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Hydrology and Earth System Sciences
Discussions

Interactive comment on "A systematic assessment of drought termination in the United Kingdom" *by* S. Parry et al.

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General Comments

The reviewer raises important points on the novelty of the approach and the overgeneralisation of results which we have addressed below. We hope that our responses are acceptable, and we thank the reviewer for their constructive and complimentary review which has improved the manuscript.

Specific Comments

Page 4 Lines 3–10:

Whilst some of the studies cited conduct analysis at the monthly time step (as we do here), and some use the PDSI which accounts for the water balance over recent

months, these studies do refer to a day (e.g. Kam et al. 2013) or month (e.g. Patterson et al. 2013) in which drought termination occurs. Where SPI3 (e.g. Kam et al. 2013) or a three-month termination criterion (e.g. Patterson et al. 2013) are used, any implied 'termination duration' is 'hard coded' to be three months. This does not give an appreciation of the variability in the duration of drought termination, and in both studies the day or month of drought termination (as an instantaneous point in time) is further analysed (e.g. for the season in which that point in time occurs). Our study differs from these because drought termination is a defined period of a drought event with its own start and end and a duration in between these points. The drought termination rate is the magnitude of change in river flow anomalies over time during this period and the seasonality is the seasons through which the period occurs. Our approach could complement existing threshold-based methods by subdividing an identified period of drought into drought development and drought termination phases based on the minimum value of the index used (e.g. PDSI). We have updated the text at the end of the Introduction to clarify the differences between our approach and those of other studies.

Page6, Lines 18–23:

We thank the reviewer for their comments on this important aspect of our approach. The decisions on the parameter values are probably the most important factor in the number and characteristics of the identified drought termination events. For a previous application (not published), we conducted a very preliminary sensitivity analysis which demonstrated the impact of varying the parameter values. For this application, we tested a smaller number of combinations of parameter values (informed by that previous sensitivity analysis) and found that values of 10, 1 and 2 for D, R and T (respectively) identify droughts (and terminations) that are well documented in the literature (e.g. Marsh et al. 2007 and Parry et al. 2013, both cited in the manuscript). These values also capture the spatial variability in drought risk in the UK (lower in the north and west, higher in the south and east). The reviewer is correct that there are instances in the chronologies of drought termination presented in the manuscript when

a drought termination period is immediately followed by the next drought development phase (when two months are above average followed by nine out of the next ten months below average) which would be classified as the same event if T=3. However, the same issue would arise if T=2,3,4,.... The subjective decisions we have made here are not different to those of many studies in the literature on threshold-based drought indices which may make arbitrary choices on the threshold quantile and n-month accumulation periods. We agree with the reviewer that a comprehensive sensitivity analysis is required, but it is a complex question that we believe is worthy of a study in its own right. This paper aims to be a proof of concept that the approach is useful in systematically identifying and characterising drought terminations in the historical record. We have strengthened the text in the discussion to explain our future plans to more comprehensively address the question of parameter selection.

Page 6 Line 27:

We have tested for normality in each of the series used in correlation analysis through the Shapiro-Wilk test and quantile-quantile (Q-Q) plots. The majority of the series are not normally distributed so the use of Spearman correlations is justified. We have modified the manuscript to better justify our use of the Spearman approach.

Page 4 Line 23:

We have restructured the first sentence to emphasise the selection criteria and de-emphasise the importance of the number of catchments which satisfy these criteria.

Page 10 section 4.4:

The sentence relates specifically to the 1995-1998 and 2009-2012 events, drawing on the analyses provided in sections 4.2 and 4.3. This statement also holds true for some other events; for example, the top 5 drought termination durations for the 1973 event are the Bedford Ouse, Wensum, Lud, Stringside and Colne (see Figure 3), all of which are in Anglian region and have moderate to high BFI values (0.52-0.90), indicative

of groundwater influence in the catchments. However, we agree with the reviewer that the link between larger groundwater influence in catchments and longer drought termination durations does not apply for all identified drought termination events. We have extended the sentence to acknowledge that this does not apply to all events.

Similarly, on Page 12 Lines 11–16:

We accept that the spatio-temporal distribution of rainfall will impact the spatio-temporal variability of drought termination in river flows. Two of the most important factors in the characteristics of drought termination in a given catchment are the amount and timing of rainfall and the modulating effect of the catchment characteristics. We only claim on page 12, lines 11-16 that characteristics are partly (i.e. not wholly) attributable to catchment characteristics, but we agree that the link to rainfall could be made more explicitly. We have modified the manuscript accordingly.

Technical Corrections

Abstract, Line 1:

We have removed “storms and” from the first line of the Abstract.

Page 15 Lines 3:

We have replaced the numbers with percentages, as well as the reference to “five catchments” later in the same sentence (for consistency).

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