Hydrology and
Earth System
Sciences

Supplement of

From meteorological to hydrological drought using standardised indicators

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1 **Supplementary Material**

2 S1 Modified Chelton method

3 The following outlines the implementation of the 'modified Chelton' method (Pyper and

4 Peterman, 1998) for determining the level of autocorrelation in time series.

5 The effective degrees of freedom will be fewer in an autocorrelated series, resulting in a larger

6 critical value (r_{crit}) that the correlation coefficient must exceed to be considered significant. The

7 effective degrees of freedom is estimated based on the method outlined in Chelton (1984),

8
$$\frac{1}{N^*} \approx \frac{1}{N_{comp}} + \frac{2}{N_{comp}} \sum_{j=1}^{N_{lag}} \rho_{XX}(j)\rho_{YY}(j),$$

9 where N_{comp} is the number of complete data-pairs across the two series, N_{lag} is the maximum

10 number of lags, j, over which the autocorrelation values $\rho_{XX}(j)$ and $\rho_{YY}(j)$ are summed. N_{lag} was

11 calculated *as N_{comp}*/5, as recommended by Pyper and Peterman (1998). The critical correlation

12 value (r_{crit}) was calculated using a two-sided test for N^*-2 degrees of freedom,

13
$$r_{crit} = \sqrt{\frac{t_{\alpha,N^*-2}^2}{t_{\alpha,N^*}^2\left(t_{\alpha,N^*}^2 + N^*\right)}},$$

14 where t is the Student's t-distribution calculated using a two-sided test and a significance level

15 (α) of 0.05 (Zar, 1996).

16 The autocorrelation values $\rho_{XX}(j)$ and $\rho_{YY}(j)$ are calculated using methods outlined in Pyper and

17 Peterman (1998), amended to take missing data at any time step, i, into account, by using the

18 term $N_{comp,j}$ which denotes the number of complete pairs of data for series X when lagged by

19 lag j,

20
$$\rho_{XX}(j) = \frac{\frac{1}{N_{comp,j}}\sum_{t=1}^{N-j}\left[(X_t - \bar{X})(X_{t+j} - \bar{X})\right]}{\frac{1}{N_x}\sum_{t=1}^{N}(X_t - \bar{X})^2},$$

