Nonlinear Processes
in Geophysics
Open Access
Discussions

Interactive comment on "Geometric and topological approaches to significance testing in wavelet analysis" *by* J. A. Schulte et al.

Anonymous Referee #2

Received and published: 21 November 2014

The manuscript describes new methodology for advancing statistical significance testing of wavelet power spectra. The methodology builds from previous work in significance testing and addresses several problems that previous work did not address. The manuscript is generally very well written and concise, in particular given that it blends sophisticated time-frequency decomposition, statistical, and topological concepts. The work represents advancement in the quantitative interpretation of wavelet analysis, which is a topic that has received criticism. Therefore, I recommend it for publication in Nonlinear Processes in Geophysics. However, I have several general and specific comments that should be addressed before publication.

General Comments

(1) The manuscript describes significance testing based on geometric and topological

properties of regions within the wavelet power spectrum. These properties are closely tied to the parameters of the wavelet. The manuscript only considers the Morlet wavelet with $\omega 0=6$. The authors should discuss the sensitivity of their results to other commonly used wavelets or wavelet parameters that provide more (less) precision in the time domain and less (more) in the frequency domain compared to Morlet.

(2) What is the purpose of using the NAO time series as an example to assist with describing and testing the new methods? After it is introduced, it is largely dismissed as being a poor choice for this task and the focus shifts to the Nino 3.4 index.

(3) The Cone of Influence (COI) is referenced in the figure captions, but not described in the text. For pointwise significance, identifications are idepenendent, so pointwise significance outside the COI can be ignored in the same way that wavelet power can be ignored outside the COI. It seems like this might not be true for geometric and topological methods. Therefore, are topological and geometric tests sensitive to edge effects (i.e., can edge effects influence significance even in regions where power is not influenced by edge effects)? If so, please provide more information about the importance of the COI and how it might influence results using the proposed methods.

(4) Significance is determined by the 90% confidence level for the areawise and geometric tests, but 95% is used for the pointwise test. What is the reason for this inconsistency?

(5) Throughout the text and captions, Figures 1, 2, 6, and 7 are described as "wavelet power spectra", but wavelet power is not shown in the figures. The authors should find another way to describe the contents of the figures or include contours of wavelet power.

(6) There is no discussion about how "holes" are identified and I don't feel that there is enough information for future work to adopt the method. Minimally, holes should be defined quantitatively somehow, but it might also be helpful to describe how an algorithm could be developed to identify them. I am further confused because I cannot see

all the holes that are identified in Figure 6 and 7, in part perhaps because the wavelet power is not shown, and in part because the significance patch does not completely encircle them.

Specific Comments

(1) S1333L20: To better orient the reader, can you please provide a sentence or two that describes the main problems with pointwise testing?

(2) S1335L16-18: This sentence should reference Figure 1.

(3) S1335L18-20: This sentence should reference Figure 2. The sentence states that periods from 16 to 64 months are significant, but Figure 2b only goes from 1 to 7 months. I suspect that the axis is actually in years or that the values are j not sj. However this is resolved it would be good to maintain consistency between Figs. 1 and 2.

(4) Section 3.1: Please define the term "patch". Section 3.1 is good place to define the term similarly to how it is defined in the captions to Figs. 1 and 2, but the introduction might be a good place too.

(5) S1336L5: Can this sentence be rearranged to define a and b at the beginning? Also, is it necessary to use b and a? Does b = t = tappendixA and does a = s = aappendixA ?

(6) S1336L15-17: This sentence is not quite clear. If a kernel fits within the patch is the entire continuous patch interpreted as significant or only the points that fall within the kernel?

(7) Section 4.1: It would be helpful to lead this section (or alternatively close the previous section) with a sentence that reminds the reader of the objectives of the developing a new geometric test to improve upon the areawise test.

(8) S1337L15 & Eq. 6: Please define j. Shouldn't it be tn and sj instead of ti and si

C620

since s and t are independent (n need not equal j) and also have different maximum values (i.e., $J \neq N$)? Thus, pn,j not pi?

(9) S1338 Equations: Again, I'm confused about i. I think it is used appropriately for t, but the index of s is an entirely different coordinate than that of t. Additionally, n is defined as the index of time (1 to N) in Eq. (2). It seems to be redefined here.

(10) S1340L24: The p-value here is not the same as p in S1337L15, yes?

(11) S1346L18: Is "top panel" actually the bottom panel (Fig. 6c)?

(12) Captions for Figures 1 and 2: It might be helpful to call out relevant sections throughout the captions, as was done for Fig. 2a.

(13) Caption for Figure 3: Please clarify in the caption that the reproducing kernel is associated with the areawise test and not the geometric test, but is shown for reference.

———————————————

Interactive comment on Nonlin. Processes Geophys. Discuss., 1, 1331, 2014.