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Time Dependent Intrinsic Correlation Analysis of Temperature and Dissolved Oxygen Time Series Using Empirical Mode Decomposition

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In the marine environment, many fields have fluctuations over a large range of different spatial and temporal scales. These quantities can be nonlinear, nonstationary, and often interact with each other. A good method to study the multiple scale dynamics of such time series, and their correlations, is needed. In this paper we present an application of an empirical mode decomposition based time dependent intrinsic correlation, to two coastal oceanic time series: temperature and dissolved oxygen (saturation percentage). The two time series are recorded every 20 minutes during 7 years, from 2004 to 2011. We illustrate the application of the Empirical Mode Decomposition on such time series, and estimate the power spectra of the time series using the Hilbert transform (Hilbert spectral analysis). We find power-law regimes with slopes of 1.33 for dissolved oxygen and 1.68 for temperature at high frequencies (between 1.2 and 12 hours) and both close to 1.9 for lower frequencies (time scales from 2 to 100 days). We consider the time evolution and scale dependence of cross correlations between both series. The trends are perfectly anti-correlated. The modes of mean year 2.6 years and 1 year have also negative correlation, whereas higher frequency modes have a much smaller correlation. The estimation of time-dependent intrinsic correlations helps to show patterns of correlations at different scales, for different modes.