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Geomorphic approaches for flood risk mapping

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Floods frequency, magnitude and cost of damage are on the rise all over the world. Thus, the societal demands for protection from flood devastation is becoming everyday more pressing.
In conditions of scarce data availability a preliminary and cost-effective floodplain delineation can be carried out using procedures that relay on the analysis of geomorphic features (Manfreda et al., 2014). In fact, fluvial geomorphology has a substantial role in analysing flooding, and is increasingly recognized as a vital discipline to rigorously assess flood hazards.
We carried out several years of research on this topic, investigating the dominant topographic control for the flood exposure using techniques of pattern classification based on Digital Elevation Model (DEM)-derived morphologic features. The analyses highlighted the potential of a descriptor named Geomorphic Flood Index (GFI) (Samela et al., 2017), later adopted to develop a procedure for the identification of flood susceptible areas. The procedure exhibited high accuracy in several test sites in Europe, U.S., and Africa (Manfreda et al., 2015; Samela et al., 2016) and has been implemented in a QGIS plugin named Geomorphic Flood Area (GFA) – tool (Samela et al., 2018). This tool performs a linear binary classification based on the GFI, and allows to extend the delineation in the undetermined areas of the basin.
Besides the flood extent, in many riverine settings the most important flood condition is the inundation depth that is the controlling factor for the estimation of direct flood damage. In fact, most of the flood damage models are based on a relationship that relates flooding depth and consequent expected monetary damage to a specific property or land use type. In this regard, we are currently defining a procedure for the estimation of the water surface elevation in the river and the surrounding areas, with the aim to use such damage functions to obtain a preliminary assessment of expected flood damage. Our findings may help the definition of new strategies for flood hazard and risk studies over large-scale basins, continental or global domains, providing information that, although approximate, may be of practical utility for flood management and mitigation.

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