

Verification of the Origins of Rotation in Thunderstorms Experiment-Southeast (VORTEX-SE) Meso18-19 National Weather Service Radiosonde Data Set

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Original Data Source:

NOAA/NWS

2.0 Dataset Overview

The National Weather Service (NWS) routinely releases radiosondes at 00 and 12 UTC with occasional special releases at sites throughout the United States. This data set includes the quality controlled VORTEX-SE Meso18-19 NWS soundings released at 13 sites (Figure 1) throughout the southeastern United States region during the Meso18-19 field phase (31 October 2018 to 20 April 2019). One of the stations was only available at the mandatory and significant levels (KOUN). During Meso18-19 operations, the NWS stations released soundings at 06 and 18 UTC as well as the usual 00 and 12 UTC times. A total of 4539 1-second vertical resolution and 375 mandatory/significant level soundings are contained in the final Meso18-19 data set.

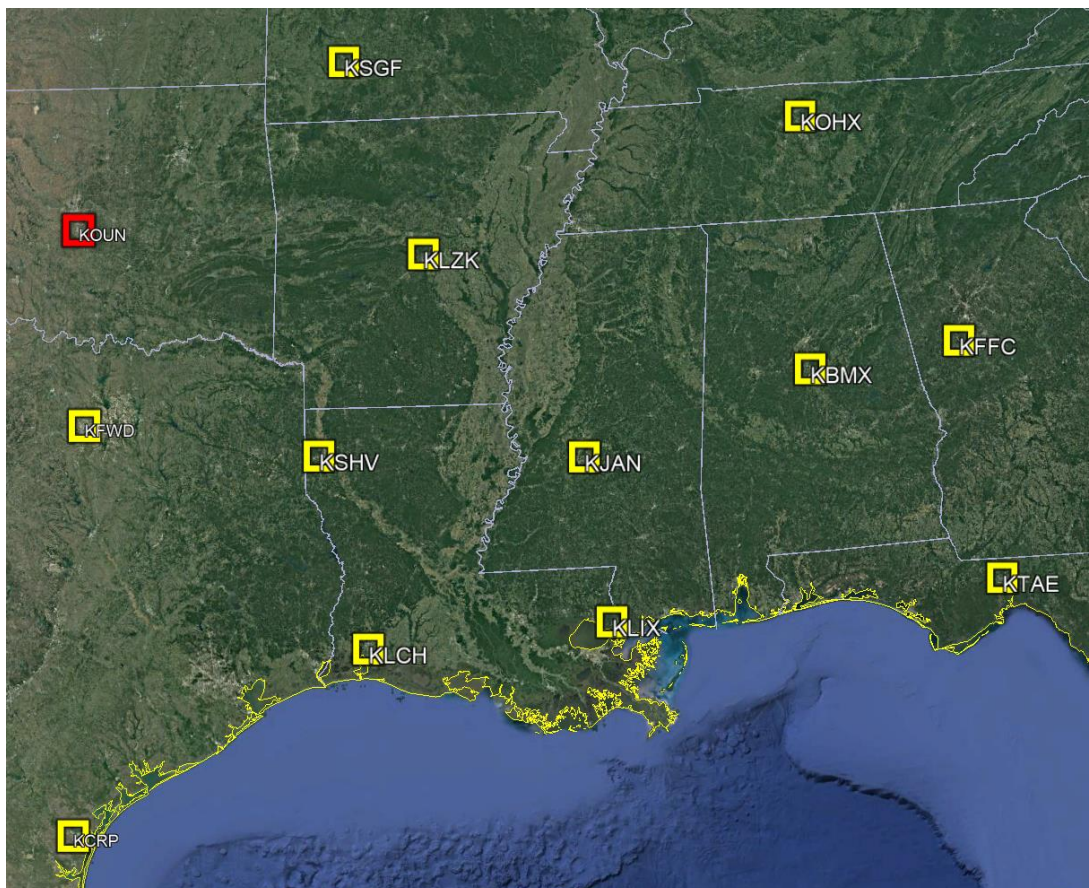


Figure 1. Location of Meso18-19 NWS radiosonde sites. Stations with a yellow square have one second vertical resolution data and those with red square have mandatory and significant level data.

