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Nonlinear Processes in Geophysics
Discussions
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Interactive comment on "Wavelet analysis of the singular spectral reconstructed time series to study the imprints of Solar–ENSO–Geomagnetic activity on Indian climate" *by* S. Sri Lakshmi and R. K. Tiwari

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Reply to the interactive comment on "Wavelet analysis of the singular spectral reconstructed time series to study the imprints of solar-ENSO- Geomagnetic activity on Indian climate' by S. Sri Lakshmi and R.K.Tiwari Anonymous Referee #1 The authors are very much thankful to the reviewer for his professional comments and suggestions for improving the manuscript. We have incorporated the reviewer's suggestions accordingly: Introduction: 1. Page 1449, line 8-11: The sentence has been modified accordingly and has been split for better clarification. (The Sun's long-term mag-

netic variability caused by the sunspots is considered as the primary driver of climatic changes. The short-term magnetic variability is due to the disturbances in Earth's magnetic fields caused by the solar activity and is indicated by the geomagnetic indices.) 2. Page 1450, line 6: The reference of (Gray et. al., 2010) has been added to the sentence before "Recent Studies".

Methods: 1. Page 1456, line 15: The authors have clearly modified and indicated the events they are referring in the manuscript. (We have applied the wavelet analysis to analyze the non-stationary signals which permits the identification of main periodicities of ENSO-sunspot-geomagnetic in the time series. The results give us more insight information about the evolution of these variables in frequency-time mode.) 2. Page 1457: The word "sliding method" has been modified to "sliding window". 3. Page 1458, equation 8: The explanation for W is given in page 1458 and in line 10.(The wavelet power is and the complex argument of can be interpreted as the local phase.) 4. Page 1457: Explanation for 'a' is given (The variable 'a' is called the scaling parameter that determines the frequency (or scale) so that varying 'a' gives rise to wavelet spectrum.)

Results and Discussion: 1. Page 1459, line 8: As suggested by the reviewer, the words "have taken" has been replaced with "analyzed" and the latter "and analysed 'has been removed from the sentence. 2. The repetitions in the manuscript in page 1459 (line 22-23) has been removed. 3. The figures as well as text have been modified and order of the data has been maintained as suggested by the reviewer. 4. Page 1462, line 1: The words in the sentence "checking the breaks in the Eigen value spectra" has been replaced by "identification of gaps". 5. The word 'monsoon" has been substituted by the word "climate" in order to avoid confusion.

Conclusion 1. The first sentence of the manuscript has been modified accordingly as suggested by the reviewer. 2. The second sentence has been clarified. 6. The author has added sentences relating to the 33-year cycle in the conclusions of the manuscript.

Technical corrections:

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Introduction: Page 1451, line 20: The word “evidence for” has been modified as “evidence of”.

Data The reference for tree ring data is (Yadav et. al., 2004). The data has been provided to us by Dr. R.R.Yadav. Hence the authors have acknowledged in the manuscript Dr. R.R.Yadav for providing his data for carrying out the analysis.

Methods 1. Page 1454, line 5 and 17: Repetition of step 1 has been replaced by step 2. 2. Page 1455, line 9: the words “is”, “if”, “strands” etc., has been replaced as suggested by the reviewer. 3. Page 1456, line 17 & 19: Repetition of Morlet wavelet has been removed. 4. Page 1456, line 2: New paragraph has been started here. 5. Page 1456, line 4: The word “method” is added. 6. Page 1456, line 9: The word “In particular” is added. 7. The word “morlet” has been modified as “Morlet” throughout the manuscript. 8. Page 1463, line 13: The word “plays” is modified to “play”. 9. Page 1463, line 27: The influence of the Earth’s magnetic field on the time series on a shorter and longer time scales.

Conclusion 1. The abbreviation WH is written as Western Himalayas. 2. Line 16: “continent” has been replaced by “Indian subcontinent”.

Acknowledgements: 1. The authors have modified the sentence accordingly as suggested by the reviewer.

