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Portable Flux Tower Deployments Field Campaign Report

MS Torn
SC Biraud
L Kueppers
DP Billesbach

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ARM

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MS Torn, Lawrence Berkeley National Laboratory (LBNL)
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Acronyms and Abbreviations

AC	alternating current
ARM	Atmospheric Radiation Measurement
DOE	U.S. Department of Energy
EBBR	energy balance Bowen ratio station
ECOR	eddy correlation flux measurement system
H	sensible heat flux
LE	latent heat flux
NDVI	normalized difference vegetation index
PRI	photochemical reflectance index
SGP	Southern Great Plains
UPS	uninterruptible power supply

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1.0 Summary

In May of 2015, a portable eddy covariance flux tower was installed by David Billesbach at the U.S. Department of Energy (DOE) Atmospheric Radiation Measurement (ARM) user facility's Southern Great Plains (SGP) observatory E-32 extended facility west of Medford, Oklahoma. The goal of this deployment was to provide data sets that could be used to test land-atmosphere models and surface forcing from the SGP region. This site was chosen as being underrepresented in current data inventories.

In January of 2016, a second portable flux system was installed (by Billesbach and Sebastien Biraud) in a field at the southeast corner of the intersection of Oklahoma highways 11 and 74 (also near Medford and designated as site 74). This site was chosen because it was to be planted in grain sorghum (milo) which is also an underrepresented crop.

A secondary goal for this deployment was to refine the operational parameters of the newly rebuilt portable eddy correlation flux systems (ECOR), which incorporate several new sensors. These new measurements were designed to accommodate more advanced modeling and integration with remote-sensing products such as normalized difference vegetation index (NDVI), photochemical reflectance index (PRI), and diffuse solar radiation. Another secondary goal was to assess how well surface energy components—sensible heat flux (H) and latent heat flux (LE)—measured by ECOR and energy balance Bowen ratio (EBBR) instruments could be compared.

Operations were terminated at the E-32 site in June of 2017 and Billesbach removed the equipment from the site. Operations at site 74 were terminated in October of 2017 and Billesbach (with assistance from SGP-Central Facility personnel) again removed the equipment from the field.

The most notable event at the E-32 site was the retrenching of site power. This operation opened a wide gap in the normally grass-covered footprint of our optical sensors. We are still evaluating the effects that the bare soil had on our NDVI and PRI data. At site 74, we learned after germination that soy beans instead of grain sorghum had been planted for the second (2017) growing season.

2.0 Results

Our primary results are presented in a paper to *Geophysical Research – Atmospheres*. In summary, we found that primary drivers of the partitioning of net solar energy (into H and LE) were cropping system and green leaf area. At both sites more energy was diverted to H when green leaf area was low such as after senescence and after hay cutting. Because of the growth pattern differences between pasture (site E-32) and row-crop (site 74), the change in energy partitioning occurs at different times of the year.

By comparing our eddy covariance measurements of H and LE to those made by the adjacent EBBR system at the E-32 site, we were able to determine that data sets from EBBR and ECOR instruments could be intermixed in synthesis studies such as this. We would, however, caution that this result is from only one site and further intercomparison studies should be undertaken to verify this on a broader scale.

3.0 Publications and References

Bagley, J, L Kueppers, D Billesbach, I Williams, S Biraud, and M Torn. 2017. "The influence of land cover on surface energy partitioning and evaporative fraction regimes in the U.S. Southern Great Plains." *Journal of Geophysical Research – Atmospheres* 122(11): 5793-5807, doi:10.1002/2017JD026740.

4.0 Lessons Learned

There are several significant gaps in the E-32 data set due to power issues at the site. Despite being plugged into the site's uninterruptible power supply (UPS) which should have filtered the AC power for our instrument system, spikes and "brown outs" caused numerous equipment failures. These difficulties were not seen with the identical instrument system at site 74, which was solar powered. Once the source of these difficulties was discovered, we installed our own UPS between the site power and our instruments, which solved the problem.

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