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

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2.0 Dataset Overview

The National Severe Storms Laboratory (NSSL) operated a mobile radiosonde system for the Mesoscale Predictability Experiment (MPEX) during the period from 15 May to 14 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 Purdue University. This final NSSL MPEX data set includes a total of 111 quality controlled, high vertical resolution (1 second) soundings (Figure 1).

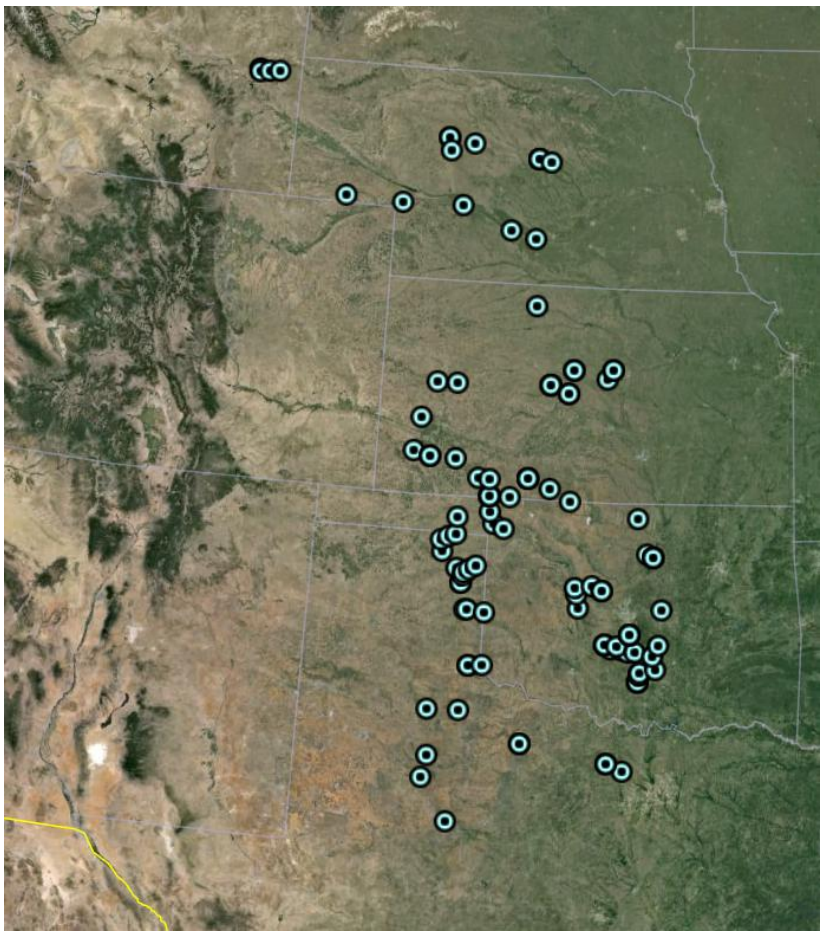

Figure 1. NSSL Mobile radiosonde release locations during MPEX.

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 sill 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:

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

The NSSL Mobile platform utilized iMet-1 radiosondes with GPS windfinding during MPEX. The ground station software utilized was either the iMet-3050 or iMet-3150 software. Radiosonde serial numbers were not noted by the data source.

These data include the proprietary processing performed by the iMet software which includes smoothing of data values and a standard radiation correction.

The surface data record (0 seconds) in these data files is from independent instruments mounted atop a Dodge Minivan at approximately 4 m AGL. The temperature and humidity probes were mounted within a U-tube and an RM Young anemometer was used for the surface winds. A high accuracy barometer was used for the surface pressure measurement.

Additional information can be found in the readme for the original iMet format version of this data set provided by NSSL:
http://data.eol.ucar.edu/codiac/dss/id=371.013

3.4 Sample Data

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

```
Data Type:                      NSSL Mobile/Ascending
Project ID:                     MPEX
Release Site Type/Site ID:      NSSL Mobile
Release Location (lon,lat,alt):  099 14.04'W, 33 35.76'N, -99.234, 33.596, 413.5
UTC Release Time (y,m,d,h,m,s):  2013, 05, 15, 20:12:00
Sonde Type:                     iMet-1 with GPS windfinding
Ground Station Software:        iMET-3050 or iMet-3150
Surface Data Source:            Independent instruments mounted atop Dodge Minivan (approx 4 m AGL)
```

```
/
/
/
Nominal Release Time (y,m,d,h,m,s):2013, 05, 15, 20:12:00
 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  960.0  28.0  15.7  47.0   -1.3    5.0   5.2 165.4 999.0  -99.234   33.596 999.0 999.0   413.5  1.0  1.0  1.0  1.0  1.0  9.0
   1.0  959.5  27.9  15.2  45.8    1.7    6.4   6.6 194.9   8.0  -99.234   33.596 999.0 999.0   421.5  1.0  1.0  1.0  1.0  1.0  1.0
   2.0  959.0  27.8  14.7  44.7    1.7    6.4   6.6 194.9   8.0  -99.234   33.596 999.0 999.0   429.5  1.0  1.0  1.0  1.0  1.0  1.0
```

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. NSSL conducted an initial QC processing with multiple passes through automated algorithms and manual checks. Obviously bad data were removed, with other questionable data flagged. These flags were converted to the NCAR/EOL QC flags and were used as the starting point for NCAR/EOL QC process.

2. Each sounding was converted from its original format (columnar ASCII) into the ESC format described above.

3. 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.

4. 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 > 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 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	< -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

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

201305160017
201305232212
201305312239
201306082049
201306090120

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:

201305160046 – 830 hPa
201305191900 – 755 hPa
201305232341 – 730 hPa
201305302030 – 688 hPa

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 increasing or decreasing (e.g. 201305190001 around 844-874 seconds and 933-959 seconds) as the pressure data seems to have been smoothed and the geopotential altitude data was not.

Sounding specific issues

201305181839 – no GPS
201305190001 – Temperature data bad from 844-1048 seconds. Both pressure and altitude increase from 844-874 and 933-959 seconds.
201305192051 - temperature bad 434-302mb.
201305202030 – data questionable above 536mb.
201305202100 – PTH above 490mb sparse and questionable.
201305202131 – PTH above 815mb erratic
201305202206 – PTH above 552mb erratic
201305232031 – no RH
201305280202 – near surface very warm
201305292349 – periods of increasing pressure with increasing altitude 849-920 seconds.
201306082342 – surface elevation likely too high (reported as 1053 m while Google Earth reports 880 m).
201306111815 – no GPS
201306111900 – no GPS

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.