Summary

The author is grateful for the constructive comments provided by the reviewers. Substantial modifications have been made to the revised manuscript. The overall length of the manuscript has been reduced by nearly five pages. Some subsections containing redundant information have been deleted. Sentences throughout the manuscript have been simplified and numerous paragraphs have been consolidated. The reduction in text volume allows the cumulative areawise to be better emphasized and also enhances the overall readability of the manuscript. Additionally, the formalization of the persistent homology method enhances the readability of Section 3. Provided below are the reviewer comments in bold text and the responses to the comments.

Reviewer 2

First of all, the manuscript has two distinct goals, one on the methodology and the other on its application. This distracts the audience from reading the manuscript.

Text describing the physical interpretation of results has been shorted to put less emphasis on the applications. However, the author feels that geophysical examples in a journal aimed at geophysical research is important because the inclusion sets important benchmarks for further application of the method.

The second critical point is that the manuscript has an imbalance in section structure.

Substantial reconstructing of sections has been made to balance the text volume among the sections. Please see the response to the comment below.

Section 1, 2, and 3 have understandable text volume, but section 4 is very long (with 6 subsections). Section 5 and 6, in contract, are very short. I cannot read section 4 so easily (i.e., without repeating from the beginning of the section) for its tiring construction.

The length of Section 4 has been dramatically reduced. Subsections 4.2, 4.4 and 4.5 have been deleted. Text from the deleted subsections have been consolidated and shortened. Subsection 4.6 has been made into a new section (Section 8) and split into two subsections. The new Section 8 describes the statistical properties of the cumulative areawise test and is thus separate from the development section, which now Section 7. The result of the text consolidation and the splitting of Section 4 in the original manuscript is shorter sections with text volume more balanced with the other sections in the revised manuscript.

The manuscript is organized as follows. Here are my comments on each section.

Section 1 addresses the wavelet estimator among other spectral estimators, and discusses the problem or importance of the test for statistical significance in the wavelet spectrum. The goal of the manuscript is not clearly set and it is difficult to follow the strategy of the method development in the manuscript.

The objectives of the manuscript are now clearly stated in Section 1. The clearly stated objectives will help the reader follow the overall strategy of the method development.

Section 2 reviews the significance tests such as pointwise and geometric tests. This section essentially overlaps with the author's recent paper (NPG, 22, 139-156, 2015). I propose to delete this section. The contents are already published by the author. Also, Figure 1 distracts the audience from concentrating on the new method with homology.

The review of the existing tests has been substantially shortened to reduce the amount of overlap with worked published in Schulte et al., 2015. A complete removal of the section seems inappropriate because knowledge of the existing procedures is necessary to understand the development of the cumulative areawise test.

Section 3 finally (on page 12) presents the method of the homology with an application to red-colored noise. Nevertheless, the exact or quantitative definition is not given, so it is unclear to the readers how the algorithm is constructed to evaluate the persistent topology. This section needs a lot more explanations with equations and definitions. As the concept of the homology is not quantitatively defined, I do not follow the homology method.

Some equations and formal definitions are now presented in Section 3 (now Section 6). However, a full mathematical treatment of persistent homology is beyond the scope of the paper. A full treatment would require the introduction of concepts from general topology, group theory, and algebraic topology, which would substantially increase the length of the manuscript. Nevertheless, the formal definitions added are adequate for a basic understanding of persistent homology applied in this paper. The reader is referred to cited works for details of persistent homology because Reviewer 1 found the paper too long and encouraged the use of citations throughout the manuscript. It is also noted that Figure 4 has been changed to reflect the changes made throughout Section 6 in the revised manuscript.

Section 4 is hard to read. It is too long (13 pages and 6 subsections). The subsections are: 4.1 Geometric pathways, 4.2 Pointwise significance level selection: maximization method, 4.3 Application to ideal pathways, 4.4 The null distribution, 4.5 Computational remarks, 4.6 Comparison with geometric test. This structure is not understandable, and I do not see what the author wants to say in this section.

Section 4 (now Section 7) has been substantially shortened. Subsections 4.4 and 4.5 have been removed entirely. Moreover, subsection 4.6 has made into its own section (now Section 8). The reason for making subsection 4.6 into a new section is that the subsection examines the properties of the cumulative areawise test and therefore does not belong in the development section.

Section 5 (Climate applications) is a small section with only 1.5 pages (35 lines), and presents an application of the developed method. The text volume is too small and I do not see any necessity or reason to add this section into the manuscript. Delete the section.

The author feels that this section is important because the intended audience of the paper is geophysical researchers. The application of the testing procedure provides important benchmarks for further applications of the method. The author could not find a way of increasing the text volume of the Section 5 (now Section 9) without compromising the flow of the paper.

Section 6 (Conclusions) is merely summarizing the manuscript and does not discuss the method in depth. For examples, what is the limit of the method? Also, I do not appreciate to state that a Matlab software is available without presenting the algorithm in this manuscript. Delete the sentence.

Section 6 (now Section 10) has been expanded by inserting a paragraph describing the limitations of the test. Also, included is a paragraph describing the application of the procedure to wavelet coherence and global wavelet spectra and discussion of its generalizations to higher dimensions.

The algorithm was presented throughout the manuscript and therefore stating the availability of Matlab software seems appropriate.

References:

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