

Plains Elevated Convection at Night (PECAN) National Weather Service Radiosonde Data Set

1.0 Contacts:

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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 PECAN NWS soundings released at 22 sites (Figure 1) throughout the Central Plains during the PECAN field phase (1 June to 16 July 2015). A total of 2055 quality-controlled, high vertical resolution (1-second) soundings are contained in the final PECAN data set.

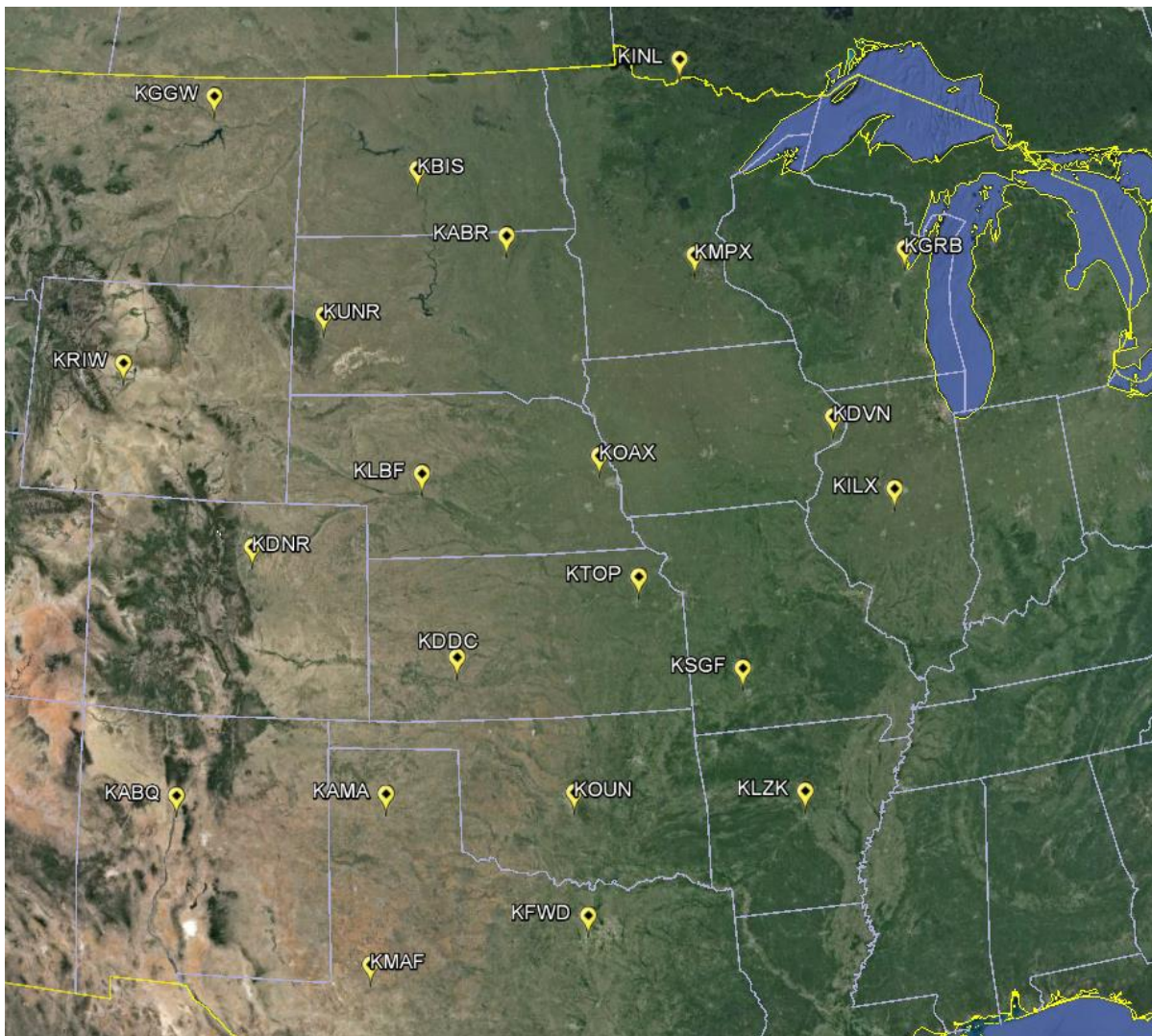


Figure 1. Location of PECAN NWS radiosonde sites.

