Geophysical Research Abstracts
Vol. 16, EGU2014-2232, 2014
EGU General Assembly 2014

Continuous Time-Frequency Transform for Unevenly Sampled Time Series and Significance Testing

Guillaume Lenoir and Michel Crucifix
Université Catholique de Louvain, ELI, ELIC - TECLIM, Louvain-la-Neuve, Belgium

Spectral analysis is a common approach for the interpretation of climate time series. In particular, the continuous wavelet transform and the Gabor transform are generally well-suited for non-stationary, multi-periodic and highly noisy data.

The purpose of this contribution is to propose a rigorous framework to estimate the significance of wavelet spectra given unevenly sampled data. To this end, we expand the theory developed by G. Foster [1], originally targeted for astronomical data, as follows:
(i) Define the model: Significance testing is always based on a model, that needs to be properly defined.
(ii) Define the parametric hypotheses H0 (null case) and H1 (alternative case), and attempt to find an appropriate statistical summary. The idea is to obtain a well-known distribution under H0, allowing an analytical approach and avoiding most of Monte-Carlo simulations which can be expensive in time.

We also discuss the choice to be done for the analysis function of the time-frequency transform. Indeed, Morlet wavelet is often chosen, but it is not always the best option. Some examples of paleoclimate time series analysis will be given. Finally, we investigate whether considering the interpolated data to get a constant time step and using the traditional tools may lead to significant errors.

Reference:
[1] G. Foster. Wavelets for period analysis of unevenly sampled time series. The Astronomical Journal, 112(4):1709–1729, 1996.