Ocean Sci. Discuss., 7, 501–519, 2010
www.ocean-sci-discuss.net/7/501/2010/

Temporal energy partitions of Florida extreme sea level events as a function of Atlantic multidecadal oscillation

J. Park, J. Obeysekera, and J. Barnes

Addressed in this paper is essentially an approach to assess the relative energy distribution of non-stationary extreme sea level events across different temporal scales. An energy-conservative metric based on the discrete wavelet transform is applied thereof. A non-stationary time-series analysis based on the so-called Maximal Overlap Discrete Wavelet Transform (MODWT) is used to evaluate surge events by decomposing event energy into independent components.

Among several possible choices of wavelet method the Discrete Wavelet Transform (DWT) is widely used; but DWT transform is not translation invariant and imposes a restriction on the stretch of the data set if a complete multi-resolution analysis is to be done. So, the MODWT is preferred by the authors since it avoids some disadvantages of the DWT in certain contexts, but at the expense of storing additional coefficients as part of the analysis.

Relevant to this paper, the authors indicate that, though the underlying temporal shifts in the ocean-related issues warrant a frequency analysis, owing to the transient nature of such events a Fourier decomposition will (**or may?**) poorly represent the event power as a function of frequency. As such, the authors prefer a better tool for transient analysis, namely, the wavelet transform. They also recognize that the wavelet transform typically does not (**or may not?**) provide the degree of spectral resolution afforded by Fourier analysis, its ability to decompose non-stationary signals into independent energy components is a significant advantage; and, they use the MODWT to analyze non-tide residual events across a spectrum of temporal scales.

The wavelet estimation via the maximal overlap DWT (MODWT) is an undecimated or translation invariant or shift invariant DWT and is computed by the same filtering steps as in ordinary DWT but without sub-sampling the filtered output. By this approach, the MODWT, however, gives up orthogonality in order to gain features which the DWT does not possess.

Queries… The nonstationarity of the underlying temporal process is implicitly assumed… Is such nonstationarity proven to be inherent in the ocean context? Or is quasi-stationary? (The authors can justify it)
Assuming the process to be nonstationary (as the authors done)….

In order to adapt to unknown features in the underlying spectral density function, the filtering sequence of the MODWT may be generalized to allow any arbitrary dyadic partition of the frequency interval using wavelet packets [Selesnick I W 2002 The design of approximate Hilbert transform pairs of wavelet bases *IEEE Trans. Signal Process.* **50** 1144–52]. Relevant transform is known as the MODHWPT (maximal overlap discrete

wavelet packet transform using Hilbert wavelet pair filters) wherein both broad- and narrow-band features can be investigated by varying the frequency intervals based on the depth of the transform. Classical univariate and bivariate statistics in the spectral domain (e.g., power spectrum, coherence, phase) can be calculated from the analytic wavelet coefficients—thus producing a scale-by-scale time-varying spectral analysis. Two types of estimates, cyclical and evolutionary (non-staionary) are known to analyze an event that is either repeating or continuously changing, respectively. The assumption of block stationarity, or a smoothly varying spectrum, is common when estimating time-varying spectral characteristics in either the frequency or wavelet domain.

When developing asymptotic theory of spectral estimators for non-stationary time series, ‘‘asymptotic’’can be defined such that as the number of observations goes to infinity one can gain information about the process on a finer grid over a fixed interval in time (meaning the so-called *infill asymptotics*), rather than gathering future observations of the process. Such theoretical framework is useful in the present context because the sampling rate for the test time series (in Reviewer’s opinion) may ensure that there is a fine grid of sub-second observations. Relevant block stationarity imposed thereof on scales can be calculated by the authors and the and hence, any implicit limitations imposed by the sampling rate of the data (that can be detected) have to be elucidated. If the data are truly non-stationary across these scales, then the only solution would be to acquire observations at a higher sampling rate.

In summary…

This Reviewer finds the work as original and interesting
The authors can enhance the contents of the paper in view of my observations as above on non-stationarity aspects plus introducing MODHWPT estimations to compare with the MODWT results.