

Regulation of watershed hydrology by plant-water relations and topographic controls.

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Abstract:

Components of a forest hydrologic cycle, including stomatal conductance, sap flow, soil moisture, vapor pressure and net radiation were measured at two elevations (100m difference) in a 1.5 km² watershed dominated by *Quercus* spp. in the Black Rock Forest, near Cornwall, NY. A V-notch weir was used to monitor stream discharge. Close correlations were observed at 20 minute intervals between VPD, transpiration and soil moisture at the higher elevation site. Stream discharge and soil moisture at the lower elevation site responded to transpiration rates on slightly longer time scales. Canopy processes were modeled using the SPA canopy model and a ten-layer, 1D soil column model. The analytic form of TOPMODEL equations were used to represent the topographic controls over surface hydrologic processes. This formulation permits for the consistent calculation of the partial contributing area and the baseflow that supports this area. Modeled stream discharge, soil moisture, and transpiration were in good agreement with observations. Results identify the importance of including topographically determined heterogeneity in plant-water relations when analyzing hydrologic processes at the watershed scale.