



Supplement of

A multi-objective ensemble approach to hydrological modelling in the UK: an application to historic drought reconstruction

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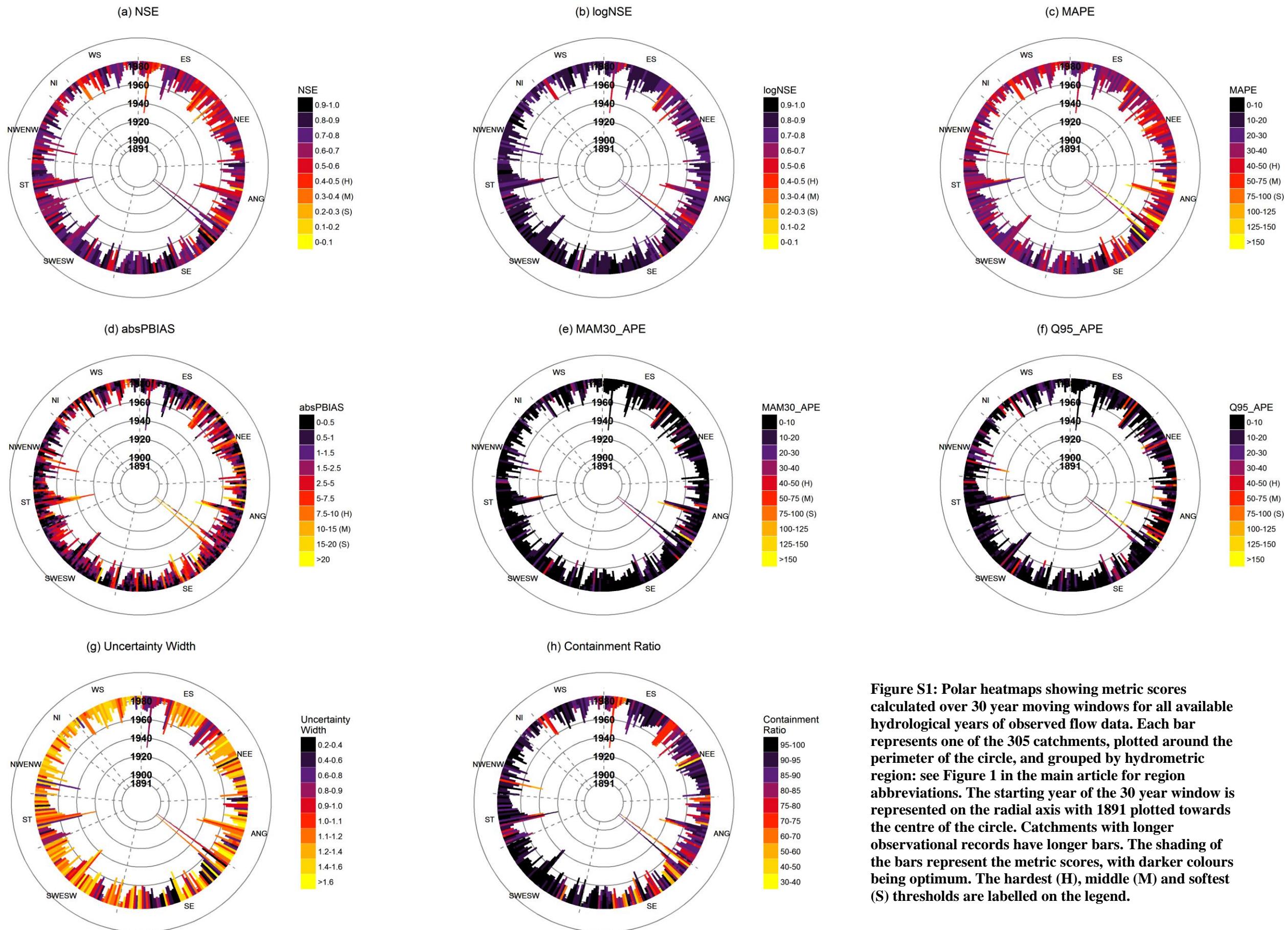


Figure S1: Polar heatmaps showing metric scores calculated over 30 year moving windows for all available hydrological years of observed flow data. Each bar represents one of the 305 catchments, plotted around the perimeter of the circle, and grouped by hydrological region: see Figure 1 in the main article for region abbreviations. The starting year of the 30 year window is represented on the radial axis with 1891 plotted towards the centre of the circle. Catchments with longer observational records have longer bars. The shading of the bars represent the metric scores, with darker colours being optimum. The hardest (H), middle (M) and softest (S) thresholds are labelled on the legend.

