Posted on 21 Nov 2022 — The copyright holder is the author/funder. All rights reserved. No reuse without permission. — https://doi.org/10.1002/essoar.10501830.1 — This a preprint and has not been peer reviewed. Data may be preliminary.

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

MODI ZHU[1], Jingfeng Wang[1], Tang Yao[2], Weiqiang Jing[1], Daniel Markewitz[3], and Rafael Bras[1]

[1]Gatech
[2]Lawrence Berkeley National Laboratory
[3]The University of Georgia, Athens, Georgia

November 21, 2022

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.

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

[1]Modi Zhu (modizhu@gatech.edu) , [2]Yao Tang, [1]Weiqiang Jing, [3]Daniel Markewitz, [1]Rafael L Bras, [1]Jingfeng Wang

[1]Georgia Institute of Technology, Atlanta, Georgia, [2]Lawrence Berkeley National Laboratory, Berkeley, California [3]The University of Georgia, Athens, Georgia

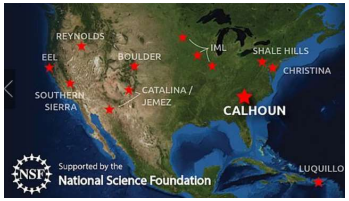
B33J-2613

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.

Acknowledgement This study is sponsored by NSF CZO project EAR-1331846. We thank Drs. Alex Cherkinsky, and Jason Austin at University of Georgia, and Daniel Richter, Will Cook, and Zachary Brecheisen at Duke University for their generous support with the constructions of the field sites.

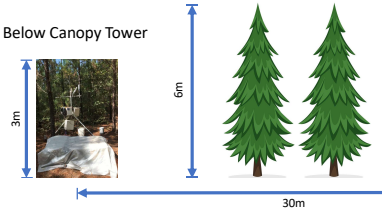
Observation Site



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

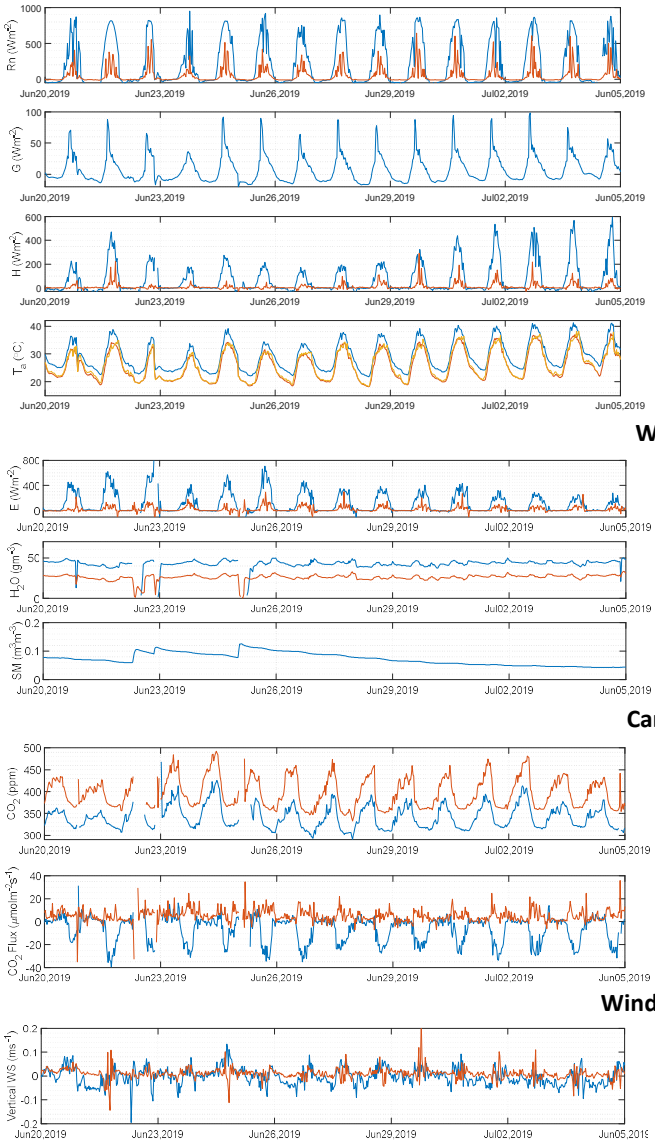


Discussions

- 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.

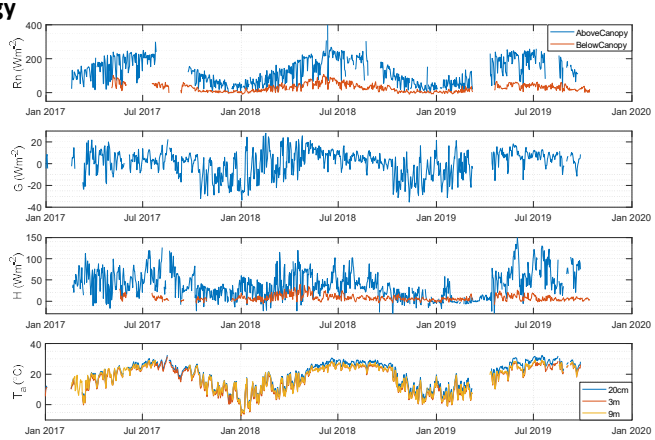
AGU Fall Meeting Dec 9 – 13, 2019

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

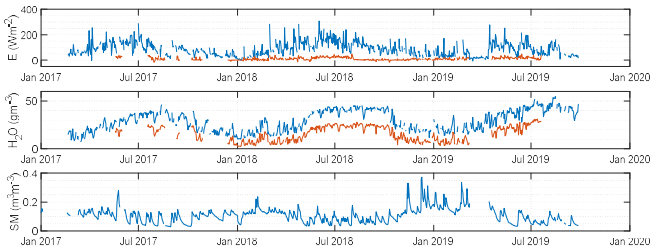


Seasonal (Jan, 2017 - Oct, 2019)

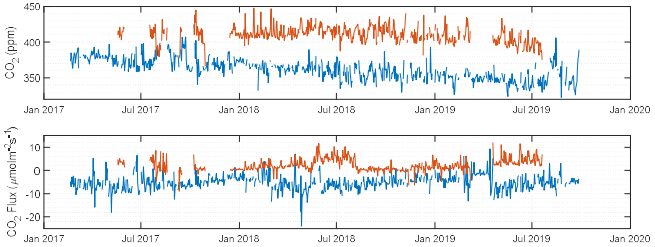
Energy



Water



Carbon



Wind Speed