

# Verification of the Origins of Rotation in Tornadoes Experiment-Southeast (VORTEX-SE) 2020 The University of Alabama in Huntsville Radiosonde Data

## 1.0 Contacts:

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## 2.0 Overview

The University of Alabama in Huntsville (UAH) used five to six mobile radiosonde systems at various locations around North Alabama and one stationary system at the Severe Weather Institute-Radar and Lightning Laboratories (SWIRLL) during the VORTEX-SE 2020 Intensive Operation Periods (IOPs). Due to the COVID-19 restrictions, data was only gathered from Courtland, AL, Hanceville, AL, the SWIRLL location, and any serial soundings launched by the M3V platform after IOP6 . The systems used include 3 mobile iMet systems and two mobile Windsond systems. The stationary system used at SWIRLL was an interMet (iMet system). This document outlines the instrumentation specifications and the format of the files. The data from the iMet systems are unchanged other than quality controlling for inconsistent heights and bad wind data. These checks are outlined in section 7. However, the wind data from the Windsond systems were calculated based on the GPS from the sonde using methods described in section 7. The data for both systems were rearranged into a consistent format using python code.

## 2.1 IOP Sounding Dates

IOP 1	2019/12/16
IOP 2	2019/12/29
IOP 3	2020/01/11
IOP 4	2020/02/05
IOP 5	2020/02/12
IOP 6	2020/03/03
IOP 7	2020/03/34
IOP 8	2020/03/28
IOP 9	2020/04/08
IOP 10	2020/04/12
IOP 11	2020/04/23

### 3.0 Instrumentation Description

UAH used InterMet's iMet-1-ABxn 403 MHz GPS with Pressure Sensor radiosonde and Windsong S1H radiosonde. The manufacturer's specifications for both radiosondes are below. The software used with the iMet system was the iMetOS-II software with the iMet-3050A and iMet-3050 Portable Sounding system. The software used with the Windsong was the WS-250 for Windows software with the RR1-250 and RR2 Radio Receivers. The specifications are available via the links:

**iMet:** [http://www.intermetsystems.com/ee/pdf/202060\\_iMet-1-ABxn\\_Data\\_161006.pdf](http://www.intermetsystems.com/ee/pdf/202060_iMet-1-ABxn_Data_161006.pdf)

**Windsong:** [http://windsong.com/windsong\\_catalog\\_Feb2019.pdf](http://windsong.com/windsong_catalog_Feb2019.pdf)

#### **iMet-1-ABxn Sonde Specifications**

Temperature Resolution	<0.01 Deg
Temperature Accuracy	0.2 Deg C
Humidity Resolution	<0.1% RH
Humidity Accuracy	5% RH
Pressure Resolution	<0.01 hPa
Pressure Accuracy	0.5 hPa
Wind Accuracy	1.0 m/s
GPS Position Accuracy	10 m
Altitude Accuracy	15 m

#### **Windsong S1H Sonde Specifications**

Temperature Resolution	0.01 Deg
Temperature Accuracy	0.3 Deg C
Humidity Resolution	<0.01% RH
Humidity Accuracy	2% RH
Pressure Resolution	<0.02 hPa
Pressure Accuracy	1 hPa
Wind Accuracy	0.1 m/s
GPS Position Accuracy	0.1 Deg

### 4.0 Filename and Headers

The filename format is as follows:

*upperair.UAH\_Sonde.YYYYMMDDHHMM.City\_State.txt*

where upperair indicates the type of platform, UAH indicates the institution ID, Sonde is the type of data, YYYY is the year, MM is the month, DD is the day, HH is the hour, and MM is the minute of the launch, City\_State is the city and state of the launch site.

The header information provided contains several characteristics about the sounding. The headers are the first three lines of the file and are as follows:

Line 1: Data Type

Line: Release date, time, and location. The date and time are in UTC time.

