Hydrological Connectivity in the Laramie Mountains: Implications for Water Resources Management

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Abstract

Mountains are the "water towers" of the West. However, groundwater hydrology in mountain environments is virtually unknown. As part of the NSF-funded WyCEHG effort, we drill, instrument, monitor, and test groundwater wells in granite bedrock of the Laramie Mountains at the Blair Wallis Fractured Rock Hydrology Research Well Field. By analyzing the well field data collected since 2014, we determined that bedrock groundwater is a significant component of the water budget. Groundwater reservoir is connected to the surface through fractures and is recharged, annually, by snowmelt. Groundwater flows from this mountain to adjacent basin fills, and *subsurface* mountain front recharge can account for up to 19% of the total precipitation over the mountain. Recent drilling of 2 multilevel wells at Government Gulch, a watershed adjacent to the mountain front at Blair Wallis, suggests a pervasive fracture flow system that is sub-charging the overlying basin aquifers, thus confirming the proposed mountain front recharge. Currently, time-lapsed measurements are being made using borehole sensors and borehole and surface geophysical imaging, while precipitation, surface water, soil water, snow water equivalent, and climate data are also being collected. Similar to groundwater, soil and surface water storages and fluxes respond strongly to annual snowmelt. Based on all the data, an emerging picture is an *interconnected* hydrological system that spans from the surface to subsurface and that includes both mountains and basins. Our ongoing work now focuses on building and calibrating an integrated surface/subsurface hydrological model, driven by remotely sensed climate data. The model will be used to verify the conceptual model, project hydrological responses to natural and manmade disturbances, and be used as a water resources management tool. Our findings so far and the planned future work will have significant implications for water resources management for both headwater and downstream regions in the mountain West.