Micrometeorological Observations at Calhoun Critical Zone Observatory

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The objective of the flux towers is to measure the fluxes of energy, water and gases of chemical substance for understanding the impact of land cover change over the critical zone on the hydro-meteorological and geochemical processes. The design focuses on the selection of site(s), sensors and configuration of instrument. Working closely with the Duke team and the UGA team, we built two flux towers, one with above-canopy measurements and one with below-canopy measurements at re-grow forest site, and a below-ground measurement at the crop site.

The above-canopy flux tower follows the original (last year's) plan to have above-canopy, below-canopy and below-ground instruments. The main instruments of the above-canopy component are a 9-meter guyed tower with an eddy-covariance (EC) system mounted on the top of the tower. The EC system includes 3D sonic anemometer(s) for measuring turbulent fluctuations of horizontal and vertical wind velocities, open path gas analyzer(s) for measuring turbulent fluctuations of H_2O and CO_2 concentration in the boundary layer, net radiometer(s) (four-component) for measuring short- and long-wave radiation. The below-canopy component is a suite of sensors to measure hydro-meteorological variables for retrieving below canopy water vapor and heat fluxes using the maximum entropy production (MEP) model and CO_2 flux using the half-derivative model. The below-canopy instruments include multi-level temperature and humidity sensors along the tower at 20 cm, 1m, 3m, 5m, and 9 m above ground, one infrared thermometer for measuring ground (skin) temperature, and a tipping bucket rain gauge. The below-ground instruments include four soil heat flux plates (at 80 cm, 40 cm, 15 cm, and 2 cm below-ground), six soil moisture probes (at 80 cm, 60 cm, 40 cm, 30 cm, 15 cm, and 2 cm below-ground), and six soil temperature probes (at 80 cm, 60 cm, 40 cm, 30 cm, 15 cm, and 2 cm below-ground), to collect the time-series records of soil moisture, temperature and soil heat fluxes for retrieval of heat and water fluxes using the generalized half-derivative models. The EC data are recorded at 10 Hz, and the micrometeorological data are recorded every minute, and the rain fall data are recorded every 30 minutes.

To extend our understanding of the carbon cycle at CCZO, we installed a below-canopy flux tower to measure the soil respiration also at the re-grow forest site. The below-canopy flux tower is 30 m away from the above-canopy flux tower. The instruments of the below-canopy flux tower include a 3-meter tripod tower with an EC system mounted at 2 m above ground, a net radiometer, two temperature and humidity probes (one at 2 m and one at 20 cm above ground), one infrared thermometer, one tipping bucket rain gauge, one soil moisture probe (at surface), one soil temperature probe (at surface), and one soil heat flux plate (at surface). The EC data are recorded at 10 Hz, and the micrometeorological data are recorded every minute, and the rain fall data are recorded every 30 minutes.

To study the soil temperature and soil moisture at CCZO, we installed below-ground instruments up to 7 m below ground at the crop site. The instruments include soil temperature probes (at surface, 30 cm, 50 cm, 1 m, and 2 m below ground) and soil moisture probes (at surface, 30cm, 1.3 m, and 2 m). The time-series records of soil temperature and soil moisture are recorded every minute.

The constructions of the experiments are completed on May 19, 2017. A network is set up to connect the sites and transport the data back to office via telephone service. Solar panel systems are built to provide sufficient power supply for the instruments. We visit the sites once every month for maintenance.