3.0 Project Overview

The Verification of the Origins of Rotation in Tornadoes Experiment-Southeast (VORTEX-SE) is a research program to understand how environmental factors characteristic of the southeastern United States affect the formation, intensity, structure, and path of tornadoes in this region. VORTEX-SE will also determine the best methods for communicating forecast uncertainty related to these events to the public, and evaluate public response. For the Meso18-19 2018 field season a large array of 10 research radiosonde systems were deployed throughout the southeastern United States and a smaller scale set of profiling instrumentation and surface meteorological stations were deployed around northern Alabama from 1 November 2018 to 20 April 2019. Further information on VORTEX-SE is available at the VORTEX-SE web site at NCAR/EOL: https://www.eol.ucar.edu/field_projects/vortex-se and information on the Meso18-19 deployments is available at the Meso18-19 Field Catalog: <http://catalog.eol.ucar.edu/meso18-19>.

4.0 EOL Sounding Composite (ESC) File Format Description

The ESC is a columnar ASCII format consisting of 15 header records for each sounding followed by the data records with associated data quality flags.

4.1 Header Records

The header records (15 total records) contain a variety of metadata about the sounding (i.e. location, time, radiosonde type, etc). The first five header lines contain information identifying the sounding, and have a rigidly defined form. The following 7 header lines are used for auxiliary information and comments about the sounding, and may vary from dataset to dataset. The last 3 header records contain header information for the data columns. Line 13 holds the field names, line 14 the field units, and line 15 contains dashes ('-' characters) delineating the extent of the field.

The file standard header lines are as follows:

Line	Label (padded to 35 char)	Contents
1	Data Type:	Description of the type and resolution of data
2	Project ID:	Short name for the field project
3	Release Site Type/Site ID:	Description of the release site.
4	Release Location (lon,lat,alt):	Location of the release site.
5	UTC Release Time (y,m,d,h,m,s):	Time of release.

The release location is given as:

lon (deg min), lat (deg min), lon (dec. deg), lat (dec. deg), alt (m)

Longitude in deg min is in the format: ddd mm.mm'W where ddd is the number of degrees (with leading zeros if necessary), mm.mm is the decimal number of minutes, and W represents W or E for west or east longitude, respectively. Latitude has the same format as longitude, except there are only two digits for degrees and N or S for north/south latitude.

The time of release is given as: yyyy, mm, dd, hh:nn:ss.

Where yyyy is the year, mm is the month, dd is the day of month, and hh:nn:ss are the UTC hour, minute, and second respectively.

The seven non-standard header lines may contain any label and contents. The labels are padded to 35 characters to match the standard header lines. Records for this data set include the following non-standard header lines:

Line	Label (padded to 35 char)	Contents
6	Ascension Number	Number sounding this year
7	Radiosonde Serial Number	
8	Balloon Manufacturer/Type	
9	Balloon Lot Number/Weight	
10	Radiosonde Type/RH Sensor Type	
11	Surface Observations	

4.2 Data Records

The data records each contain time from release, pressure, temperature, dew point, relative humidity, U and V wind components, wind speed and direction, ascent rate, balloon position data, altitude, and quality control flags (see the QC code description). Each data line contains 21 fields, separated by spaces, with a total width of 130 characters. The data are right-justified within the fields. All fields have one decimal place of precision, with the exception of latitude and longitude, which have three decimal places of precision. The contents and sizes of the 21 fields that appear in each data record are as follows:

Field	Width	Format	Parameter	Units	Missing Value
1	6	F6.1	Time since release	Seconds	9999.0
2	6	F6.1	Pressure	Millibars	9999.0
3	5	F5.1	Dry-bulb Temperature	Degrees C	999.0
4	5	F5.1	Dew Point Temperature	Degrees C	999.0
5	5	F5.1	Relative Humidity	Percent	999.0
6	6	F6.1	U Wind Comp	m/s	9999.0
7	6	F6.1	V Wind Comp	m/s	9999.0
8	5	F5.1	Wind speed	m/s	999.0
9	5	F5.1	Wind direction	Degrees	999.0
10	5	F5.1	Ascent Rate	m/s	999.0
11	8	F8.3	Longitude	Degrees	9999.0
12	7	F7.3	Latitude	Degrees	999.0
13	5	F5.1	Elevation Angle	Degrees	999.0
14	5	F5.1	Azimuth Angle	Degrees	999.0
15	7	F7.1	Geopotential Altitude	Meters	99999.0
16	4	F4.1	QC for Pressure	Code	99.0
17	4	F4.1	QC for Temperature	Code	99.0
18	4	F4.1	QC for Humidity	Code	99.0
19	4	F4.1	QC for U Wind	Code	99.0
20	4	F4.1	QC for V Wind	Code	99.0
21	4	F4.1	QC for Ascent Rate	Code	99.0

