High Ice Water Content (HIWC) Radar 2015 GTS Radiosonde Data Set

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2.0 Dataset Overview

National weather agencies around the world routinely release radiosondes at 00 and/or 12 UTC with occasional special releases. This data set includes the quality controlled GTS soundings released at sites in the southeastern United States, the Mexican Gulf Coast, and Caribbean (Figure 1) for which high vertical resolution data were not available for the period of HIWC Radar 2015 operations, 10-24 August 2015. A total of 238 quality-controlled, mandatory and significant level resolution soundings are contained in the final data set.

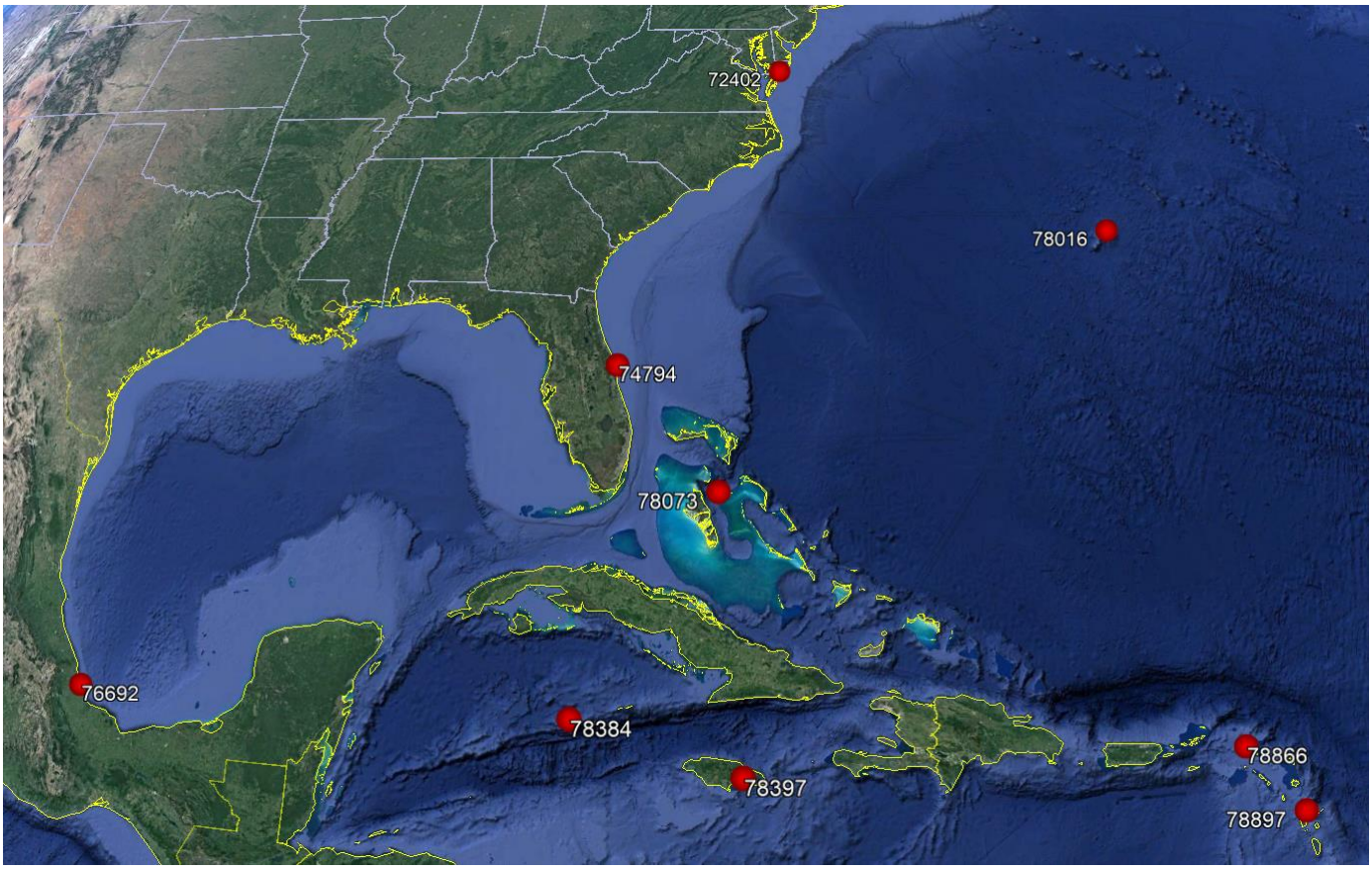

Figure 1. GTS sounding locations included in the HIWC Radar 2015 data set.

