

NOAA/ARL/ATDD Micrometeorological Tower Metadata
VORTEX-SE, Spring 2017

PIs

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1. Data set overview

To support research activities during the Verification of the Origins of Rotation in Tornadoes EXperiment-Southeast (VORTEX-SE), NOAA/ARL/ATDD (NOAA Air Resources Laboratory Atmospheric Turbulence and Diffusion Division) installed two 10 m towers outfitted with a suite of meteorological instruments at the beginning of the spring 2016 VORTEX-SE campaign. One tower was installed approximately 2 km north of Belle Mina, AL at the Tennessee Valley Research and Extension Center (TVREC) (34.691394 N, 86.870989 W, 183 m above mean sea level [msl]) in late January 2016. A second 10 m tower was installed approximately 55 km south of Belle Mina near Cullman, AL at the Auburn University North Alabama Horticulture Research Center (34.194047 N, 86.799239 W, 242 m msl) in mid-February 2016. Both towers were removed on 1-2 May 2017 following the conclusion of the final intensive observation period of VORTEX-SE. Only data obtained between 1 March and 1 May 2017 are posted. Data available before these dates can be obtained by contacting Temple Lee (temple.lee@noaa.gov).

2. Instrument description

The micrometeorological towers at Belle Mina and Cullman consist of an identical suite of meteorological instruments to sample temperature, humidity, incoming and outgoing shortwave and longwave radiation, wind speed and direction, rainfall, pressure, soil moisture, soil temperature, and fluxes of sensible and latent heat. Descriptions of the instruments are found in Table 1. Most instruments were installed along a 10 m tower; however, due to space limitations on the tower, a tripod was installed approximately 8 m from the base of the 10 m tower to support the 3 m RM Young propeller anemometer and 3 m eddy covariance instruments (i.e. EC155 closed path infrared gas analyzer and CSAT3 sonic anemometer).

Table 1: Meteorological variable, sampling instrument, and sampling height(s) for the variables measured at Belle Mina, AL and Cullman, AL during the spring 2017 VORTEX-SE campaign.

Variable	Instrument	Sampling Height(s) (m above ground level [agl])
Temperature, dew point temperature	Vaisala HMP110 humidity and temperature probe	1.5
Temperature	Platinum resistance thermometer (PRT) in aspirated shield	3, 10
Pressure	RM Young 61302V	1
Net radiation	Hukseflux 4-component net radiometer	2.5
Soil temperature	TP01 soil temperature probe	-0.02, -0.05, -0.10, -0.20, -0.50
Soil moisture	Vegetronix	-0.05, -0.10, -0.20
Wind speed, wind direction	RM Young propeller anemometer	3, 10
Rainfall	TB3 tipping bucket rain gauge	2.5
Latent heat flux	EC155 closed path infrared gas analyzer	3, 10
CO ₂ flux	EC155 closed path infrared gas analyzer	3, 10
Sensible heat flux	CSAT3 sonic anemometer	3, 10
Photosynthetically active radiation (PAR)	LI-190	3

3.0 Data collection and processing

With the exception of the sonic anemometers and gas analyzers which sample at 10 Hz, all other instruments on both towers (Table 1) sample at 5 s. 30 min means were calculated for most measurements, with the exception of rainfall, from which 30 min totals were computed. The 10 Hz data obtained from the eddy covariance instruments were used to compute 30 min fluxes of sensible heat, latent heat, and CO₂ and to calculate turbulence statistics.

4.0 Data Format

4.1 Files with .30met extension

The .30met files contain the 30 min meteorological data and have the following naming convention: locationYear_DayOfYear.30met (e.g. the file *VB17_081.30met* contains the Belle Mina data for day of year 81 in 2017). The format of the half-hour data listed in each of these files is found in Table 2. All times are listed in UTC (UTC=LST+6), and files are saved as .txt files. Missing data are represented by -6999. There is one .30met file per station per day.

4.2 Files with .dat1 extension

The .dat1 files contain the 30 min meteorological and flux data sampled at 3 m agl and 10 m agl and include the names “tripod” and “main,” respectively. For example, the file *VB17Trip_081.dat1* contains the Belle Mina data for day of year 81 in 2017 sampled 3 m agl, whereas the file *VB16Main_081.dat1* contains the Belle Mina data for day of year 81 in 2017 sampled 10 m agl. Descriptions of each of the data columns are found in Table 3. As with the .30met files, all times are listed in UTC (UTC=LST+6), and all files are saved as .txt files. Missing meteorological data, covariances, and fluxes are represented by -6999, -9.9, and -999, respectively. Because data from the tripod and tower are saved into separate files, there are two .dat1 files per station per day.