Fields 16 through 21 contain the data quality flags from the NCAR/Earth Observing Laboratory (EOL) sounding quality control procedures. The data quality flags are defined as follows:

Code	Description
1.0	Checked, datum seems physically reasonable. ("GOOD")
2.0	Checked, datum seems questionable on a physical basis. ("MAYBE")
3.0	Checked, datum seems to be in error. ("BAD")
4.0	Checked, datum is interpolated. ("ESTIMATED")
9.0	Checked, datum is missing. ("MISSING")
99.0	Unchecked (QC information is "missing".) ("UNCHECKED")

4.3 Data Specifics

The files contain data at one-second intervals.

The data are in files by day, so all soundings for a particular day are concatenated into a single file ordered by time. The file naming convention is:

NWS_yyyymmdd.cls where yyyy is the year, mm is the month, and dd is the day of the month.

The KBMX, KFFC, KFWD, KJAN, KLZK, KOHX, KSHV, and KTAE stations utilized the Lockheed Martin Sippican LMS-6 Radiosonde with the capacitance RH sensor and GPS windfinding during WE-CAN.

KOUN utilized the Lockheed Martin Sippican LMS6 with the chip thermistor, external boom mounted capacitance relative humidity sensor, and derived pressure from GPS height during WE-CAN.

The KLCH, KLIX, and KSGF stations utilized the Vaisala RS92-NGP radiosonde with twin alternatively heated Humicap capacitance RH sensors and GPS windfinding during WE-CAN.

4.4 Sample Data

The following is a sample of the NWS radiosonde data in ESC format.

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Data Type:                GTS Sounding/Ascending
Project ID:                VORTEX-SE Mesol8-19
Release Site Type/Site ID: 72357 OUN
Release Location (lon,lat,alt): 097 28.20'W, 35 13.80'N, -97.470, 35.230, 362.0
UTC Release Time (y,m,d,h,m,s): 2018, 10, 31, 23:06:00
/
/
/
/
/
/
Nominal Release Time (y,m,d,h,m,s):2018, 11, 01, 00:00:00
Time  Press  Temp  Dewpt  RH    Ucmp  Vcmp  spd  dir  Wcmp  Lon  Lat  Ele  Azi  Alt  Qp  Qt  Qrh  Qu  Qv  QdZ
sec   mb     C     C     %    m/s   m/s   m/s  deg  m/s   deg  deg  deg  deg  m   code code code code code code
-----
0.0   972.0   10.2   8.0   86.2   0.5   -2.0   2.1 345.0 999.0 -97.470 35.230 999.0 999.0 362.0 2.0 2.0 2.0 99.0 99.0 9.0
9999.0 1000.0 999.0 999.0 999.0 9999.0 9999.0 999.0 999.0 999.0 9999.000 999.000 999.0 999.0 105.0 2.0 9.0 9.0 9.0 9.0 9.0
9999.0 978.2 999.0 999.0 999.0 0.5 -2.0 2.1 345.0 999.0 9999.000 999.000 999.0 999.0 304.0 99.0 9.0 9.0 99.0 99.0 9.0

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4.5 Station List

Site ID	WMO ID	Site Name	State	Latitude	Longitude	Elev (m)
KBMX	72230	Birmingham	AL	33.180	-86.783	174
KCRP	72251	Corpus Christi	TX	27.779	-97.505	15
KFFC	72215	Peachtree City	GA	33.356	-84.567	245
KFWD	72249	Fort Worth	TX	32.835	-97.298	195
KJAN	72235	Jackson	MS	32.320	-90.080	91
KLCH	72240	Lake Charles	LA	30.126	-93.217	5
KLIX	72233	Slidell	LA	30.338	-89.825	10
KLZK	72340	Little Rock	AR	34.836	-92.260	173
KOHX	72327	Nashville	TN	36.247	-86.562	180
KOUN	72357	Norman	OK	35.230	-97.470	362
KSGF	72440	Springfield	MO	37.236	-93.402	391
KSHV	72248	Shreveport	LA	32.452	-93.842	85
KTAE	72214	Tallahassee	FL	30.446	-84.300	53

5.0 Data Quality Control Procedures

1. Each sounding was converted from its original format into the ESC format described above.
2. Each sounding was passed through a set of automated data quality checks which included basic gross limit checks as well as rate of change checks. This is further described in Section 4.1.
3. Each sounding was visually examined utilizing the NCAR/EOL XQC sounding quality control software. This is further described in Section 4.2.

