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1 Computationally efficient flood water level prediction (with uncertainty)

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Water level predictions made with hydraulic models are uncertain. Evaluating that uncertainty using Monte Carlo ensemble predictions is computationally expensive. While such ensemble methods have been used (albeit rarely) for probabilistic flood risk mapping and (even more rarely) for flood forecasting, it would be very useful, therefore, to be able to emulate the outputs of a fully distributed hydraulic model using a computationally efficient approach. The outputs from a distributed hydraulic model are, however, nonlinear with dynamics that depend on the nature of the inputs and the spatial patterns of flooding in a particular event. In this paper we show how a simple nonlinear transfer function approach can be used to reproduce with high accuracy the outputs of a 1-D hydraulic model (HEC-RAS) at every cross-section along the Montford to Buildwas reach of the River Severn, with estimates of the uncertainty in the predictions. The methodology can also be extended to act as an 'emulator' in wider sense sense: namely emulating the response of the hydraulic model in the whole region of its defined parameter space. In this way, given some historical inundation extent data for the cross-sections it might be possible to identify the set of hydraulic parameters that will match the observations in a much more computationally efficient way