Table S1: Summary statistics for the LHS1 runs for nine case study catchments. Evaluation metrics scores given in black are for the calibration period 1982-2014, those in red italics show the scores for the case study period 1971-1980, both using hydrological years.

catchid	River	Area (sqkm)	Region	Obs Start	Threshold Met	NSE		logNSE		MAPE		absPBIAS		MAM30 _{APE}		Q95 _{APE}		Uncertainty Width		Containment Ratio		
						Calib	CS	Calib	CS	Calib	CS	Calib	CS	Calib	CS	Calib	CS	Calib	CS	Calib	CS	SSI-12 CS
8004	Avon	542.8	ES	1952	2	0.40	0.21	0.43	0.34	51.67	56	10.34	12	59.04	48.1	65.94	60.98	0.88	0.9	73.21	73.42	55.83
27051	Crimple	8.1	NEE	1972	2	0.52	0.44	0.76	0.77	73.71	60.97	9.00	14.28	0.31	1.404	17.22	0	1.51	1.52	86.20	86.41	53.75
28072	Greet	46.2	ST	1974	1	0.50	0.63	0.74	0.79	26.59	25.61	0.54	3.018	7.53	3.365	1.09	6.383	0.87	0.88	91.42	94.20	56.90
33018	Tove	138.1	ANG	1962	1	0.65	0.62	0.81	0.87	36.84	27.62	1.12	10.07	6.21	3.353	3.24	15.42	1.18	1.2	88.44	92.83	50.00
39019	Lambourn	234.1	SE	1962	1	0.91	0.86	0.91	0.85	12.50	12.57	0.11	1.314	0.15	9.399	1.42	12.12	0.22	0.23	48.08	51.93	25.83
45005	Otter	202.5	SWESW	1963	1	0.52	0.49	0.68	0.69	40.45	39.8	5.38	4.574	0.92	0.012	0.61	12.35	1.03	1.04	90.30	91.71	68.33
67018	Dee	53.9	NWENW	1969	1	0.79	0.73	0.84	0.84	47.97	44.8	1.47	3.397	15.31	13.77	46.71	19.13	1.41	1.44	92.75	92.64	30.00
81002	Cree	368	WS	1963	1	0.84	0.78	0.92	0.9	27.37	31.2	0.59	5.921	7.27	16.06	6.83	6.025	1.43	1.46	92.68	91.73	36.67
204001	Bush	299.2	NI	1972	1	0.67	0.67	0.76	0.74	37.48	50.82	0.85	7.728	2.90	20.9	0.49	46.55	1.10	1.11	91.29	87.13	46.48

