University of Maryland Baltimore County Surface Weather Station

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1. Data Set Overview

This data set contains surface observations of temperature, pressure, relative humidity, wind, solar radiation, and precipitation accumulation from a Vaisala HydroMet Automatic Weather Station (model MAWS201). The weather station was located at the PECAN FP-2 site in Greensburg, KS (37.60695°N, -99.27606°E). Figure 1 shows the weather station was it was positioned during data acquisition. Data collection began on 28 May 2015 and ended on 15 July 2015. The data have a time resolution of one minute.

2. Instrument Description

Below is a summary of the quantities and the sensors they were measured by.

Barometric pressure was measured by a Vaisala BARO-1QML. The measurement range is 1100 to 500 hPa.

Precipitation accumulation was measured by a Vaisala QMR101. It has a 0.2 mm capacity tipping spoon.

Temperature and relative humidity were measured by a Vaisala HUMICAP Humidity and Temperature Probe HMP155. The following relative humidity and temperature specifications are taken from the HMP155 Datasheet (http://www.vaisala.com/Vaisala%20Documents/Brochures%20and%20Datasheets/HMP155-Datasheet-B210752EN-E-LoRes.pdf).

Relative Humidity	
Measurement range	0 – 100%
Accuracy (including non-linearity, hysteresis, and repeatability) at:	
+15 to +25°C	±1% RH (0 – 90% RH) ±1.7% RH (90 – 100% RH)
-20 to +40°C	±(1.0 + 0.008 * reading) % RH
-40 to -20°C	±(1.2 + 0.012 * reading) % RH
+40 to +60°C	±(1.2 + 0.012 * reading) % RH
-60 to -40°C	±(1.4 + 0.032 * reading) % RH

Factory calibration uncertainty (+20°C)	±0.6% RH (0 to 40% RH)* ±1.0% RH (40 to 97% RH)*

* Defined as ±2 standard deviation limits. Small variations possible, see also calibration certificate.

Response time at +20°C in still air with a sintered PTFE filter	
63%	20 s
90%	60 s

Temperature

Measurement range	-80 to +60°C
Accuracy with voltage output at	
-80 to +20°C	±(0.226 - 0.0028 * temperature) °C
+20 to +60°C	±(0.055 + 0.0057 * temperature) °C
Response time with additional temperature probe in 3 m s^{-1} air flow	
63%	< 20 s
90%	< 35 s

Solar radiation was measured by a Vaisala QMS101 pyranometer.

Wind speed and direction were measured by a Vaisala WINDCAP Ultrasonic Wind Sensor WMT52. The following wind speed and direction specifications are taken from the WMT52 Datasheet (http://www.vaisala.com/Vaisala%20Documents/Brochures%20and%20Datasheets/WMT52-Datasheet-B210553EN-E-LOW.pdf)

Wind Speed

Range	0 to 60 m s^{-1}
Response time	250 ms
Available variables	average, maximum, and minimum
Accuracy	±3% at 10 m s^{-1}
Output resolution	0.1 m s^{-1}

Wind Direction

Azimuth	0 to 360°
Response time	250 ms
Available variables	average, maximum, and minimum
Accuracy	±3°
Output resolution	1°

Measurement Frame

Averaging time	1 to 3600 s, at 1 s steps on the basis of samples taken at 4 Hz rate (configurable)
Update interval	1 to 3600 s, at 1 s steps

Figure 1. University of Maryland Baltimore County weather station at its location in Greensburg, KS (FP-2) during PECAN. The camera is facing northwest.

3. Data Collection and Processing

The data from each sensor are collected into daily files and all sensor observations are combined together in the netCDF files. Note that Figure 1 shows the unit assembled with a cup anemometer and wind vane on a mast. These devices were not calibrated during the setup at PECAN so their data are not used. All wind data in the data files are from the sonic anemometer. The only quality checking that was performed on the data was to ensure that the data values were between the valid minimum and valid maximum for those sensors which had a valid sensible range or to make sure that the data values were realistic (in the case of the pyranometer). The wind speed and direction averages, maximums, and minimums were output by the sensor / software and were not calculated during any kind of post-processing of the data.

