Combining a national-scale grid-based hydrological model with an initial-condition climate ensemble: broad-scale analyses of changes in river flows

Kay AL, Lane RA, Missault N, Chan WCH

UK Centre for Ecology & Hydrology, Wallingford, UK, OX10 8BB

Corresponding Author: alkay@ceh.ac.uk

Supplementary Material

1. Methods

Figure S1 shows part of the LE GCM grid covering Britain, and the ratios used for downscaling precipitation in each GCM grid box (based on Standard Average Annual Rainfall (SAAR) data).

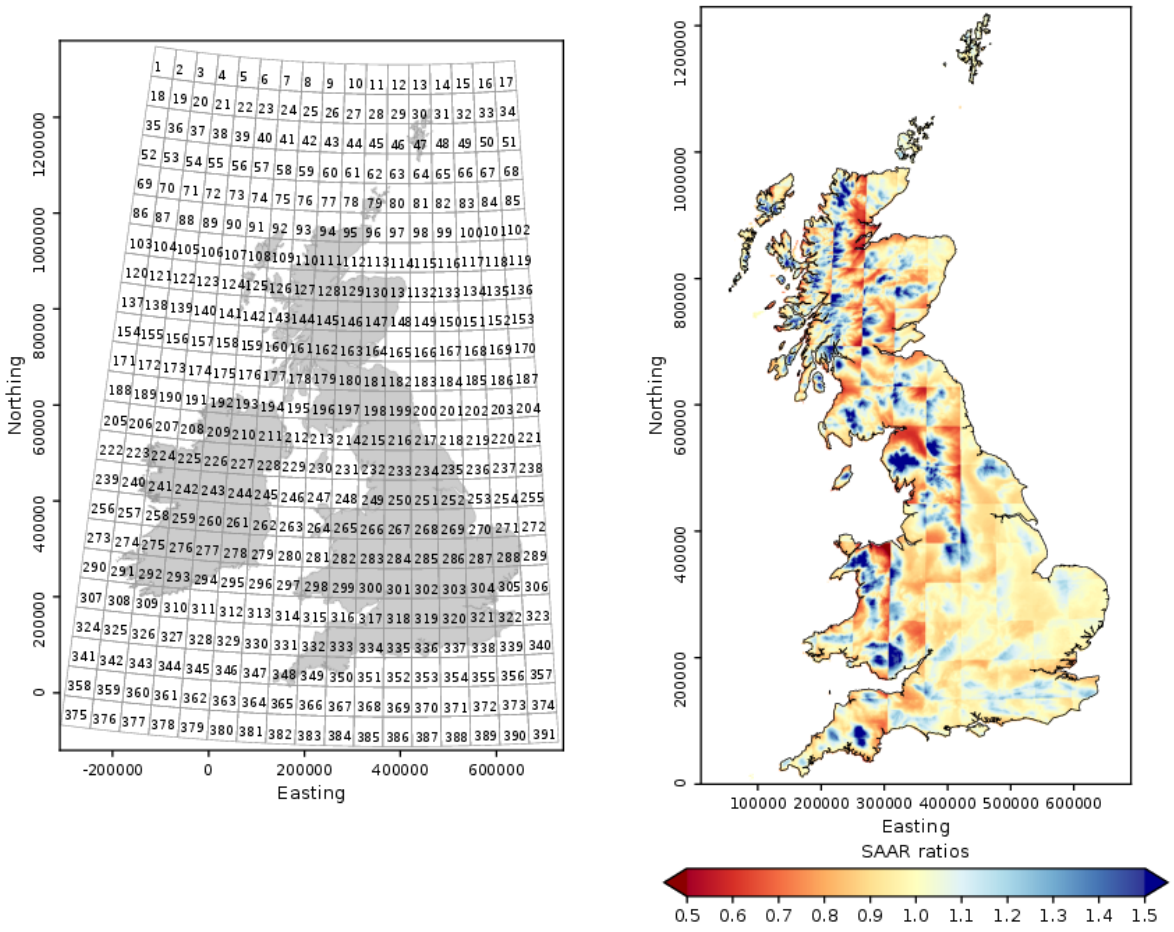


Figure S1 Part of the LE GCM grid over Britain (left) and the SAAR ratios used for downscaling precipitation within each GCM grid box (right).

