Links between soil water availability and soil respiration in semi-arid ecosystems along the Colorado Front Range

Katherine Powell, University of Colorado*

Drylands cover approximately 40% of the world's terrestrial ecosystems, and this includes mostly arid and semi-arid regions. As water-limited environments, they are sensitive to changes in soil water content which may result in large carbon efflux from soils in response to precipitation events. Previous research has demonstrated that soil temperature and soil water content (e.g. volumetric or gravimetric) are the primary controls on soil respiration (Rs), however, few studies relate soil water potential to Rs, although it may be a better metric for representing how water is available to soil microbes and vegetation. Therefore, resolving how episodic changes in soil water potential cause arid/semi-arid ecosystems to shift from a carbon sink to a source is important for improving future estimates of terrestrial ecosystem fluxes in these areas. Our study focuses on above and belowground fluxes of CO_2 and water at two grassland sites and one montane forest site in Colorado. Continuous (hourly) soil CO_2 concentration profile measurements, at 5 cm, 10 cm and 20 cm (15 cm in the grasslands) are coupled with continuous (30 minute), collocated soil water content and soil temperature (Ts) measurements. Soil water availability is determined by using tensiometers at each site to relate volumetric water content to matric potential values. All of the sites have ongoing eddy covariance-based surface measurements of water, carbon and energy fluxes, including net ecosystem exchange (NEE). To estimate Rs at the surface, discrete fluxes of CO_2 are measured with a portable photosynthesis system (chamber) and soil surface CO_2 concentration measurements. To characterize changes in aboveground biomass, vegetation samples are routinely collected from each of the sites and leaf area index (LAI) and dry biomass are determined. Time-series plots of Rs are compared with aboveground fluxes of CO_2 as well as soil water, Ts, precipitation, air temperature (Ta), photosynthetically active radiation (PAR), humidity, evapotranspiration (ET), and LAI. Preliminary results show soil CO_2 concentration increases were well correlated with soil water content increases at the same soil depth following precipitation events. More measurements and calculations will be required to determine monthly and seasonal responses and to make further comparisons with aboveground fluxes and biomass changes.