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Kolmogorov complexity based measures applied to the analysis of different river flow regimes

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Scientists in different fields study behavior of rivers, which is significantly influenced by human activities, climatic change and many other factors that change mass and energy balance of the rivers. Influenced by the aforementioned factors, the river flow may range from being simple to complex, fluctuating in both time and space. Therefore, it is of interest to determine the nature of complexity in river flow processes, in particular in different parts of its course that cannot be done by traditional mathematical statistics which requires the use of different measures of complexity. It seems that one of the key problems in hydrology is that instead of use of complexity measures in analysis of river flow, hydrologists rather use traditional statistical methods, which are not usually adequate since they are mostly based on assumptions which cannot find a niche in complex systems analysis. We have used the Kolmogorov complexities and the Kolmogorov complexity spectrum to quantify the randomness degree in river flow time series of seven rivers with different regimes in Bosnia and Herzegovina, representing their different type of courses, for the period 1965-1986. We have calculated the Kolmogorov Complexity (KC) based on the Lempel-Ziv Algorithm (LZA) (lower-KCL and upper-KCU), Kolmogorov complexity spectrum highest value (KCM) and overall Kolmogorov complexity (KCO) values for each time series. The results indicate that the KCL, KCU, KCM and KCO values in seven rivers show some similarities regardless of the amplitude differences in their monthly flow rates. The KCL, KCU and KCM complexities as information measures do not see a difference between time series which have different amplitude variations but similar random components. However, it seems that the KCO information measures better takes into account both the amplitude and the place of the components in a time series.

Biography

Dragutin T Mihailovic is a Professor in Meteorology and Environmental Fluid Mechanics at the University of Novi Sad in Serbia. He was the Visiting Professor at University at Albany, The State University of New York at Albany, USA, Visiting Scientist at University of Agriculture, Wageningen, Netherlands and the Norwegian Meteorological Institute, Norway. He has more than 100 peer-reviewed scientific papers in the international journals in subjects related to land-atmosphere processes, air pollution modeling and chemical transport models, boundary layer meteorology, physics and modeling of environmental interfaces, modeling of complex biophysical systems, nonlinear dynamics and complexity. He has edited and wrote seven books. He was the Member of the Editorial Board of Environmental Modeling and Software (1992-2010) and Reviewer in several scientific journals. He was the Principal Investigator in many international projects with USA and several European countries.

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