Stony Brook Univ. Windsond Data for PERiLS-2022

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1.0 Dataset Description

The accompanying dataset consists of Windsond data obtained by Stony Brook Univ. (SBU) researchers during the PERiLS-2022 field campaign. SBU participated in three intensive observing periods (IOPs) during the 2022 field campaign, IOPs 1, 2, and 4. Our goal was to launch Windsonds rapidly in advance of approaching QLCSs to sample the environment in the lowest 2-3 km above the ground, ideally at locations favorable for imminent mesovortex and/or tornado development.

Version: 1.0
Date: 1 August 2024
Status: Final
Time period: March-April of 2022
Location: Variable (see section 3.0)
Frequency: Variable (see section 3.0)

2.0 Instrument Description

The Windsond data we collected used Windsonds developed by Sparv Embedded (http://windsond.com/windsond_catalog_Feb2019.pdf). The Windsond system consists of temperature and moisture sensors housed within a Styrofoam cup that is powered by a lithium rechargeable battery. The cup can be tied to a latex weather balloon via a string, and once launched, is tracked via GPS using a receiver and Sparv Embedded's proprietary software. We used sonde type S1H3-R Reusable and RR2 radio receiver that allows for multiple sondes to be launched and tracked simultaneously. Data frequency are 1 Hz ideally but may sometimes be reduced owing to poor receiver connectivity. Sondes can be programmed to detach from the balloon and descend to the ground at a specified height level, details of which are given in section 3.0. Sparv Embedded provides the following accuracy information for atmospheric variables:

Variable	Specification
GPS	Rated to altitude of 40 km ASL
Pressure/Altitude	Range: 1100-300 hPa Pressure accuracy/resolution: 1 hPa / 0.02 hPa Altitude accuracy/resolution: 7 m / 0.4 m (at sea level)
Temperature	Accuracy/resolution: 0.2° C / 0.01° C at 25°C Response time: 6 s
Moisture	Accuracy/resolution: 1.8% / 0.05% Response time: 6 s
Wind speed	Accuracy/resolution: ~5% / 0.1 m s^{-1}
Wind direction	Resolution: 0.1°

3.0 Data Collection and Processing

Data were obtained in three of the four IOPs for PERiLS-2022. For each IOP, sondes were launched from the same location but at different times (i.e., not all sondes were launched simultaneously). Also, the time between sondes launched varied depending on motion of the QLCS, QLCS evolution, and the number of sondes and helium remaining. The table below summarizes the locations, times, and number of sondes successfully launched for these three IOPs:

IOP	Date	Location	Times	Sondes
1	22 March 2022	32.9668° N, 88.5457° W; just SE of Shuqualak, MS	19:22 – 20:22 UTC	5
2	30 March 2022	33.3018°N, 88.5925° W; just E of Crawford, MS	22:14 – 23:31 UTC	11
4	13 April 2022	36.1904° N, 89.8721° W; ~17 km ESE Kennett, MO	18:34 – 20:23 UTC	15

More details of the three IOPs are provided in the table below:

IOP	Description/Notes
1	Our team set up in the southern part of the PERiLS domain at a deployment site that proved challenging to operate from, and which led to several failed launches. Nonetheless, we launched a test sonde at 19:22 UTC that was successful. Soon after, it became obvious that we would be in the path of a supercell out ahead of the impending target QLCS. We launched four more sondes between 19:35 and 20:05 UTC that sampled the environment of the supercell and QLCS behind it. We did run into two issues, one was that some of the balloons were not filled enough and so failed to clear an area of trees to our north and the second was that we ran into software problems when failed sondes that ended prematurely were not recognized as such. As a result, despite launching 10+ Windsonds, only five successfully obtained data, varying in peak heights sampled from 300 m to 6.5 km.
2	The SBU team was limited by a poor selection of deployment sites, and ultimately chose one of the few remaining sites to launch sondes, so our location was not meteorologically driven, but rather logistically-driven. QLCS motion was slow, and we waited until we

	estimated the target line was ~1 hour away before launching sondes to sample the pre-line environment. We launched one Windsond every ~6 min from 22:40-22:58 UTC and then every ~2 min from 22:58-23:08 UTC; sampling was up to 2 km above the ground. We did not sample as close to the convective line as we wanted because of leading stratiform precipitation.
4	Our team set up in the southern part of the PERiLS domain where the most intense convection was located. Once we reached our location, the target QLCS was quickly approaching, so we began launching Windsonds immediately. Twelve sondes were launched every 2-4 min from 18:34-19:14 UTC as the QLCS approached our location. By then, some cells with moderate rain out ahead of the main line impacted our location. Once the cells passed, we sampled the pre-line environment again at 19:45 UTC. We then waited another 20 min to use our remaining three Windsonds to sample as close to the line as possible before it impacted our area; they were launched between 20:05 and 20:09 UTC. Windsonds were programmed to sample up to 3 km AGL before cut and descent.

