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Bivariate multiscale analysis of paleoclimate records

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Paleoclimate records often need to be "correlated" in order to obtain phase relationships between them. After the physical and potentially hard problem of obtaining coherent chronologies of two records, the question of their phase dependence has to be elucidated in order to infer physical relationships. If such a phasing exists, its stability through time is often assumed when performing standard cross-spectral analyses. This assumption is certainly faulty when considering threshold mechanisms or non-stationary processes. This problem becomes more acute when at least one of the time series is a mixture of oscillations with a wide range of periods, like Quaternary proxy records, which yield oscillations of periods between 1500 years and 100000 years. In this presentation, I will discuss a method inspired from multiscale analysis that determines the optimal phase lags between two time series, and their dependence on the epoch and timescale. This method is based on local regressions, with varying windows. I will give an application of such method on the methane and isotopic records of Vostok, covering the last 400000 years. The evolution of the phase lags and their dependence on the time scale will be discussed.