3.0 Project Overview

The High Ice Water Content (HIWC) Radar field campaigns were aimed at developing a means to remotely identify regions of HIWC ahead of an aircraft to enable tactical detect and avoidance decision making by a flight crew. This season of HIWC was based out of Fort Lauderdale, Florida and utilized the NASA DC-8 aircraft. Further information on HIWC Radar 2015 is available at the HIWC Radar 2015 web site: https://www.eol.ucar.edu/field_projects/hiwc-radar-study/

4.0 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.

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 (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		
7		
8		
9		
10		
11		

In these files all of these records contain just a "/".

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	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”)

4.1 Data Specifics

The files contain data at mandatory and significant levels.

The data are in files by day and contain all stations and soundings from the day. The files are named like:

GTS_YYYYMMDD.cls

Where YYYY is the year, MM is the month, DD is the day of the month.

4.2 Sample Data

The following is a sample of the radiosonde data in EOL format.

```
Data Type:                          GTS Sounding/Ascending
Project ID:                         HAIC-HIWC
Release Site Type/Site ID:          72402 WAL
Release Location (lon,lat,alt):     075 28.80'W, 37 55.80'N, -75.480, 37.930, 13.0
UTC Release Time (y,m,d,h,m,s):     2015, 08, 09, 23:00:00
/
/
/
/
/
/
Nominal Release Time (y,m,d,h,m,s):2015, 08, 10, 00:00:00
 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 1015.0  24.0  17.0  64.9   -1.8    3.1   3.6 150.0 999.0  -75.480  37.930 999.0 999.0    13.0 99.0 99.0 99.0 99.0 99.0  9.0
9999.0 1000.0  22.2  16.2  68.8   -2.3    2.8   3.6 140.0 999.0 9999.000 999.000 999.0 999.0   139.0 99.0 99.0 99.0 99.0 99.0  9.0
9999.0  980.9 999.0 999.0 999.0   -3.4    2.4   4.1 125.0 999.0 9999.000 999.000 999.0 999.0   304.0 99.0  9.0  9.0 99.0 99.0  9.0
```

4.3 Station List

Site ID	WMO ID	Site Name	State or Country	Latitude	Longitude	Elev (m)
KWAL	72402	Wallops Island	VA	37.93	-75.48	13
KXMR	74794	Cape Canaveral	FL	28.48	-80.55	5
MMVR	76692	Veracruz	MX	19.17	-96.12	13
TXKF	78016	Bermuda	BM	32.37	-64.68	37
MYNN	78073	Nassau	BS	25.05	-77.47	2
MWCR	78384	Grand Cayman	KY	19.30	-81.37	3
MKJP	78397	Kingston	JM	17.93	-76.78	1
TNCM	78866	Saint Maarten	AN	18.05	-63.12	3
TFFR	78897	Guadeloupe	GP	16.27	-61.52	8

5.0 Data Quality Control Procedures

1. Each sounding was converted from its original format into the EOL Sounding Composite (ESC) format.

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. Each sounding was then converted to the EOL sounding format described above.

5.1 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).

5.1.1 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

5.1.2 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

5.2 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.

5.3 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.

78016_201508092357 – no data above 664mb
78016_201508172316 – no data above 653mb
78073_201508111200 – no data above 503mb
78073_201508131200 – winds below 740mb bad
78073_201508181200 – winds at 948mb bad
78073_201508191200 – winds below 790mb quest/bad
78384_201508202247 – bad surface RH
78384_201508232309 – winds 925-880mb bad
78397_201508101200 – winds 98-63mb bad
78397_201508131200 – winds below 700mb questionable
78397_201508142319 – winds below 880mb bad

78397_201508190000 – no data below 80mb
78397_201508212345 – no wind data
78397_201508252308 – winds below 730mb bad
78866_201508102304 – winds above 215mb bad
78866_201508122336 – winds above 140mb bad
78866_201508231200 – winds above 165mb bad
78866_201508241200 – winds above 250mb questionable

6.0 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.