Verification of the Origins of Rotation in Tornadoes Experiment-Southeast (VORTEX-SE) Meso18-19
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 East Mississippi and one stationary system at the Severe Weather Institute-Radar and Lightning Laboratories (SWIRLL) during the VORTEX-SE Meso18-19 Intensive Operation Periods (IOPs). The systems used include 3 mobile iMet systems and two to three mobile Windsond systems. The stationary system used at SWIRLL was an interMet (iMet) system and was also a part of the high density meso alpha sounding network which launched radiosonde soundings every 6 hours during each IOP. This document outlines the instrumentation specifications and the format of the files. The data from the iMet systems were 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 UAH-Deployed IOP Sounding Dates

The operating domain for UAH during the Meso18-19 season included Northern AL and East MS. If an IOP included severe weather outside of this domain, UAH did not deploy resources. Therefore, IOPs that UAH deployed is listed below. However, UAH did participate in all meso alpha sounding launches for each IOP of Meso18-19.

IOP 1	2018-11-05 2230UTC - 2018-11-06 0957 UTC
IOP 5	2019-02-22 1830 UTC - 2019-02-24 0330 UTC
IOP 7	2019-03-09 1800 UTC - 2019-03-10 0230 UTC
IOP 8	2019-04-13 2300 UTC - 2019-04-14 0830 UTC
IOP 9	2019-04-18 1800 UTC - 2019-04-19 0130 UTC

Table 1. List of IOPs in which UAH deployed instrument platforms

3.0 Instrumentation Description

UAH used InterMet's iMet-1-ABxn 403 MHz GPS with Pressure Sensor radiosonde and Windsond 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 Windsond 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
Windsond: http://windsond.com/windsond_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

Windsond 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):

UAH Radiosonde Data
2018-03-19, 1500 UTC, Falkville, AL, 189 m
latitude (deg), longitude (deg),UTC (HH:MM:SS),height (m MSL),pressure(mb),temp (deg C),RH (%),dewpoint (deg C),Calculated wind speed (kts),Calculated wind direction (deg)
34.36696, -86.88823, 15:1:11, 213.0, 983.7, 16.36, 81.95, 13.32, 5.1, 124
34.367, -86.8883, 15:1:14, 231.0, 981.64, 15.92, 82.25, 12.95, 11.5, 124
34.36709, -86.88846, 15:1:17, 247.0, 979.8, 15.6, 83.2, 12.81, 7.1, 155
34.36718, -86.88851, 15:1:20, 261.0, 978.14, 15.38, 84.2, 12.77, 5.0, 106
34.3672, -86.88859, 15:1:23, 272.0, 976.86, 15.24, 85.2, 12.81, 6.5, 152

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 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.

-Data files may contain data after the balloon has launched due to missed detection of launch by sounding software. If this occurs, sounding data may start 10-30 meters above ground level. This occurs most often with the Windsond system.

-Windsonds log height data as Mean Sea Level while iMet records above ground level heights. The headers in the file mark which height is used. So, please keep this in mind when using the data.