1. **Contacts:**

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**Original Data Source:**

NOAA/NWS

1. **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.

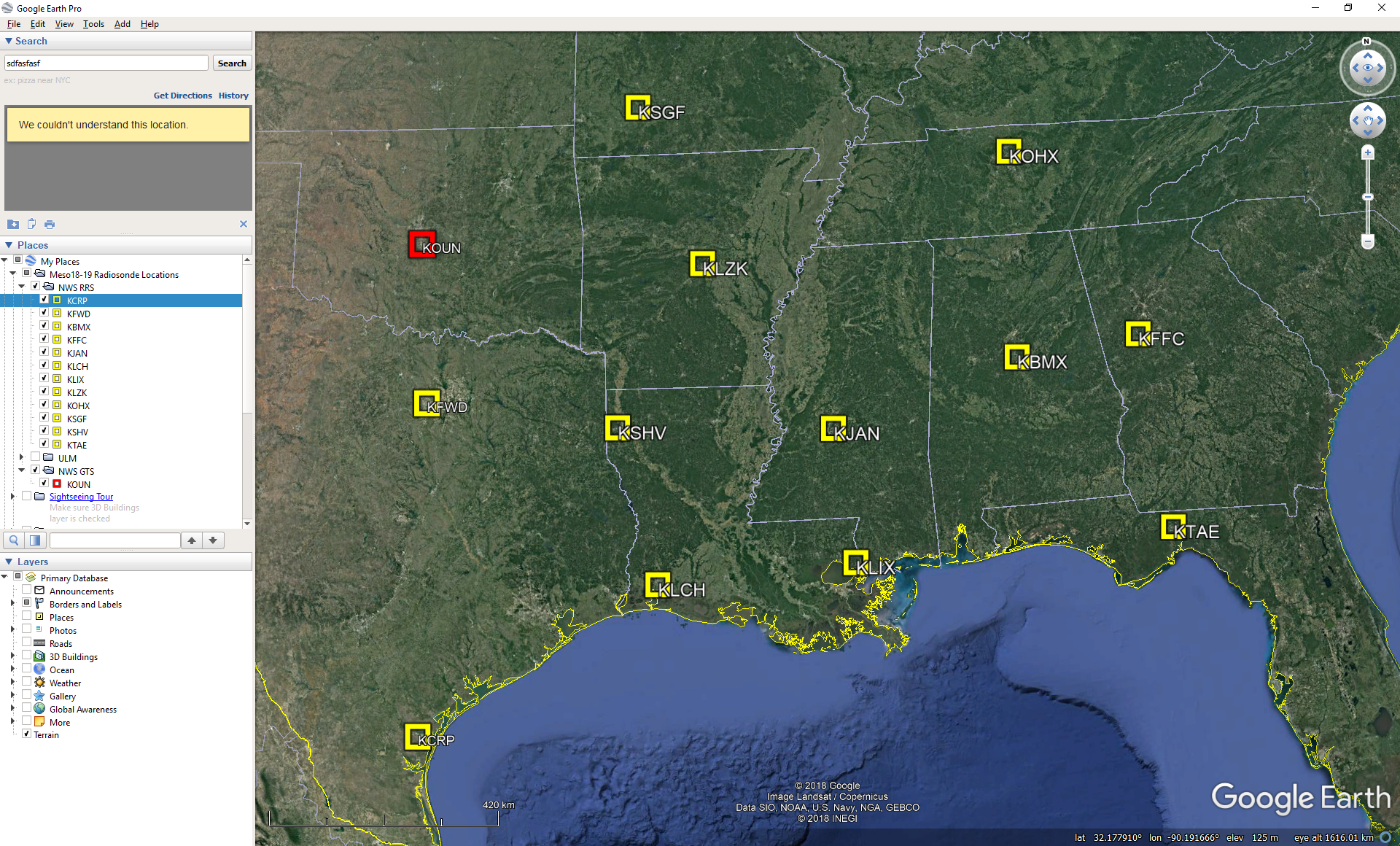


Figure 1. Location of Meso18-19 NWS radiosonde sites. Stations with a yellow square have one second vertical resolution data and those with red square have mandatory and significant level data.

1. **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>.

1. **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.

Data Type: GTS Sounding/Ascending

Project ID: VORTEX-SE Meso18-19

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

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/

/

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

**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 where 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  > T | RH  T, RH | Q  Q |
| Wind Speed | < 0 or > 100  > 150 | U, V  U, V | Q  B |
| U Wind | < 0 or > 100  > 150 | U  U | Q  B |
| V Wind | < 0 or > 100  > 150 | V  V | Q  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 where 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  > 1mb/s or < -1mb/s  > 2mb/s or < -2mb/s | P, T, TH  P, T, TH  P, T, TH | Q  Q  B |
| Temperature | < -15oC/km  < -30oC/km  > 50oC/km  > 100oC/km | P, T, RH  P, T, RH  P, T, RH  P, T, RH | Q  B  Q  B |
| Ascent Rate | > 3m/s or < -3m/s  > 5m/s or < -5m/s | P  P | Q  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.