# Ontario Winter Lake-effect Systems (OWLeS) 2013-2014 Hobart and William Smith Colleges Mobile Radiosonde Data Set

## 1.0 Contacts:

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## 2.0 Dataset Overview

The Hobart and William Smith (HWS) Colleges operated a mobile radiosonde system during lake-effect systems on Lake Ontario. HWS operations were focused along the south shore of Lake Ontario and along the Finger Lakes (Figure 1). This data set contains the 73 quality controlled, high vertical resolution (1-second) HWS soundings released during the OWLeS field phase (7 December 2013 to 28 January 2014).

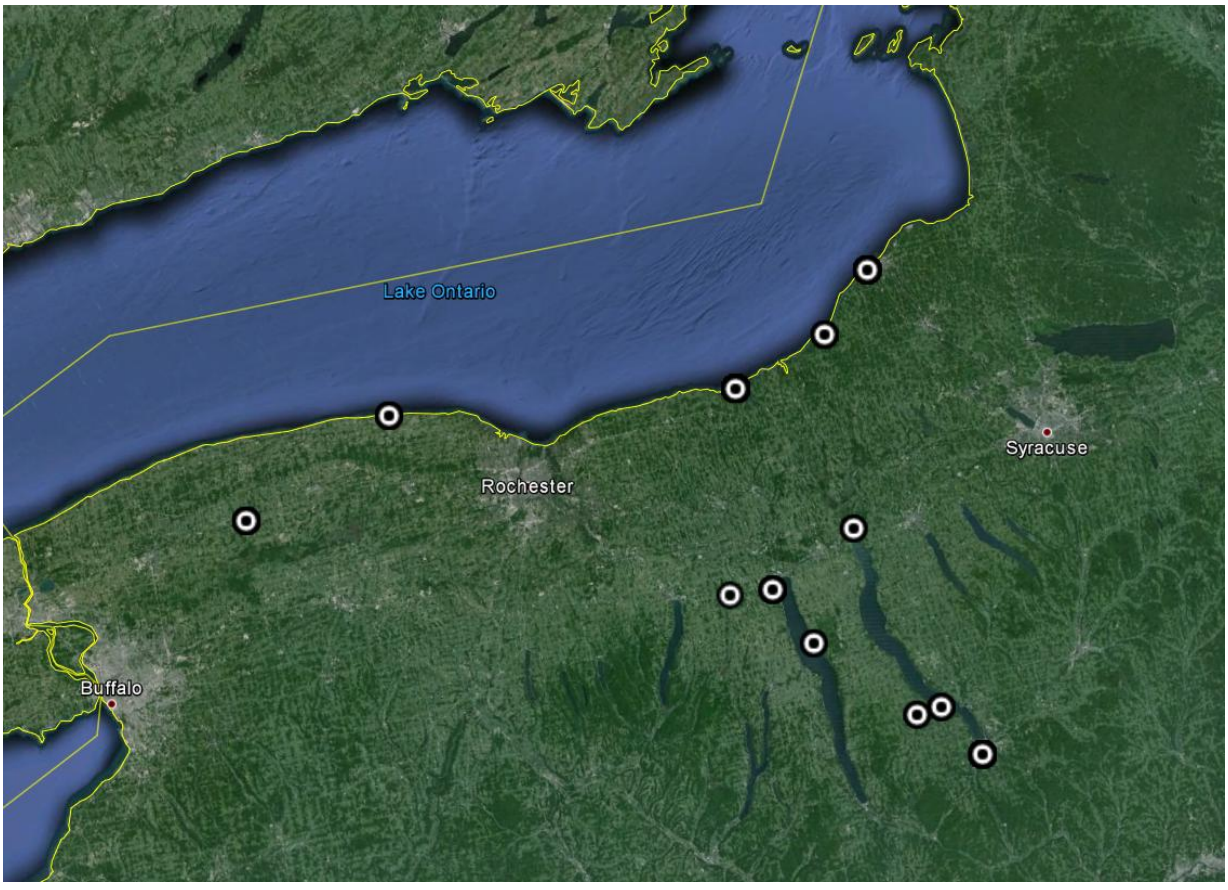


Figure 1. Location of the HWS radiosonde release locations during OWLeS.

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 Type | |
| 7 | Ground Station Software | |
| 8 | 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:

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

HWS utilized GRAW DFM-09 radiosondes with GPS windfinding during OWLeS for all releases. GRAWmet version 5.9.2.4 ground station software was used. The surface data were obtained from a Kestrel 3400 Pocket Weather Tracker.

### 3.5 Sample Data

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

```
Data Type:                          HWS Colleges Mobile Radiosonde/Ascending
Project ID:                         OWLeS
Release Site Type/Site ID:          Sodus Point, NY
Release Location (lon,lat,alt):     076 58.49'W, 43 16.44'N, -76.975, 43.274, 76.0
UTC Release Time (y,m,d,h,m,s):     2013, 12, 07, 17:16:00
Sonde Type:                         GRAW DFM-09 GPS Radiosonde
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, 17:16:00
 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 1019.3  -0.5  -9.6  50.0    1.5   -0.3   1.5 280.0 999.0  -76.975  43.274 999.0 999.0    76.0  1.0  1.0  1.0  1.0  1.0  9.0
   1.0 1018.6  -0.7  -9.7  50.0    2.3   -0.1   2.3 273.0   5.6  -76.975  43.274 999.0 999.0    81.6  1.0  1.0  1.0  1.0  1.0 99.0
   2.0 1017.9  -0.8  -9.7  51.0    3.0    0.0   3.0 270.0   5.7  -76.974  43.274 999.0 999.0    87.3  1.0  1.0  1.0  1.0  1.0 99.0
```

### 3.6 Station List

| Site ID | WMO ID | Site Name | State | Latitude | Longitude | Elev (m) |
|---|---|---|---|---|---|---|
| HWS | N/A | Mobile | Mobile | 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<br>> T | RH<br>T, RH | Q<br>Q |
| Wind Speed | < 0 or > 100<br>> 150 | U, V<br>U, V | Q<br>B |
| U Wind | < 0 or > 100<br>> 150 | U<br>U | Q<br>B |
| V Wind | < 0 or > 100<br>> 150 | V<br>V | Q<br>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.

1. Several files had periods of spuriously low wind speeds for short periods. Most of these periods have been flagged as Bad and some as Questionable.
   201312110218 – 505-495mb
   201312111129 – 343-327mb
   201312122021 - above 315mb
   201312122304 - above 350mb
   201312130203 - 590-580mb
   201312182309 - several periods above 320mb
   201401030813 - 310-300mb
   201401062016 - 263-242mb and 185-170mb
   201401070327 - above 400mb
   201401070502 - 332-317mb
   201401070816 - 240-233mb
   201401071424 - 267-240mb and above 182mb
   201401081842 - above 123mb

201401201717 - 226-218mb and 197-192mb
201401201910 - 200-195mb
201401202319 - above 263mb
201401211154 - several periods above 480mb
201401232324 - several periods above 242mb
201401261118 - above 374mb
201401271720 - 195-185mb

2. All raw data files had a surface elevation of 0m and thus incorrect geopotential height data. The surface elevation data were corrected using values from Google Earth at the provided release location and the geopotential height data were derived using these new surface values.

**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.