

High/Altitude Ice Crystals-High Ice Water Content (HAIC-HIWC) Bureau of Meteorology Darwin Radiosonde Data Set

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Original Data Source:

Atmospheric Radiation Measurement (ARM)

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2.0 Data Set Authors

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3.0 Dataset Overview

The Australian Bureau of Meteorology routinely releases radiosondes from Darwin (WMO 94120) which is on the north-central coast of Australia (Figure 1). During the HAIC-HIWC field phase, soundings were routinely released four times daily (00, 06, 12, and 18 UTC; wind only at 06 and 18 UTC). This data set includes the quality controlled Darwin soundings released for the HAIC-HIWC field phase (15 January to 15 March 2014). A total of 254 quality-controlled, high resolution (2-second) soundings are contained in the final HAIC-HIWC data set.

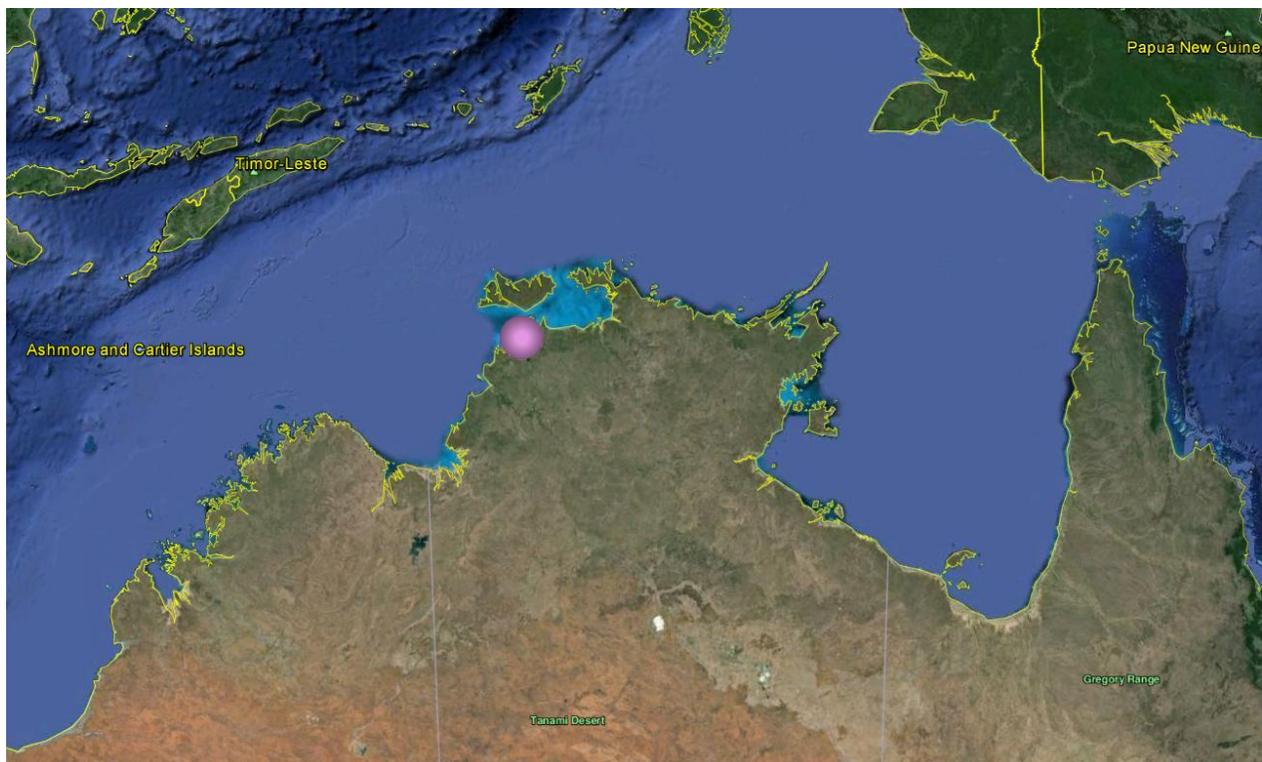


Figure 1. Location of the Bureau of Meteorology Darwin radiosonde site.