Figures: All the information in the figures is added in the caption of the figures. Figure 1: The coordinates of the data are added in the figures. Figure 2: The font size on the subfigures has been increased. Figure 3: The black line separating the subfigures is removed. Figure 5: The abbreviations in the captions are spelled out as suggested by the reviewer. Figure 6: As it was difficult to plot all the subfigures with increasing font, we have tried to split the figure and renamed as Figure 6 & Figure 7. As pointed out by the reviewer, upper left corner plot – i.e. the sunspot RC (1) & RCs (2-3) are combined and plotted as RC(1-3) in a single plot. And the lower left figure – i.e. geomagnetic Indices, the RC (1); RCs (2-5); RCs (6-8) & RCs (10-13) are plotted in

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subplots separately. Figure 7: The labels to the right-hand subplots are added and renamed as Figure 8. Figure 9: The fonts and units are added to both the axes and renamed as Figure 10.

Please also note the supplement to this comment:
http://www.nonlin-processes-geophys-discuss.net/2/C681/2016/npgd-2-C681-2016-supplement.pdf

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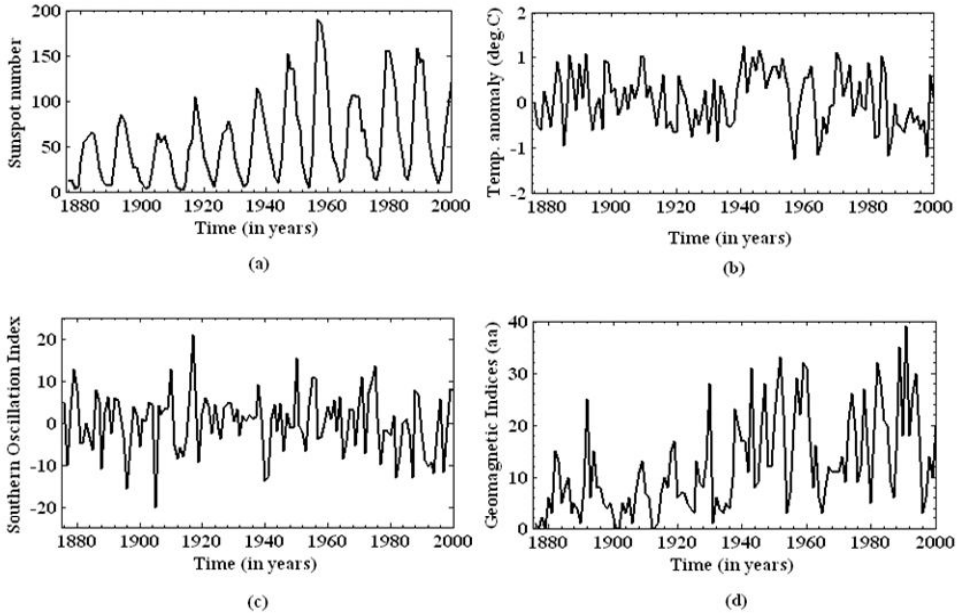

Fig. 1. Time series data of (a) Sunspot Index (b) the mean pre-monsoon temperature anomalies of the Western Himalayas (c) Southern Oscillation Index (SOI) and (d) Geomagnetic Indices (aa indices) fo

