



*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),

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

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,

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

14 where  $t$  is the Student’s  $t$ -distribution calculated using a two-sided test and a significance level  
15 ( $\alpha$ ) 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  $j$ ,

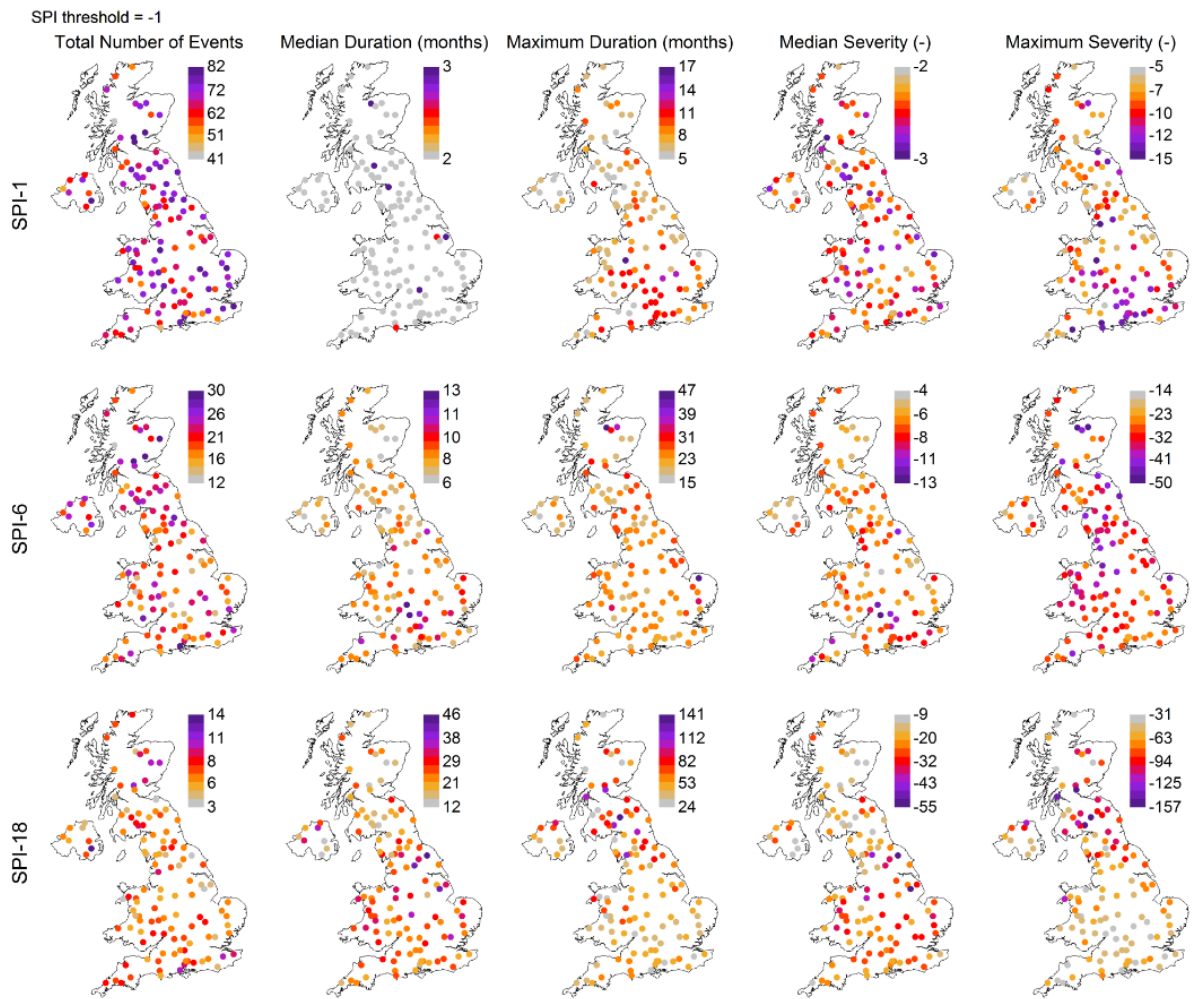
$$20 \quad \rho_{XX}(j) = \frac{\frac{1}{N_{comp,j}} \sum_{t=1}^{N-j} [(X_t - \bar{X})(X_{t+j} - \bar{X})]}{\frac{1}{N_x} \sum_{t=1}^N (X_t - \bar{X})^2}$$

