WINTRE-MIX: 5hPa Resolution Radiosonde Composite

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1.0   Data Set Description

Interpolated 5hPa vertical resolution radiosonde data from research and operational sources during the WINTRE-MIX campaign converted into a common format (EOL Sounding Composite format which is a columnar ASCII format). The composite includes data from radiosondes from locations around Quebec, Canada and the northeastern United States. The radiosondes were released by the University at Albany (three sites), University of Colorado Boulder (four sites), Université du Québec à Montréal (three sites), McGill University (three sites), and the National Weather Service (four sites).

Data Version: 1.0
Data Status: Final
Time Period: 30 January to 16 March 2022
Physical Location: 40.865 to 46.349N and 70.257 to 78.725W
Data Frequency: Varies by location
Vertical Resolution: 5 hPa
Data Source: University at Albany, University of Colorado Boulder, Université du Québec à Montréal. McGill University, and NOAA/National Weather Service
Data Restrictions: Limited to WINTRE-MIX investigators through 17 March 2023. Open access thereafter.

1.1 WINTRE-MIX Description

The WINTRE-MIX campaign had the overarching goal of gaining a better understanding of how multi-scale processes influence the variability and predictability of precipitation type and amount under near-freezing surface condition. The WINTRE-MIX field campaign was conducted in the region around Montreal, Canada during February and March 2022. The study region had a strong backbone of existing state-of-the-art mesoscale observation networks, and experiences

plentiful near-freezing precipitation with interesting terrain influences. WINTRE-MIX supplemented existing networks with additional observations from aircraft, mobile radars, and other surface-based instruments. Information on WINTRE-MIX operations and Intensive Observation Periods (IOPs) can be found in the WINTRE-MIX Field Catalog (http://catalog.eol.ucar.edu/wintre-mix) and additional background information can be found at the WINTRE-MIX website (https://www.eol.ucar.edu/field_projects/wintre-mix).

2.0   Instrument Description

2.1 Instrumentation

University at Albany (UA) used iMet-4 radiosondes performed with the iMet-3050A sounding system for IOP1-4 and the iMet-3150 sounding system for IOP6-11 (no soundings were released for IOP5). Soundings were processed using the iMetOS-II Meteorological Operating Software version 3.133.0C**.**

University of Colorado Boulder (UCB) used Vaisala RS41-SG radiosondes processed with the Vaisala Sounding System MW41 version 2.11.

Université du Québec à Montréal (UQAM) used iMet-4 radiosondes performed with the iMet-3050A sounding system. Soundings were processed using the iMetOS-II Meteorological Operating Software version 3.133.0C.

McGill University (MU) used iMet-4 radiosondes performed with the iMet-3050A sounding system. Soundings were processed using the iMetOS-II Meteorological Operating Software version 3.133.0C.

NWS KALY (Albany, New York) used Lockheed Martin Sippican LMS-6 GPS radiosondes with a capacitance humidity sensor.

NWS KBUF (Buffalo, New York) used Vaisala RS41 radiosondes (DigiCORA MW41) with a Humicap capacitance humidity sensor with active de-icing method.

NWS KGYX (Gray, Maine) and KOKX (Upton, New York) used Vaisala RS92-NGP/Intermet IMS-2000 radiosondes with a twin alternatively-heated humicap capacitance humidity sensor