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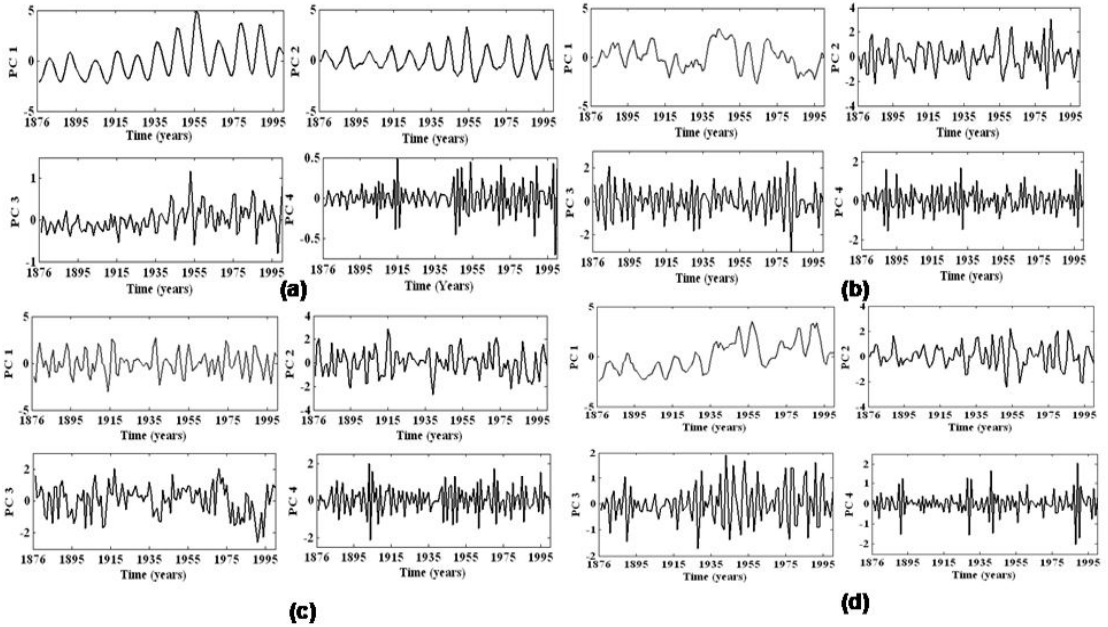

Fig. 2. First four principal components (PCs:1-4) for time series (a) Sunspot numbers (b) the mean pre-monsoon temperature anomalies of the Western Himalayas (c) SOI index and (d) Geomagnetic Indice

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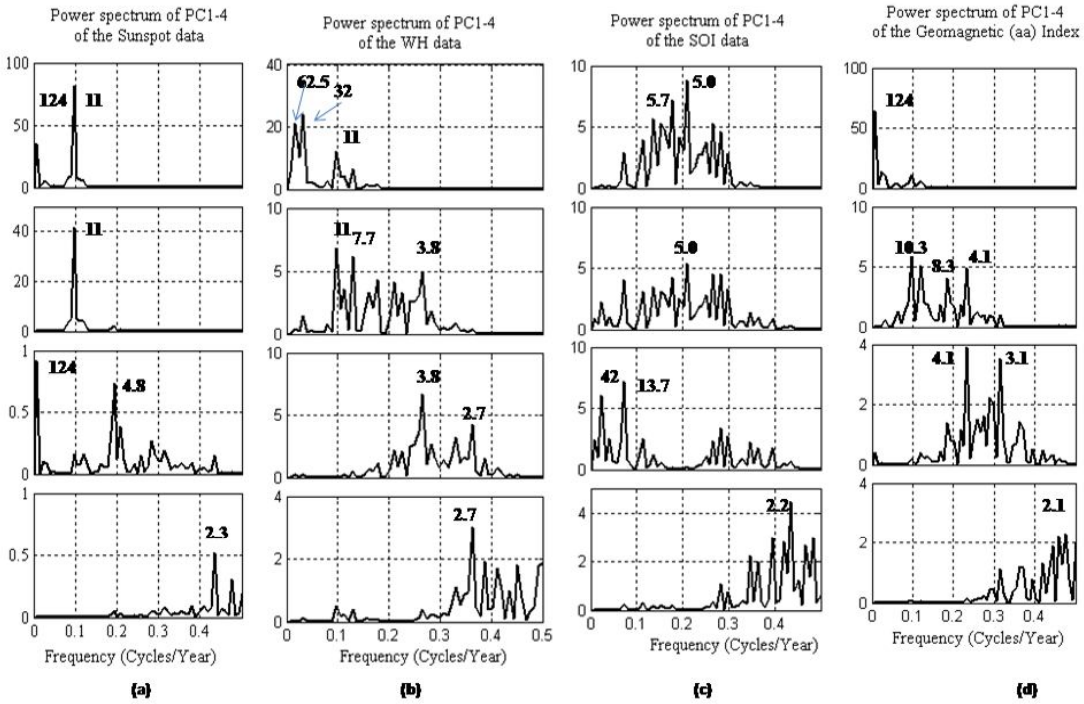

