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Estimating Median Annual Maximum Floods in Small Catchments in the UK

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One standard method for estimating the median (1-in-2 year) flood (QMED) at ungauged sites in the UK is to make use of catchment descriptors and equations determined via generalised linear regression. These QMED equations are based on the AMAX series and catchment descriptors of 602 rural catchments of up to 9931 km2 in area, only 85 of which are smaller than 40.9 km¬2 (Kjeldsen, Jones and Bayliss, 2008). However, the model fit for these smaller catchments is typically worse (Vesuviano *et al.*, 2016). To this end, an extended data set of small catchments has been obtained in addition to the small catchments with gauging stations in the UK NRFA Peak Flow dataset. This data set improves the average record length to 30.4 from 25.6 years, and provides a further 2000 AMAX events.

Generalised linear regression using forward stepwise model selection was applied to select from 25 covariates, using a distance-correlation relationship to better describe both sampling error and model misspecification error, in a similar fashion to Kjeldsen, Jones and Bayliss (2008). This led to a new formulation for the QMED equation to be applied to small catchments. Compared to the original formulation published in the Flood Estimation Handbook (FEH; IH, 1999), the 2008 formulation and a recalibrated 2008 version using the same covariates but refitted using the small catchments dataset, the new small-catchment QMED equation shows some improvement in terms of standard error and R2, but the recalibrated 2008 equation proved to be the most successful. In cases where detailed high-flow data and storm-event rainfall depth was available, a similar QMED equation incorporating these was investigated, but the small sample led to high uncertainty.

At sites where discharge records are short or non-existent, donor transfer can be applied where a weighted average of the catchment descriptor equation and a QMED estimate from gauged flow data at the donor site can be applied to improve the estimate. Kjeldsen *et al.*(2015) suggest the use of up to 6 donors, but in the case of small catchments where residual error in QMED is less spatially correlated, selecting the closest proves to be less effective. Due to the higher uncertainty of the new small-catchment QMED equation, spatial correlation of model residual is lessened and so donor transfer is less effective, and should not be applied blindly. However, caution should always be heeded and in practice hydrological similarity should be considered before applying donor transfer.