2.2 Station Locations

| Site ID	Source	Site Name	State	Latitude	Longitude	Elev (m)
DOW-US-N	UA	Champlain	NY	44.955	-73.387	46
DOW-US-P	UA	Plattsburgh	NY	44.684	-73.526	109
ESSX	UA	Essex Farm	NY	44.308	-73.374	67
DOW-CAN-N	UCB	Acton Vale	QC	45.704	-72.644	69
DOW-CAN-SE	UCB	St. Blaise-sur-Richelieu	QC	45.212	-73.285	47
DOW-CAN-S	UCB	Noyan	QC	45.085	-73.271	37
JEAN	UCB	St. Jean-sur-Richelieu	QC	45.324	-73.266	37
Sorel	UQAM	Sorel	QC	46.030	-73.110	13
TR	UQAM	Trois-Rivières	QC	46.349	-72.581	52
JEAN	UQAM	St. Jean-sur-Richelieu	QC	45.324	-73.266	37
Gault	MU	Mont St. Hilaire	QC	45.535	-73.149	132
KALY	NWS	Albany	NY	42.692	-73.833	95
KBUF	NWS	Buffalo	NY	42.940	-78.725	218
KGYX	NWS	Gray	ME	43.893	-70.257	124
KOKX	NWS	Upton	NY	40.865	-72.863	20
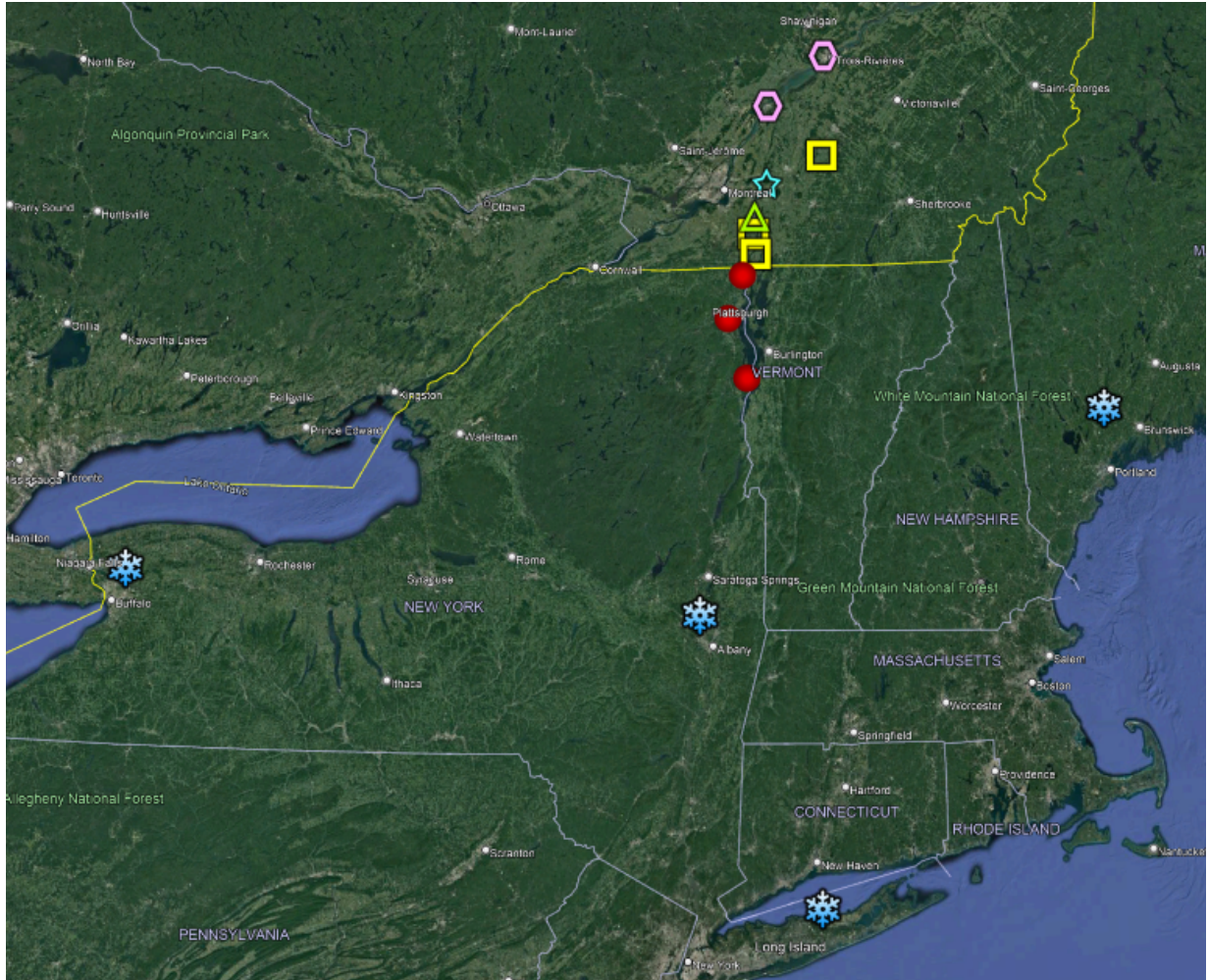
Figure 1. Map of WINTRE-MIX radiosonde composite locations. Red circles are UA sites, yellow squares are UCB sites, the green triangle is a combined UCB/UQAM site, the pink hexagons are UQAM sites, the green star is the MU site, and the blue snowflakes are the NWS sites.

3.0   Data Collection and Processing

This dataset takes the data from the WINTRE-MIX High Resolution Radiosonde Composite and interpolates the data to a consistent 5hPa vertical resolution. A total of 491 soundings are included in this dataset.