21 here, $\bar{X}$ is the mean of data series X and N_x is the number of non-missing values in X.
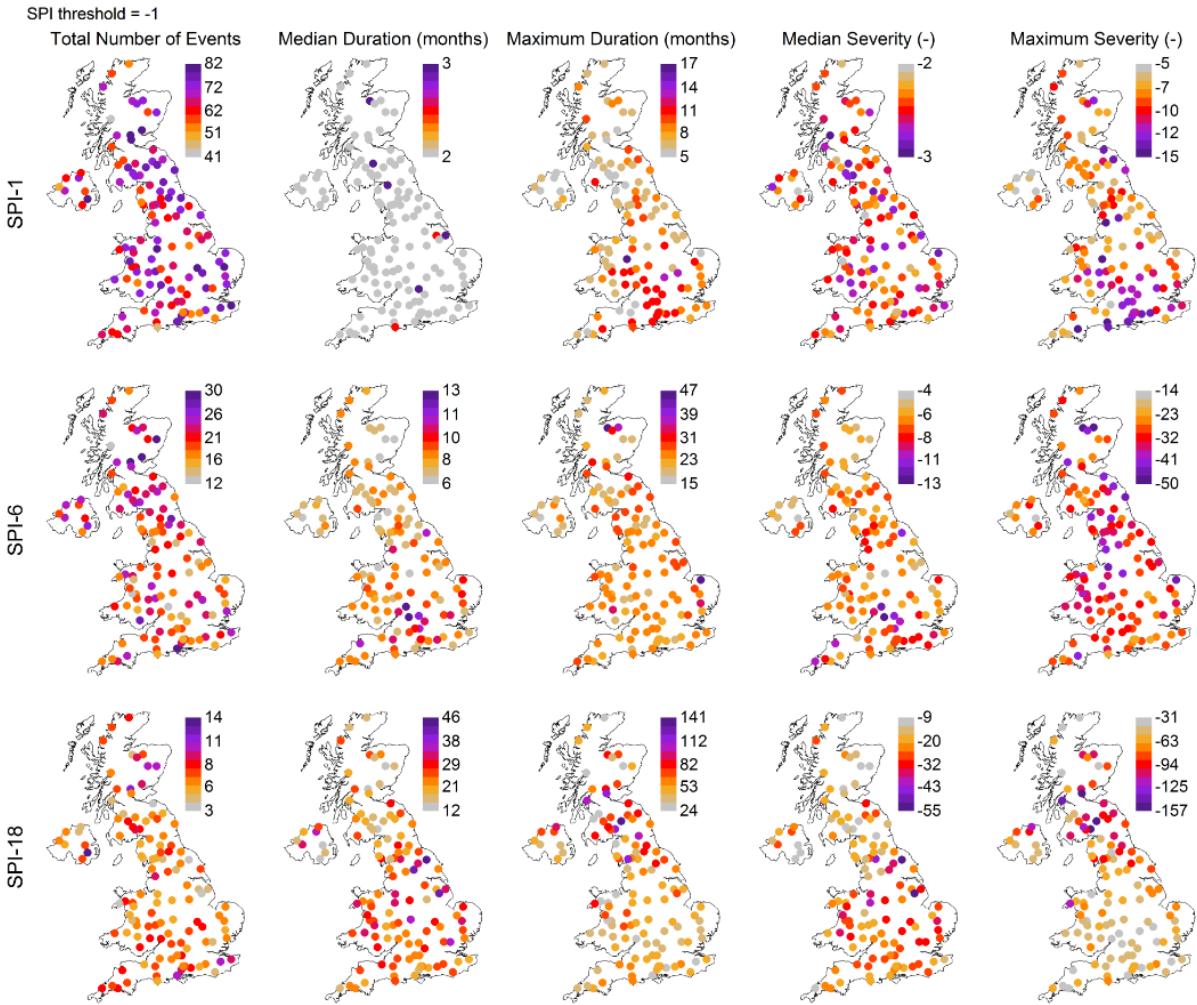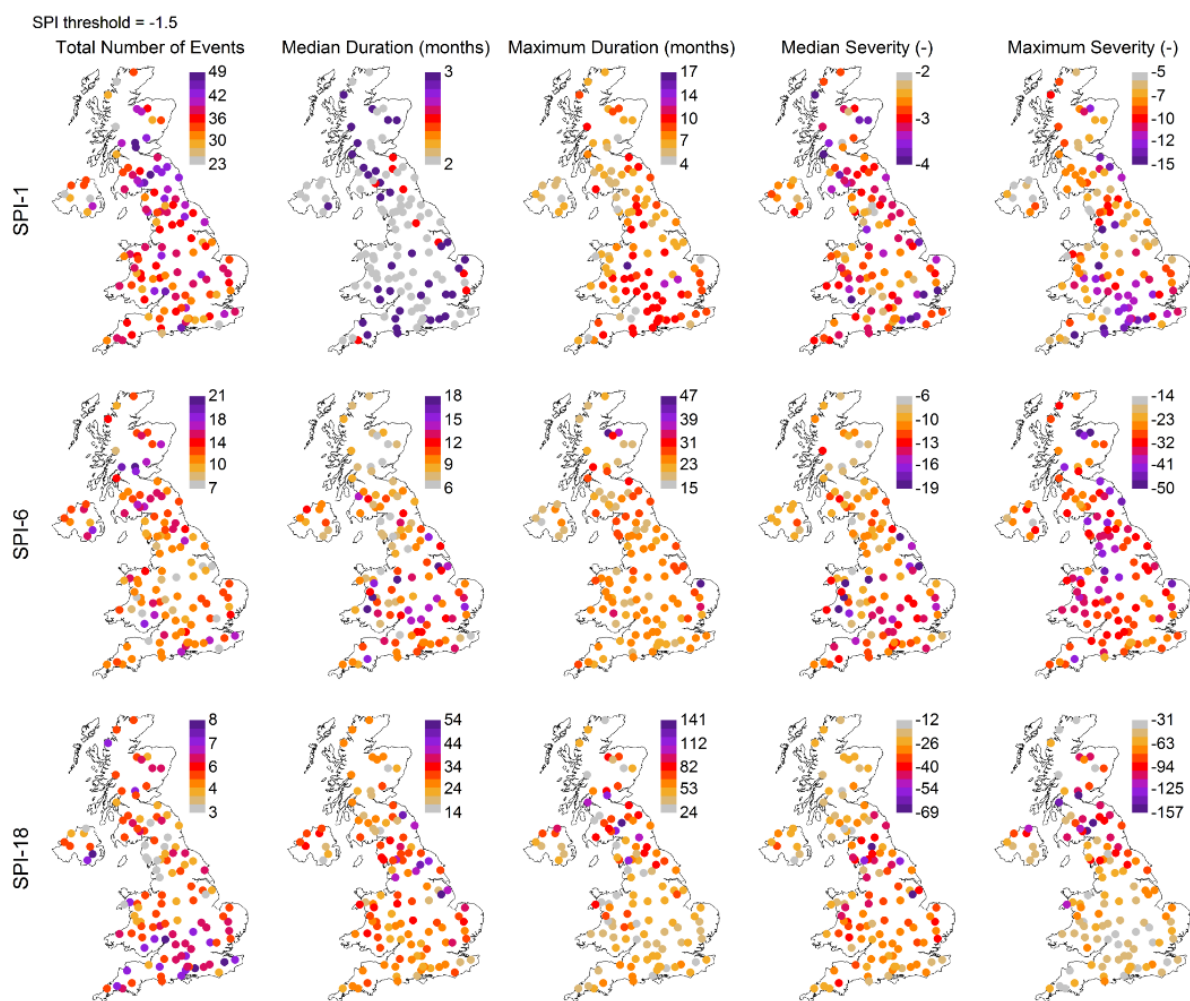
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S2 Drought characteristic maps

Figure S1. Maps showing selected meteorological drought characteristics based on SPI-1, SPI-6 and SPI-18 using a threshold of -1. Note that the colour scale is different for each accumulation period to best show the spatial variability of the results.
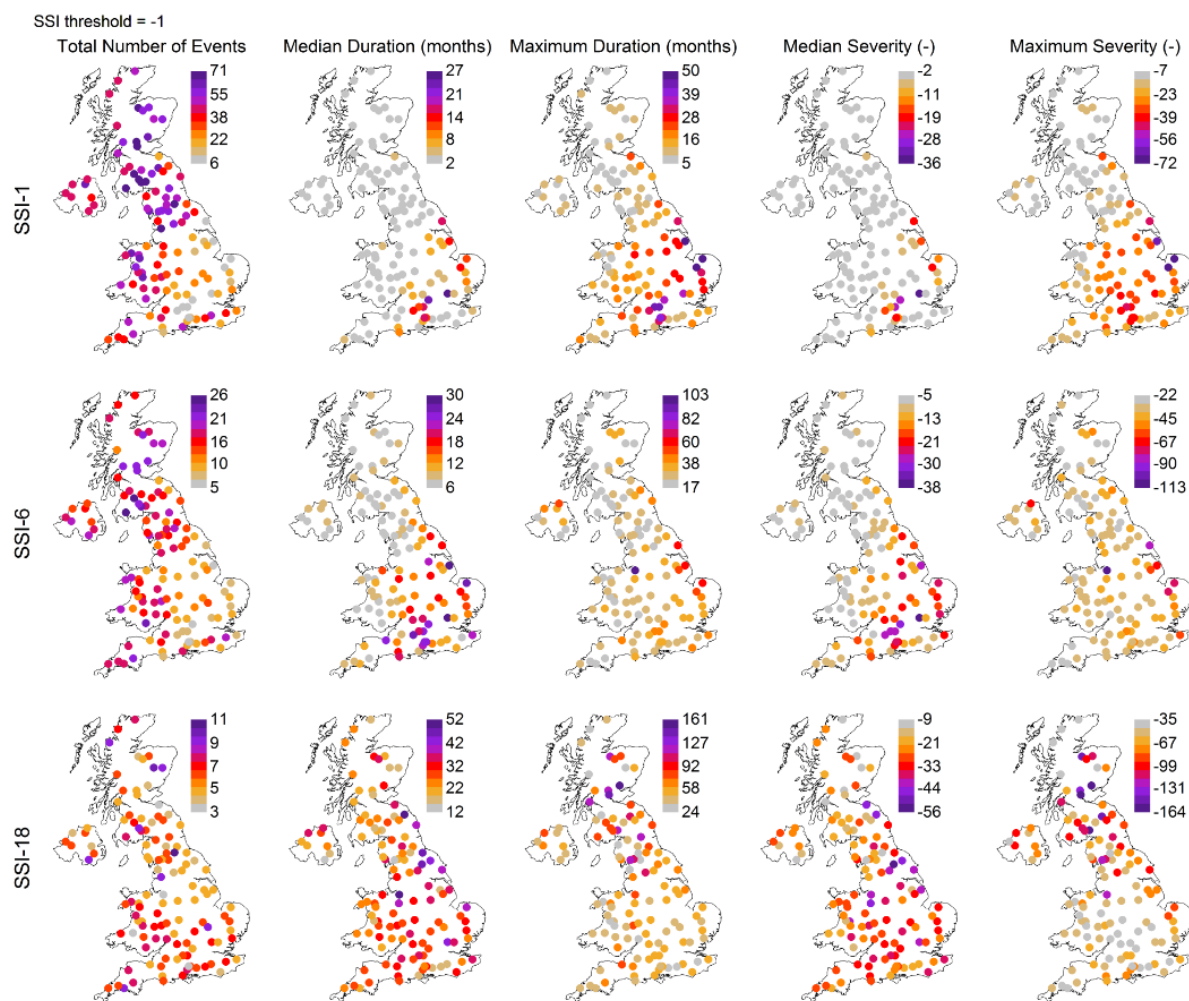
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Figure S2. Maps showing selected meteorological