Plains Elevated Convection at Night (PECAN)

10 Meter Flux Tower

A Component of

Millersville University Atmospheric Research and Aerostat Facility

(MARAF)

Author:
Dr. Richard Clark
717-871-7434
richard.clark@millersville.edu

1.0 Data Set Overview:

This dataset contains data from the Millersville University Flux Tower located at 38.9405°N, 99.5661°W at 646 meters above sea level from 1 June 2015 to 15 July 2015.

2.0 Daily Reports:

1 JUNE 2015	Nothing Unusual to Report
2 JUNE 2015	Nothing Unusual to Report
3 JUNE 2015	Nothing Unusual to Report
4 JUNE 2015	Nothing Unusual to Report
5 JUNE 2015	Nothing Unusual to Report
6 JUNE 2015	Nothing Unusual to Report
7 JUNE 2015	Nothing Unusual to Report
8 JUNE 2015	Report: Data Loss 20:16:46.6”- 22:14:59.9”
9 JUNE 2015	Report: New Datalogger Program Was Installed Data Loss 17:42:52.4”- 18:00:24.9”
10 JUNE 2015	Nothing Unusual to Report
11 JUNE 2015	Nothing Unusual to Report
12 JUNE 2015	Nothing Unusual to Report
13 JUNE 2015	Report: Data Loss 00:07:49.4”- 00:31:59.9”
14 JUNE 2015	Report: Data Loss 00:08:33”- 00:31:10.4”
15 JUNE 2015	Report: Data Loss 00:02:21.5”- 00:27:52.9”
16 JUNE 2015	Nothing Unusual to Report
17 JUNE 2015	Nothing Unusual to Report
18 JUNE 2015	Nothing Unusual to Report
19 JUNE 2015	Nothing Unusual to Report
20 JUNE 2015	Nothing Unusual to Report
21 JUNE 2015	Nothing Unusual to Report
22 JUNE 2015	Nothing Unusual to Report
23 JUNE 2015	Nothing Unusual to Report
24 JUNE 2015	Report: Data Loss 01:56:17.3”- 02:11:20.2”
25 JUNE 2015	Nothing Unusual to Report
26 JUNE 2015	Nothing Unusual to Report

27 JUNE 2015 Nothing Unusual to Report
28 JUNE 2015 Nothing Unusual to Report
29 JUNE 2015 Nothing Unusual to Report
30 JUNE 2015 Report: Barometric Pressure Transducer Replaced;
Data Loss 00:00:00”- 01:07:40.1” 19:16:48.8”- 19:55:59.9”
1 JULY 2015 Nothing Unusual to Report
2 JULY 2015 Nothing Unusual to Report
3 JULY 2015 Nothing Unusual to Report
4 JULY 2015 Nothing Unusual to Report
5 JULY 2015 Nothing Unusual to Report
6 JULY 2015 Nothing Unusual to Report
7 JULY 2015 Nothing Unusual to Report
8 JULY 2015 Nothing Unusual to Report
9 JULY 2015 Nothing Unusual to Report
10 JULY 2015 Nothing Unusual to Report
11 JULY 2015 Nothing Unusual to Report
12 JULY 2015 Report: Data Loss 08:51:42”- 23:59:59.9”
13 JULY 2015 Nothing Unusual to Report
14 JULY 2015 Nothing Unusual to Report
15 JULY 2015 Report: Power Was Lost; Data Loss 07:47:00”-23:59:59.9”

3.0 Instrument Description:

The Flux Tower is 30 feet or approximately 9.14 meters in height
The Flux Tower contained the following instruments:

1) One CSAT-3 3D Sonic Anemometer located at 8.5 meters
2) One CSAT-3 3D Sonic Anemometer located at 2 meters
3) One LI-7500 LICOR Carbon Dioxide and Water Vapor Sensor located at 8.5 meters
4) One Q7.1 Net Radiometer located at 2 meters
5) One HMP45C Temperature and Humidity Sensor located at 2 meters
6) One CR5000 Datalogger located at 2 meters
7) One CS100 Barometric Pressure Transducer (ranging from 600mb-1100mb) located inside the CR5000 Datalogger Box
8) One Lightning Rod located at 10 meters
9) Two Solar Panels as a back-up energy source located next to the flux tower

4.0 Data Collection and Processing:

The data was collected at a frequency of 10 Hz and averaged over 30 minutes through 9 June 2015. We downloaded a new data collection program on 9 June 2015 which averaged the 10 Hz data in one minute intervals through 15 July 2015.

