



HAAR WAVELET ANALYSIS OF CLIMATIC TIME SERIES

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In order to extract the intrinsic information of climatic time series from background red noise, we will first give an analytic formula on the distribution of Haar wavelet power spectra of red noise in a rigorous statistical framework. The relation between scale a and Fourier period T for the Morlet wavelet is $a = 0.97T$. However, for Haar wavelet, the corresponding formula is $a = 0.37T$. Since for any time series of time step δt and total length $N\delta t$, the range of scales is from the smallest resolvable scale $2\delta t$ to the largest scale $N\delta t$ in wavelet-based time series analysis, by using the Haar wavelet analysis, one can extract more low frequency intrinsic information. Finally, we use our method to analyze Arctic Oscillation which is a key aspect of climate variability in the Northern Hemisphere, and discover a great change in fundamental properties of the AO,—commonly called a regime shift or tripping point.

Our partial results have been published as follows:

[1] Z. Zhang, J.C. Moore and A. Grinsted, Haar wavelet analysis of climatic time series, *Int. J. Wavelets, Multiresol. & Inf. Process.*, in press, 2013

[2] Z. Zhang, J.C. Moore, Comment on "Significance tests for the wavelet power and the wavelet power spectrum", *Ann. Geophys.*, 30:12, 2012