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Understanding flood risk sensitivity and uncertainty in a subcatchment of the Thames River (United Kingdom)

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Floods are a global threat to social, economic and environmental development and there is a likelihood, that they could occur more frequently in the future due to climatic change. The severity of their impacts, which can last for years, has led to the urgent need for local communities and national authorities to develop flood warning systems for a better flood preparedness and emergency response. The flood warning systems often rely on hydrological forecasting tools to predict the hydrological response of a watershed before or during a flood event.
Hydrological models have been substantially upgraded since the first use of hydrographs and the use of simple conceptual models. Hydrodynamic and hydraulic routing enables the spatial and temporal prediction of flow rates (peak discharges) and water levels. Moreover, the hydrodynamic modeling in 2D permits the estimation of the flood inundation area. This can be particularly useful because the flood zones can provide essential information about the flood risk and the flood damage.
In this study, we use a hydrodynamic model which can simulate water levels and river flows in open channel conditions. The model can incorporate the effect of several river structures in the flood modeling process, such as the existence of bridges and weirs. The flood routing method is based on the solution of continuity and energy momentum equations. In addition, the floodplain inundation modeling which is based on the solution of shallow water equations along the channel's banks, will be used for the mapping of flood extent. A GIS interface will serve as a database, including high resolution topography, vector layers of river network, gauging stations, land use and land cover, geology and soil information.
The flood frequency analysis, together with historical records on flood warnings, will enable the understanding on the flow regimes and the selection of particular flood events for modeling. One dimensional and two dimensional simulations of the flood events will follow, using simple hydrological boundary conditions. The sensitivity testing of the model, will permit to assess which parameters have the potential to alter significantly the peak discharge during the flood, flood water levels and flood inundation extent. Assessing the model's sensitivity and uncertainty, contributes to the improvement of the flood risk knowledge.
The area of study is a subcatchment of the River Thames in the southern part of the United Kingdom. The Thames with its tributaries, support a wide range of social, economic and recreational activities. In addition, the historical and environmental importance of the Thames valley highlights the need for a sustainable flood mitigation planning which includes the better understanding of the flood mechanisms and flood risks.