Figure S2a shows the 644 catchments across GB used for the performance analysis. The daily flow time-series for these gauges are obtained from the National River Flow Archive (NRFA; https://nrfa.ceh.ac.uk/). They each have an area greater than 50km^2 and less than 20% missing observed data in the period 1971-2010.

Figure S2b shows the six regions used for analysis of regional mean changes in flows. They are derived by combining UKCP18 river-basin regions (Met Office Hadley Centre 2019), based on prior knowledge of typical west/east and north/south differences in flow regimes and climate change impacts on flows, but the choice inevitably represents a balance between showing regional differences without too many plots.

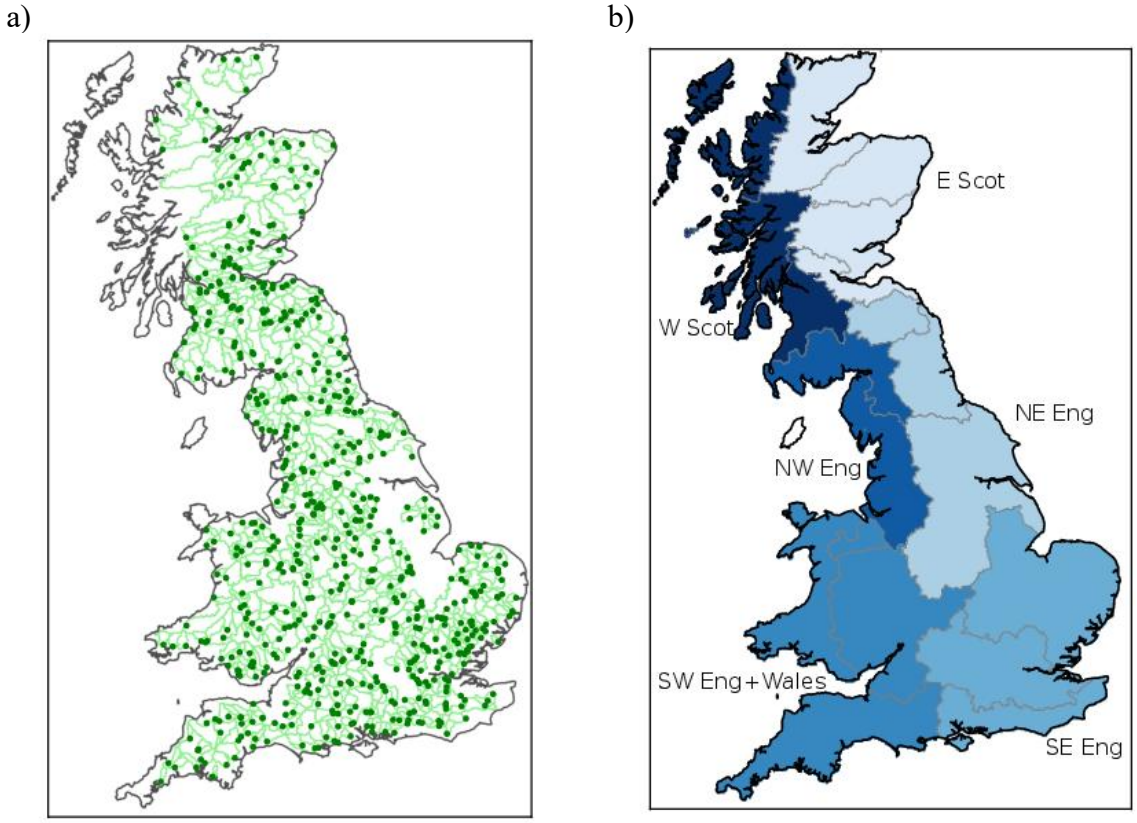


Figure S2 a) The 644 catchments used for the performance analysis, and b) the six regions used for the analysis of regional mean changes in flows.

2. Results

Table S1 shows the standard deviations of the time-series of GB-mean flows and soil moisture from Sim_Obs versus the range from Sim_LE for the overlapping historical period (1969-2014) (the time-series plotted in Figure 3). For each variable, the value from Sim_Obs sits within the range of that from Sim_LE.