The High Altitude Ice Crystals – High Ice Water Content field campaign was aimed at collecting cloud data in deep convective clouds to fulfill industry and scientific objective. The project brought the French SAFIRE Falcon 20 aircraft to Darwin equipped with active remote sensing instruments providing 3D high-resolution characterization of the dynamical and microphysical properties of ice clouds in situ as well as a state of the art in situ microphysical package. Further information on HAIC-HIWC is available at the HAIC-HIWC web site: https://www.eol.ucar.edu/field_projects/haic-hiwc and information on HAIC-HIWC operations is available at the HAIC-HIWC Field Catalog: <http://catalog.eol.ucar.edu/haic-hiwc/>.

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	Sonde Id/Sonde Type	Serial number and type of sonde
7	Ground Station Software	

The nominal release time for these soundings is 0000, 0600, 1200, or 1800 UTC.

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")

4.3 Data Specifics

The files contain data at two-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:

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

The Bureau of Meteorology Hobart station utilized Vaisala RS92-15 radiosondes with radar windfinding during HAIC-HIWC. The Vaisala DigiCORA III ground station was used.

The Bureau of Meteorology released the radiosondes, the data were retrieved from the ARM archive (ARM, 1994).

The 00 and 12 UTC soundings contain complete meteorological and wind data, the 06 and 18 UTC soundings contain only wind data.

4.4 Sample Data

The following is a sample of the HAIC-HIWC Bureau of Meteorology Darwin high resolution radiosonde data in ESC format.

```
Data Type: Bureau of Meteorology Radiosonde/Ascending
Project ID: HAIC-HIWC
Release Site Type/Site ID: C3: Darwin, Australia/94120
Release Location (lon,lat,alt): 130 53.40'E, 12 25.20'S, 130.890, -12.420, 30.0
UTC Release Time (y,m,d,h,m,s): 2014, 01, 14, 23:15:00
Sonde Id/Sonde Type: H3243989/Vaisala RS92-15 with radar-tracked winds
Ground Station Software: DigiCora III
/
/
/
Nominal Release Time (y,m,d,h,m,s):2014, 01, 15, 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 m code code code code code code
-----
0.0 996.9 26.4 23.6 85.0 8.9 -2.6 9.3 286.0 999.0 130.890 -12.420 999.0 999.0 30.0 99.0 99.0 99.0 99.0 99.0 99.0
2.0 995.5 26.1 24.2 90.0 9.8 -3.0 10.2 287.0 6.0 130.890 -12.420 999.0 999.0 42.0 99.0 99.0 99.0 99.0 99.0 99.0
4.0 994.4 26.1 24.2 89.0 10.5 -3.6 11.1 289.0 5.8 130.890 -12.420 999.0 999.0 53.0 99.0 99.0 99.0 99.0 99.0 99.0
```

4.5 Station List

Site ID	WMO ID	Site Name	Country	Latitude	Longitude	Elev (m)
YPDN	94120	Darwin	Australia	-12.420	130.890	30

5.0 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.

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 were 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	< -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 were 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.

The 06 and 18 UTC soundings contain only wind data.

201401181115 – has cycling RH data from 500-487 mb.

201401290635 – a wind spike from 580-510mb was flagged as questionable.

A number of soundings did not reach at least 500 mb, a number of them had second releases that reached higher levels:

201401151720 – 525mb
 201401152325 – 505mb
 201401180528 – 555mb
 201401180557 – 590mb
 201401302332 – 540mb
 201402020515 – 620mb

201402151115 - 660mb
201402160518 - 695mb
201402171715 - 900mb
201402181716 - 596mb
201402181757 - 560mb

201402231115 - contained only a few records above the surface and was not included in the final data set.

6.0 References

Atmospheric Radiation Measurement (ARM) Climate Research Facility. 1994, updated daily. Balloon-borne sounding system (SONDEWNPN). 2014-01-15 to 2014-03-15, 12.425 S, 130.892 E: Tropical Western Pacific (TWP) Darwin, Australia (C3). Compiled by R Coulter, J Prell, M Ritsche, and D Holdridge. ARM Data Archive: Oak Ridge, Tennessee, USA. Data set accessed 2014-11-10 at <http://dx.doi.org/10.5439/1021460>.

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.