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Analysis of daily river flow fluctuations using empirical mode decomposition and arbitrary order Hilbert spectral analysis

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In this work, we present the analysis of two long time series of daily river flow data, 32 years recorded in the Seine river (France), and 25 years recorded in the Wimereux river (Wimereux, France). We apply a scale based decomposition method, namely Empirical Mode Decomposition (EMD), on these time series. The data are decomposed into several Intrinsic Mode Function (IMF). The mean frequency of each mode indicates that the EMD method acts as a filter bank. Furthermore, the cross-correlation between these IMF modes from the Seine river and the Wimereux river demonstrates strong correlation among the large scale IMF modes, which indicates that both rivers are influenced by the same events. We also find that the large scale parts have the same evolution trend. We finally apply arbitrary order Hilbert spectral analysis (Huang et al. EPL, 2008), a new technique coming from turbulence studies and time series analysis, on the flow of the Seine river. This new method provides on amplitude-frequency representation of the original time series, giving a joint pdf $p(\omega, \mathcal{A})$. When marginal moments of the amplitude are computed, one obtains an intermittency study in the frequency space. Applied to river flow discharge data from the Seine river, this shows the scaling range and characterizes the intermittent fluctuations over the range of scales from 4.5 day to 60 days.

Reference

Huang Y.X., Schmitt F. G., Lu Z.M. And Liu Y.L. An amplitude-frequency study of turbulent scaling intermittency using Hilbert spectral analysis *Europhys. Lett.* 2008, 84: 40010