Fig. 3. Power spectra of the first four principal component (PCs) (PC1-4 shown in Fig. 2) for all the data sets with their significant periodicities at 124, 11, 4 and 2.8 years are indicated in bold

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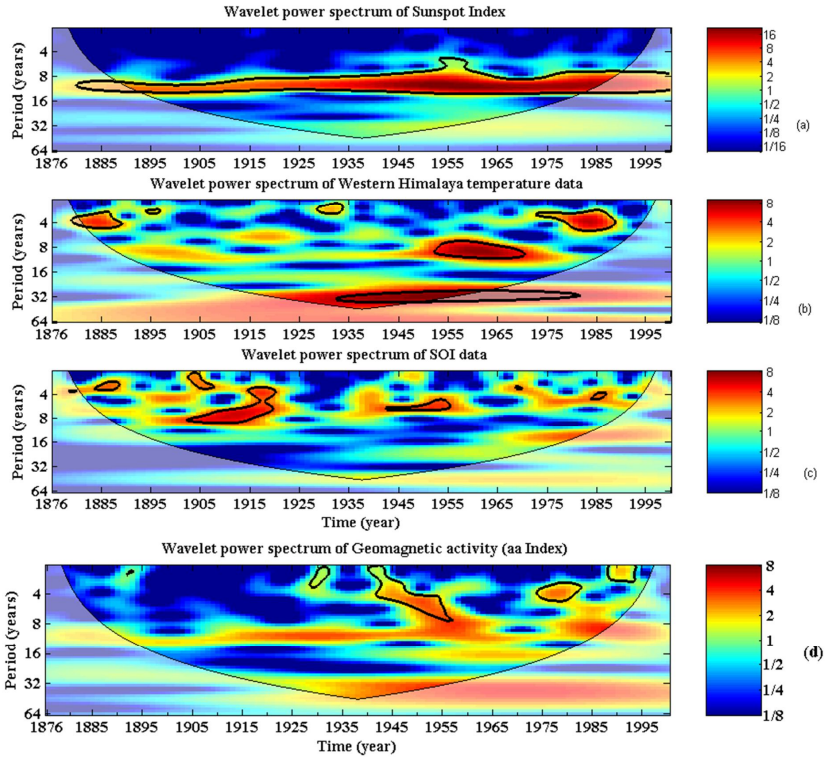

Fig. 4. Wavelet power spectrum of (a) Sunspot Number (b) Western Himalaya temperature data (c) Southern Oscillation Index (SOI) and (d) Geomagnetic activity (aa Indices) with cone of influence (lig

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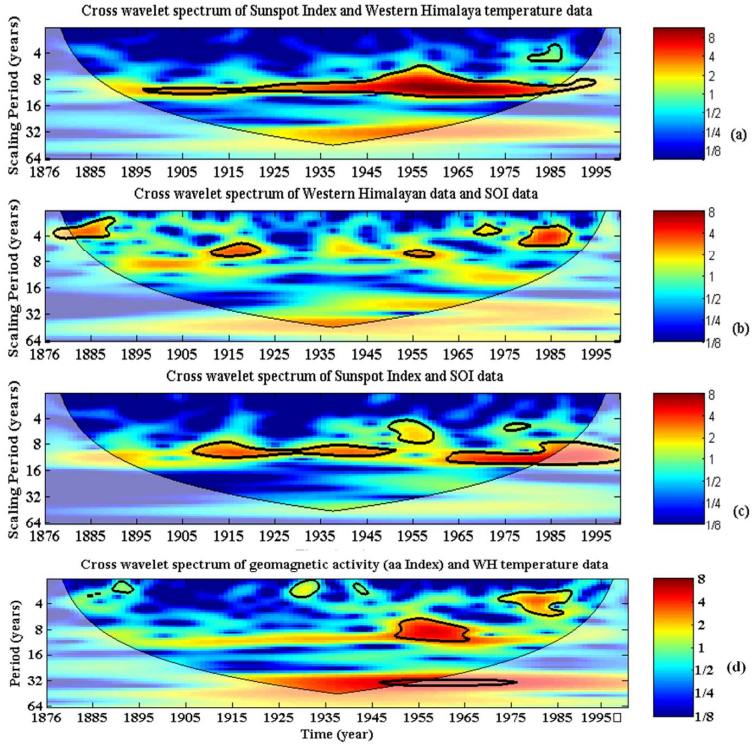

