Rainfall threshold curves and machine learning approaches for pluvial flood forecasting based on local news reports in Croatia

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This study presents a forecasting model for pluvial flooding in the city of Zadar, Croatia, where a huge mesoscale convective system recently caused massive pluvial flooding and widespread property damage. Flood forecasting approaches based on hydrologic-hydraulic models require a large set of accurate data to provide reliable simulations. They also require many simulations, which can be computationally expensive and time consuming. Therefore, we are investigating the possibility of using a data-driven approach based on local news reports of pluvial flooding combined with a local high-resolution rain gauge. To this end, we considered two different computational approaches. The first - a conventional one - is based on rainfall threshold curves that define the critical rainfall depth for different time periods above which flooding is likely to occur. The second approach is based on machine learning and a classification problem - predicting whether accumulated rainfall depths over different time periods will lead to pluvial flooding. For the second approach, we considered 10 different methods that belong to five categories of machine learning typically used for classification problems. They are logistic regression, support vector machine, discriminant analysis, decision trees, and nearest neighbours. After a careful analysis, we defined rainfall threshold curves for Zadar that can be used for an early warning system and flood forecasting. We show that some machine learning models can provide slightly more accurate predictions than the threshold curve, with quadratic discriminant analysis being the most successful method for this purpose. Overall, this study shows that flood forecasting based on news reports in the city of Zadar can be a reliable approach. The analysis conducted in this study has laid the foundation for the implementation of an early warning system and pluvial flood forecasting in the Croatian coastal area.