5.1 Automated Data Quality Checks

This data set was passed through a set of automated data quality checks. This procedure includes both gross limit checks on all parameters as well as rate-of-change checks on temperature, pressure, and ascent rate. A version of these checks is described in Loehrer et al. (1996) and Loehrer et al. (1998).

5.1.1 Gross Limit Checks

These checks were conducted on each sounding and the data quality flags in the ESC files were adjusted as appropriate. Only the data point under examination was flagged. All checks also produced warning messages that specified the location of the problem and the severity of the issue. These warning messages were then summarized statistically and examined to determine any consistent issues.

For this data set NCAR/EOL conducted the following gross limit checks. In the table P = pressure, T = temperature, RH = relative humidity, U = U wind component, V = V wind component, B= bad, and Q = questionable.

Parameter	Check	Parameter(s) Flagged	Flag Applied
Pressure	< 0 or > 1050	P	B
Altitude	< 0 or > 40000	P, T, RH	Q
Temperature	< -90 or > 45	T	B
Dew Point	< -99.9 or > 33	RH	Q
	> T	T, RH	Q
Wind Speed	< 0 or > 100	U, V	Q
	> 150	U, V	B
U Wind	< 0 or > 100	U	Q
	> 150	U	B
V Wind	< 0 or > 100	V	Q
	> 150	V	B
Wind Direction	< 0 or > 360	U, V	B
Ascent Rate	< -10 or > 10	P, T, RH	Q

5.1.2 Vertical Consistency Checks

These checks were conducted on each sounding and the data quality flags in the ESC files were adjusted as appropriate. These checks were started at the surface and compared each neighboring data record. In the case of checks that ensured that the values increased/decreased as expected, only the data point under examination was flagged. However, for the other checks, all of the data points used in the examination were flagged. All items within the table are as previously defined. All checks also produced warning messages that specified the location of the problem and the severity of the issue. These warning messages were then summarized statistically and examined to determine any consistent issues.

Parameter	Check	Parameter(s) Flagged	Flag Applied
Time	Decreasing/equal	None	None.
Altitude	Decreasing/equal	P, T, RH	Q
Pressure	Increasing/equal	P, T, TH	Q
	> 1mb/s or < -1mb/s	P, T, TH	Q
	> 2mb/s or < -2mb/s	P, T, TH	B
Temperature	< -15°C/km	P, T, RH	Q
	< -30°C/km	P, T, RH	B
	> 50°C/km	P, T, RH	Q
	> 100°C/km	P, T, RH	B
Ascent Rate	> 3m/s or < -3m/s	P	Q
	> 5m/s or < -5m/s	P	B

5.2 Visual Data Quality Checks

Each sounding was visually examined using the NCAR/EOL XQC sounding data quality control software. This software allows the user to view a skew-t/log-p diagram of each sounding and apply data quality flags as appropriate. The user can zoom in on sections of soundings for detailed examination and can adjust the data quality flags for an individual point, sections of soundings, or entire soundings for each parameter

individually. The software also allows the user to override the quality flags applied by the automated procedure.

5.3 Data Quality Issues of Note

The data quality control procedures outlined above allows us to identify and, in some cases, resolve issues that could potentially impact research performed using these data sets. The following issues were noted in these soundings.

