Geophysical Research Abstracts,
Vol. 11, EGU2009-6476, 2009
EGU General Assembly 2009

The influence of a changing subsurface and catchment heterogeneity on subarctic streamflow

S.K. Carey
Department of Geography and Environmental Studies, Carleton University, Ottawa, Canada (sean_carey@carleton.ca)

The depth of the active layer, or seasonally thawed zone, has a critical role in controlling both the lateral and vertical fluxes of water in permafrost environments. Permafrost acts as an aquitard, restricting vertical movement of water and enhancing lateral subsurface drainage. In alpine discontinuous permafrost environments, slopes with permafrost contribute a large fraction of precipitation to runoff compared to slopes with only seasonal frost. In addition, permafrost-underlain slopes have a strong temporal variance in their storage capacity, which increases throughout the summer as thaw progresses. Aggregating and upscaling energy-based hillslope and sub-catchment processes is essential for the accurate prediction of runoff. Hydrometric and hydrochemical data at the hillslope and catchment scale suggest that during the freshet, catchment units contribute to streamflow based largely on their topologic position in the drainage network. Following freshet and rapid ground melt on seasonally frozen hillslopes, runoff is controlled by the disposition of permafrost, which occurs largely based on microclimatic conditions. As active layer thaw progresses, the storage capacity of the catchment increases to the point where summer rainstorms rarely produce a streamflow response and only deeper subsurface water sustains baseflow. Results from this research provide an important guidelines for the conceptualization of runoff processes in subarctic environments where energy and frozen ground are critical controls on the water balance.