SOCIETAL IMPLICATIONS OF COMPLEXITY IN THE HYDROLOGIC CYCLE

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The hydrologic cycle is an important contributor to life and economic stability for this planet and its citizens. This cycle is characterized by complex interactions that operate over a broad range of space and time scales. These complexities lead to a number of societal implications including the occurrence of floods, droughts and other environmental extremes, and chaotic signals that propagate through the physical environment to introduce variability and instability into socio-economic systems. This presentation will begin with an outline of the interactions between natural and socio-economic systems in terms of their variability and human ambitions to construct systems that minimize surprise. Although civilization has matured and technological capabilities have emerged, modern socio-economic systems are still sensitive to complex forcing by natural systems. For example, natural events such as major floods that surprise society are still frequent and potentially devastating.

Prediction systems attempt to deal with the future time evolution of complexity in the water cycle to provide lead-time for responding to anticipated hazards or supply limitations. Prediction of the water cycle components takes place on daily to seasonal time scales although the skill in these predictions is limited by chaotic fluctuations within the cycle. On a longer time scale, potential abrupt climate change that could be triggered by rising concentrations of atmospheric greenhouse gases is another consequence of complexity. At seasonal time scales, strongly forced situations (e.g. El Nino) that can be predicted with some skill retain a chaotic component that leads to sudden events such as local floods that can have devastating impacts. More frequently the atmosphere is only weakly forced resulting in limited predictability at climate time scales. Paradigms such as probability and sophisticated learning based decision systems are needed for communicating to the public the consequences of complexity and uncertainty for predictions at all time scales.