

Hydrol. Earth Syst. Sci. Discuss., referee comment RC2  
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## Comment on hess-2021-572

Neil Macdonald (Referee)

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Referee comment on "The importance of non-stationary multiannual periodicities in the North Atlantic Oscillation index for forecasting water resource drought" by William Rust et al., Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2021-572-RC2>, 2022

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I very much enjoyed reading the paper and found it thought provoking. There are a number of points I feel the authors need to address, highlighted below, there is also an attached version of the manuscript with additional minor edits they may wish to consider.

Key points:

- Greater clarity could be offered in the text in several places, the paper considers streamflow and groundwater series, not water resources, which includes additional data that are not discussed within the manuscript (e.g. lakes & reservoirs). In addition, it would be beneficial to be clear on the regional scope of the study, groundwater data from England (+Wales?) and streamflow data from the UK; in the abstract and conclusion inference is made to this being a European study, these need to be pulled back to UK, the clarity will help the reader.
- The study focuses on low flows, not droughts, nor extremes as no discussion of high flow events. This requires clarification throughout.
- Paragraph (lines 77-97) needs to make a clearer case for the relationship between NAO and streams/groundwater and multiannual periodicities, as the relationship between NAO and summer streamflow, when low flows are expected, is weak.
- Aim and Objectives need revising, to reflect UK study, low flows not extremes and not studying European rainfall
- In each case (streamflow and groundwater) 20-year series are included into the analysis, this study would be more robust if only longer series were included. 20 years is too short for multiannual analysis, consider >40 years.
- You state there is no UK benchmark river flow series, there is, why not use this to overcome concerns you then note (<https://doi.org/10.2166/nh.2017.058>).
- Typo on NAOI length line 168
- The threshold sampling approach you apply does not identify droughts, but low flows. This might seem pedantic but is important. You need to present some indication of how many years are identified as low flow years for each station using this approach as low flow years.
- I am concerned by the grouping of the results in section 4.1 together. We know that

droughts are regionally coherent and often impact regions rather than the whole country, this will impact on low flows. There is also a skew towards stations of longer length and greater density in the SE with reducing length and frequency as you move north, this will skew your findings. This section would be much better if it was undertaken regionally, as you demonstrate the phased relationship to NAO for streamflow (Fig 5) is regionally highly variable. I actually think this is a really interesting section and further exploration of the regional low flow-NAO periodicity would be of interest and insightful, this could then be discussed further and would allow a more nuanced understanding to be garnered of regional patterns. You might expand the discussion of NAO track shifts too, based on the regionalisation, as the stronger consistent signal in north would suggest that that the change is consistent with that postulated by Comas-Bru & McDermott (2013). You can then assess whether the 7.5 years is consistent across regions. This is a key section and frames much of the rest of the results and discussion, as from this section you select the 7.5 year periodicity. Greater consistency is identified in groundwater-NAO phases, but this really only covers England, with a strong skew to SE again.

Please also note the supplement to this comment:

<https://hess.copernicus.org/preprints/hess-2021-572/hess-2021-572-RC2-supplement.pdf>