Fig. 5. Cross Wavelet spectrum between (a) Sunspot number-Western Himalayan data (b) Western Himalayan-Southern Oscillation Index (c) Sunspot number- Southern Oscillation Index and (d) Geomagnetic

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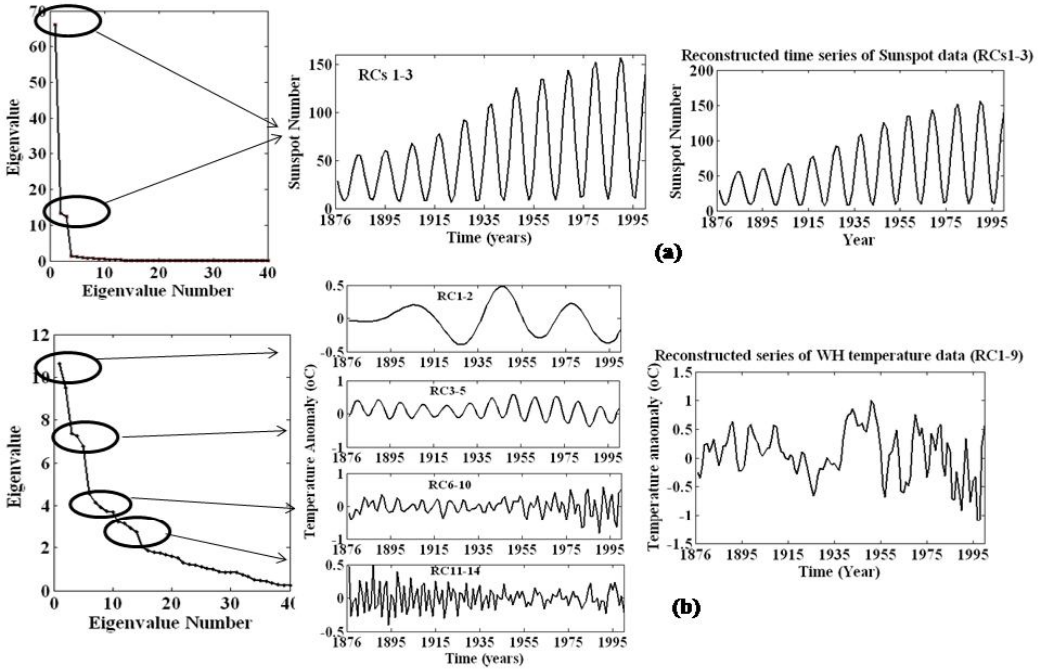

Fig. 6. Singular spectra with its SSA decomposed components & its reconstructed time series for (a) Sunspot Number (b) Western Himalaya temperature data

