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Nonlinear Dynamics of Extended Hydrologic Systems over long time scales

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We often view our knowledge of hydrology and hence of nature as intransient, at least over the time scales over which we study processes we wish to predict and understand. Over the last few decades, this assumption has come under question, largely because of the vocal expression of a changing climate, but also the recurrent demonstration of significant land use change, both of which significantly affect the boundary conditions for terrestrial hydrology that is our forte. Most recently, the concepts of hydromorphology and social hydrology have entered the discussion, and the notion that climate and hydrology influence human action, which in turn shapes hydrology, is being recognized. Finally, as a field, we seem to be coming to the conclusion that the hydrologic system is an open system, whose boundaries evolve in time, and that the hydrologic system, at many scales, has a profound effect on the systems that drive it – whether they be the ecological and climatic systems, or the social system. What a mess! Complexity! Unpredictability!
At a certain level of abstraction, one can consider the evolution of these coupled systems with nonlinear feedbacks and ask what types of questions are relevant in terms of such a coupled evolution? What are their implications at the planetary scale? What are their implications for a subsistence farmer in an arid landscape who may under external influence achieve a new transient hydro-ecological equilibrium? What are the implications for the economy and power of nations?
In this talk, I will try to raise some of these questions and also provide some examples with very simple dynamical systems that suggest ways of thinking about some practical issues of feedback across climate, hydrology and human behavior.