Ontario Winter Lake-effect Systems (OWLeS) 2013-2014 Millersville University Mobile Radiosonde Data Set

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2.0 Dataset Overview

Millersville University operated a mobile radiosonde system during lake-effect systems on Lake Ontario. Millersville University operations were on the eastern side of Lake Ontario and in the Finger Lakes (Figure 1). This data set includes the quality controlled Millersville University soundings released for the OWLeS field phase (7 December 2013 to 28 January 2014). A total of 65 quality controlled, high resolution (1-second) soundings are contained in the final OWLeS data set.

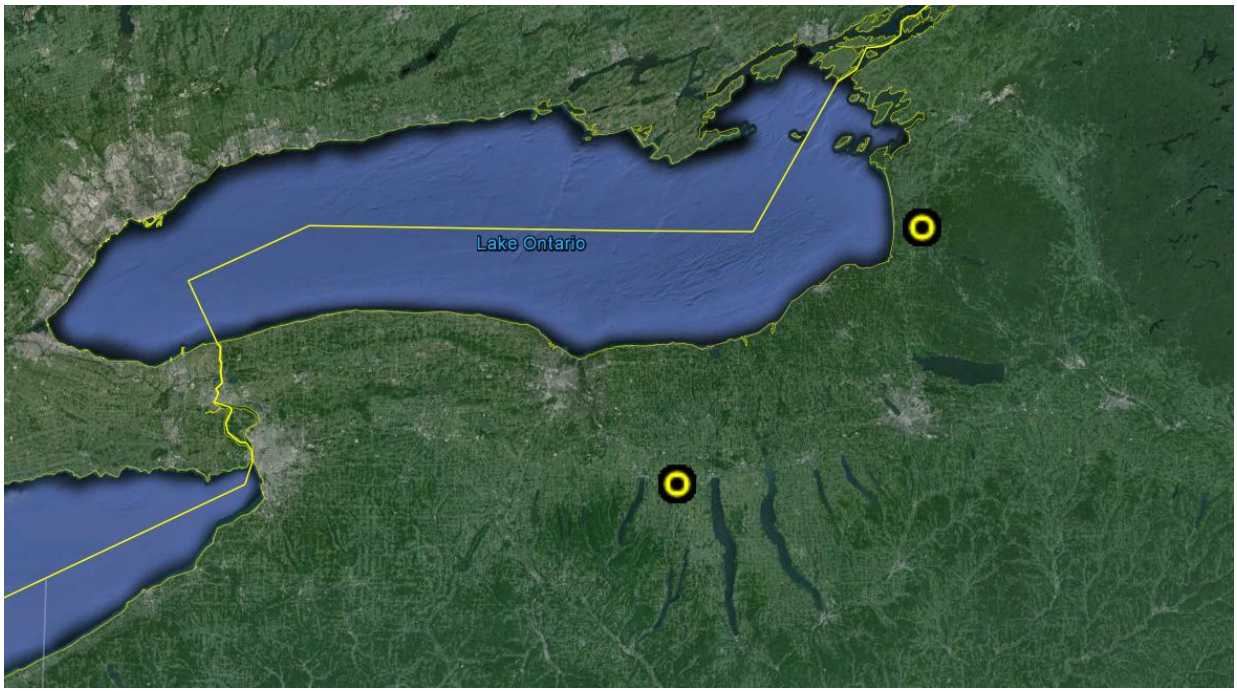

Figure 1. Locations of the Millersville University mobile radiosonde release locations included in the OWLeS data set.

The Ontario Winter Lake-effect Systems (OWLeS) was a field campaign aimed at investigating the formation mechanisms, cloud microphysics, boundary layer processes, and dynamics of lake-effect systems (LeS) using new observational tools capable of detailing LeS characteristics not observed in previous LeS field experiments. Observations were focused around Lake Ontario because of its geometry and size, the influence of upstream lakes, the frequency of LeS, nearby

orography, and its proximity to several participating universities. The University of Wyoming King Air aircraft took part in the experiment as well as several mobile radars and five mobile radiosonde sites. Further information on OWLeS is available at the OWLeS web site: https://www.eol.ucar.edu/field_projects/owles and information on OWLeS operations is available at the OWLeS Field Catalog: http://catalog.eol.ucar.edu/owles/.