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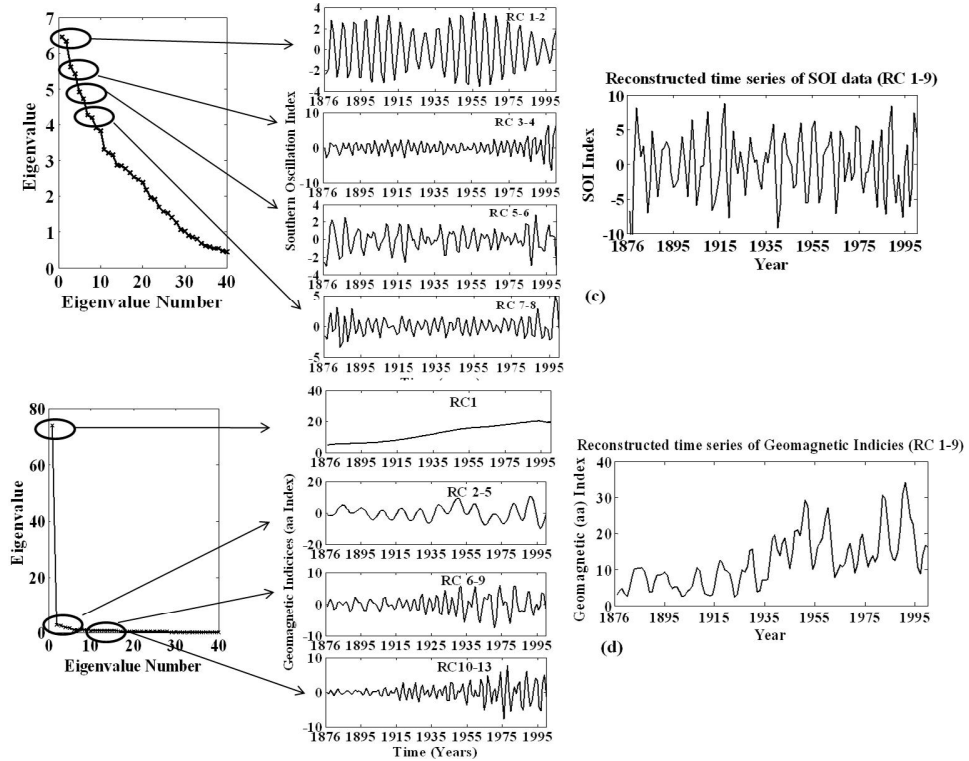

Fig. 7. Singular spectra with its SSA decomposed components & its reconstructed time series for (c) SOI and (d) Geomagnetic activity (aa Indi

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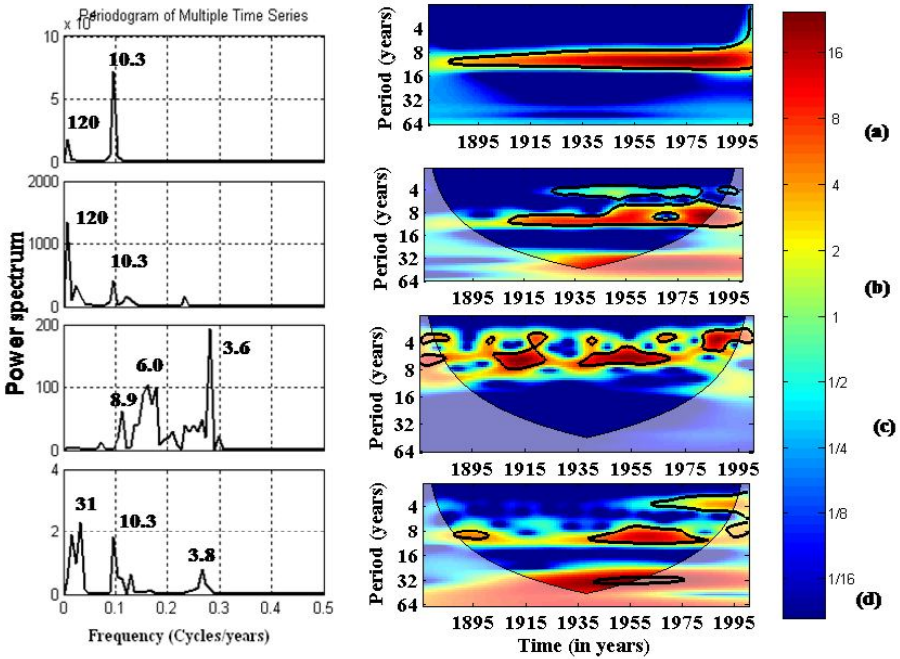

Fig. 8. Power spectrum and Wavelet power spectrum of SSA reconstructed (a) Sunspot data (b) Geomagnetic Indices (aa index) (c) SOI index and (d) the Western Himalayas temperature data with cone of i