Data checks and QC was complicated by our common position close to the QLCS. We more often were sampling the "near-field" environment rather than the "far-field" environment of the QLCS. As a result, Windsonds often encountered precipitation, which can be difficult to distinguish from bad data. Comparison with the large number of contemporary radiosondes and Windsonds launched in any individual IOP is likely to be the best indicator of bad data. The wind speed and direction data can be quite noisy, which is normal for Windsonds. We encourage use of smoothing, but allow the user to apply the smoothing procedure that best works for their own work (e.g., interpolation, 1-2-1 filters, etc.). As a result, the datasets consist of the raw data as they were obtained with one exception. Raw data included the heading of the Windsond instead of the meteorological wind direction; the wind direction was obtained by simply subtracting 180˚ if the heading was ≥ 180˚ or adding 180˚ if the heading was < 180˚.

4.0 Data Format

The data are provided as .csv files (comma separated values format) with a common file structure that is the same as other Windsond teams used in PERiLS. The file name is given as follows:

YYYY-MM-DD_TTTT.ttt.csv

where YYYY is the year, MM is the month, DD is the day, TTTT is the UTC time, and ttt further describes the type of file, detailed more below. Importantly, the date and time in the filename indicate when the Windsond first began to collect data, not necessarily the time it was launched. Given that we often ensured Windsonds were working properly long before they were launched, it should be expected that the times in the filename will often be several minutes prior to when data first were obtained above the surface.

For each IOP Windsond, three .csv files are included (ttt):

raw_history: This file includes all of the data obtained by the Windsond, which is as follows:

UTC time: time of the observation in UTC
Altitude (m MSL): approximate height of the observation above mean sea level in m
Altitude (m AGL): height of the observation above the ground in m
Pressure (Pascal): atmospheric pressure in Pa
Speed (m/s): wind speed in m s^{-1}
Heading (degrees): The direction the Windsond traveled in degrees
Direction (degrees): wind direction in degrees according to meteorological convention (i.e., 90˚ indicates an east/easterly wind)
Temperature (C): temperature in degrees C
Relative humidity (%): relative humidity in percent
Internal temperature (C): the temperature within the Windsond in degrees C
Latitude: latitude of the observation in degrees
Longitude: longitude of the observation in degrees
Rise speed(m/s): the ascent rate of the Windsond in m s^{-1}

Note that data from prolonged periods on the surface before launch are also included. We often prepared Windsonds several minutes prior to launch, including turning them on, at which point they would start logging measurements. This file includes all of those data, which we do not recommend using as Windsonds were often kept near or inside a vehicle during this time. As a result, they do not necessarily represent the character of the air in the free atmosphere near the ground. To avoid these data, please use the raw flight history csv file (see below).

raw_flight_history: This file includes all of the data obtained by the Windsond once it was launched and does not include the data obtained by Windsonds prior to their launch. Otherwise, the data are the same as those in the raw_history file above.

sounding: The sounding file contains data that are interpolated every 20 m above the ground starting at 20 m AGL. No data are included after the Windsonds are cut from the ballon and descend towards the ground.

There are two additional files included for each Windsond/IOP:

YYYY-MM-DD_TTTT.kml: A file that tracks the Windsond in Google Earth. Note again that this file will contain sometimes long periods of time from before the Windsond was launched.

SBU_IOPn_d.jpeg: A picture of the deployment site for each IOP, n is the IOP number and d is the approximate cardinal direction the photo is directed in (i.e., “E” indicates the photo looks towards the east).

5.0 Data Remarks

- As discussed above, a sometimes-significant amount of data are included from before Windsonds were launched. These data should be used carefully, if at all, owing to their location within or immediately adjacent to the vehicle used to store them.

- Occasionally, data are missing during times of poor receiver connectivity.
- The Windsond launched at ~20:04 UTC in IOP-4 does not have an interpolated csv file.
- Ascent rates were sometimes very low owing to improperly filled balloons and/or precipitation. In such cases, there may be several consecutive observations from almost identical heights.
- If there are no descent data in the raw_history or raw_flight_history file, then the Windsond could no longer be tracked by the receiver following the last recorded observation
- Some csv files may be appended with "_1", which indicates that another Windsond was not properly terminated. The data are unaffected.
- Biased sensors and other data quality issues are difficult to identify, however practice launches of Windsonds in Stony Brook, NY displayed temperature and humidity data near the ground that were qualitatively similar to those from the nearby Stony Brook, NY Mesonet station.

6.0 References

http://windsond.com/windsond_catalog_Feb2019.pdf