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Data-theoretic approaches to modelling catchment management impacts on flood magnitude

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The standard approach to evaluating the impact of upstream catchment management upon downstream flood risk involves the combination of physically-based hydrological and hydraulic models. The difficulties of using these models to evaluate catchment management options are well-documented and include: data availability issues; the effects of parameter uncertainty; limits on spatial and temporal resolution; and uncertainties over process representation. The role of more complex models has been questioned because the associated parameter demands necessitate complex sensitivity analyses that are then precluded by concurrent computational demands. This becomes a particular issue for scenario testing to reduce downstream flood risk, where the management activities being tested are small in magnitude but large in number. For example, schemes encompassing different arrangements of upland planting and pond storage, or low impact flow restraints in the flood plain, may require many simulations to assess their impacts, precluded by conventional hydrologic-hydraulic modelling approaches. As an alternative, we show how the problem can be approached differently, using 'data-theoretic' models. These models begin with available data on flow, and then apply appropriate geomorphological, hydrological and hydraulic theory to allow predictions to be made of patterns of flow over both time and space, in response to the rain events that are likely to generate flooding. Drawing on research relating to the town of Pickering, in Yorkshire, northern England, the talk will be illustrated with examples of how data-theoretic models have the potential to be used to predict flow discharges, rising and falling stages, changes in flow connectivity, and the impacts of different pond storage and flow restraint measures. We will also comment on how in-

sight from data-theoretic modelling may be linked to and incorporated in hydrological models more generally.