Sensor	Manufacturer	Model	Parameter	Rate
3-D Sonic Anemometer	Campbell Scientific	CSAT3	U,v,w – (m/s) T*vs* – (°C)	60 sps
Open-Path Gas Analyzer	LI-COR	LI-7500	H2O/CO2 Concentration	20 sps
Temperature and RH Sensor	Campbell Scientific	HMP45C	Temperature, RH	
Net Radiometer	Micromet Systems	Q*7	Net Radiation – W/m^2	1 Hz
Barometric Pressure Transducer	Setra	278	Pressure - mb	

5.0 Measured parameters:

Hs	Sensible heat flux using sonic temperature [W / m^2]
Fc_wpl	Carbon dioxide (LI-7500) flux, with Webb et al. term [mg / {m^2 s}]
LE_wpl	Latent heat (LI-7500) flux, with Webb et al. term [W / m^2]
Hc	Sensible heat calculated from Hs and LE_wpl [W / m^2]
tau	Momentum flux [kg / {m s^2}]
u_star	Friction velocity [m / s]
Ts_ mean	Average sonic temperature [C]
stdev_Ts	Standard deviation of sonic temperature [C]
cov_Ts_Ux	Covariance of sonic temperature and horizontal wind (x-axis) [m C / s]
cov_Ts_Uy	Covariance of sonic temperature and horizontal wind (y-axis) [m C / s]
cov_Ts_Uz	Covariance of sonic temperature and vertical wind [m C / s]
CO2_mean	Average carbon dioxide (LI-7500) density [mg / m^3]
stdev_CO2	Standard deviation of carbon dioxide (LI-7500) density [mg / m^3]
cov_CO2_Ux	Covariance of carbon dioxide (LI-7500) density and horizontal wind (x-axis) [mg / {m^2 s}]
cov_CO2_Uy	Covariance of carbon dioxide (LI-7500) density and horizontal wind (y-axis) [mg / {m^2 s}]
cov_CO2_Uz	Covariance of carbon dioxide (LI-7500) density and vertical wind [mg / {m^2 s}]
H2O_Avg	Average water vapor (LI-7500) density [g / m^3]
stdev_H2O	Standard Deviation of water vapor (LI-7500) density [g / m^3]
cov_H2O_Ux	Covariance of water vapor (LI-7500) density and horizontal wind (x-axis) [g / {m^2 s}]
cov_H2O_Uy	Covariance of water vapor (LI-7500) density and horizontal wind (y-axis) [g / {m^2 s}]
cov_H2O_Uz	Covariance of water vapor (LI-7500) density and vertical wind [g / {m^2 s}]
Ux_Avg	Average horizontal wind (x-axis) [m / s]
stdev_Ux	Standard deviation of horizontal wind (x-axis) [m / s]
cov_Ux_Ux	Variance of the horizontal wind (x-axis) [(m / s)^2]
cov_Ux_Uy	Covariance of horizontal winds (x-axis and y-axis) [(m / s)^2]
cov_Ux_Uz	Covariance of horizontal wind (x-axis) and vertical wind [(m / s)^2]
Uy_Avg	Average horizontal wind (y-axis) [m / s]
stdev_Uy	Standard deviation of horizontal wind (y-axis) [m / s]
cov_Uy_Uy	Variance of the horizontal wind (y-axis) [(m / s)^2]
cov_Uy_Uz	Covariance of horizontal wind (y-axis) and vertical wind [(m / s)^2]
Uz_Avg	Average vertical wind [m / s]
stdev_Uz	Standard deviation of vertical wind [m / s]
cov_Uz_Uz	Variance of the vertical wind [(m / s)^2]
press_mean	Average barometric pressure (LI-7500) [kPa]
t_hmp_mean	Average temperature from HMP45C [C]
H2O_hmp_mean	Average water vapor density from HMP45C [g / m^3]
rh_hmp_mean	Average relative humidity [percent]
rho_a_mean	Average air density [kg / m^3]
wnd_dir_compass	Resultant wind direction using compass coordinate system [degrees]