drought characteristics based on SPI-1, SPI-6 and SPI-18 using a threshold of -1.5. Note that the colour scale is different for each accumulation period to best show the spatial variability of the results.
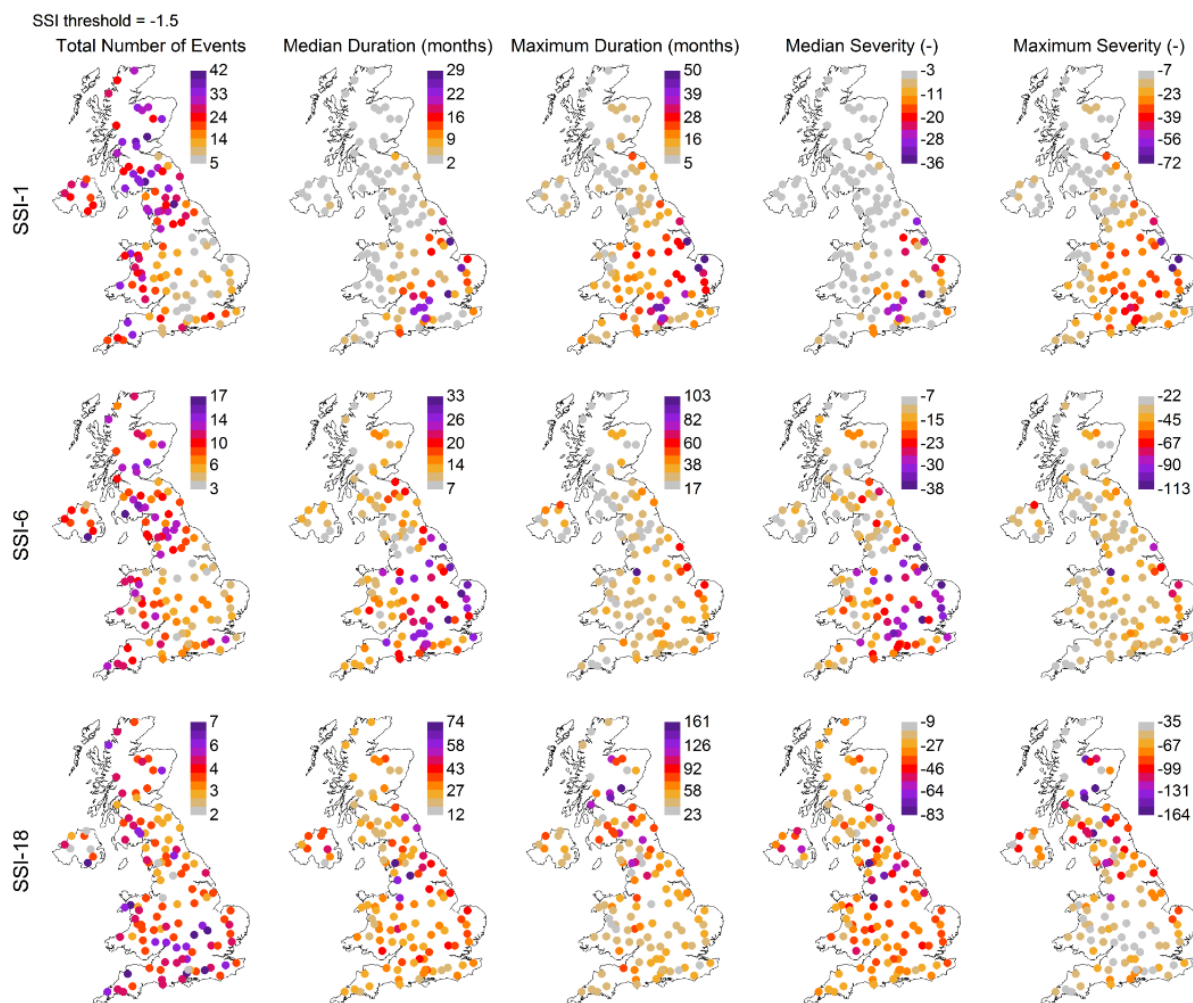
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Figure S3. Maps showing selected hydrological drought characteristics based on SSI-1, SSI-6

