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A Fresh Start for Flood Estimation in Ungauged UK Catchments

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The standard regression-based method for estimating the median annual flood in ungauged UK catchments has a high standard error (95% confidence interval is +/- a factor of 2). This is also the dominant source of uncertainty in statistical estimates of the 100-year flood. Similarly large uncertainties have been reported elsewhere. These large uncertainties make it difficult to do reliable flood design estimates for ungauged catchments. If the uncertainty could be reduced, flood protection schemes could be made significantly more cost-effective. Here we report on attempts to develop a new practical method for flood estimation in ungauged UK catchments, by making more use of knowledge about rainfall-runoff processes.

Building on recent research on the seasonality of flooding, we first classify more than 1000 UK catchments into groups according to the seasonality of extreme rainfall and floods, and infer possible causal mechanisms for floods (e.g. Berghuijs et al, Geophysical Research Letters, 2016). For each group we are developing simplified rainfall-runoff-routing relationships (e.g. Viglione et al, Journal of Hydrology, 2010) which can account for spatial and temporal variability in rainfall and flood processes, as well as channel network routing effects. An initial investigation by Viglione et al suggested that the relationship between rainfall amount and flood peak could be summarised through a dimensionless response number that represents the product of the event runoff coefficient and a measure of hydrograph peakedness. Our hypothesis is that this approach is widely applicable, and can be used as the basis for flood estimation.

Using subdaily and daily rainfall-runoff data for more than 1000 catchments, we identify a subset of catchments in the west of the UK where floods are generated predominantly in winter through the coincidence of heavy rain and low soil moisture deficits. Floods in these catchments can reliably be simulated with simple rainfall-runoff models, so it is reasonable to expect simple flood estimators. We will report on tests of the several components of the dimensionless response number hypothesis for these catchments.