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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1 S2 Drought characteristic maps

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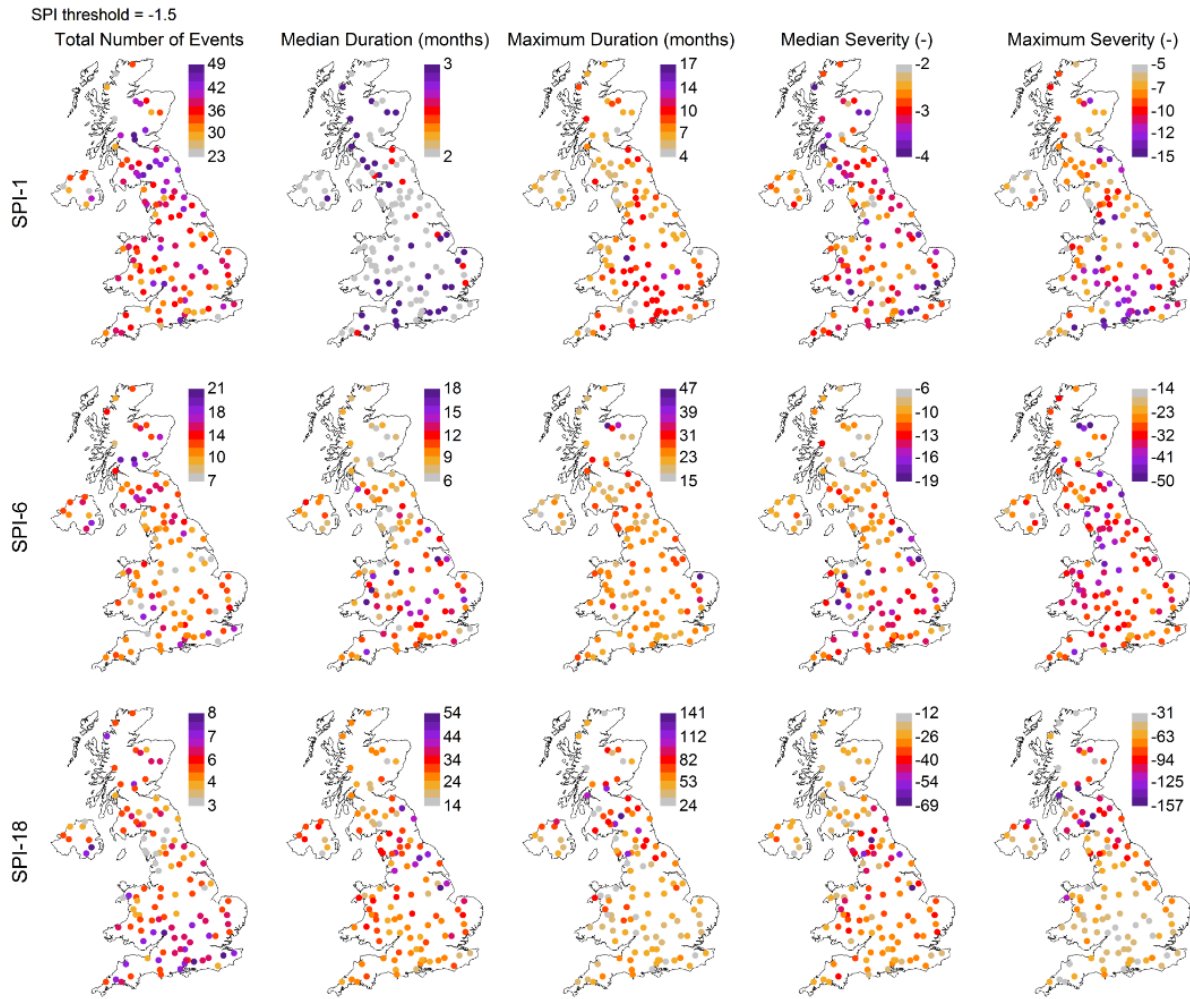
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4 Figure S1. Maps showing selected drought characteristics for SPI-1, SPI-6 and SPI-18  
5 calculated using a threshold of -1. Note that the colour scale is different for each accumulation  
6 period to best show the spatial variability of the results.

