Geophysical Research Abstracts
Vol. 14, EGU2012-4595-1, 2012
EGU General Assembly 2012

Climate wavelet spectrum estimation under chronology uncertainties

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Several approaches to estimate the chronology of palaeoclimate records exist in the literature: simple interpolation between the tie points, orbital tuning, alignment on other data... These techniques generate a single estimate of the chronology. More recently, statistical generators of chronologies have appeared (e.g. OXCAL, BCHRON) allowing the construction of thousands of chronologies given the tie points and their uncertainties. These techniques are based on advanced statistical methods. They allow one to take into account the uncertainty of the timing of each climatic event recorded into the core.

On the other hand, when interpreting the data, scientists often rely on time series analysis, and especially on spectral analysis. Given that paleo-data are composed of a large spectrum of frequencies, are non-stationary and are highly noisy, the continuous wavelet transform turns out to be a suitable tool to analyse them. The wavelet periodogram, in particular, is helpful to interpret visually the time-frequency behaviour of the data.

Here, we combine statistical methods to generate chronologies with the power of continuous wavelet transform. Some interesting applications then come up: comparison of time-frequency patterns between two proxies (extracted from different cores), between a proxy and a statistical dynamical model, and statistical estimation of phase-lag between two filtered signals. All these applications consider explicitly the uncertainty in the chronology. The poster presents mathematical developments on the wavelet spectrum estimation under chronology uncertainties as well as some applications to Quaternary data based on marine and ice cores.