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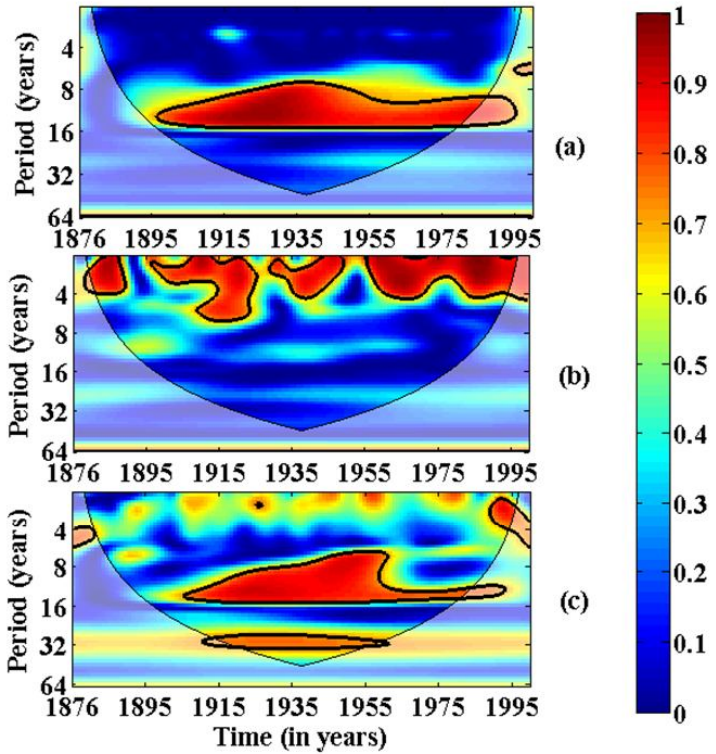

Fig. 9. Squared wavelet coherence plotted for the SSA reconstructed time series between (a) WH-SSN (b) WH-SOI and (c) WH-aa index with cone of influence (lighter shade smooth curve) and black lines

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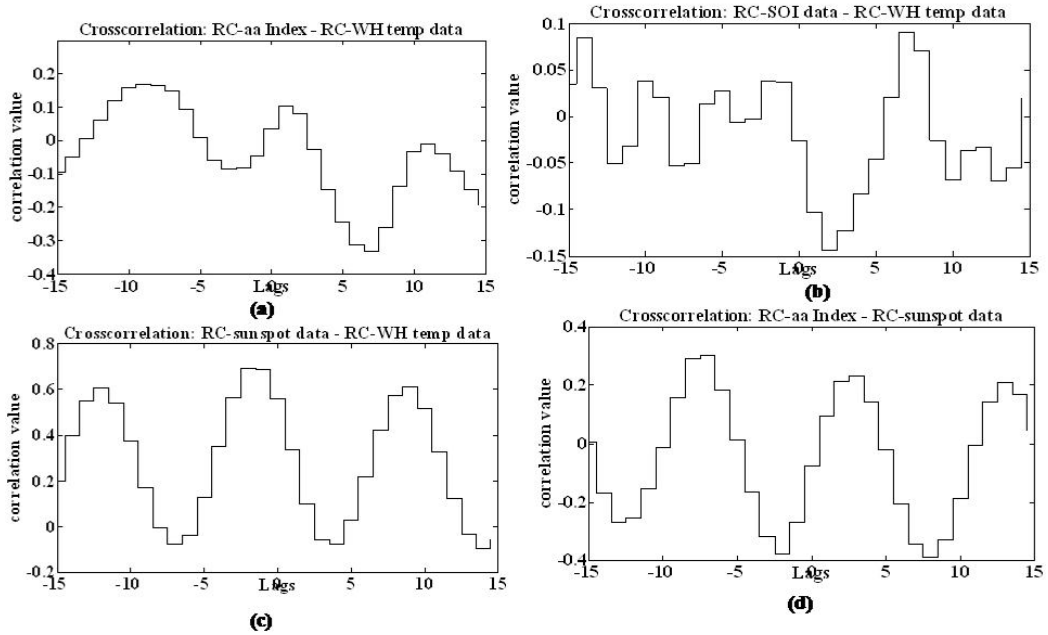

Fig. 10. Cross-correlation of SSA reconstructed time series of (a) aa Index-Western Himalayan (WH) temperature data; (b) SOI-WH temperature data; (c) sunspot –WH data and (d) aa Index-sunspot data.

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