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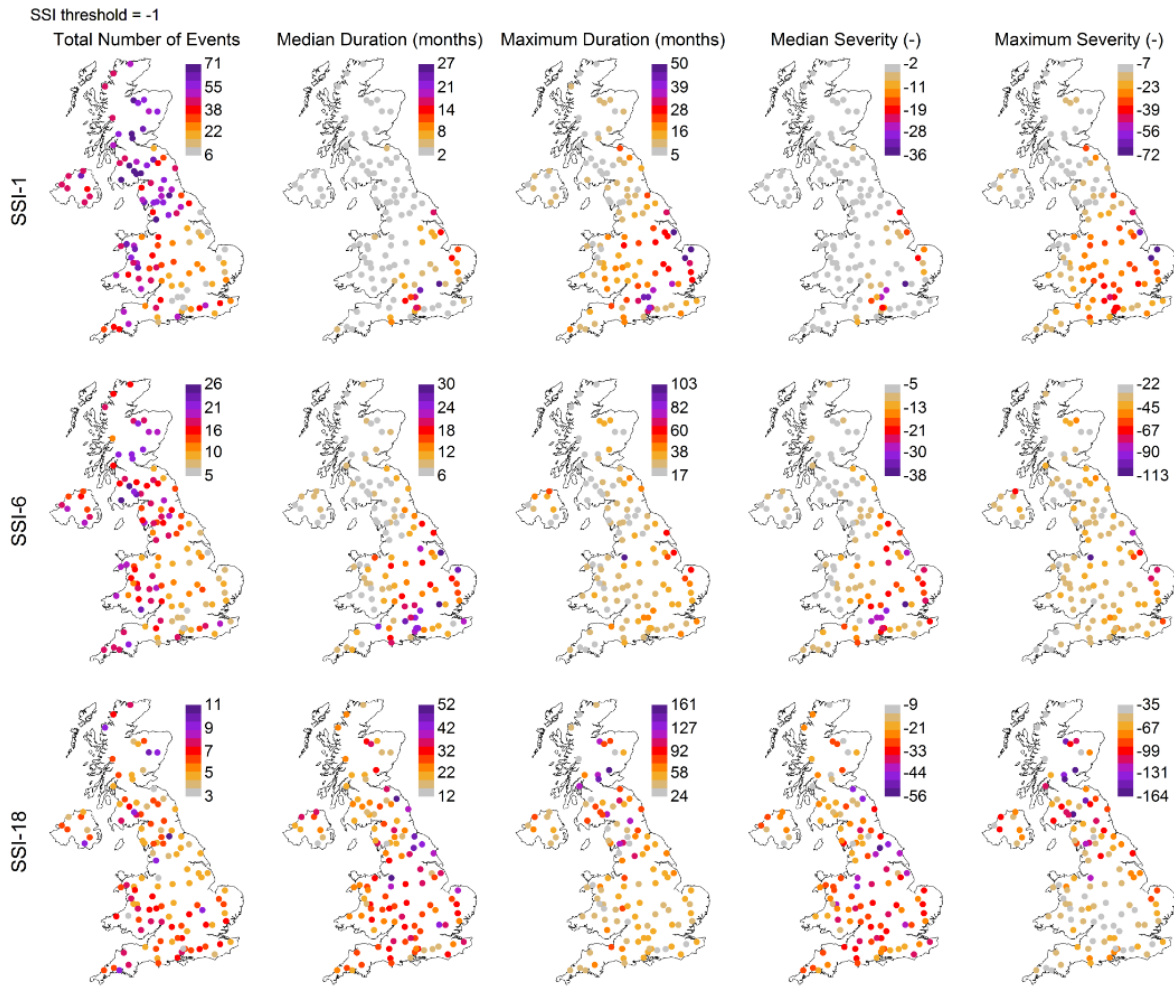
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3 Figure S2. Maps showing selected drought characteristics for SPI-1, SPI-6 and SPI-18  
4 calculated using a threshold of -1.5. Note that the colour scale is different for each accumulation  
5 period to best show the spatial variability of the results.

