Title: Windsond Quality Controlled Data for TORUS LItE

Authors:
Madeline Diedrichsen - OU/CIWRO/NSSL
madeline.diedrichsen@noaa.gov

1.0 Dataset Overview:

The 2023 TORUS Windsond dataset was collected from 23 May 2023 to 15 June 2023 within the domain outlined on the TORUS EOL database main page. One dedicated Windsond platform conducted deployments of up to 16 sondes on a single receiver through the duration of the campaign. Two other NSSL mobile mesonet platforms were equipped with Windsonds in addition to the primary mission to launch when given the opportunity.

2.0 Instrument Description:

The Windsond system used in TORUS LItE was developed by Sparv Embedded, a Swedish company. Each Windsond is a 12 gram styrofoam cup equipped with a temperature sensor, RH sensor, and a GPS chip on the computer board from which wind speed and direction are derived. Data points are collected at a 1 Hz frequency dependent on receiver connection, occasionally dropping to a 0.2-0.33 Hz frequency. The hardware details can be found in the Sparv Windsond Catalog along with an overview in the table below.

Variable Specifications:

Temperature	Sensor Type: Band Gap Measurement Range: -40 to 80 °C Accuracy: 0.3 °C Resolution: 0.01 °C Response Time: 6 sec
Relative Humidity (RH)	Sensor Type: Capacitive Measurement Range: 0 to 100% Accuracy: 2.0% Resolution: 0.05% Response TIme: 6 sec
Pressure	Measurement Range: 300 to 1100 hPa Accuracy: 1.0 hPa Resolution: 0.02 hPa
Wind Speed	Measurement Range: 0 to 150 m/s Accuracy: ca 5% Resolution: 0.1 m/s
Wind Direction	Measurement Range: 0 to 360° Accuracy: Depends on GPS connectivity Resolution: 0.1°

Sparv Embedded has developed multi-sonde receivers to allow for multiple sondes to be launched from a single receiver and collect data from the receiver simultaneously. In this field campaign, 16 sonde RR2 receivers were used for the Windsond platform.

3.0 Data Collection and Processing:

Deployments dates broken into deployments (chronologically by launch time) including the number of sondes and launch location of each platform launching in the deployment:

23 May 2023:

Deployment	Number of Sondes	Latitude	Longitude
1	3	34.35278	-102.887233
2	1	34.017368	-102.08414

24 May 2023:

Deployment	Number of Sondes	Latitude	Longitude
1	1	34.708615	-102.953872
2	11	34.471217	-103.126652

26 May 2023:

Deployment	Number of Sondes	Latitude	Longitude
1	1	33.95345	-103.336943
2	1	34.425418	-102.992873
3	3	34.445478	-102.991232

27 May 2023:

Deployment	Number of Sondes	Latitude	Longitude
1	1	33.511492	-103.007195
2	5	33.3339	-102.819872

01 June 2023:

Deployment	Number of Sondes	Latitude	Longitude
1	1	33.145557	-102.31187
2	4	32.492013	-100.878377

02 June 2023:

Deployment	Number of Sondes	Latitude	Longitude
1	1	32.731502	-101.992982
2	10	32.711768	-102.743753
3	9	32.562278	-102.01965

09 June 2023:

Deployment	Number of Sondes	Latitude	Longitude
1	1	33.798218	-101.284152
2	2	34.406497	-101.309752

11 June 2023:

Deployment	Number of Sondes	Latitude	Longitude
1	6	37.218263	-103.6255

12 June 2023:

Deployment	Number of Sondes	Latitude	Longitude
1	10	35.980617	-103.68523
2	4	35.642145	-103.056628
3	4	35.562868	-103.167857

13 June 2023:

Deployment	Number of Sondes	Latitude	Longitude
1	1	36.140025	-102.022493
2	5	36.212353	-102.134698
3	5	35.939053	-101.474453

15 June 2023:

Deployment	Number of Sondes	Latitude	Longitude
1	1	35.239525	-100.250943
2	4	36.103863	-99.759567

The Windsond data was qc'd by flight for each deployment. The data collected between when a sonde was turned on and launched was excluded. This was done by determining the point at which the altitude was continually increasing for 100 m and when the ascent rate exceeded 1 m/s. The flight altitude was then corrected if the raw agl altitude was less than 0 m.

Dew point temperature was derived in post processing from the raw relative humidity and temperature at each data point. When the relative humidity value exceeds 100%, the relative humidity values were corrected such that values exceeding 100% were allowed, but a nan value was assigned to the dew point temperature field.

In addition, the wind speed and direction fields were smoothed by a cubic spline interpolation from the 1 Hz data. The number of knots selected for the cubic spline was determined independently for each flight in order to output the same amount of smoothing for each flight. The smoothness threshold value was found by calculating the difference in hodograph length between uncorrected and corrected wind profiles of a Vaisala radiosonde dataset collected during the TORUS campaign.

4.0 Data Format:

The data is comma-separated value formatted with headers for each variable in the first row. The filename is output in the following format:

{Platform name}_{Date of launch YYYYMMDD}_{time of launch (UTC) in HHMM}_{number in deployment if multiple sondes were launched each minute)}.csv

The heading descriptions are as follows:

Date	Date when the datapoint was taken (with respect to the UTC time)
hour	UTC decimal hour of each datapoint
time	UTC time in HH:MM:SS for each datapoint
lat_deg_N	Latitude derived from onboard GPS (decimal degrees)
lon_deg_E	Longitude derived from onboard GPS (decimal degrees)
elev_MSL_m	Raw altitude (MSL) in meters
elev_AGL_m	Relative altitude (AGL) in meters
temp1_C	Raw temperature values in degrees Celsius
tempD_C	Derived dewpoint temperature values in degrees Celsius
RH	Raw Relative Humidity in percent
hPa	Pressure in hectopascals
dir_deg	Raw GPS derived wind direction in degrees
spd_mPerS	Raw GPS derived wind speed in meters per second
corr_dir_deg	Smoothed GPS derived wind direction in degrees
corr_spd_mPerS	Smoothed derived wind speed in meters per second

Nan values are denoted by ‘nan’ in the data columns. Data gaps occur when the Windsonds lose reception with the receiver for greater than five seconds.

5.0 Data Remarks:

Windsondes are a relatively new instrument (within ~10 years) and haven’t been objectively compared with other instruments to understand biases in thermodynamic and kinematic variables. Therefore no corrections were made to account for any potential biases in the thermodynamic variables. This includes any correction of surface values using mobile mesonets or other surface observations. Results from a study in 2023 may lead to updates in thermodynamic corrections in the future.

6.0 References:

https://sparvembedded.com/products/windsond/