Title: **Seasonal origins of tree water-use along a hillslope in the East River Watershed**

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BER Program: SBR

Project: University Project: Space and time dynamics of transpiration in the East River watershed: biotic and abiotic controls (DE-SC0019210)

Project Abstract:

Transpiration is a key component of the hydrological budget of the East River Watershed (ERW). Unlike evaporation, which can be estimated with some confidence using energetic constraints, transpiration is more complicated to model due to complex dynamics associated with root distributions and the stomatal response to atmospheric forcing. To provide constraints for future modeling, we developed continuous transpiration fluxes for three key species in the ERW (*Picea engelmannii*, *Abies lasiocarpa* and *Populus tremuloides*) along a ~500 m hillslope transect during 2019-2020. The observations show that the conifers have the highest levels of transpiration in late May and early June followed by a long-term decline through the end of the growing season. This progressive decline is interrupted by a modest increase in early August associated with a series of summer rain events. The seasonal trend largely mirrors surface soil moisture. On the other hand, the aspens show two transpiration peaks of similar magnitude in early July and early August. The largest transpiration fluxes appear to be around 3200 m, which marks an intermediate elevation between water-limitation at lower elevations and temperature-limitation at upper elevations. While the temporal dynamics seem to largely be explainable by seasonal trends in soil moisture, a lag emerges in July between the time of day when transpiration reaches its peak and the period of highest atmospheric evaporative demand, which shows how the stomatal response to atmospheric conditions further modulate transpiration. In addition to the transpiration measurements, we also measured the water isotopic ratio of the xylem water to understand the water sources the trees relied on. As expected, the trees almost exclusively utilized snow melt early in the growing season. As the season progressed, some trees transitioned into use of precipitation while others continued to use snowmelt through the entire growing season. Interestingly, snowmelt reemerged as the predominant water source across the hillslope at the end of the season reflecting either use of deeper waters or that older waters had migrated into the root zone as evaporative demand increased. Ongoing work includes tree-level modeling of transpiration using the Soil-Plant-Atmosphere (SPA) model, continuing the sap flux and isotopic measurements through the 2020 growing season, adding canopy-scale thermal imaging of the canopy to better understand leaf level processes and making measurements of the metal content in the xylem water to separate the current season's snow melt from groundwater.