Geophysical Research Abstracts,
Vol. 11, EGU2009-10211, 2009
EGU General Assembly 2009

Multifractal Conceptualisation of Hydro-Meteorological Extremes

I. Tchiguirinskaia (1,2), D. Schertzer (1,3), and S. Lovejoy (4)

(1) Univ. Paris-Est, Cereve ENPC-UPVM-ENGREF, 6-8 avenue Blaise Pascal, Champs sur Marne, F 77455 Marne-la-Vallee cedex 2, France; (ioulia@cereve.enpc.fr), (2) CEMAGREF, 3275 route de Cezanne CS 40061, 13182 Aix-en-Provence, Cedex 5, France, (3) Meteo-France, 2, Avenue Rapp, 75007 Paris, France, (4) McGill U., 3600 University st., Montréal, Canada

Hydrology and more generally sciences involved in water resources management, technological or operational developments face a fundamental difficulty: the extreme variability of hydro-meteorological fields. It clearly appears today that this variability is a function of the observation scale and yield hydro-meteorological hazards. Throughout the world, the development of multifractal theory offers new techniques for handling such non-classical variability over wide ranges of time and space scales. The resulting stochastic simulations with a very limited number of parameters well reproduce the long range dependencies and the clustering of rainfall extremes often yielding fat tailed (i.e., an algebraic type) probability distributions. The goal of this work was to investigate the ability of using very short or incomplete data records for reliable statistical predictions of the extremes. In particular we discuss how to evaluate the uncertainty in the empirical or semi-analytical multifractal outcomes. We consider three main aspects of the evaluation, such as the scaling adequacy, the multifractal parameter estimation error and the quantile estimation error.

We first use the multiplicative cascade model to generate long series of multifractal data. The simulated samples had to cover the range of the universal multifractal parameters widely available in the scientific literature for the rainfall and river discharges. Using these long multifractal series and their sub-samples, we defined a metric for parameter estimation error. Then using the sets of estimated parameters, we obtained the quantile values for a range of excedance probabilities from 5% to 0.01%. Plotting the error bars on a quantile plot enable an approximation of confidence intervals that would be particularly important for the predictions of multifractal extremes.

We finally illustrate the efficiency of such concept on its application to a large database (more than 16000 selected stations over USA and Canada) by showing how the mean flow information can be used to estimate reliable return periods of extreme flood events.