Plains Elevated Convection at Night (PECAN)
MP1 OU/NSSL CLAMPS Radiosonde Data Set

1.0 Contacts:

NCAR/EOL Processing and Quality Control:
Scot Loehrer (NCAR/EOL)
loehrer@ucar.edu

Original Data Source:
Petra Klein (University of Oklahoma)
pkklein@ou.edu

DOI:
10.5065/D6416VDH

Example Citation:

Klein, P., D. Turner, E. Smith, J. Gebauer, 2016. Mobile PISA 1 OU/NSSL CLAMPS Radiosonde Data. http://doi.org/10.5065/D6416VDH. Accessed 13 July 2016.

2.0 Dataset Overview

The PECAN Mobile PISA (PECAN Integrated Sounding Array) 1 was the Collaborative Lower Atmospheric Mobile Profiling System (CLAMPS) facility run by the University of Oklahoma and NOAA/NSSL. CLAMPS released radiosondes at locations around the Central United States (Figure 1) during some of the PECAN Intensive Observation Periods (IOPs) and Unofficial Field Operations (UFOs). This data set includes the 98 high vertical resolution (1-second), quality controlled PECAN Mobile PISA 1 CLAMPS soundings released for the PECAN field phase (1 June to 16 July 2015).
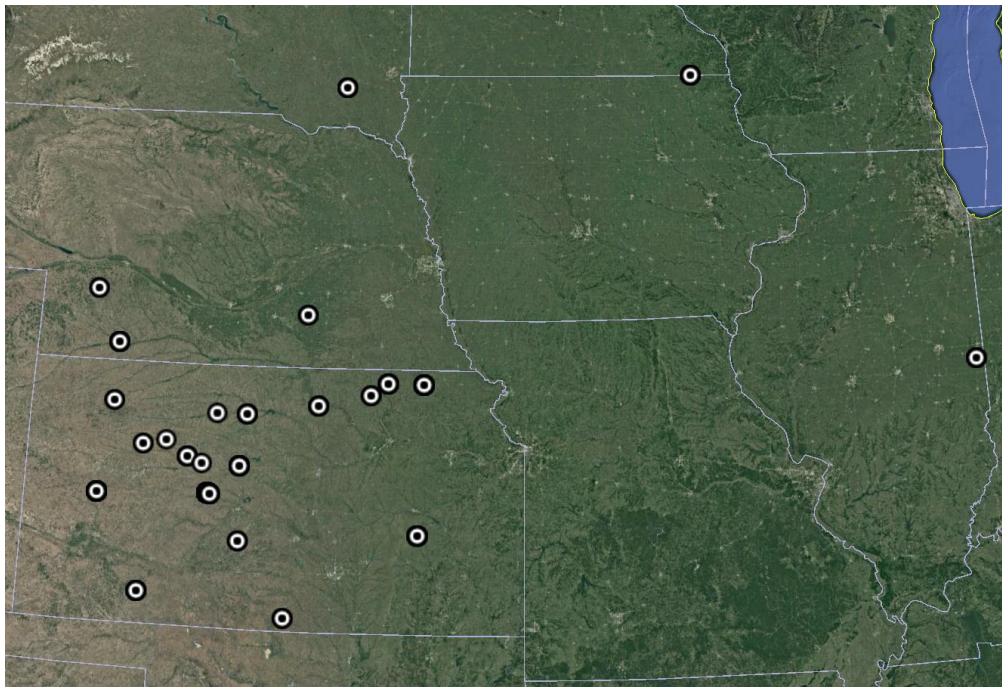

Figure 1. Location of the MP1 CLAMPS radiosonde release sites during PECAN.

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	Radiosonde Type	
7	Sonde Id/Sonde Type:	
8	Ground Station Equipment	

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:

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

The MP1 OU/NSSL CLAMPS utilized InterMet IMET1 radiosondes using GPS for windfinding during PECAN.

3.4 Sample Data

The following is a sample of the MP1 OU/NSSL CLAMPS high resolution radiosonde data in ESC format.

```
Data Type:                         OU/NSSL CLAMPS Mobile/Ascending
Project ID:                        PECAN
Release Site Type/Site ID:         OU/NSSL CLAMPS Mobile
Release Location (lon,lat,alt):    099 20.58'W, 38 52.13'N, -99.343, 38.869, 608.0
UTC Release Time (y,m,d,h,m,s):    2015, 06, 01, 03:00:00
Sonde Id/Sonde Type:               IMET1
Ground Station Equipment:          iMET-3050
/
/
/
/
Nominal Release Time (y,m,d,h,m,s):2015, 06, 01, 03:00:00
 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  946.1  20.2  12.5  61.3    0.0    0.0   0.0   0.0 999.0 -99.343  38.869 999.0 999.0  608.0  2.0  2.0  2.0 99.0 99.0  9.0
   1.0  945.9  19.9  13.6  66.9   -9.2   11.0  14.3 140.3   2.2 -99.346  38.871 999.0 999.0  610.2  2.0  2.0  2.0 99.0 99.0 99.0
   2.0  945.6  19.6  14.6  72.6   -9.1   11.1  14.3 140.4   2.2 -99.349  38.873 999.0 999.0  612.5  2.0  2.0  2.0 99.0 99.0 99.0
```

3.5 Station List

Site ID	WMO ID	Site Name	Latitude	Longitude	Elev (m)
MP1	N/A	CLAMPS	Mobile	Mobile	Mobile

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 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	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

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 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	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

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.