Line 3: Variables and units

## 5.0 Data

The data is provided as a .txt file and is comma separated. The data contains balloon position (latitude and longitude), UTC time, height, pressure, temperature, relative humidity, dew point temperature, wind speed, and wind direction every 5 seconds as the balloon ascends. The contents are as follows:

Field	Parameter	Units	Missing Value
1	Latitude	Degrees	-9999.0
2	Longitude	Degrees	-9999.0
3	Time	UTC Time	-9999.0
4	Height	Meters (MSL or AGL)*	-9999.0
5	Pressure	mb	-9999.0
6	Temperature	Celsius	-9999.0
7	Relative Humidity	Percent	-9999.0
8	Dew Point	Celsius	-9999.0
9	Wind Speed*	Knots	-9999.0
10	Wind Direction*	Degrees	-9999.0

\*Wind data headers may say Calculated due to Windsond quality controlled outlined in section 7. Windsond and iMet log height differently.  
The proper height scale will be noted in file headers

Each data file is one individual sounding launched.

## 6.0 Sample Data

This is a sample of the UAH radiosonde data (Note - The variables and units line will be one line in file):

```
#VORTEX-SE 2017 UAH Radiosonde Data
#20170325, 1605 UTC, NACC, AL, 398 m
latitude (deg), longitude (deg),time (sec),height (m MSL),pressure(mb),temp (deg C),RH (%),dewpoint
(deg C),Calculated wind speed (kts),Calculated wind direction (deg)
34.54688, -85.91045, 16:5:21, 431.0, 975.54, 22.89, 49.65, 12.04, 1.2, 180
34.54711, -85.91045, 16:6:3, 454.0, 972.78, 20.86, 51.3, 10.63, 19.9, 167
34.54738, -85.91052, 16:6:6, 468.0, 971.2, 20.11, 52.45, 10.26, 16.6, 175
34.54761, -85.91054, 16:6:9, 478.0, 970.04, 19.72, 53.8, 10.27, 22.9, 168
34.54792, -85.91062, 16:6:12, 489.0, 968.74, 19.38, 55.05, 10.29, 20.7, 166
34.5482, -85.9107, 16:6:15, 500.0, 967.44, 19.16, 56.1, 10.36, 18.9, 172
34.54846, -85.91074, 16:6:18, 512.0, 966.04, 18.95, 57.05, 10.41, 19.1, 169
```

## 7.0 Data Quality Control

The data from the iMet systems were automatically quality controlled by the iMet software. The data was then run through computer code that checked for inconsistent heights or wind data and then rearranged into a consistent format. If the data showed the balloon was descending, it was omitted. If wind data was erroneous (exceeded 350 knots, it was replaced with -9999.0. These checks were added in order to reduce errors when attempting to plot data in plotting software. Windsond data was quality controlled through a two-step quality control process as follows:

1. Windsonds transmit environmental data (temperature, pressure, relative humidity, wind speed, wind direction) every 1 second. The GPS transmits every 3 seconds. Because of the discrepancy, only data that contained GPS coordinates were kept, making the data 3-second data. The data was then written into a new file.
2. Windsond-provided wind data was still sub-par. Therefore, wind data was recalculated using the GPS coordinates and the Haversine formula. Distances were calculated over a 3 point (9 second) period in order to reduce noise. This recalculated wind data were then written to a new file with the rest of the outputted data (pressure, air temperature, dew point, UTC time, and height). Wind data that has been recalculated is noted in the files by the headers.

## 8.0 Data Remarks

**Surface Data** – Surface measurements were collected via the radiosonde measurements at the surface and inserted as “surface measurements”. Verification of surface data was often completed using surface stations on the co-located mobile instrument platforms (UAH MIPS, MAX, MoDLS, RaDAPS, and M3V). Otherwise, surface measurements were compared with a Kestrel 3500.

- Occasionally, the Windsond software does not automatically detect the launch. When this happens, data is not logged and will be missing for the first few meters of the sounding. Users may notice the difference between launch site elevation and the height of the first data point to vary up to 20-30 meters.