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	Serial number and type of sonde
7	Surface Data Source	

The nominal release time for these soundings is the same as the actual 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 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:

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

Millersville University utilized Vaisala RS92-SGP radiosondes with GPS windfinding during OWLeS.

3.4 Sample Data

The following is a sample of the OWLeS University of Illinois high resolution radiosonde data in ESC format.

```
Data Type:                          University of Illinois Mobile Radiosonde/Ascending
Project ID:                         OWLeS
Release Site Type/Site ID:          Cobourg, Ontario
Release Location (lon,lat,alt):     078 10.07'W, 43 57.32'N, -78.168, 43.955, 75.0
UTC Release Time (y,m,d,h,m,s):     2013, 12, 07, 17:42:00
Radiosonde Type:                    GRAW DFM-09
Ground Station Software:            GRAWmet 5 version 5.9.2.4
Surface Data Source:                Kestrel 4500 Pocket Weather Tracker
/
/
/
Nominal Release Time (y,m,d,h,m,s):2013, 12, 07, 17:42:00
 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 1019.0   0.3  -4.5  70.0    3.1    0.0   3.1 270.0 999.0  -78.168  43.955 999.0 999.0    75.0 99.0 99.0 99.0 99.0 99.0  9.0
   1.0 1019.0   0.2  -4.6  70.0    2.8    0.0   2.8 270.0   0.0  -78.168  43.955 999.0 999.0    75.0  2.0  2.0  2.0 99.0 99.0 99.0
   2.0 1019.0   0.2  -4.6  70.0    2.5    0.0   2.5 270.0  -0.1  -78.168  43.955 999.0 999.0    74.9  2.0  2.0  2.0 99.0 99.0 99.0
```

3.5 Station List

Site ID	WMO ID	Site Name	State	Latitude	Longitude	Elev (m)
Millersville	N/A	Sandy Creek	NY	-76.070	43.650	162
Millersville	N/A	Stanley	NY	-77.110	42.860	263

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 > 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

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.

1. Three soundings have little or no wind data:
   201312152055 – no winds below 140mb
   201401261114 - none
   201401261133 - none
2. Six soundings have no relative humidity data:
   201401202107
   201401210208
   201401210507
   201401210807
   201401211408
   201401211707
3. Four soundings do not reach at least 500mb:
   201312110214 - 623mb
   201312112151 - 779mb
   201312152315 - 693mb
   201401261114 - 783mb
4. One sounding has a cycling RH:
   201312182014
5. Most (47) of the soundings have the relative humidity spike down to 1% just above the surface. It typically starts decreasing around 1 minute after release and the low humidity values last for 20-30 seconds.
6. Three soundings have surface data that does not compare well with the radiosonde data:
   201312112015 – surface temperature is warm and the RH is low

201312152055 – surface temperature is warm and the RH is low
201401152314 – surface temperature is warm

7 One sounding had a period of 21 seconds included in the original file where the radiosonde was acclimatizing while at the surface. Those first 21 seconds were not included in this final data set. The original 22 second record was given the zero second time and surface elevation and lat/lon in the final file. All geopotential altitude data were revised based off of the new surface record:
201312150215

8 Seven soundings had data included in them that was extrapolated from the actual surface to 1000 mb. The surface record in the final file was chosen based primarily off of the ascent rate. The new surface point was made the zero second record and surface elevation and lat/lon in the final file. All geopotential altitude data were revised based off of the new surface record:
201401192336
201401202107
201401202314
201401211707
201401212329
201401221554
201401282011

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.