and SSI-18 using a threshold of -1. Note that the colour scale is different for each accumulation

period to best show the spatial variability of the results.

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Figure S4. Maps showing selected hydrological drought characteristics based on SSI-1, SSI-6
and SSI-18 using a threshold of -1.5. Note that the colour scale is different for each
accumulation period to best show the spatial variability of the results.

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S3 Relationship between hydrological drought characteristics and catchment properties
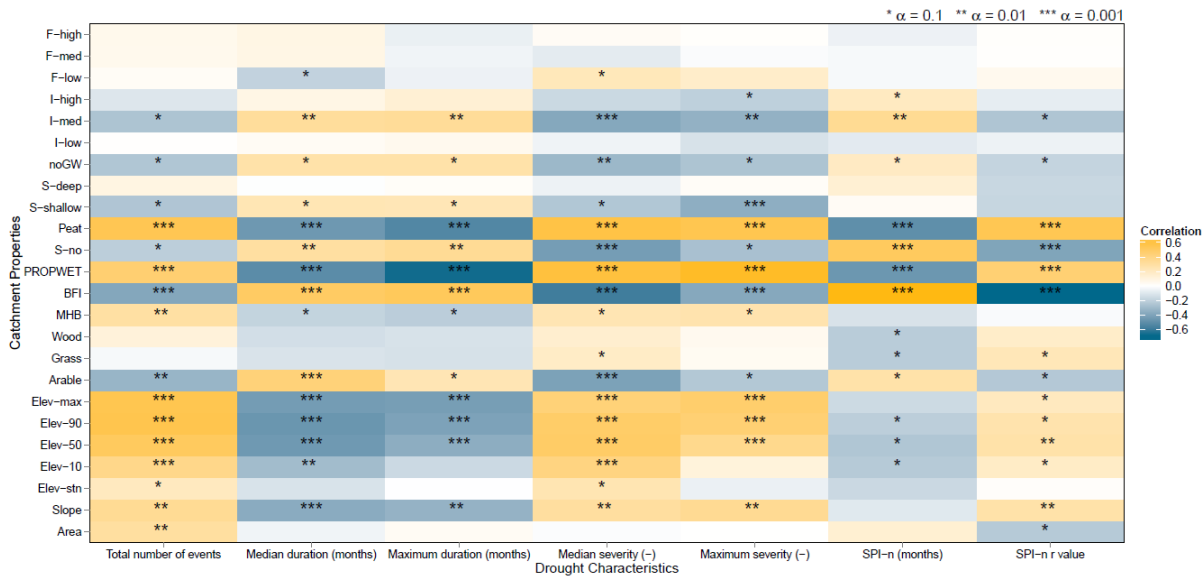
4 Fig S5. Heat map showing the correlations between selected hydrological drought
5 characteristics based on SSI-1 using a threshold of -1 and catchment properties for catchments
6 in clusters one and two. See Table 1 for descriptions of the catchment properties.

1 S4 References

2 Chelton, D.: Commentary: short-term climatic variability in the northeast Pacific Ocean, in:

3 The influence of ocean conditions on the production of salmonids in the North Pacific, Pearcy,

4 W. G. (Ed.), The Program, 1984.

5 Zar, J.: Biostatistical analysis, 3rd Edn., Prentice-Hall Inc, Upper Saddle River, New Jersey,

6 1996.

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