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Flood Mapping Using High-Resolution Topography and Crowdsourced Data with the Geomorphic HAND Approach in Rural Plains

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Flood mapping is essential for risk management and emergency response. The most common approach is hydraulic modelling, a method that is still challenging and demanding in terms of data and computation. Low complexity models are an increasingly adopted alternative that are capable of achieving good results while using minimal data input and low calculation time. Yet, the reliability and effectiveness of such approaches remain unclear in flat and engineered plains. In this study we aim to optimize flood hazard mapping based on the Height Above Nearest Drainage (HAND) geomorphic approach by utilizing a high-resolution digital elevation model (15 cm) with crowdsourced data. The approach is tested on the Ostouane river basin (144 km^2) in Lebanon, and validated using crowdsourced data of the January 2019 flood, which was the most intense flood within the past decade. The workflow begins by developing a database of spatial and topographic information, including the digital elevation model, bathymetry, land use and crowdsourced flood depths. Five scenarios representing different terrain configurations with varying levels of hydro-conditioning and feature inclusion (e.g. bathymetry, canals and levees) are simulated. The model's thresholding is then optimized by integrating rating curves produced by 1D HEC-RAS hydraulic model to assess and correct HAND based synthetic rating curves (SRC). Results shows that extensive hydro-conditioning is necessary to improve the inundation extents within the floodplains. Correcting synthetic rating curves is essential to overcome errors produced by terrain conditioning. Overall, the model is able to yield high accuracy of flood extent when ensuring hydrologic connectivity between the river and floodplain and within the floodplain itself. Our findings indicate that leveraging high-resolution topography and crowdsourced inputs can enhance the accuracy of flood mapping results. However, achieving this precision necessitates a meticulous optimization procedure.

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