Geophysical Research Abstracts
Vol. 15, EGU2013-12649, 2013
EGU General Assembly 2013
© Author(s) 2013. CC Attribution 3.0 License.

Multifractal analysis of geophysical time series in the urban lake of Créteil (France).

Yacine Mezemate (1), Ioulia Tchiguirinskaia (1), Celine Bonhomme (1), Daniel Schertzer (1), Bruno Jacques Lemaire (1), Brigitte Vinçon leite (1), and Shaun Lovejoy (2)

(1) Université Paris Est, Ecole des Ponts ParisTech, LEESU, Marne La Vallée, France (yacine.mezemate@leesu.enpc.fr), (2) McGill University, Physics department, 3600 University street, Montreal, Quebec, Canada

Urban water bodies take part in the environmental quality of the cities. They regulate heat, contribute to the beauty of landscape and give some space for leisure activities (aquatic sports, swimming). As they are often artificial they are only a few meters deep. It confers them some specific properties. Indeed, they are particularly sensitive to global environmental changes, including climate change, eutrophication and contamination by micro-pollutants due to the urbanization of the watershed. Monitoring their quality has become a major challenge for urban areas. The need for a tool for predicting short-term proliferation of potentially toxic phytoplankton therefore arises.

In lakes, the behavior of biological and physical (temperature) fields is mainly driven by the turbulence regime in the water. Turbulence is highly non linear, nonstationary and intermittent. This is why statistical tools are needed to characterize the evolution of the fields. The knowledge of the probability distribution of all the statistical moments of a given field is necessary to fully characterize it. This possibility is offered by the multifractal analysis based on the assumption of scale invariance.

To investigate the effect of space-time variability of temperature, chlorophyll and dissolved oxygen on the cyanobacteria proliferation in the urban lake of Creteil (France), a spectral analysis is first performed on each time series (or on subsamples) to have an overall estimate of their scaling behaviors. Then a multifractal analysis (Trace Moment, Double Trace Moment) estimates the statistical moments of different orders. This analysis is adapted to the specific properties of the studied time series, i. e. the presence of large scale gradients. The nonlinear behavior of the scaling functions K(q) confirms that the investigated aquatic time series are indeed multifractal and highly intermittent .The knowledge of the universal multifractal parameters is the key to calculate the different statistical moments and thus make some predictions on the fields.

As a conclusion, the relationships between the fields will be highlighted with a discussion on the cross predictability of the different fields. This draws a prospective for the use of this kind of time series analysis in the field of limnology.

The authors acknowledge the financial support from the R2DS-PLUMMME and Climate-KIC BlueGreen-Dream projects.