Ecohydrological Controls on Root and Microbial Respiration in the East River Watershed of Colorado

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Belowground in the soil, microbes breakdown organic matter, releasing CO_2. Plant roots produce CO_2 also, via their metabolism. Our research seeks to understand how moisture inputs, such as snow and rain, influence the amount of CO_2 produced belowground in the East River watershed, near Crested Butte, Colorado. In June 2021 (Year 1), we instrumented four sites along Snodgrass Mountain in the two main forest types, aspen and spruce/fir to quantify the flux of CO_2 from the soil to the atmosphere, and how plant and microbial sources of CO_2 respond to the environment, across different elevations. To do this, continuous measurements of soil CO_2 concentrations, at multiple depths, will be combined with novel radiocarbon (^{14}C) methods (Year 2) that will enable the separation of plant and microbial sources of CO_2. These measurements will be linked to measurements of forest and snow phenology (with PhenoCams), microbial activity, tree growth and water status, and environmental factors such as air and soil temperature, soil moisture, and groundwater table. Our work is motivated by our overarching hypothesis that quantifying belowground plant and microbial processes separately, and how they are influenced by snow and rain inputs, is necessary for understanding and predicting how the belowground East River watershed ecosystems will respond to changes in the environment.

To date, continuous 30-minute records from all deployed sensors have been logged at each site and transmitted remotely via cell modem to NAU. This initial snow-free season of data (June 2021 through October 2021) shows interesting forest type and seasonal patterns of soil CO_2 fluxes. Across the gradient, mid-elevation forests had much larger seasonal soil CO_2 fluxes (aspen=309, conifer=474 g C m^2) compared to high-elevation conifer and low-elevation aspen forests, 166 and 124 g C m^2, respectively. Fluxes peaked in August and September across forests and elevations coinciding with the warmest soil and air temperatures and driest soil moisture. Aspen forest CO_2 fluxes strongly declined in October coinciding with PhenoCam derived canopy greenness and leaf-fall. We are currently planning and preparing for field measurements for Summer 2022, where we will install new automated point dendrometers to measure tree growth, soil surface collars for manual CO_2 flux measurements, and collect ^{14}C samples to separate of plant and microbial sources of CO_2.