Nonlinear Dynamic Concepts for a Classification Framework in Hydrology

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Reliability in modeling and prediction of hydrologic systems depends largely on the selection of appropriate type and complexity of models. Numerous hydrologic models of differing complexities are currently in use, and still more are being developed. The uniqueness of almost every hydrologic system and process/event oftentimes exacerbates this situation. Serious concerns on this modeling trend have recently been raised, and the need for a general framework has been emphasized. To this end, the present study explores the role of nonlinear dynamic concepts for formulation of a catchment classification framework. More specifically, data embedding and nearest neighbor methods are employed to determine the 'extent of complexity' of the system, and the results are then interpreted to classify the underlying system as potentially low-, medium- or high-dimensional. A host of river-related time series observed in different geographic and climatic regions and at different scales are analyzed. The performance of the nonlinear dynamic concepts against some commonly used linear tools is also evaluated.

Keywords: Hydrologic modeling; system complexity; catchment classification; nonlinear dynamics; chaos; data reconstruction.