3.0 Project Overview

Plains Elevated Convection At Night (PECAN) was a multi-agency project designed to advance the understanding of continental, nocturnal, warm season precipitation. It focused on nocturnal convection in conditions over the central United States plains states with a stable boundary layer (SBL), a nocturnal low-level jet and the largest convective available potential energy located above the SBL. Three aircraft (University of Wyoming King Air, NOAA P-3, and NASA DC-8) as well as a large array of fixed and mobile ground instrumentation were deployed out of Kansas from 1 June to 15 July 2015. Further information on PECAN is available at the PECAN web site: https://www.eol.ucar.edu/field_projects/pecan and information on PECAN operations is available at the PECAN Field Catalog: <http://catalog.eol.ucar.edu/pecan>.

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.

3.1 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 | |

3.2 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 | 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") |

3.3 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 KABQ, KABR, KAMA, KBIS, KDDC, KDNR, KDVN, KFWD, KGGW, KGRB, KILX, KLBF, KLZK, KMAF, KMPX, KOAX, KOUN, KRIW, KTOP, and KUNR stations utilized the Lockheed Martin Sippican LMS-6 Radiosonde with the capacitance RH sensor and GPS windfinding during PECAN.

The KINL and KSGF stations utilized the Vaisala RS92-NGP radiosonde with twin alternatively heated Humicap capacitance RH sensors and GPS windfinding during PECAN.

3.4 Sample Data

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

```

Data Type: National Weather Service Sounding/Ascending
Project ID: PECAN
Release Site Type/Site ID: KABQ Albuquerque, NM / 72365
Release Location (lon,lat,alt): 106 37.37'W, 35 02.29'N, -106.623, 35.038, 1619.0
UTC Release Time (y,m,d,h,m,s): 2015, 05, 31, 23:02:23
Ascension Number: 305
Radiosonde Serial Number: 88074249
Balloon Manufacturer/Type: Totex / GP26
Balloon Lot Number/Weight: 2014 / 0.600
Radiosonde Type/RH Sensor Type: Lockheed Martin Sippican LMS-6 GPS Radiosonde / Capacitance sensor
Surface Observations: P: 838.5, T: 15.8, RH: 16.0, WS: 2.1, WD: 116.0
Nominal Release Time (y,m,d,h,m,s):2015, 06, 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 % m/s m/s m/s deg m/s deg deg deg deg m code code code code code code
-----
0.0 838.4 30.4 2.6 17.0 1.6 1.2 2.0 233.1 999.0 -106.623 35.038 999.0 999.0 1619.0 2.0 2.0 2.0 1.0 1.0 9.0
1.0 838.3 30.2 2.0 16.4 1.6 1.2 2.0 233.1 1.0 -106.623 35.038 999.0 999.0 1620.0 2.0 3.0 2.0 1.0 1.0 99.0
2.0 837.8 30.1 1.7 16.2 1.6 1.2 2.0 233.1 5.0 -106.623 35.038 999.0 999.0 1625.0 2.0 3.0 1.0 1.0 1.0 99.0

