



## **Hydrogeomorphic paradigm of stormflow generation in headwater catchments**

Roy C. Sidle

University of the Sunshine Coast, Sustainability Research Centre, Maroochydore, Australia (rsidle@usc.edu.au)

Over the past century, different paradigms have emerged to explain the processes of stormflow generation in steep, vegetated headwater catchments. These headwaters are important source areas of flood waters, sediments, nutrients, and biota that affect larger basins and coastal waters. Headwater systems exhibit unique and complex hydrogeomorphic processes from hillslopes to stream channels as well as linkages to downstream reaches. Through the 1960's, stormflow generation was largely attributed to Hortonian overland flow mechanisms. While numerous studies indicated the significance of saturated and unsaturated subsurface flow, it was not until the mid-1960's that the variable source area concept of streamflow generation emerged invoking a dynamic riparian source area that shrinks and expands in response to precipitation and fluctuating water tables. However, this concept does not specify flow mechanisms or pathways functioning at different spatial scales within the catchment.

Based on extensive studies in nested, headwater catchment components in Japan, a conceptual hydrogeomorphic model has been developed to more explicitly explain stormflow pathways and response. The conceptual model recognizes the close coupling of hillslope and channel hydrological processes and the unique contributions of geomorphic features such as riparian corridors, geomorphic hollows, and linear hillslopes. During the driest conditions, catchment water yield is very low and runoff occurs as saturated overland flow from the narrow riparian corridors and via direct channel interception. For slightly wetter conditions, subsurface flow from the soil matrix augments stormflow. As wetness increases, two significant non-linear hydrologic responses occur: (1) response from geomorphic hollows (zero-order basins) after a threshold of shallow groundwater accumulates; and (2) self-organization and expansion of preferential flow pathways that facilitate significant amounts of subsurface drainage. The temporal responses from these distinct but linked geomorphic components network forms the basis for the hydrogeomorphic concept of stormflow generation. A parsimonious model has been developed that simulates storm discharge from channel-riparian complexes using a kinematic wave algorithm and from geomorphic hollows (zero-order basins) and hillslopes using a multitank model. Simulations were in good agreement with runoff measurements.