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# Development of a coupled hydrological – hydrodynamic model for probabilistic catchment flood inundation modelling

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Computationally efficient flood inundation modelling systems capable of representing important hydrological and hydrodynamic flood generating processes over relatively large regions are vital for those interested in flood preparation, response, and real time forecasting. However, such systems are currently not readily available. This can be particularly important where flood predictions from intense rainfall are considered as the processes leading to flooding often involve localised, non-linear spatially connected hillslope-catchment responses.
Therefore, this research introduces a novel hydrological-hydraulic modelling framework for the provision of probabilistic flood inundation predictions across catchment to regional scales that explicitly account for spatial variability in rainfall-runoff and routing processes. Approaches have been developed to automate the provision of required input datasets and estimate essential catchment characteristics from freely available, national datasets. This is an essential component of the framework as when making predictions over multiple catchments or at relatively large scales, and where data is often scarce, obtaining local information and manually incorporating it into the model quickly becomes infeasible.
An extreme flooding event in the town of Morpeth, NE England, in 2008 was used as a first case study evaluation of the modelling framework introduced. The results demonstrated a high degree of prediction accuracy when comparing modelled and reconstructed event characteristics for the event, while the efficiency of the modelling approach used enabled the generation of relatively large ensembles of realisations from which uncertainty within the prediction may be represented. This research supports previous literature highlighting the importance of probabilistic forecasting, particularly during extreme events, which can be often be poorly characterised or even missed by deterministic predictions due to the inherent uncertainty in any model application.
Future research will aim to further evaluate the robustness of the approaches introduced by applying the modelling framework to a variety of historical flood events across UK catchments. Furthermore, the flexibility and efficiency of the framework is ideally suited to the examination of the propagation of errors through the model which will help gain a better understanding of the dominant sources of uncertainty currently impacting flood inundation predictions.