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Presenting hydrological and data driven flood simulation-prediction methods to develop a decision-making model

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Flooding is the number one natural disaster in terms of insured and uninsured losses annually. The development of reliable methods for flood simulation have greatly improved our ability to predict floods thereby reducing damages and loss of life in flood-prone regions. However, there is still a lot of room for improvement and innovation to provide better predictions, especially for flash floods, particularly in urban areas This is addressed in the present study, the goal of which it is to improve simulation and prediction of flash floods and to develop a spatial decision-making model for implementing flood protection measures. In this regard, different approaches for flood simulation and flood protection should be applied. The proposed methodology links flood hazard modeling, remote sensing and machine learning methods. Combining these physical models and data driven methods will result in a more reliable hybrid model that can be employed for prediction of (flash) floods and event analysis. In order to achieve the research goal of present study we: i) add more functionality to a hydrodynamic model code; ii) complement the latter with data driven methods ;iii) develop a spatial decision-making model framework for defining flood protection measures, iv) validate process-based and data driven methods, and finally v) cross-evaluate Light Detection And Radar (LiDAR) topography with available local super-resolution drone data to assess the ability to incorporate local flood defenses into the models. The most important outcome is the creation of valuable flood maps in areas where it matters - while accounting for effects of land use and climate change. This will serve scientists as well as land and risk management authorities with better actionable flood risk information in locations where people and assets are located and in danger. It also develops innovative methodologies for estimating the changing risk from flash floods based on land use scenarios and climate change projections. Moreover, developing spatial multi-criteria decision making (SMCDM) can help decision makers to determine suitable locations and methods for flood protection measures. These methods will be particularly valuable in the context of solving current challenges of accounting for and mitigating flash floods and the effects of climate change.