Surface Wind Data – No surface wind data were collected, all values missing.

Surface Release Latitude/Longitude Data – Two soundings had incorrect surface latitude and longitude data values recorded. The correct values were verified by the source and the data files corrected: 201506080300 and 201506250300.

Altitude Data – The raw files had altitude above the surface. To derive the geopotential altitudes included in these files the surface elevation was determined using the provided surface latitude and longitude and inputting them in Google Earth. Then above the surface the geopotential altitude was derived using the hypsometric equation.

Ascent Issues – These soundings contain periods there seem to be issues with the ascent of the radiosonde.
    201506040400 – Sonde reported to descend quickly (20m/s) from 507mb down to 632mb, then ascend quickly (28m/s) from 632mb back up to 466mb. Data

flagged bad during this entire period (1834-2055 seconds). Data after 3980 seconds was removed as balloon stopped ascent.

201506040600 – Sonde reported to ascend rapidly (28m/s) from 491mb up to 453mb. Then to rapidly descend from 453mb down to 481mb. Then again rapidly ascend from 481mb up to 431mb. Then again rapidly descend from 431mb down to 481mb. Finally rapidly ascends again from 481mb to 466mb. All data flagged questionable during these periods.

201506050300 – Sonde reported to ascend rapidly (20-30m/s) from 438mb up to 423 mb, then long period of descent from 423 mb down to 569mb, then rapid ascent again from 569mb up to 552mb, then descent again from 552 mb down to 581mb, then rapid ascent from 581mb back up to 403mb. Later in sounding rapid descent from 365mb down to 400mb, followed by rapid ascent from 400mb back up to 353mb. Data flagged questionable or bad during these periods.

201506060300 – Period of rapid ascent (35m/s) from 367mb up to 322mb followed by rapid descent from 322mb down to 351mb. Data flagged questionable.

201506100300 – slow ascent sonde (1.5-2 m/s).

201506110200 – Starting at ~742 mb sonde starts having periods of descent. Data flagged questionable. Data after 1561 seconds has been removed as balloon ascent stops and GPS and wind data are missing.

201506170100 – Rapid descent starts 354 mb down to 449mb, rapid ascent from 406mb up to 312mb, rapid descent from 312mb down to 375mb, rapid ascent from 352mb up to 280mb, rapid descent from 278mb down to 328mb, rapid ascent from 325mb up to 262mb, rapid descent from 255mb down to 296mb.

201507060400 – Short period of descent from 379mb down to 382mb followed by very rapid ascent from 382mb up to 330mb, then rapid descent from 330mb down to 355mb, then rapid ascent from 355mb up to 350mb.

201507060500 – Slow ascent mixed with periods of descent starting from 885mb. Data flagged questionable. Winds likely mostly interpolated after 220 seconds.

Other issues

201506110400 – No data above 600mb, several periods of slow ascent (< 2 m/s)

201506120300 – Radiosonde temperatures has a several degree cold bias relative to 0100 and 0400 soundings, temperatures flagged as bad.

201506120500 – A couple of short periods with a cool temperature spike, one ~560mb and second at ~493mb.

201506170100 – A small number of bad wind values (speeds > 100m/s) removed around 490, 479, 475, 383, 376, 372, 368, 361-357, 447-444, 419-400, 375-367, 320-326, 262-258. All winds above 233mb have zero speed and direction and flagged bad.

201506170400 – temp spike 520mb flagged questionable.

201506170500 – no data above 650mb

201506260300 – All winds above 378mb have zero speed and direction and flagged bad.

201506260600 – All winds above 677mb have zero speed and direction and flagged bad.

201506300200 – All winds above 506mb have zero speed and direction and flagged bad. Other parameters above 505mb have look of interpolated values, data flagged questionable.

201507010600 – Temperature spike at 479mb flagged questionable/bad.

201507080000 – All winds above 385mb have zero speed and direction and flagged bad. Other parameters above 485mb have look of mostly interpolated values, data flagged questionable.

201507100000 – Parameters above 396mb have look of mostly interpolated values, data flagged questionable.

201507100400 – All winds above 448mb have zero speed and direction and flagged bad. Other parameters above 459mb have look of mostly interpolated values, data flagged questionable.

201507130300 – All winds above 179mb have zero speed and direction and flagged bad.

201507130500 – All winds above 143mb have zero speed and direction and flagged bad.

201507140300 – Wind speed spike at 593mb, flagged questionable.

201507160300 – All winds above 234mb have zero speed and direction and flagged bad.

201506160400 – Periods of mixed rapid ascent and descent starting at 316mb. Parameters after the sonde resumes regular ascent have look of mostly interpolated values and are flagged questionable.

201507160500 – wetbulbing ~634mb. All winds above 219mb have zero speed and direction and flagged bad.

201506160600 – wetbulbing ~704mb. All winds above 224mb have zero speed and direction and flagged bad.

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.