

Mesoscale Predictability Experiment (MPEX) 2013 Purdue University Mobile Radiosonde (ESC Format) Data Set

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2.0 Dataset Overview

Purdue University operated a mobile radiosonde system for the Mesoscale Predictability Experiment (MPEX) during the period from 17 May to 12 June 2013. Soundings were taken intermittently as determined by the weather situation, with a focus on the pre-convective and convectively disturbed environments near deep convective storms in the central United States. Soundings were coordinated with releases from the mobile teams from Colorado State University and the National Severe Storms Laboratory (NSSL). This final MPEX data set includes a total of 94 quality controlled, high vertical resolution (1 second) soundings (Figure 1).

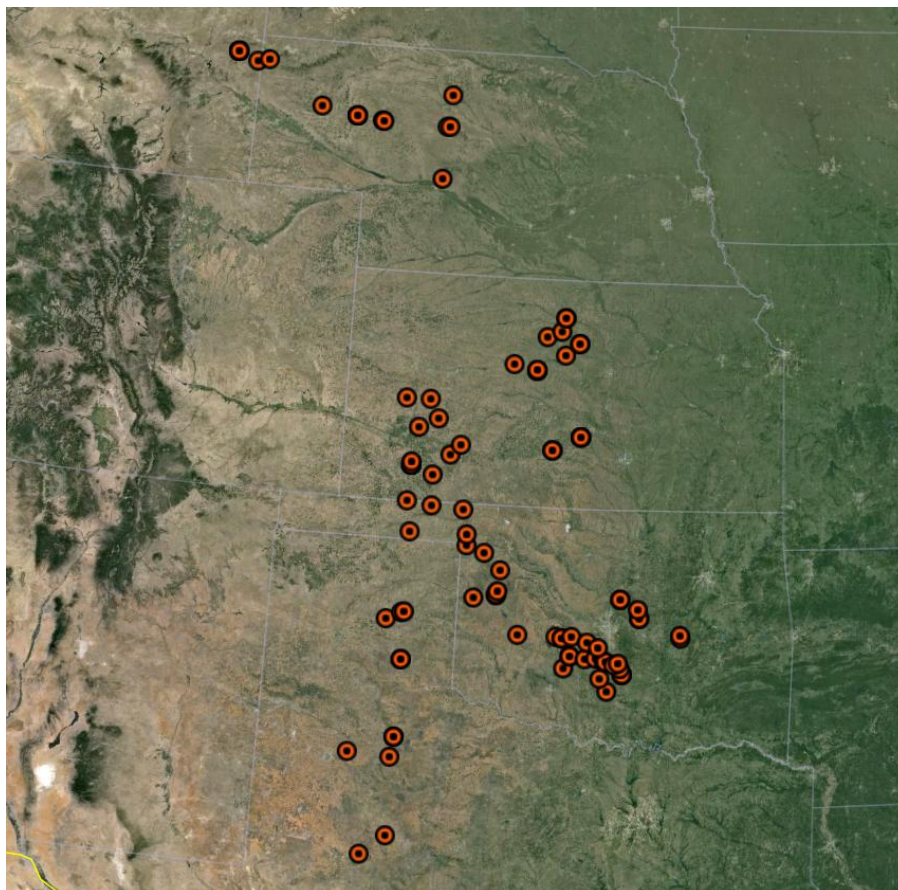


Figure 1. Purdue University Mobile radiosonde release locations during MPEX.

The Mesoscale Predictability Experiment (MPEX) was a field campaign aimed at investigating if experimental sub-synoptic observations can extend convective-scale predictability and otherwise enhance skill in regional numerical weather prediction over a 6-24 hour time span. The NSF/NCAR Gulfstream-V (GV) aircraft deploying dropsondes was the primary platform used in the experiment. There were also three groups on the ground releasing radiosondes from mobile platforms. Further information on MPEX is available at the MPEX web site: https://www.eol.ucar.edu/field_projects/mpex and information on MPEX operations are available at the MPEX Field Catalog: <http://catalog.eol.ucar.edu/mpex/>.

3.0 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	Sonde Type:	Radiosonde type
7	Ground Station Software:	Ground stations software used
8	Surface Data Source:	Source of 0 second observations
9		
10		
11		
12	Nominal Release Time (y,m,d,h,m,s):	Nominal release time

The nominal release time in the case of these soundings is the same as the actual release time.

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 1-second vertical levels

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:

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

The Purdue Mobile platform utilized iMet-1 radiosondes with GPS windfinding during MPEX. The ground station software utilized was the iMet-3050 software. Radiosonde serial numbers were not noted by the data source.

These data include the proprietary processing performed by the Vaisala Digicora software which includes smoothing of data values.

