Geophysical Research Abstracts,
Vol. 11, EGU2009-12158, 2009
EGU General Assembly 2009

Multiphysics Modeling in Watershed Systems: How Weak Nonlinearities Amplify Extreme Events

C. Duffy and M. Kumar

Penn State University, CEE Department, University Park, PA, United States (cxd11@psu.edu)

This research is developing a modeling system for the synthesis of multi-state, multi-scale distributed hydrologic processes based on the semi-discrete representation of the underlying physical process equations and state variables (Qu and Duffy, WRR 2007). Our interest is in devising a concise representation of watershed or river basin hydrodynamics, which allows interactions among major physical processes operating simultaneously, but with the flexibility to add or eliminate states/processes/constitutive relations depending on the objective of the numerical experiment or purpose of the scientific or operational application. In this paper we demonstrate how nonlinear coupling effects (e.g. unsaturated-saturated flow, gaining-losing streams) in the presence of weak periodic climate forcing can amplify or heavily damp streamflow during large rainfall events. Several examples are given where weak climate variations may have large effects on terrestrial response to large random precipitation events. The research demonstrates how climate and weather, interacting with weakly nonlinear and coupled processes in the watershed, can have a large impact on flooding from extreme precipitation events.