

## ***Interactive comment on “Exploring the role of hydrological pathways in modulating North Atlantic Oscillation (NAO) teleconnection periodicities from UK rainfall to streamflow” by William Rust et al.***

**William Rust et al.**

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We would like to thank Anonymous Referee #1 for their detailed review comments. We found them to be insightful, and, through our responses to them set out below, we believe that they have resulted in a much-improved paper.

General Comments

General Comment #1: In this paper the authors draw upon an extensive UK hydroclimatological data-set, comprising >700 gaged records of streamflow and estimated

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precipitation to examine 7-year periodicities related to the NAO. The range in catchment responses (and potential additional cycles at 2 and 5 years) are interesting and I think the paper is appropriate for this journal (with suggested revisions noted below), although I'm not personally convinced that this paper provides 'critical process understanding' as suggested in the abstract, and it's not clear how this work can translate to improvement of the practice and policy of water resources management (as suggested in the abstract).

Response to General Comment #1: We agree that the wording of 'critical process understanding' is too strong given the scale of the study. We would soften these statements to reflect the general trends we are asserting throughout the paper; this will also help to address the confidence we have in inferring hydrological pathways from the high-level catchment descriptors used (BFI and GRT). Furthermore, we agree that there needs to be further discussion around the translation to practice and policy and will add a paragraph to the discussion to account for this.

General Comment #2: For a non-UK reader it would be useful to provide more context in introducing the work and commenting on confounding influences (e.g. there is no mention / discussion of abstraction, nor the potential for anthropogenic water use / return flows, to influence streamflow). Moreover, the authors only mention one aquifer (the Chalk) and it is difficult to interrogate the results to consider the potential for varying periodicities on other geologies (and catchments with differing land use), given the scale of figures such as Fig. 5. At this scale of analysis, I would also question whether the authors are able to infer hydrological pathways with confidence (although the Groundwater Response Time concept appears very interesting).

Response to General Comment #2: We agree that the role of confounding influences has not been discussed sufficiently. We note that over the period of analysis there have been both changes in regulatory and water resource management practices and that the latter will not have been applied in a consistent manner over all the catchments. Given this we might expect anthropogenic effects to add noise to the observations, but

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that there is no reason to expect that they should impart a systematic signal or bias to the data and so systematically effect the observations or results. Counter to this, there is a president in literature for exacerbation of climatic cycles by anthropogenic processes which may affect the amplitude of cycles but again we would not expect any bias or confounding signal. We will add text to the data and discussion sections to highlight both of these points. Furthermore, we understand that, since our results only show signals in areas dominated by Chalk, it is difficult to interpret pathway processes for other geologies. As such, and in order to avoid over-interpretation of the results, we will add cautionary statements to the results to highlight the focus on the Chalk and that these relationships may not be translatable to other geologies (with different land uses).

#### Specific Comments

Specific Comment #1: There are multiple (>10) references missing in the ref. list including: Bloomfield & Marchant, 2013; Dixon et al. 2013; Forootan et al. 2018; Haarsma et al. 2015; Tanguy et al. 2016. Response to Specific Comment #1: These will be fixed, and all citations will be properly listed in the reference list

Specific Comment #2: It would be useful to include more specific details in the abstract. Response to Specific Comment #2: We will update the abstract to give a better overview of the specific findings and outcomes

Specific Comment #3: A stronger argument to demonstrate the effectiveness of the BFI in relating 'physical catchment processes to streamflow' would be helpful (e.g. as I understand the Bloomfield et al 2009 study, cited in support, focused on the Thames catchment).

Response to Specific Comment #3: We agree with this comment, and we will include a broader look at literature to demonstrate the effectiveness of BFI as an indicator for hydrological pathway dominance.

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Specific Comment #4: Lines 179-183 should be reworked (e.g. GRT is lowest in southern and eastern England, but highest in south-east England?).

Response to Specific Comment #4: Agreed, these lines will be reworded to improve clarity  
Specific Comment #5: Figures 2 & 5: are rather small, and it would be useful to reproduce these at a larger scale.

Response to Specific Comment #5: These figures will be provided at a sufficiently high resolution to enable the journal to reproduce at a larger size

Specific Comment #6: Is it possible to combine Figures 3 & 4 so the plots can be compared more easily?

Response to Specific Comment #6: We have tested this previously, but unfortunately it makes for a cumbersome plot which is more difficult to interpret. Following from this comment and others, we will update Figures 3 and 4 to more clearly show the spread of periodicity strengths.

Specific Comment #7: The Discussion is rather long and would benefit from a more selective review of the results, with more attention to suggestions for future research.

Response to Specific Comment #7: We agree that the discussion is long and following the comments from Anonymous Referee #1 and #2, we will seek to focus more on the discussion of hydrological pathways and less on the potential processes behind the results in the Winter and Summer rainfall data. This will also allow room for an improved discussion of policy and future work.

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Interactive comment on Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2020-312>, 2020.

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