Table 2: Data format for the .30met files:

Column	Variable Description
1	decimal day of year
2	Julian day
3	hourmin (ending)
4	air temperature from PRT1 at 3 m (°C)
5	air temperature from PRT2 at 3 m (°C)
6	air temperature from PRT3 at 3 m (°C)
7	air temperature from PRT1 at 10 m (°C)
8	air temperature from PRT2 at 10 m (°C)
9	air temperature from PRT3 at 10 m (°C)
10	air temperature from Vaisala (°C)
11	dewpoint from Vaisala (°C)
12	wind speed at 3 m (m s^{-1})
13	wind direction at 3 m (°)
14	standard deviation wind direction at 3 m (°)
15	wind speed at 10 m (m s^{-1})
16	wind direction at 10 m (°)
17	standard deviation wind direction at 10 m (°)
18	atmospheric pressure (mb)
19	incoming PAR ($\text{uE m}^2 \text{s}^{-1}$)
20	outgoing PAR ($\text{uE m}^2 \text{s}^{-1}$)
21	incoming global/solar radiation (W m^{-2})
22	outgoing global/solar radiation (W m^{-2})
23	incoming longwave radiation (W m^{-2})
24	outgoing longwave radiation (W m^{-2})
25	surface temperature derived from longwave radiation(°C)
26	soil temperature from probe 1 at 2 cm depth (°C)
27	soil temperature from probe 1 at 5 cm depth (°C)
28	soil temperature from probe 1 at 10 cm depth (°C)
29	soil temperature from probe 1 at 20 cm depth (°C)
30	soil temperature from probe 1 at 50 cm depth (°C)
31	soil temperature from probe 2 at 2 cm depth (°C)
32	soil temperature from probe 2 at 5 cm depth (°C)
33	soil temperature from probe 2 at 10 cm depth (°C)
34	soil temperature from probe 2 at 20 cm depth (°C)
35	soil temperature from probe 2 at 50 cm depth (°C)
36	volumetric water content from probe 1 at 5 cm depth
37	volumetric water content from probe 1 at 10 cm depth
38	volumetric water content from probe 1 at 20 cm depth
39	volumetric water content from probe 2 at 5 cm depth
40	volumetric water content from probe 2 at 10 cm depth
41	volumetric water content from probe 2 at 20 cm depth
42	accumulated precipitation for 30 minute period (mm)
43	soil storage: net temperature change at 2 cm probe 1 (°C)
44	soil storage: net temperature change at 2 cm probe 2 (°C)
45	soil storage: net temperature change at 5 cm probe 1 (°C)
46	soil storage: net temperature change at 5 cm probe 2 (°C)
47	canopy storage: net temperature change (°C)

Table 3: Data format for .dat1 files:

Column	Variable Description
1	decimal day
2	Julian day
3	HOURLMIN (ending)
4	wind speed at 10 m (m s^{-1})
5	wind direction at 10 m ($^{\circ}$)
6	wind speed at 3 m (m s^{-1})
7	wind direction at 3 m ($^{\circ}$)
8	air temperature at 3 m ($^{\circ}\text{C}$)
9	air temperature at 10 m ($^{\circ}\text{C}$)
10	relative humidity (%)
11	pressure (mb)
12	PAR ($\text{uE m}^2 \text{s}^{-1}$)
13	outgoing PAR ($\text{uE m}^2 \text{s}^{-1}$)
14	incoming shortwave (W m^{-2})
15	outgoing shortwave (W m^{-2})
16	incoming longwave (W m^{-2})
17	outgoing longwave (W m^{-2})
18	net radiation (W m^{-2})
19	soil heat storage (W m^{-2})
20	surface temperature ($^{\circ}\text{C}$)
21	soil temperature at 2 cm ($^{\circ}\text{C}$)
22	soil temperature at 5 cm ($^{\circ}\text{C}$)
23	soil temperature at 10 cm ($^{\circ}\text{C}$)
24	soil temperature at 20 cm ($^{\circ}\text{C}$)
25	soil temperature at 50 cm ($^{\circ}\text{C}$)
26	u_bar from sonic (m s^{-1})
27	u* sonic (m s^{-1})
28	u^2 ($\text{m}^2 \text{s}^{-2}$)
29	v^2 ($\text{m}^2 \text{s}^{-2}$)
30	w^2 ($\text{m}^2 \text{s}^{-2}$)
31	sensible heat (W m^{-2})
32	latent heat flux (W m^{-2})
33	CO_2 flux ($\mu\text{mol CO}_2 \text{m}^2 \text{s}^{-1}$)
34	air density (kg m^{-3})
35	volumetric water content at 5 cm ($\text{m}^3 \text{m}^{-3}$)
36	volumetric water content at 10 cm ($\text{m}^3 \text{m}^{-3}$)
37	volumetric water content at 20 cm ($\text{m}^3 \text{m}^{-3}$)
39	standard deviation of sonic temperature ($^{\circ}\text{C}$)
40	standard deviation of humidity concentrations ($\text{mmol H}_2\text{O/mol dry air}$)
41	standard deviation of CO_2 concentration ($\mu\text{mol CO}_2/\text{mole dry air}$)

5.0 Data Remarks

Any questions about the data sets should be directed to Temple Lee (temple.lee@noaa.gov).