KBMX201810311116 – wetbulbing ~785mb
KBMX201811050509 – wetbulbing ~785mb
KBMX201812272327 – wetbulbing and questionable temp 625-350mb
KBMX201812281222 – no data above 686mb
KBMX201902201131 – no GPS/wind data
KBMX201903031702 – no data above 575mb
KBMX201903142303 – no data above 605mb
KCRP201901052301 – RH cycling up to 450mb
KCRP201903030501 – no data
KFFC201811021106 – wetbulbing ~615mb
KFFC201811201121 – wetbulbing ~650mb
KFFC201812090507 – no RH from 893-630mb
KFFC201901181116 – no GPS/wind data below 310mb
KFFC201901192317 – no data above 740mb
KFFC201901201117 – no data below 832mb
KFFC201901231115 – data below 895mb interpolated
KFFC201902101111 – wetbulbing ~815mb
KFFC201904081123 – no GPS/wind data below 164mb
KFFC201904101108 – no RH data below 735mb
KFFC201904181708 – wetbulbing ~760mb
KFFC201904190511 – no data above 920mb, no GPS/wind data
KFFC201904191134 – no data above 788mb
KFWD201810311144 – wetbulbing 778mb
KFWD201901282304 – near surface temperatures bad
KFWD201902111108 – no GPS/wind data from 815-483mb
KFWD201902230508 – no GPS/wind data below 527mb
KFWD201903021109 – no GPS/wind data below 137mb
KFWD201904071125 – wetbulbing 925mb
KFWD201904072306 – wetbulbing 815mb
KFWD201904171716 – no GPS/wind data
KFWD201904180532 – no data above 732mb
KFWD201904202323 – no GPS/wind data
KJAN201811132310 – temp below 998mb bad
KJAN201811201101 – no data above 862mb, no GPS/wind data
KJAN201901022306 – no data above 652mb
KJAN201901290705 – no data above 704mb
KJAN201902282303 – little GPS/wind data below 194mb
KJAN201903101105 – wetbulbing 678mb
KJAN201903132302 – wetbulbing 728mb
KJAN201903281101 – no GPS/wind data below 498mb
KJAN201904021108 – wind data below 987mb bad
KJAN201904161118 – no GPS/wind data below 600mb

KJAN201904211104 – wind data below 987mb bad
KLCH201903132306 – no RH data
KLCH201903261124 – little GPS/wind data below 145mb
KLIX201811011156 – no GPS/wind data below 624mb
KLIX201811021103 – no GPS/wind data from 788-561mb
KLIX201812061103 – no GPS/wind data from 656-477mb
KLIX201812302306 – wetbulbing 700mb
KLIX201903032304 – spotty GPS/wind data throughout sounding
KLIX201903281109 – no GPS/wind data
KLIX201903301110 – no GPS/wind data
KLZK201903112311 – no GPS/wind data
KLZK201903131116 – no GPS/wind data from 800-333mb
KLZK201903132350 – no RH data from 947-540mb
KLZK201903202304 – no GPS/wind data below 414mb
KLZK201903221111 – spotty GPS/wind data from 579-130mb
KLZK201904131706 – no data above 760mb, no GPS/wind data
KLZK201904181705 – no data above 675mb
KOHX201812121119 – no GPS/wind data
KOHX201812132303 – no GPS/wind data
KOHX201901041123 – no RH data from 866-650mb
KOHX201901042329 – no GPS/wind data below 178mb
KOHX201901191129 – no data above 728mb, no GPS/wind data
KOHX201901232304 – no data above 742mb
KOHX201901281125 – no GPS/wind data from 550-264mb
KOHX201902171101 – no GPS/wind data from 887-536mb
KOHX201902191805 – no RH data
KOHX201902201159 – no data above 585mb
KOHX201903031744 – no RH data below 755mb; little wind data below 478mb
KOHX201903051121 – no GPS/wind data above 937mb
KOHX201903111103 – no GPS/wind data
KOHX201903121122 – no GPS/wind data
KOHX201903162303 – no GPS/wind data below 529mb
KOHX201903191909 – temperature/RH from 222-66mb interpolated
KOHX201904042304 – no GPS/wind data from 810-567mb
KOUN201811060600 – no GPS/wind data
KOUN201812261200 – bad winds
KOUN201812262318 – bad surface RH
KSGF 201901011110 – no GPS/wind data
KSGF201903091100 – no GPS/wind data
KSGF201904011033 – no GPS/wind data from 829-306mb
KTAE 201812062304 – temperature above 200mb bad
KTAE201902061105 – temperature below 987mb interpolated
KTAE201903012301 – no GPS/wind data below 585mb

6.0 References

Loehrer, S. M., T. A. Edmands, and J. A. Moore, 1996: TOGA COARE upper-air sounding data archive: development and quality control procedures. Bull. Amer. Meteor. Soc., 77, 2651-2671.

Loehrer, S. M., S. F. Williams, and J. A. Moore, 1998: Results from UCAR/JOSS quality control of atmospheric soundings from field projects. Preprints, Tenth Symposium on Meteorological Observations and Instrumentation, Phoenix, AZ, Amer. Meteor. Soc., 1-6.