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Nonlinear Deterministic Chaos in Benue River Flow Daily Time Sequence

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ABSTRACT

The Various physical mechanisms governing river flow dynamics act on a wide range of temporal and spatial scales. This spatio-temporal variability has been believed to be influenced by a large number of variables. In the light of this, an attempt was made in this paper to examine whether the daily flow sequence of the Benue River exhibits low-dimensional chaos; that is, if or not its dynamics could be explained by a small number of effective degrees of freedom. To this end, nonlinear analysis of the flow sequence was done by evaluating the correlation dimension based on phase space reconstruction and maximal Lyapunov estimation as well as nonlinear prediction. Results obtained in all instances considered indicate that there is no discernible evidence to suggest that the daily flow sequence of the Benue River exhibit nonlinear deterministic chaotic signatures. Thus, it may be conjectured that the daily flow time series span a wide dynamical range between deterministic chaos and periodic signal contaminated with additive noise; that is, by either measurement or dynamical noise. However, contradictory results abound on the existence of low-dimensional chaos in daily streamflows. Hence, it is paramount to note that if the existence of low-dimension deterministic component is reliably verified, it is necessary to investigate its origin, dependence on the space-time behavior of precipitation and therefore on climate and role of the inflow-runoff mechanism.

KEYWORDS

Deterministic Chaos, Nonlinear Dynamics, Phase Space, Correlation Dimension, Time Delay

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