Review of "Regionalisation of groundwater droughts using hydrograph classification" by Bloomfield et al.

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General comments:

This paper deals with the identification of clusters of groundwater monitoring wells in a region in the UK based on the Standardised Groundwater Index and the analysis of those clusters in terms of general drought characteristics and specific long drought events. I find this work very interesting and useful. The paper is well written, with clear explanations of methods and results, and it is very systematic and thorough. Every assumption and choice is documented well. The paper occasionally is a bit too technical/dry and has limited information on general applicability. I see the potential for this work, which can be reached with only minor adaptations. The abstract, for example, is quite technical focusing on the results in the clusters CL1, CL2 and CL4, which is not very informative for those who do not read the rest of the paper. It would be helpful to include some information on how this method could be used in other regions and how the results can be used for prediction (in time and space). Alternatively, the title can be changed to include the case study region of the Lincolnshire aquifers, limiting the work to the local results.

Specific comments:

- **clustering with expert knowledge:** The authors tested two methods of clustering and compared the results with the approach of using only expert knowledge. They did, however, not investigate the effect of clustering without any expert knowledge at all. What would have happened if no expert knowledge was used? What is the influence of the rules on p. 5308? What if these were not applied? And how appropriate are these rules?

- **assumption of spatial coherence of meteorological drought**: I find it strange that the authors support this assumption by the spatial coherence of hydrological drought (p. 5299). The high spatial coherence of hydrological drought might be due to an attenuation effect of the landscape, smoothing out spatial variability in meteorological drought. They can support their assumption better by saying that the variation in annual precipitation is very small in this region (600-700 mm) and that the whole region is governed by the same weather patterns, i.e. rain-bearing low pressure systems from the Atlantic and high pressure systems leading to lack of rainfall.

- **groundwater time series vs. drought:** The clustering in this paper is done on the complete SGI time series and not only on the dry end of the SGI. This is an important difference, especially because the following analysis does focus on droughts. The authors mention this fact in the discussion and conclude that "the resulting clusters have been shown to effectively regionalise groundwater droughts" (p. 5318). How is this "effectively" determined? By the fact that the major drought events are reproduced? The authors leave the clustering on dry SGIs for future work, which is reasonable.

- **aquifer characteristics:** very detailed information on the characteristics of the aquifers is given on p. 5301. This is useful only if used later in the classification or analysis of clusters.

On p. 5308 a “documented N-S variation in aquifer properties” is mentioned and used in the clustering. On page 5316 it is mentioned that Bloomfield and Marchant (2013) found no clear relationship between Mmax and log Diff for fractured aquifers like the ones used in this study and therefore the effect of transmissivity and storativity is not analysed further. I would advise to make a clearer link between the information of the spatial variability of aquifer characteristics and the clustering and analysis later in the paper.

- **CL6:** how can you select 1 month accumulation period for CL6 from Fig. 7, if there is effectively no correlation at all (p. 5309). It would be better not to give any number. CL6 will not be used in the further analysis of the paper anyway.

- **CL3, 5 and 6:** these clusters showed unexpected behaviour in their groundwater hydrographs and were found to be influenced heavily by human activities. These clusters are excluded from further analysis. But could these wells not have been excluded beforehand based on prior knowledge? What does the clustering approach help? What extra information is gained? In the discussion on p. 5319, the authors mention that the clustering method can be used for detection of wells with strong human influence. This might be elaborated a bit more.

- **novelty:** The results mentioned on p. 5313 are not new. This study confirms earlier finding for the groundwater droughts in this region. This is not a problem, but the authors might stress a bit more the applicability of their method to other regions or its usefulness for prediction in time and space? Section 5.2 is great, in that respect, and can even be extended! What is benefit of the clustering method? Can sites that were not used in the cluster analysis, but are located in the same region be allocated to a cluster? Can the clusters be used for prediction?

Technical comments:

p. 5298, l. 18 – p. 5299, l. 3: can you include section numbers in this paragraph?

p. 5313, l. 20: (Fig. 11) > (Fig. 11a)

p. 5314: what do you mean with “annual cycles of drought intensification and decline”? Where do we see this in Figure 5 or 9?

Figure 2 & 5: include variability around the mean SPI and SGI time series to show the range of individual wells and precipitation gauges.

Figure 3c: switch yellow and light blue points, so that the clusters are similar to those in Figure 3b.

Figure 9: include a and b and refer to Figure 9a and 9b in the text. Also reverse the colour scheme, so that drought is red and wet conditions are blue.