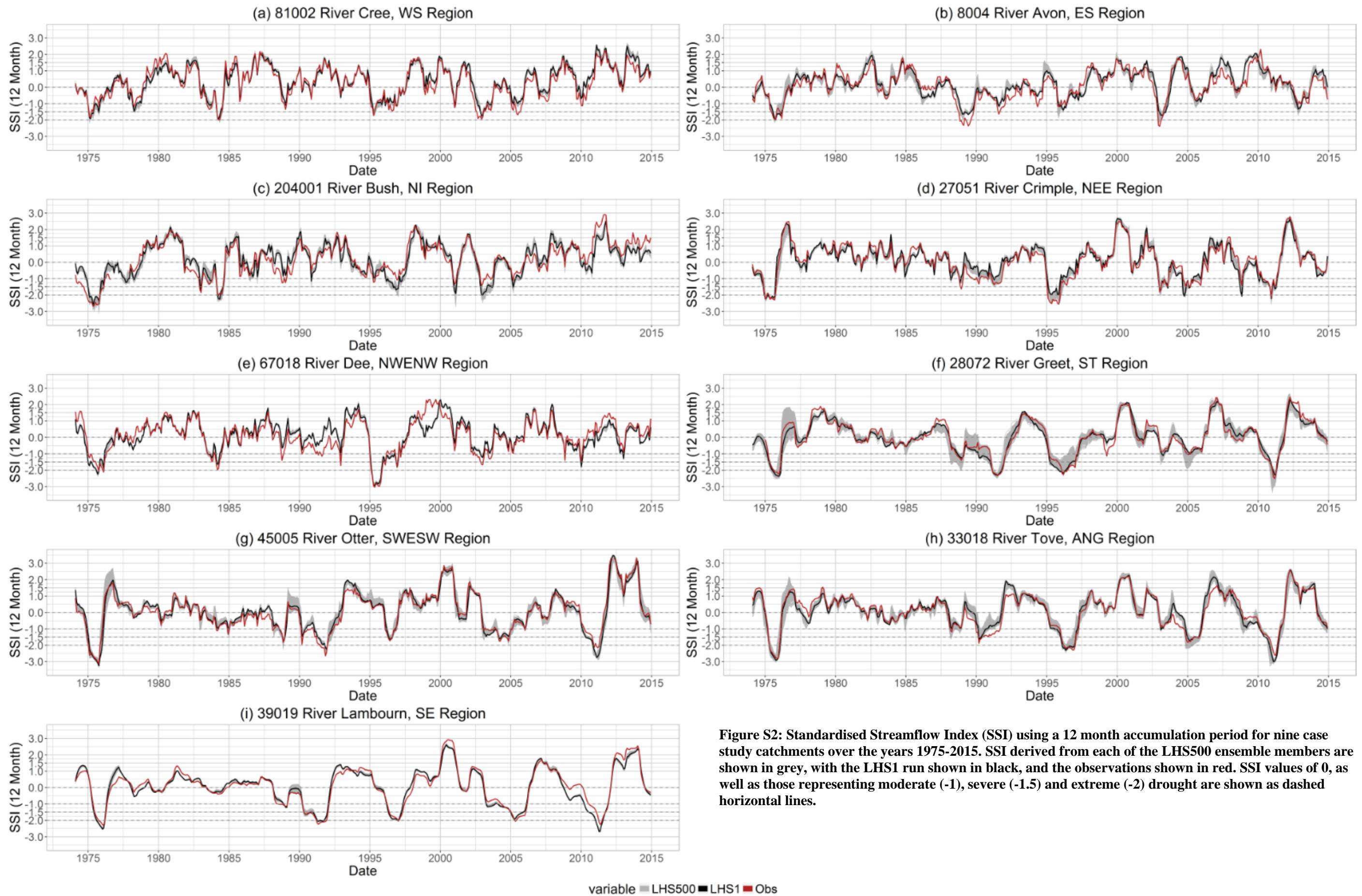


Figure S2: Standardised Streamflow Index (SSI) using a 12 month accumulation period for nine case study catchments over the years 1975-2015. SSI derived from each of the LHS500 ensemble members are shown in grey, with the LHS1 run shown in black, and the observations shown in red. SSI values of 0, as well as those representing moderate (-1), severe (-1.5) and extreme (-2) drought are shown as dashed horizontal lines.

Table S2 Table of Acronyms used in the Manuscript

Acronym	Meaning
absPBIAS	Absolute Percent Bias
ANG	Anglian
ContR	Containment Ratio
EIDC	Environmental Information Data Centre
ES	East Scotland
GLUE	Generalised Likelihood Uncertainty Estimation
GR4J	Génie Rural à 4 paramètres Journalier
LHS	Latin Hypercube Sample
LHS1	Run from the top model parameterisation, the “best” run
LHS500	Runs from the top 500 model parameterisations
logNSE	Nash Sutcliffe Efficiency calculated on log transformed flows
MAM30 _{APE}	Absolute Percent Error in Mean Annual Minimum Flows (calculated on a 30 day accumulation period)
MAPE	Mean Absolute Percent Error
NEE	North East England
NI	Northern Ireland
NRFA	National River Flow Archive
NSE	Nash Sutcliffe Efficiency
NWENW	North West England and North Wales
PEST	Parameter ESTimation
PET	Potential Evapotranspiration
Q95 _{APE}	Absolute Percent Error in the 95 th flow percentile
SCE	Shuffled Complex Evolution
SE	South England
SPI	Standardised Precipitation Index
SSI	Standardised Streamflow Index
SSI-12	Standardised Streamflow Index calculated over a 12 month accumulation period
ST	Severn Trent
SWESW	South West England and South Wales
UncW	Uncertainty Width
WS	West Scotland