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Proposal of a new flash flood severity scale (FFSS) for the classification and mapping of flash flood impacts

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Flash floods cause some of the most severe natural disasters in Europe and around the world. They induce devastating damages on property and infrastructure and cause numerous casualties on a yearly basis. The diversity and discontinuity of flash flood impacts, which are controlled mostly by surface properties, leads to major difficulties in obtaining a holistic appraisal and a realistic overview of flash flood effects and makes predicting future impacts a significant challenge. Previous studies have identified the need for a better understanding and prediction of flash flood impacts and a more systematic recording of their severity and have tried to tackle the problem by categorizing effects in various severity levels organized by different general criteria.

The present study proposes a method that provides a coherent overview of flash flood effects through classification of their type, severity and mapping of their spatial extent. To this end, flood effects are grouped into 4 categories depending on the affected elements, namely: (i) Impacts on built environment (including any human-built structure, property or infrastructure), (ii) Impacts on mobile objects (including all types of vehicles, household and other man-made mobile objects), (iii) Impacts on the natural environment (including vegetation and agriculture, pollution phenomena, geomorphic effects) and (iv) Impacts on the human population (entrapments, injuries, fatalities). Each of the four above categories is classified in a system of 10 severity classes that are defined by objective class boundaries and are ordered by increasing importance of damages. The system's application is illustrated in the present work in two major, well-described flash flood events. The first one is the 2014 flash flood in Athens, Greece that caused extensive and very diverse damages in an urban environment, and the second one is the catastrophic flash flood of Mandra, Greece, in 2017, that killed 24 people and devastated a small town.

The categorization and classification of flood effects in both cases resulted in the development of high spatial resolution impact-severity maps that revealed interesting damage patterns and highlighted high damage-severity areas. The proposed approach fits the event-based, opportunistic nature of flash flood studies that focus on post-flood surveys using post-event hydrometeorological, societal and impact-related observations. The method enhances the appraisal of flash flood damages, simplifies the complexity of flood effects and indirectly facilitates the prediction of future flash flood impacts in space. In addition, it shows potential for application in larger flood event datasets that could at a later time allow correlations between hydrometeorological characteristics and impact severity.