

## ***Interactive comment on “Long term variability of the annual hydrological regime and sensitivity to temperature phase shifts in Saxony/Germany” by M. Renner and C. Bernhofer***

### **Anonymous Referee #2**

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This is an interesting analysis and presents a new and probably useful way to think about the relationship between changes in the seasonality of temperature and changes in seasonality of the hydrological cycle. I recommend publication, but also feel that the analysis and presentation can be improved substantially.

Major critiques:

(1) This paper's approach is to analyze each river basin separately and only present results on a basin-by-basin approach. It would be easier for me to get a sense of the strength of the overall results if the analysis were also done in an averaged sense, averaged across either all basins or across all basins within a given cluster. I would

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expect this to give stronger results and it would allow for a clearer and more succinct communication of the fundamental findings of the study.

(2) It is somewhat difficult to ascertain how significant the various findings are. Given the large number of tests performed in this study, a succinct statement of the significance of each result (P value), how this significance estimate was arrived at, and how autocorrelation of the time series was dealt with, should be made in each instance at the point that the result itself is presented. This would be made easier if analysis was also done aggregated over the entire dataset (or cluster).

(3) The two methods used for computing the amplitude and phase of the 1/year Fourier component are fundamentally the same, down to a choice of windows. Equation (5) implies a boxcar filter of width 1-year. The methods state that equation (2) is evaluated using a "simple moving average filter", presumably also a boxcar filter. Thus it appears that the only difference is window length.

(4) This paper contains a large number of different analysis and the authors should do more to help the reader identify what is important. For example, the two most interesting results of this paper are (a) that runoff ratio has shifted earlier for basins with elevation above 400 meters and has shifted later for basins with elevation below 400 meters (figure 6), and (b) the identification of a relationship between temperature phase variability and runoff ratio variability. Point (a) is sufficiently buried that it would be easy for a casual reader to miss, and its significance is not assessed. Point (b) is given more attention, but still, for example, does not appear until the fourth paragraph of the abstract.

(5) The abstract is much too long. Much of the material in the abstract is not necessary to communicate the fundamental results, and the rest can be stated more succinctly.

Minor Comments:

(1) It is not clear what is meant by "Approximating the annual cycle by the means of

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harmonic functions gave acceptable results" What is acceptable? The paper should report the average fraction of the runoff ratio time series variance that is explained by the 1/year Fourier component. I see numbers for 6 specific years in Lichtenwalde in figure 1, but would like an aggregate number to get a sense of how well this works in general.

(2) p812, 12-14 Approximation of annual cycle using the 1/year Fourier component requires 3 parameters, not 2 (mean, phase, amplitude).

(3) p814 19-22 What is a "pronounced hydrological regime"? And why are metrics such as half-flow date not useful in these regimes?

(4) p815 23 "So instead OF using ..."

(5) p824 19-20

I see no evidence of periodicity at low frequencies, and none is presented. The following sentence seems to indicate that the authors as well find no evidence of low-frequency periodicity.

(6) p826 3-14

From figure 5, the high frequency component appears quite similar between the two clusters as well. Is it the case that the two clusters are distinguished, primarily, by their low-frequency behavior?

(7) p827 1-5 (a) What does it mean for annual phase of basins of cluster 2 to be "more pronounce"? Is the statement that the phase is later? In general the word "pronounced" seems to be used in this paper to convey something specific, but that meaning is not clear to this reader. Strongly suggest replacing it with more specific adjective in all cases. (b) The trends in the phases here represent one of the two fundamental results of this paper, and yet this result is buried, and its significance does not appear to have been estimated. This should be one of the leads, and in the abstract. (c) suggest adding arrow to figure 6 to indicate direction of rotation associated with "later" seasons.

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