```

3.5 Station List

| Site ID | WMO ID | Site Name | State | Latitude | Longitude | Elev (m) |
|---------|--------|---------------------|-------|----------|-----------|----------|
| KABQ | 72365 | Albuquerque | NM | 35.038 | -106.623 | 1619 |
| KABR | 72659 | Aberdeen | SD | 45.455 | -98.414 | 398 |
| KAMA | 72363 | Amarillo | TX | 35.233 | -101.709 | 1095 |
| KBIS | 72764 | Bismarck | ND | 46.772 | -100.762 | 506 |
| KDDC | 72451 | Dodge City | KS | 37.762 | -99.969 | 790 |
| KDNR | 72469 | Denver | CO | 39.768 | -104.870 | 1611 |
| KDVN | 74455 | Quad Cities | IA | 41.612 | -90.582 | 230 |
| KFWD | 72249 | Fort Worth | TX | 32.835 | -97.298 | 195 |
| KGGW | 72768 | Glasgow | MT | 48.206 | -106.627 | 693 |
| KGRB | 72645 | Green Bay | WI | 44.498 | -88.112 | 209 |
| KILX | 74560 | Lincoln | IL | 40.151 | -89.338 | 179 |
| KINL | 72747 | International Falls | MN | 48.565 | -93.397 | 357 |
| KLBF | 72562 | North Platte | NE | 41.134 | -100.700 | 849 |
| KLZK | 72340 | Little Rock | AR | 34.836 | -92.260 | 173 |
| KMAF | 72265 | Midland | TX | 31.943 | -102.190 | 874 |
| KMPX | 72649 | Minneapolis | MN | 44.849 | -93.564 | 290 |
| KOAX | 72558 | Omaha | NE | 41.320 | -96.366 | 351 |
| KOUN | 72357 | Norman | OK | 35.181 | -97.438 | 345 |
| KRIW | 72672 | Riverton | WY | 43.065 | -108.477 | 1699 |
| KSGF | 72440 | Springfield | MO | 37.236 | -93.402 | 391 |
| KTOP | 72456 | Topeka | KS | 39.073 | -95.630 | 268 |
| KUNR | 72662 | Rapid City | SD | 44.073 | -103.210 | 1029 |

4.0 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.

4.1 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).

4.1.1 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 > 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 |

4.1.2 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 > 1mb/s or < -1mb/s > 2mb/s or < -2mb/s | P, T, TH P, T, TH P, T, TH | Q Q B |
| Temperature | < -15°C/km < -30°C/km > 50°C/km > 100°C/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 |

4.2 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.

4.3 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.

The following routine (00 or 12 UTC) soundings do not have high resolution data available:

KABQ 20150604 00 UTC
KAMA 20150629 00 UTC
KAMA 20150707 00 UTC
KAMA 20150709 12 UTC
KBIS 20150604 00 and 12 UTC
KBIS 20150605 00 and 12 UTC
KBIS 20150715 00 and 12 UTC
KBIS 20150716 00 and 12 UTC
KDVN 20150707 00 UTC
KGRB 20150607 12 UTC
KGRB 20150608 12 UTC
KINL 20150626 00 UTC
KINL 20150628 00 UTC (there was a late release at 0130 UTC)
KLZK 20150716 00 UTC
KMAF 20150613 00 UTC
KMAF 20150710 00 UTC (there was a late release at 0059 UTC)
KUNR 20150603 00 UTC
KUNR 20150620 12 UTC (there was a late release at 1347 UTC)

KABR 201507152303 – period of slow/no ascent around 360mb

KAMA 201506151102 – wetbulbing ~606mb

KBIS 201506031101 – no data above 596mb

KBIS 201506242307 – no winds above 542mb

KDDC 201507151103 – periods of slow ascent below 450mb

KDNR 201507032301 – wetbulbing ~640mb

KFWD 201506171213 – no data above 600mb

KGGW 201506021100 – temperature data bad 697-459mb

KGRB 201506011115 – no GPS/wind data

KGRB 201506012308 – no GPS/wind data

KGRB 201506051110 – no GPS/wind data

KGRB 201506082306 – no GPS/wind data

KILX 201506011133 – no GPS/wind data above 745mb

KILX 201506021120 – no GPS/wind data

KILX 201506052322 – no GPS/wind data above 630mb

KILX 201506071706 – no GPS/wind data
KILX 201506072349 – no GPS/wind data, temperature data bad above 613mb, no data above 591mb
KLZK 201506021110 – no GPS/wind data
KLZK 201506252306 – no data above 722mb.
KMAF 201506301130 – no data above 720mb
KMPX 201506171105 – no RH data
KOAX 201506071105 – no RH data
KOAX 201507061107 – slow ascent sounding
KOUN 201506172304 – no RH above 357mb
KOUN 201507041102 – no GPS/wind data above 695mb and no data above 414mb
KSGF 201505312302 – no RH data above 926mb
KTOP 201506012301 – no GPS/wind data above 941mb
KTOP 201506032307 – little GPS/wind data above 400mb
KTOP 201506111158 – wetbulbing ~374mb
KTOP 201506142312 – no GPS/wind data above 429mb
KTOP 201507062330 – no data above 646mb

5.0 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.