

The groundwater-land-surface-atmosphere connection: Feedbacks and scaling in watershed processes.

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The hydrologic cycle is composed of a number of coupled processes, yet it is seldom treated as such. Often models are developed in a compartmentalized manner that follows scientific and disciplinary boundaries and ignores important process interplay. In an effort to provide a more integrated approach, a unique, fully coupled model of the hydrologic cycle is used to examine the interaction between coupled water and energy processes. This parallel, integrated model computes the movement of water and energy in the surface, subsurface and atmosphere in a three-dimensional manner. This model is then used to study a number of fundamental questions regarding process interplay in the hydrologic cycle: Are there spatiotemporal correlations between land surface variables and subsurface storage? Do these feedbacks persist into the atmospheric boundary layer? Can we use the model to guide observations and field campaigns? Can we use the model to understand residence times, cycling and scaling of water parcels? Can we use such representations to better understand impacts and feedbacks to the hydrologic cycle under a changing climate? Simulation results provide insight into these questions, demonstrating correlations between subsurface, land surface and atmospheric processes. Additionally, spatial correlations and spectral methods are used to identify other process interrelationships. These results can be also be used to identify locations and times for observation and point to the need for integrated study of the hydrologic cycle.