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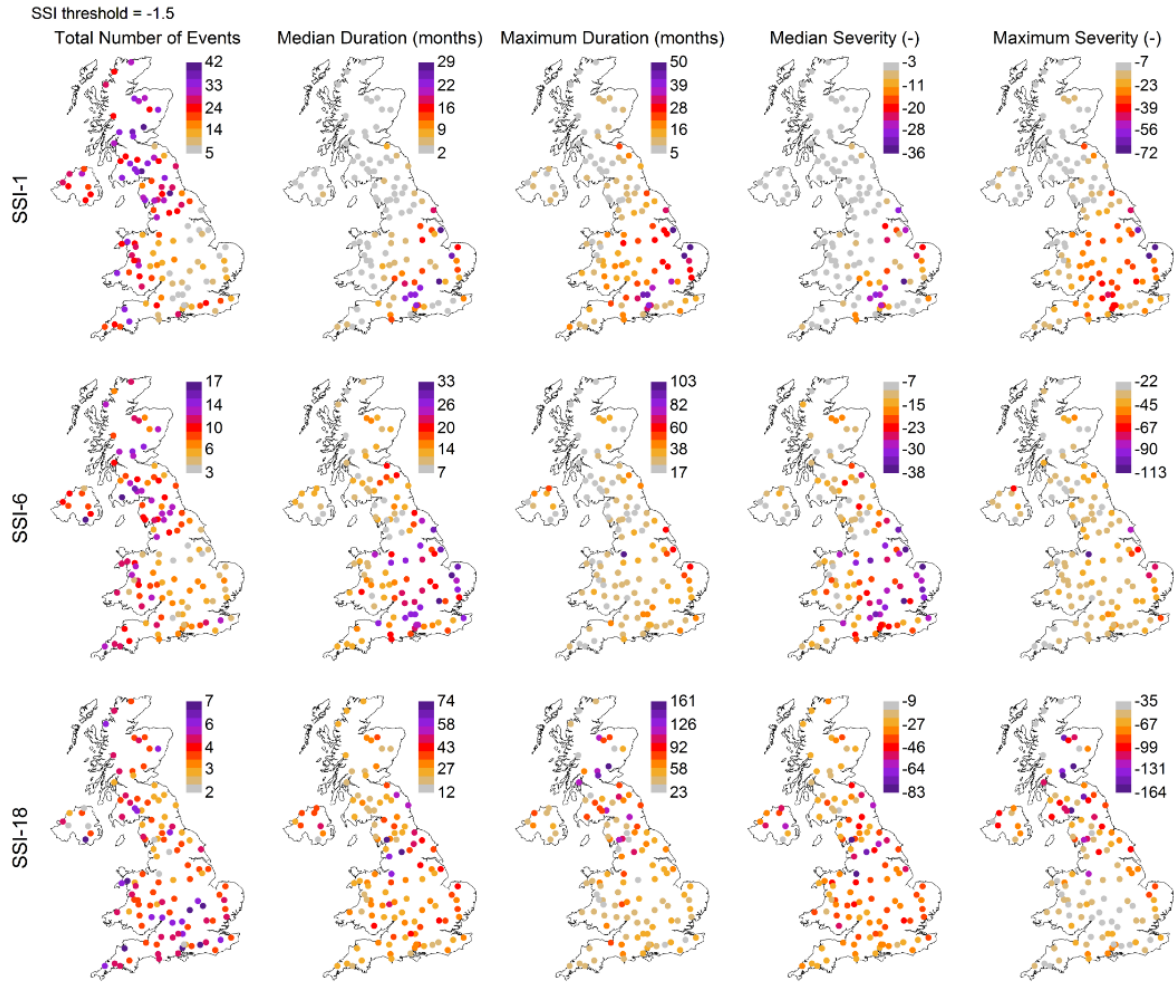
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3 Figure S3. Maps showing selected drought characteristics for SSI-1, SSI-6 and SSI-18  
4 calculated using a threshold of -1. Note that the colour scale is different for each accumulation  
5 period to best show the spatial variability of the results.

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

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1 S3 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, Percy,  
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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