The zero second records in these files were the first observations from the radiosonde after launch has been detected so do not represent surface conditions. There was launch-to-launch variation in this detection, so some of the zero second records are further above the surface than others.

The sounding from 2349 UTC on 16 May 2013 does not have latitude/longitude information above the surface.

Additional information can be found in the readme for the original iMet format version of this data set provided by Purdue:

<http://data.eol.ucar.edu/codiac/dss/id=371.012>

3.4 Sample Data

The following is a sample of the MPEX Purdue University Mobile high resolution radiosonde data in ESC format.

```
Data Type:          Purdue Mobile/Ascending
Project ID:         MPEX
Release Site Type/Site ID:  Purdue Mobile
Release Location (lon,lat,alt): 101 00.99°W, 38 21.76°N, -101.017, 38.363, 927.3
```

```

UTC Release Time (y,m,d,h,m,s): 2013, 05, 17, 00:04:01
Sonde Type: iMet-1 with GPS windfinding
Ground Station Software: iMET-3050
Surface Data Source: Radiosonde
/
/
/

```

```

Nominal Release Time (y,m,d,h,m,s):2013, 05, 17, 00:04:01
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  902.0  27.7  8.5  29.9  -4.5  7.3  8.6 148.3 999.0 -101.017 38.363 999.0 999.0 927.3 1.0 1.0 1.0 1.0 1.0 9.0
1.0  901.6  27.4  8.3  30.0  -4.6  7.3  8.6 148.2 10.9 -101.017 38.363 999.0 999.0 938.2 2.0 1.0 1.0 1.0 1.0 99.0
2.0  901.1  27.1  8.1  30.1  -4.5  7.5  8.7 148.6  7.0 -101.017 38.363 999.0 999.0 945.2 2.0 1.0 1.0 1.0 1.0 99.0

```

3.5 Station List

ID	Site Name	State	Longitude	Latitude	Elev (m)
N/A	Purdue Mobile	Mobile	Mobile	Mobile	Mobile

4.0 Data Quality Control Procedures

1. Each sounding was converted from its original format (columnar ASCII) 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	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

Surface Data

As noted above, there is no surface data recorded in these soundings. The first (zero-second) record in the data files is the first data from the radiosonde system after release has been detected. The detection of release varies from sonde to sonde so some of these records are further above the surface than others. The elevation in

the "Release Location" record of the header is just the first altitude value from the radiosonde.

In some cases, the detection of release seems to have been quite delayed as the first reported elevation is greater than 100 m above the altitude at that location from Google Earth. These soundings include:

20130519004106	- reported alt 645.5m	google earth alt 550m
20130603210902	- reported alt 1040m	google earth alt 863m
20130604182603	- reported alt 1100.8m	google earth alt 975m
20130611223505	- reported alt 1300.3m	google earth alt 1158m
20130612213404	- reported alt 1647.2m	google earth alt 1539m

Updraft Soundings

Several soundings were released into (or ascended into) updrafts. Data during these updraft periods should be considered suspect:

201305232032
201305232329
201305312234
201305312300
201306010100
201306010236

Wetbulbing

Typically occurs after radiosonde ascends through a moist layer into the dry air above as there is a rapid cooling as the water evaporates from the thermistor:

201305200050 - 570mb
201305231928 - 687mb
201305302034 - 750mb
201305302107 - 708mb
201305302216 - 615mb
201305312234 - 567mb

Pressure vs Geopotential Altitude Data

The pressure data seems to have been smoothed independent of the geopotential altitude data. There are many periods where the pressure and geopotential altitude are both decreasing (e.g. 201305181711 around 164mb and 140mb) as the pressure data seems to have been smoothed and the geopotential altitude data was not.

Sounding specific issues

201305190135 - Temperature data bad 457- 162 hPa. Other parameters are highly questionable. The geopotential altitude increases throughout the file, but pressure has several periods of increase.
201305192144 - A few RH spikes above 450 hPa.
201305192220 - Temperature questionable above 360 hPa.
201305202045 - Temperature bad above 366 hPa.
201305240013 - Pressure entirely missing.

201305280055 – Data questionable above 497 hPa.
201305282357 – A few RH spikes above 450 hPa.
201305292349 – Temperature has several periods of bad data below 666 hPa.
201306040117 – Several periods of falling data from 346-826 seconds.
201306041810 – Excluded from final data set as all pressure and most temperature data are bad and only 70 mb of data before end of file.
201306041826 – Very warm near surface.
201306112316 – Temperature questionable above 420 hPa. Several RH spikes 420-297 hPa.
201306120212 – Temperature bad and noisy RH 300-228 hPa.
201306121959 – Very warm near surface.

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.