4. Data Format

The netCDF file header is shown below.

```
netcdf surfaceMet_FP2_20150601 {
dimensions:
      time = UNLIMITED ; // (1440 currently)
variables:
      double base_time ;
            base_time:long_name = "base time" ;
            base_time:units = "seconds since 01 Jan 1970 00:00:00 UTC to
start_time" ;
      float time_offset(time) ;
            time_offset:long_name = "time offset from base_time" ;
            time_offset:units = "number of seconds since base_time" ;
      float pres(time) ;
            pres:_FillValue = 9.96921e+36f ;
            pres:long_name = "pressure" ;
            pres:units = "hPa" ;
            pres:sensor = "Vaisala BARO-1QML" ;
            pres:valid_min = 500 ;
            pres:valid_max = 1100 ;
      float precip(time) ;
            precip:_FillValue = 9.96921e+36f ;
            precip:long_name = "liquid precipitation accumulation during the
current time interval" ;
            precip:units = "mm" ;
            precip:sensor = "Vaisala QMR101" ;
      float rh(time) ;
            rh:_FillValue = 9.96921e+36f ;
            rh:long_name = "relative humidity" ;
            rh:units = "%" ;
            rh:sensor = "Vaisala HUMICAP Humidity and Temperature Probe
HMP155" ;
            rh:valid_min = 0 ;
            rh:valid_max = 100 ;
      float solar_rad(time) ;
            solar_rad:_FillValue = 9.96921e+36f ;
            solar_rad:long_name = "solar radiation" ;
            solar_rad:units = "W/m^2" ;
            solar_rad:sensor = "Vaisala QMS101 Pyranometer" ;
            solar_rad:valid_min = 0 ;
            solar_rad:valid_max = 1370 ;
      byte status(time) ;
```

```
            status:long_name = "system status" ;
            status:units = "unitless" ;
            status:value_0 = "good" ;
            status:value_1 = "bad" ;
      float air_temperature(time) ;
            air_temperature:_FillValue = 9.96921e+36f ;
            air_temperature:long_name = "air temperature" ;
            air_temperature:units = "C" ;
            air_temperature:sensor = "Vaisala HUMICAP Humidity and
Temperature Probe HMP155" ;
            air_temperature:valid_min = -80 ;
            air_temperature:valid_max = 60 ;
      float wd_sonic(time) ;
            wd_sonic:_FillValue = 9.96921e+36f ;
            wd_sonic:long_name = "sonic anemometer instantaneous wind
direction" ;
            wd_sonic:units = "degrees" ;
            wd_sonic:sensor = "Vaisala WINDCAP Ultrasonic Wind Sensor WMT52"
;
            wd_sonic:valid_min = 0 ;
            wd_sonic:valid_max = 360 ;
      float wd_sonic_2MA(time) ;
            wd_sonic_2MA:_FillValue = 9.96921e+36f ;
            wd_sonic_2MA:long_name = "sonic anemometer average wind direction
during the previous 2 minutes" ;
            wd_sonic_2MA:units = "degrees" ;
            wd_sonic_2MA:sensor = "Vaisala WINDCAP Ultrasonic Wind Sensor
WMT52" ;
            wd_sonic_2MA:valid_min = 0 ;
            wd_sonic_2MA:valid_max = 360 ;
      float wd_sonic_2MM(time) ;
            wd_sonic_2MM:_FillValue = 9.96921e+36f ;
            wd_sonic_2MM:long_name = "sonic anemometer minimum wind direction
during the previous 2 minutes" ;
            wd_sonic_2MM:units = "degrees" ;
            wd_sonic_2MM:sensor = "Vaisala WINDCAP Ultrasonic Wind Sensor
WMT52" ;
            wd_sonic_2MM:valid_min = 0 ;
            wd_sonic_2MM:valid_max = 360 ;
      float wd_sonic_2MX(time) ;
            wd_sonic_2MX:_FillValue = 9.96921e+36f ;
            wd_sonic_2MX:long_name = "sonic anemometer maximum wind direction
during the previous 2 minutes" ;
            wd_sonic_2MX:units = "degrees" ;
            wd_sonic_2MX:sensor = "Vaisala WINDCAP Ultrasonic Wind Sensor
WMT52" ;
            wd_sonic_2MX:valid_min = 0 ;
            wd_sonic_2MX:valid_max = 360 ;
      float wd_sonic_10MA(time) ;
            wd_sonic_10MA:_FillValue = 9.96921e+36f ;
            wd_sonic_10MA:long_name = "sonic anemometer average wind
direction during the previous 10 minutes" ;
            wd_sonic_10MA:units = "degrees" ;
            wd_sonic_10MA:sensor = "Vaisala WINDCAP Ultrasonic Wind Sensor
WMT52" ;
            wd_sonic_10MA:valid_min = 0 ;
            wd_sonic_10MA:valid_max = 360 ;