wnd_dir_csat3	Resultant wind direction using the CSAT3's right handed coordinate system [degrees]
wnd_spd	Horizontal wind speed [m / s]
rslt_wnd_spd	Resultant horizontal wind speed [m / s]
std_wnd_dir	Standard deviation of wind direction [degrees]
Fc_irga	Carbon dioxide (LI-7500) flux without the Webb et al. term [mg / {m^2 s}]
LE_irga	Latent heat (LI-7500) flux without the Webb et al. term [W / m^2]
CO2_wpl_LE	Carbon dioxide (LI-7500) Webb et al. term due to latent heat flux [mg / {m^2 s}]
CO2_wpl_H	Carbon dioxide (LI-7500) Webb et al. term due to (sonic) sensible heat flux [mg / {m^2 s}]
H2O_wpl_LE	Water vapor (LI-7500) Webb et al. term due to latent heat flux [W / m^2]
H2O_wpl_H	Water vapor (LI-7500) Webb et al. term due to (sonic) sensible heat flux [W / m^2]
n_Tot	Number of samples in the statistics (fluxes, variances, means, etc.) [samples]
csat_warnings	Number of times any CSAT3 warning flag was set high [samples]
irga_warnings	Number of times any LI-7500 warning flag was set high [samples]
del_T_f_Tot	Number of delta temperature warnings from CSAT3 [samples]
sig_lck_f_Tot	Number of poor signal lock warnings from CSAT3 [samples]
amp_h_f_Tot	Number of amplitude high warnings from CSAT3 [samples]
amp_l_f_Tot	Number of amplitude low warnings from CSAT3 [samples]
chopper_f_Tot	Number of chopper warnings from LI-7500 [samples]
detector_f_Tot	Number of chopper detector from LI-7500 [samples]
pll_f_Tot	Number of chopper pll from LI-7500 [samples]
sync_f_Tot	Number of chopper synchronization warnings from LI-7500 [samples]
agc_Avg	Average AGC from LI-7500 [unitless]
agc_excded_Tot	Number times the LI-7500 AGC exceeded a fixed user defined threshold [samples]
panel_temp_Avg	Average datalogger panel temperature [C]
batt_volt_Avg	Average battery voltage [V]
Rn_meas_Avg	Average Rn measured [W/m^2]
Rn_corr_Avg	Average Rn corrected [W/m^2]
press	Barometric pressure [mbar]

Additional Parameters:

Specific Humidity	The average water vapor density (H2O_hmp_mean) per average air density (rho_a_mean)
TKE	The turbulent kinetic energy calcuated with the sum of the variances of horizontal wind (cov_Ux_Ux and cov_Uy_Uy) and vertical wind (cov_Uz_Uz) multiplied by (1/2).

6.0 File Naming Convention:

surface.FP3_Millersville_Flux.201506100000.Data

Data Remarks:

From 1 June 2015 through 9 June 2015 the datalogger program was averaging the 10 Hz data every 30 minutes. On 9 June 2015 starting at 18:00:25 UTC, a new datalogger program was installed averaging the 10 Hz data every minute. One minute averages for certain intervals during the dates of 1 June 2015 through 9 June 2015 can be obtained by request.

The tower was not exactly oriented true north. As a result, the horizontal components of the wind speed had to be adjusted with the following equations:

Ux_Avg = Y5*COS(0.185004901)-AE5*SIN(0.185004901)

Uy_Avg = Y5*SIN(0.185004901)+AE5*COS(0.185004901)

Due to the adjustment of the x and y components of the wind, the wind direction had to be adjusted by 10.6 degrees. Column AT kept all positive angles the same and added 360 degrees to any negative angles. Column AU added the 10.6 degree adjustment and subtracted 360 degrees if the adjustment made the angle greater than 360 degrees.

References: