Approaches to Identify and Predict Water Exports across and within Subsystems in the East River Watershed

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Project Abstract:
Understanding water partitioning as a function of perturbations is critically important for snow dominated mountainous systems, such as the East River watershed within the Upper Colorado River Basin. As such, a priority of the current phase of the Watershed SFA is to quantify and predict how snow dynamics, including snowmelt timing and variability in snowpack accumulation, affect water exports from hillslope to watershed scales. Within the East River watershed, significant uncertainty remains in association with evaluation of evapotranspiration (ET), groundwater recharge, and surface runoff, all of which vary significantly as a function of elevation, vegetation and topography. To improve the predictive understanding of water cycling and water exports associated with specific functional zones and in response to snow dynamics, we are: (a) constraining ET rates through measurements and models across scales and at sites located in functional zones having representative landscape characteristics, (b) collecting and synthesizing data on the impact of snow dynamics on water discharge, and (c) using high-resolution models to quantify hydrologic partitioning as a function of landscape position and snow dynamics. A key goal is to integrate field studies and associated observational datasets (e.g., stream discharge, LiDAR-derived snow water equivalent) into predictive models describing aggregated watershed hydrologic behavior.

For constraining ET rates, a Penman-Monteith model has been developed for four different locations covering meadow, conifer, and aspen within a lower montane functional zone referred to as the ‘Pumphouse site’. ET partitioning is quantified using meteorological, energy, and water signals measured with a sensor suite that are further benchmarked through use of a mesoscale SMART soil experimental testbed. Further, existing field and remote sensing data are used to constrain predictive models like *ecosys* and ParFlow-CLM. In parallel, isotopic and geochemical data are used to provide constraints on estimates of groundwater recharge. In particular, seasonal variations in stable water isotopes of precipitation are used to apportion groundwater and runoff sources.

Given the complexity in snow melt and accumulation rates, ParFlow-CLM simulations are being used to assess the partitioning of water components in different functional zones and as a function of snow dynamics. The ParFlow-CLM model is being used to test the hypotheses that different functional zones have distinct water partitioning and residence times. These numerical investigations will inform the development and validation of functional zone-based models.