ANALYSIS AND MODELLING OF SCALING PROCESSES IN THE OCEAN SCIENCES

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In the geosciences, many fields and processes are highly fluctuating over large range of time and space scales. At smaller scales, the variability is often related to turbulent forcing, inducing scaling properties and possible intermittent fluctuations. We work here in such framework and consider time series in oceanographic sciences, recorded at high frequency.
Often such time series possess scaling fluctuations, superposed to deterministic forcing associated with tidal, daily or annual scales. We discuss how to analyse and model fluctuations in such situations. We especially present an analysis approach of intermittency, based on Empirical Mode Decomposition (EMD), a decomposition method developed in the late 1990s to represent a nonlinear time series into a sum of modes, each having a characteristic frequency. Based on EMD, we have developed a method called arbitrary order Hilbert spectral analysis: such method is able to extract intermittency scaling exponents from time series possessing strong deterministic forcing [1, 2].
Here we present this method and we illustrate it using several examples from the field of oceanic sciences [3]:

- Coastal marine velocity turbulence, recorded in the surf zone using an Acoustic Doppler Velocimeter (ADV);
- Oceanic temperature compared to atmospheric simultaneous values, dissolved oxygen, as well as fluorescence measurements, each recorded every 20 minutes in the coastal waters of the English Channel (Boulogne-sur-mer);
- Hourly water level series, modelled and measured, in the ports of Boulogne-sur-mer, Calais and Dunkerque (Eastern English Channel).

We finally discuss scaling stochastic processes able to generate series possessing such scaling and intermittent properties.

References

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