Nonlinear Processes in Geophysics
European Geosciences Union

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Preface

Nonlinear deterministic dynamics in hydrologic systems: present activities and future challenges

Recent decades of research on nonlinear deterministic dynamics have meant new insights in our dealing with complex systems. A noticeable growth in the application of nonlinear deterministic dynamic concepts to hydrologic systems has been evident in many scientific journals in the field of hydrology and water resources, and even beyond (see Sivakumar, 2000, 2004 for reviews). An important reason for this is the promising potential for simplification of modeling and predictions of such "complex" systems by unraveling their hidden order.

If literature is any indication, applications of nonlinear deterministic dynamic concepts in hydrology will only continue to increase in the future, probably at a much faster pace. There is, however, also a sense of discomfort on the validity of these concepts in hydrologic systems, their relevance for real-world hydrologic problems, and physical interpretation of the outcomes (see Schertzer et al., 2002 and Sivakumar et al., 2002 for a debate). There is indeed an urgent need to address these issues, so that the potential of these concepts for hydrologic systems can be realized to the fullest extent. This is the motivation for this Special Issue entitled "Nonlinear deterministic dynamics in hydrologic systems: present activities and future challenges." The overall objectives of this Special Issue are:

1. to disseminate the latest research activities and initiatives on the use of nonlinear deterministic dynamic concepts in hydrologic systems;

2. to bring forth the future potential of nonlinear deterministic dynamic concepts in dealing with various aspects of hydrologic systems; and

3. to address the important issues in the use of existing nonlinear deterministic dynamic methods to hydrologic systems and potential developments.

This Special Issue consists of 15 papers (contributed by a total of over 50 authors), falling under one or more of these three general objectives. These papers cover a variety of nonlinear deterministic dynamic concepts and techniques applied to a host of hydrologic systems, processes and problems. The topics addressed are (in the order as they appear): flow partitioning and unstable divergence in fluviokarst evolution (Phillips and Walls), streamflow disaggregation (Sivakumar et al.), uncertainty estimation in soil moisture simulation (Hossain et al.), nonlinear detection in river flows (Laio et al.), soil nutrient cycles as a nonlinear dynamic system (Manzoni et al.), spatio-temporal dynamics of small water bodies (Daya Sagar), detection and predictive modeling of chaos in hydrologic time series (Khan et al.), testing and modeling autoregressive conditional heteroskedasticity of streamflow processes (Wang et al.), multivariate analysis of southern oscillation index and local precipitation and temperature (Jin et al.), rainfall estimation from satellite images (Tsonis and Georgakakos), solute transport in heterogeneous aquifers (Sivakumar et al.), ensemble forecasts of climate time series (Regonda et al.), surrogate data method for nonlinear detection in streamflow dynamics (She and Basketfield), aggregation and sampling implications for chaos identification in hydrologic processes (Salas et al.), and role of hydrologic cycle in regulating the planetary climate system (Nordstrom et al.). The outcomes of the studies are interesting and promising as to the utility and suitability of nonlinear deterministic dynamic concepts in hydrology, but at the same time bring forth the caution needed in their applications.

Due to the fundamental as well as applied aspects of these papers, dealing with hydrologic systems from different geographic, climatic, ecologic and watershed characteristics, the Special Issue is expected to benefit both practitioners and theoreticians in hydrology and water resources, and geophysics in general. Over the years, "Nonlinear Processes in Geophysics" has been serving as an excellent medium for disseminating research activities and initiatives on nonlinear deterministic dynamics and related topics, and it is hoped that this Special Issue would further enhance this aspect.

We thank all the contributors for their interest, willingness, diligence and completion of their papers in a timely manner, both in the initial submission stage and in the subsequent revision(s). All the manuscripts submitted to this Special Issue were subjected to a peer-review process, as would any other paper submitted to a regular issue of "Nonlinear Processes in Geophysics". Our sincere appreciation and thanks to the following reviewers (some of

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