```

```
      float wd_sonic_10MM(time) ;
            wd_sonic_10MM:_FillValue = 9.96921e+36f ;
            wd_sonic_10MM:long_name = "sonic anemometer minimum wind
direction during the previous 10 minutes" ;
            wd_sonic_10MM:units = "degrees" ;
            wd_sonic_10MM:sensor = "Vaisala WINDCAP Ultrasonic Wind Sensor
WMT52" ;
            wd_sonic_10MM:valid_min = 0 ;
            wd_sonic_10MM:valid_max = 360 ;
      float wd_sonic_10MX(time) ;
            wd_sonic_10MX:_FillValue = 9.96921e+36f ;
            wd_sonic_10MX:long_name = "sonic anemometer maximum wind
direction during the previous 10 minutes" ;
            wd_sonic_10MX:units = "degrees" ;
            wd_sonic_10MX:sensor = "Vaisala WINDCAP Ultrasonic Wind Sensor
WMT52" ;
            wd_sonic_10MX:valid_min = 0 ;
            wd_sonic_10MX:valid_max = 360 ;
      float ws_sonic(time) ;
            ws_sonic:_FillValue = 9.96921e+36f ;
            ws_sonic:long_name = "sonic anemometer instantaneous wind speed"
;
            ws_sonic:units = "m/s" ;
            ws_sonic:sensor = "Vaisala WINDCAP Ultrasonic Wind Sensor WMT52"
;
            ws_sonic:valid_min = 0 ;
            ws_sonic:valid_max = 60 ;
      float ws_sonic_2MA(time) ;
            ws_sonic_2MA:_FillValue = 9.96921e+36f ;
            ws_sonic_2MA:long_name = "sonic anemometer average wind speed
during the previous 2 minutes" ;
            ws_sonic_2MA:units = "m/s" ;
            ws_sonic_2MA:sensor = "Vaisala WINDCAP Ultrasonic Wind Sensor
WMT52" ;
            ws_sonic_2MA:valid_min = 0 ;
            ws_sonic_2MA:valid_max = 60 ;
      float ws_sonic_2MM(time) ;
            ws_sonic_2MM:_FillValue = 9.96921e+36f ;
            ws_sonic_2MM:long_name = "sonic anemometer minimum wind speed
during the previous 2 minutes" ;
            ws_sonic_2MM:units = "m/s" ;
            ws_sonic_2MM:sensor = "Vaisala WINDCAP Ultrasonic Wind Sensor
WMT52" ;
            ws_sonic_2MM:valid_min = 0 ;
            ws_sonic_2MM:valid_max = 60 ;
      float ws_sonic_2MX(time) ;
            ws_sonic_2MX:_FillValue = 9.96921e+36f ;
            ws_sonic_2MX:long_name = "sonic anemometer maximum wind speed
during the previous 2 minutes" ;
            ws_sonic_2MX:units = "m/s" ;
            ws_sonic_2MX:sensor = "Vaisala WINDCAP Ultrasonic Wind Sensor
WMT52" ;
            ws_sonic_2MX:valid_min = 0 ;
            ws_sonic_2MX:valid_max = 60 ;
      float ws_sonic_10MA(time) ;
            ws_sonic_10MA:_FillValue = 9.96921e+36f ;
```

```
            ws_sonic_10MA:long_name = "sonic anemometer average wind speed
during the previous 10 minutes" ;
            ws_sonic_10MA:units = "m/s" ;
            ws_sonic_10MA:sensor = "Vaisala WINDCAP Ultrasonic Wind Sensor
WMT52" ;
            ws_sonic_10MA:valid_min = 0 ;
            ws_sonic_10MA:valid_max = 60 ;
      float ws_sonic_10MM(time) ;
            ws_sonic_10MM:_FillValue = 9.96921e+36f ;
            ws_sonic_10MM:long_name = "sonic anemometer minimum wind speed
during the previous 10 minutes" ;
            ws_sonic_10MM:units = "m/s" ;
            ws_sonic_10MM:sensor = "Vaisala WINDCAP Ultrasonic Wind Sensor
WMT52" ;
            ws_sonic_10MM:valid_min = 0 ;
            ws_sonic_10MM:valid_max = 60 ;
      float ws_sonic_10MX(time) ;
            ws_sonic_10MX:_FillValue = 9.96921e+36f ;
            ws_sonic_10MX:long_name = "sonic anemometer maximum wind speed
during the previous 10 minutes" ;
            ws_sonic_10MX:units = "m/s" ;
            ws_sonic_10MX:sensor = "Vaisala WINDCAP Ultrasonic Wind Sensor
WMT52" ;
            ws_sonic_10MX:valid_min = 0 ;
            ws_sonic_10MX:valid_max = 60 ;

// global attributes:
            :equipment = "Vaisala HydroMet Automatic Weather Station MAWS201"
;
            :creating_program = "Vaisala_HydroMetTxt_to_daily_netCDF.py" ;
            :project_name = "PECAN" ;
            :site_name = "FP2" ;
            :site_elev_mASL = 681. ;
            :start_time = "01 Jun 2015 00:00:00 UTC" ;
            :site_lat_N = 37.60695 ;
            :creation_time = "15 Mar 2016 19:57:26 UTC" ;
            :site_lon_E = -99.27606 ;
            :owner = "University of Maryland Baltimore County" ;
}
```