (Height Above the Nearest Drainage, Rennó et al., REMOTE SENS ENVIRON, 2008) or GFI (Geomorphic Flood Index, Samela et al., ADV WATER RESOUR, 2017), have been shown to be particularly helpful for riverine flood-hazard mapping over large geographical regions in which information on flooding potential is limited. On the other hand, the literature is still sparse on the potential of simplified DEM-based algorithms for assessing flood hazard associated with intense rainstorms and cloudbursts in urban environments. Yet, this is topical issue since: (1) climate change is very likely to amplify extreme precipitation in many areas around the world (see e.g. IPCC, 2014), (2) increasing urbanisation and growing capital density, population growth and inappropriate land use planning contribute to increasing flood risk and damage, and (3) the availability of freely accessible high-resolution DEMs (see e.g. LiDAR DEMs) is steadily increasing. Concerning pluvial flooding, a very promising class of DEM-based algorithms are the Hierarchical Filling and Spilling and Puddle-to-Puddle Dynamic Filling and Spilling (abbreviated herein as FSA, see e.g. Zhang et al., J HYDROL, 2014, Chu et al., WATER RESOUR RES, 2013). We present an application of SFA, whose implementation requires also the selection of a suitable reference (observed or synthetic) storm event and some simplifying assumptions on infiltration rates and conveyance of the existing stormwater drainage system, to two urban areas in Northern Italy. As part of the activities of the EIT Climate-KIC Demonstrator project “SAFERPLACES”, we apply SFA to the study areas relative to two recent pluvial flooding events, for which detail numerical 2D hydrodynamic simulations are also available. We discuss limitations of the algorithm and its potential for climate services and decision support systems, as well as possible future research avenues.