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Dynamic Hydrologic Connectivity through the Vadose Zone: Snowmelt Interaction with Groundwater and Streamflow

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Quantifying spatial and temporal dynamics of rainfall and snowmelt movement into groundwater and stream networks presents many challenges, especially in the vadose zone in snow dominated systems of forested mountain environments. Soil thickness and physical properties vary widely. The structure and hydraulic properties of the saprolite within the weathering zone are poorly understood. Forest disturbances alter snow hydrology, change the magnitude and timing of snowmelt, and alter infiltration into and through the vadose zone. Knowledge emerges on individual components and processes while modelling studies provide insights into effects of changing climate drivers on streamflow based on generalized connections of precipitation and groundwater systems. Prediction of groundwater recharge and streamflow regimes under scenarios of climate and land cover change requires broad-scale integration of surface and sub-surface hydrology with improved understanding of vadose zone processes. Research initiatives at the Wyoming Center for Environmental Hydrology and Geophysics combine near-surface geophysics and conventional and experimental methods in ecohydrology, hydropedology, and hydrogeology to quantify and characterize effects of forest disturbance on the timing, magnitude, and pathways of snowmelt in the Snowy Mountains of Wyoming. This presentation provides conceptual models and preliminary data from of this integrated research approach.