Complete information on the collection, processing and quality control procedures of the full resolution data at each site can be found in the documentation at their respective dataset pages in the NCAR/EOL Field Data Archive:

NWS: https://doi.org/10.26023/C20Y-VK2S-YG11

UA/UCB/UQAM/MU: https://doi.org/10.26023/DN6Q-VKKE-V002

The procedures used to develop the High Resolution Radiosonde Composite upon which these data are based can be found in the documentation at its dataset page in the NCAR/EOL Field Data Archive:

High Resolution Composite: https://doi.org/10.26023/RNQB-2CJ5-2F0W

3.1 5hPa Interpolation Procedures

The surface data point was kept as the initial level in each sounding. The first interpolated data point was at the next lowest pressure evenly divisible by 5 and then every 5 hPa pressure level beyond that point to either 50 hPa or the lowest pressure level reached by the radiosonde, whichever came first. The first 15 lines of each file (the header information) were kept without change.

For the interpolation, the software searched for two data points around the desired pressure level. The search was conducted by looking for two valid (i.e. non-missing) data points around the desired pressure level, while also paying attention to the time difference between the two data points as well as their quality control flags. There was a search for the two best possible data points to use in the interpolation. If the desired pressure level was within the original dataset, that data point was used without interpolation.

There was first a search for values flagged as good within some time range (50 sec for temperature, humidity, and wind and 100 sec for pressure; hereafter termed the ARANGE) and the interpolated data point was flagged as good. Failing that, it searched for values flagged as estimated within the same time range and the interpolated data point was flagged as estimated. Then the search went for good values within a wider time range (100 sec for temperature, humidity, and wind and 200 sec for pressure; hereafter termed the BRANGE) the flag for the interpolated data point here was then degraded (even though two `good' data points were used there was a significant time difference between them) to questionable. Then, in turn, estimated values within the BRANGE were used (flag set to questionable), questionable values within the BRANGE (flag set to bad), good values greater than the BRANGE apart (flag set to bad), estimated values greater than BRANGE apart (flag set to bad), questionable values greater than BRANGE apart (flag set to bad), finally any bad values (flag set to bad). This search was conducted separately for each interpolated variable (pressure, temperature, relative humidity, and the u and v wind components.

Thus for each interpolated data point, the quality control flag was set to the worst case among the data points used in the interpolation, except, for each time range apart, the quality control flag was degraded one level (i.e. good to questionable, etc).

The quality control flags should be carefully heeded in these files. While some of the data may look good, it may have been interpolated over large pressure intervals, and thus be suspect.

For each interpolated data point the dew point was calculated from the temperature and relative humidity (Bolton 1980) and the total wind speed and direction were calculated from the interpolated u and v component values. Also, the altitude and time were interpolated using the

same data points used for the pressure interpolation. The ascension rate was recalculated based on the time and altitude values from the two data points used to interpolate the 5 hPa data point. Thus the ascension rate values do not reflect the values based on the interpolated data. The latitude and longitude values were interpolated using the same data points used in the wind component interpolation.

4.0 Data Format

The data are in files by day and include radiosonde data from all sites for the day concatenated into a single file. The file naming convention is: WINTRE-MIX_2022_5MB_yyyymmdd.cls where yyyymmdd is the UTC year, month, and day of month.

The final dataset is in the EOL Sounding Composite (ESC) format. ESC is a columnar ASCII format that consists of 15 header records for each sounding with the remaining records containing the radiosonde data and their associated data quality flags.

4.1 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	Contents
1	Data Type:	Description of the type and resolution of data
2	Project ID:	Short name for the field campaign
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. They typically include things such as radiosonde type, radiosonde serial number, sensor information, balloon information, and/or ground station software.

4.2 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	6.1	Time since release	Seconds	9999.0
2	6	6.1	Pressure	hPa	9999.0
3	5	5.1	Temperature	ºC	999.0
4	5	5.1	Dew Point Temperature	ºC	999.0
5	5	5.1	Relative Humidity	Percent	999.0
6	6	6.1	U Wind Component	m/s	9999.0
7	6	6.1	V Wind Component	m/s	9999.0
8	5	5.1	Wind Speed	m/s	999.0
9	5	5.1	Wind Direction	Degrees	999.0
10	5	5.1	Ascent Rate	m/s	999.0
11	8	8.3	Longitude	Degrees	9999.0

12	7	7.3	Latitude	Degrees	999.0
13	5	5.1	Elevation Angle	Degrees	999.0
14	5	5.1	Azimuth Angle	Degrees	999.0
15	7	7.1	Geopotential Altitude	Meters	99999.0
16	4	4.1	QC code for Pressure	Code	99.0
17	4	4.1	QC Code for Temperature	Code	99.0
18	4	4.1	QC Code for Humidity	Code	99.0
19	4	4.1	QC Code for U Wind	Code	99.0
20	4	4.1	QC Code for V Wind	Code	99.0
21	4	4.1	QC Code 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. ("QUESTIONABLE")
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")

5.0 Data Remarks

See the respective FDA dataset pages linked in Section 3.1 for any details on data quality issues.

6.0 References

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