Mesoscale Predictability Experiment (MPEX) 2013 NSF/NCAR G-V Dropsonde (ESC Format) Data Set

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2.0 Dataset Overview

The National Center for Atmospheric Research/Earth Observing Laboratory (NCAR/EOL) operated a dropsonde system on-board the NSF/NCAR G-V aircraft during 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. This data set includes a total of 426 quality controlled, high vertical resolution (0.25 second) soundings are contained in the final MPEX data set (Figure 1).
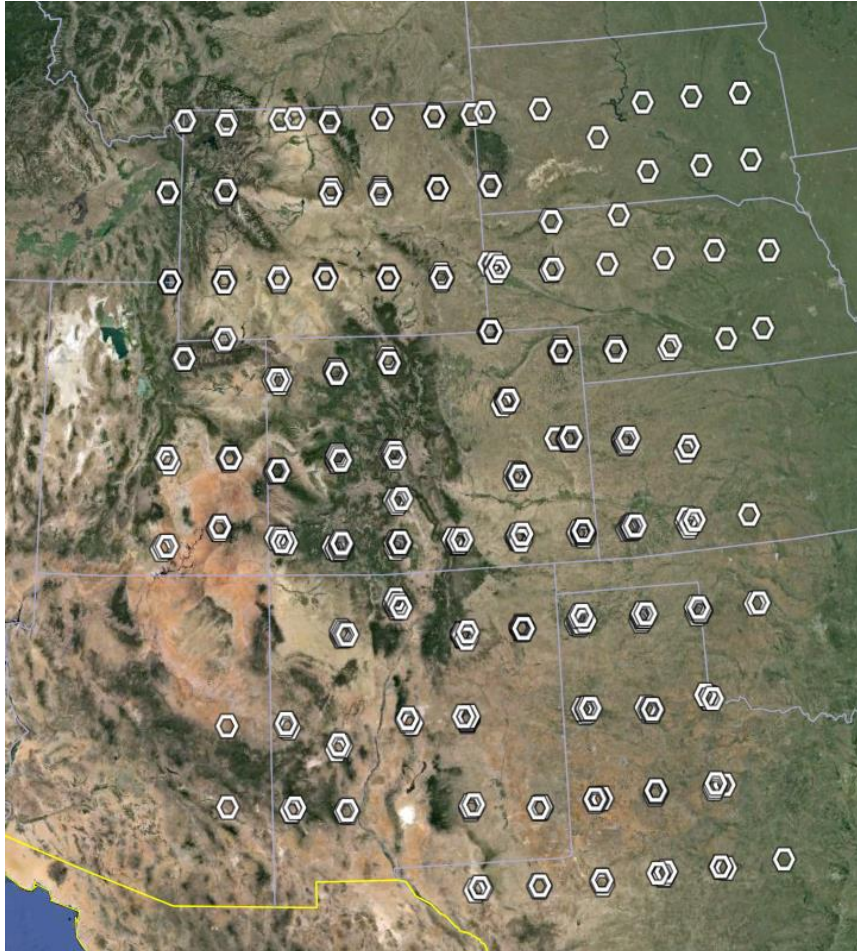

Figure 1. NSF/NCAR G-V dropsonde release locations during MPEX.

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 Id/Sonde Type:	Radiosonde type
7	Reference Launch Data Source/Time:	Source of initial data
8	System Operator/Comments:	Comments
9	Post Processing Comments:	Processing comments
10		
11		
12	Nominal Release Time (y,m,d,h,m,s):	Nominal release time

The nominal release time is 1200 UTC for these soundings.

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 0.25 second vertical levels. GPS parameters are included every 0.25 seconds and other parameters every 0.5 seconds.

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:

NCAR_GV_N677F_yyyymmdd.cls where yyyy is the year, mm is the month, and dd is the day of the month.

The NSF/NCAR G-V platform utilized Vaisala RS-93 dropsondes with GPS windfinding during MPEX.

Complete information on the original NCAR/EOL data quality control processing and findings are available in the original data set readme file:
http://data.eol.ucar.edu/codiac/dss/id=371.005

3.4 Sample Data

The following is a sample of the MPEX NSF/NCAR G-V high resolution dropsonde data in ESC format.

```
Data Type:                     AVAPS SOUNDING DATA, Channel 1/Descending
Project ID:                    MPEX
Release Site Type/Site ID:     Gulfstream V, N677F
Release Location (lon,lat,alt): 105 00.18'W, 37 29.50'N, -105.003, 37.492, 12543.1
UTC Release Time (y,m,d,h,m,s): 2013, 05, 15, 09:19:15
Sonde Id/Sonde Type:           112425017/Vaisala RD93
Reference Launch Data Source/Time: IWGADTS Format (IWG1)/09:19:16
System Operator/Comments:      Remote Operator/none, none
Post Processing Comments:      Aspen Version 3.1; Created on 17 Jul 2013 02:52 UTC; Configuration ModMiniDropsonde
/
/
Nominal Release Time (y,m,d,h,m,s):2013, 05, 15, 09:19:15
 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
------ ----- ---- ---- ---- ------ ------ ----- ---- ----- -------- ------- ----- ----- ------- ---- ---- ---- ---- ---- ----
 668.3 745.2 12.6  0.3 42.7 9999.0 9999.0 999.0 999.0 999.0 9999.000 999.000 999.0 999.0  2599.8  1.0  1.0  1.0  9.0  9.0  9.0
 667.8 9999.0 999.0 999.0 999.0   3.6    1.9   4.0 242.6 999.0 9999.000 999.000 999.0 999.0 99999.0  9.0  9.0  9.0 99.0 99.0  9.0
 667.5 9999.0 12.6  0.3 42.8   3.6    1.9   4.1 242.9 999.0 -105.024 37.491 999.0 999.0 99999.0  9.0 99.0 99.0 99.0 99.0  9.0
```

3.5 Station List

ID	Site Name	State	Longitude	Latitude	Elev (m)
N677F	NSF/NCAR G-V	Mobile	Mobile	Mobile	Mobile

4.0 Data Quality Control Procedures

1. Each sounding underwent a quality control process led by Kate Young of NCAR/EOL and that process and findings are available from that data set (see Section 3.3 above)

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	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	< -25 or > 25	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	Increasing/equal	P, T, RH	Q
Pressure	Decreasing/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

See the readme of the original data set for detailed quality control findings:
http://data.eol.ucar.edu/codiac/dss/id=371.005

20130515105433 – No RH data.
20130518121022 – No Temperature data.
20130611115658 – Temperature data questionable.

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.

Young, K, J. Wang, T. Hock, and D. Lauritsen, 2013: MPEX 2013 Dropsonde Data Quality Report. Available on-line at: http://data.eol.ucar.edu/datafile/nph-get/371.005/readme.MPEX-2013.GVdropsonde.pdf