Table S1 The standard deviations of the time-series of GB-mean flows (annual mean, AMAX and AMIN7d) and soil moisture from Sim_Obs, versus the min-max range of standard deviations from the 40-member Sim_LE.

Variable	Sim_Obs	Sim_LE min	Sim_LE max
Annual mean flow	2.550	1.899	2.753
Annual mean soil moisture	0.0123	0.0089	0.0153
AMAX flow	16.426	13.909	27.700
AMIN7d flow	0.588	0.528	0.830

Figure S3 shows the results of the cluster analysis of pixel-based high and low flow changes, here derived using fitted extreme value distributions rather than the empirical distributions used for the equivalent plots in the main text. They illustrate a particular issue with the fitted distributions for low flows when looking at at higher return periods; these show a lot of variation as the 30-year window is moved through time.

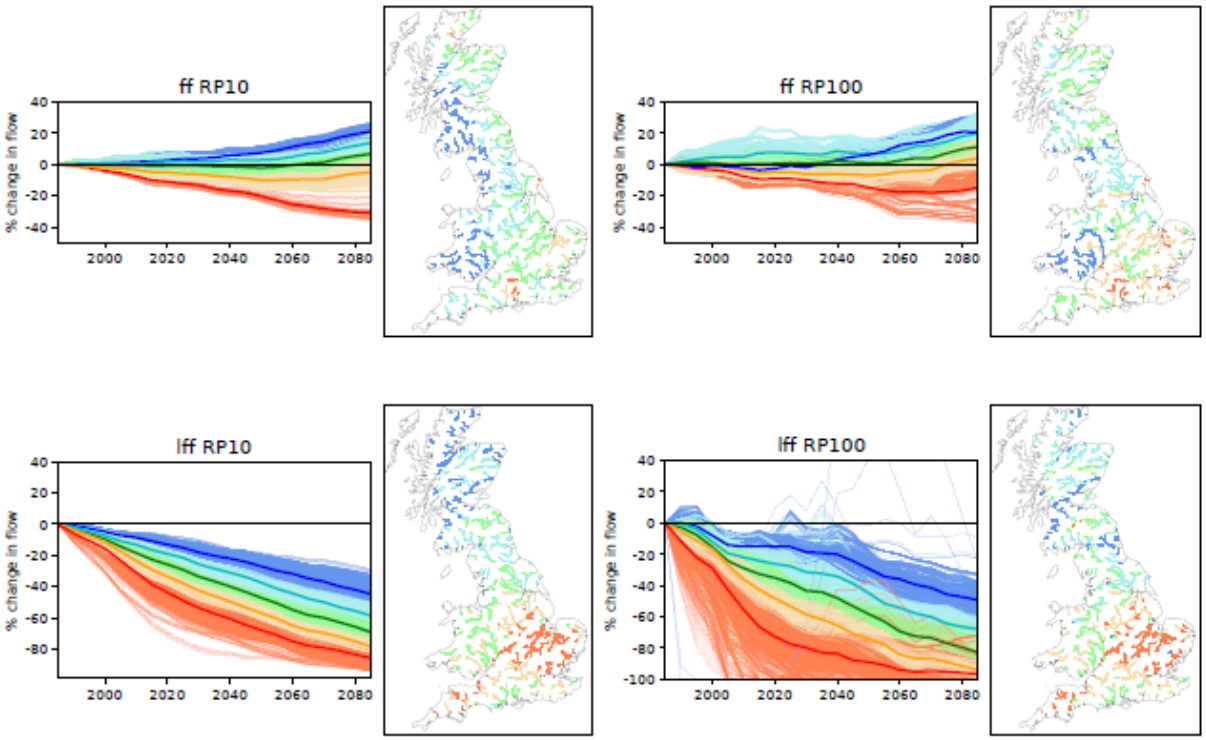


Figure S3 Clusters of river pixels (area ≥ 200km^2) with similar changes in high flows (top) or low flows (bottom), for 10- and 100-year RPs (left and right) derived using fitted extreme value distributions (cf. use of empirical distributions; Figure 6 in main text).

References

Met Office Hadley Centre (2019). UKCP18 Guidance: Data availability, access and formats. https://www.metoffice.gov.uk/binaries/content/assets/metofficegovuk/pdf/research/ukcp/ukcp18-guidance-data-availability-access-and-formats.pdf