

Observations of Water, Energy and CO₂ Fluxes at Calhoun Critical Zone Observatory

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Abstract

The Calhoun Critical Zone Observatory (CCZO) has been collecting above- and below canopy water, energy and carbon fluxes and other hydro-meteorological processes since 2016. The observations provide a unique opportunity to investigate the coupling between aboveground environmental conditions and belowground fluxes of mass and energy in general and the fate of fixed carbon in forested ecosystems in particular. The simultaneous measurements of soil-canopy-atmosphere states and fluxes reveal the role of pine forest in diurnal and seasonal dynamics of the CCZ ecosystem.

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Observation Site

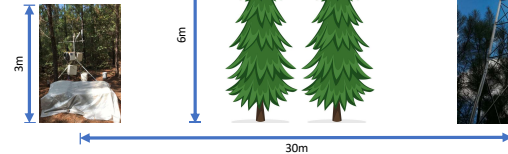


The observation site locates in a fast growing young pine forest in north central South Carolina (34.6° N, 81.7° W)

Above Canopy Tower



Below Canopy Tower

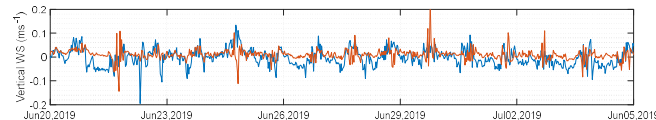
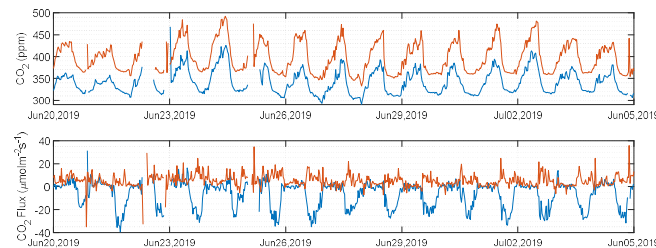
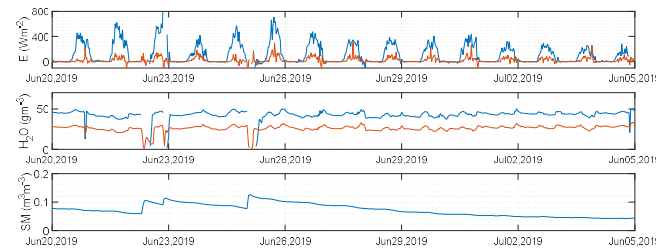
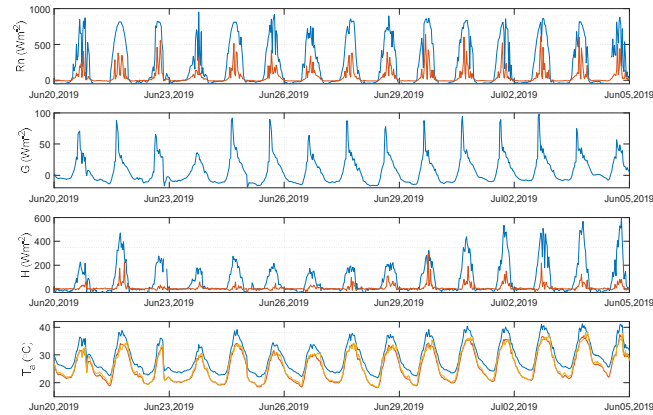


Discussions

- Canopy shading substantially reduces below-canopy latent and sensible heat flux while ground heat flux tends to dominate soil surface energy budget. Even with shading effect, near-ground air temperature is higher than near-canopy top air temperature with diminishing air temperature gradient across canopy.
- Above- and below-canopy water vapor flux closely follows net radiation at diurnal and seasonal scale. Above-canopy vapor density is consistently higher (by a steady amount) than below-canopy vapor density with much weaker diurnal cycle than seasonal cycle.
- Photosynthesis caused above-canopy CO₂ flux and soil CO₂ efflux are well captured with strong diurnal cycle but weaker seasonal cycle. Above-canopy CO₂ concentration is consistently lower (by a steady amount) below-canopy CO₂ with much stronger diurnal cycle than seasonal cycle.
- Soil moisture is out of phase with water vapor (latent heat) flux at seasonal scale.

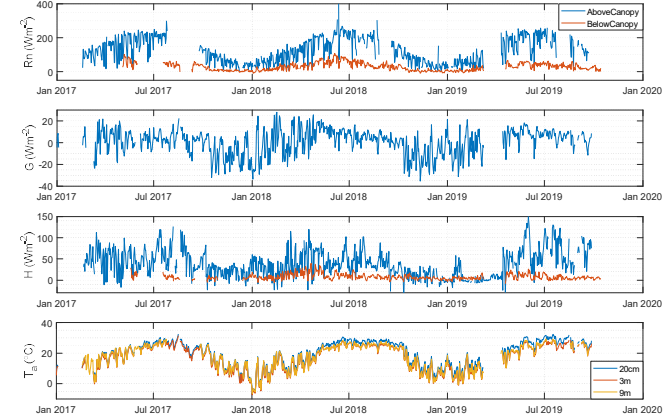
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Diurnal (Jun 20, 2019 to Jul 05, 2019)

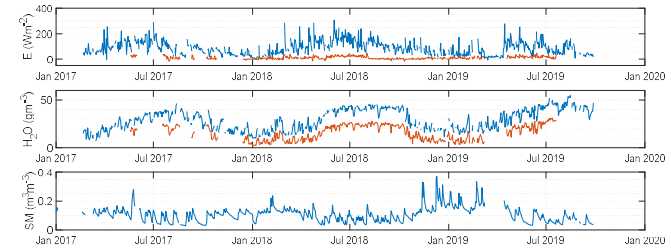


Seasonal (Jan, 2017 - Oct, 2019)

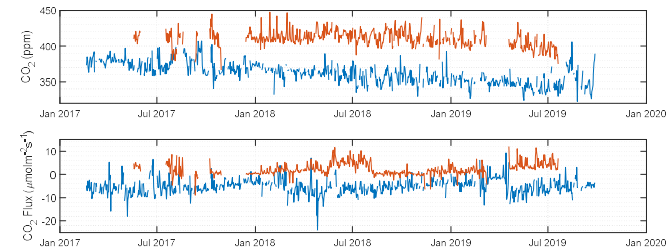
Energy



Water



Carbon



Wind Speed

