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# Exploring large-scale atmospheric influences on high river flow clustering in the UK

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Following several recent, large-scale flood events in the UK (including central and eastern England in Easter 1998; northern England in autumn 2000; northern and central England in 2007; and Scotland and northern England in 2009), research to explain their occurrence has shifted away from "searching for a trend". Instead, new studies have demonstrated that in the UK, high river flows are temporally clustered into flood-rich and flood-poor periods over decadal time-scales (e.g. Lane, 2008; Wilby et al., 2008; Raven et al., in prep) which may lead to under or over-estimation of event probabilities (Khaliq et al., 2006). Understanding the spatial and temporal occurrence of large-scale flood events is important for flood frequency estimation for policy-making, risk management and the insurance industry.

We combine knowledge and techniques from hydrology and meteorology to: (1) demonstrate the presence of decadal and multi-decadal length flood-rich and flood-poor periods; and (2) identify their causes using simple predictor variables that allow us to introduce time-dependence into event probabilities. Our approach uses analysis of river flow time-series using the longest available records in the UK, to create peak over threshold series for 21 locations. We analyse the clustering of yearly counts of peak river flows by testing a dispersion statistic given by the ratio of variance and mean of the counts. It is found that the dispersion statistic exhibit clear-cut regional patterns, with statistically significant overdispersion occurring in most stations located on rivers in Central UK and large overdispersion characterising the peak series near the area of London.

The statistical dependence of peak river flows from atmospheric and climatic patterns is analysed by Poisson regression where the North Atlantic Oscillation (NAO), the Atlantic Multidecadal Oscillation (AMO) and the Southern Oscillation are used as covariates. The AMO is found to have a positive effect on the yearly rate of occurrence of peaks for the rivers in Wales, whereas the NAO has a negative effect for the rivers in Central UK. These climatic patterns, however, do not explain the large overdispersion of the rivers in the London area. Aggregating peak counts from rivers in the same geographical area yields a strongly enhanced overdispersion: this is shown to be due to spatial correlation of the processes leading to the occurrence of peak river flows.