Bunny Fence Experiment 2007 (BUFEX) Quality Controlled Radiosonde Data Set

Contents:

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http://www.eol.ucar.edu/instrumentation/sounding/gaus

I. Project/Dataset Overview

The Bunny Fence Experiment (BUFEX) of 2007 is the second phase of a coordinated effort to study how atmospheric circulation patterns and cloud formations are impacted by a contrast in landscape between extreme agricultural use and undisturbed native vegetation. Two sites in Southwest Australia, near Lake King, were chosen because of a 750 km long "bunny" fence, meant to keep rabbits from the crops, that clearly defines one type of land use from the other (Figure 1). The first phase of the project was conducted in December 2005, during which time 167 radiosondes were launched. The second phase took place in August 2007, and 214 radiosondes were launched; 108 radiosondes were launched from the West site and 106 from the East site.

The NCAR/EOL GPS Advanced Upper-air Sounding system (GAUS) was developed to replace the GPS LORAN Atmospheric Sounding System (GLASS). GAUS incorporates Vaisala RS92 next generation radiosondes, has portability, built-in test capability and flexibility for multiple channel operations, and delivers users high precision GPS measurements of radiosonde positions. The Vaisala RS92 radiosonde delivers high quality wind measurements from the ground with code-correlating GPS technology, as well as pressure, temperature and humidity measurements all transmitted digitally to the receiving station. Digital technology will reduce missing data due to noise and increase overall reliability of the system. The Vaisala RS92 provides much better

humidity measurements with a heated twin-sensor design and incorporates a new reconditioning procedure before launch.

Figure 1 Maps of the GAUS site locations. The top map is an aerial view of the southwestern tip of Australia which shows the site location in proximity to Perth. The bottom map shows a zoom of the same area and displays more clearly the contrast in vegetation on either side of the "bunny fence".

II. EOL File Format

EOL has introduced a new ascii "EOL file format" for all radiosonde and dropsonde sounding files. This new file format is similar to the CLASS format, used in the past, but has been improved to include a revised header with more detailed sounding information, addition of UTC time, an increase in accuracy of the longitude and latitude to six decimal places, and GPS altitude is now

also provided in addition to geopotential altitude (Table 1). Additionally, all missing values are now set to -999.

The "D" files are one second, ascii format data files with appropriate corrections and quality control measures applied. The naming convention for these files is - "D", followed by "yyyymmdd_hhmmss_P.1cQC.eol" where yyyy = year, mm = month, hh = hour of the day GMT, mm = minute of the hour, ss = second of the hour and ".eol" refers to the file format type

The header records now consist of 14 lines which contain information such as data type, project name, site location, actual release time, and other specialized information. The first seven header lines contain information identifying the sounding. The release location is given as : lon (deg min), lon (dec. deg), lat (deg min), lat (dec. deg), altitude (meters). Longitude in deg min is in the format: ddd mm.mm'W where ddd is the number of degrees from True North (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 following three header lines contain information about the aircraft data system and auxiliary information and comments about the sounding. The last 3 header lines contain header information for the data columns. Line 12 holds the field names, line 13 the field units, and line 14 contains dashes (--- characters) signifying the end of the header. Data fields are listed below in Table 2.

```
Data Type/Direction:                    GAUS/Ascending
File Format/Version:                    EOL Sounding Format/1.0
Project Name/Platform:                  T-REX/NCAR GAUS
Launch Site:                            IOP01 08z
Launch Location (lon,lat,alt):          119 20.88'W -119.347997, 36 19.74'N 36.328918,    90.98
UTC Launch Time (y,m,d,h,m,s):          2006, 03, 02, 08:33:34
Sonde Id/Sonde Type:                    043937408/Vaisala RS92-SGP (ccGPS)
Reference Launch Data Source/Time: Vaisala WXT510/08:33:32.80
System Operator/Comments:               Vic/Tim, Good Sounding
Post Processing Comments:               Aspen Version
/
Time     UTC     Press Temp Dewpt RH  Uwind  Vwind  Wspd   Dir  dZ  GeoPoAlt Lon   Lat   GPSAlt
sec   hh mm ss   mb    C    C     %    m/s    m/s    m/s    deg  m/s     m     deg   deg     m
----  --  --  --  -----  ----  -----  ---  -----  -----  -----  ---- ----- -------  ------ -----  -------
```

Table 1. Example of new EOL format used for both dropsonde and radiosonde sounding files

Field No.	Parameter	Units	Measured/Calculated
1	Time	Seconds	----------
2	UTC Hour	Hours	----------
3	UTC Minute	Minutes	----------
4	UTC Second	Seconds	----------
5	Pressure	Millibars	Measured
6	Dry-bulb Temp	Degrees C	Measured
7	Dewpoint Temp	Degrees C	Calculated

8	Relative Humidity	Percent	Measured
9	U Wind Component	Meters/Second	Calculated
10	V Wind Component	Meters/Second	Calculated
11	Wind Speed	Meters/Second	Measured
12	Wind Direction	Degrees	Measured
13	Ascension Rate	Meters/Second	Calculated
14	Geopotential Altitude	Meters	Calculated
15	Longitude	Degrees	Measured
16	Latitude	Degrees	Measured
17	GPS Altitude	Meters	Measured

Table 2. Lists all parameters provided in the sounding files, their unit of measurement, and if the values are measured or calculated

III. Data File Specifics

The files contain data calculated at one-second intervals. The variables pressure, temperature, and relative humidity are calibrated values from measurements made by the radiosonde. The dew point is calculated from the relative humidity and temperature. The geopotential altitude is calculated from the hydrostatic equation using pressure, temperature, and relative humidity. The rate of ascent is calculated from pressure. The radiosonde position (lat, lon, GPSAlt) and winds are measured by use of a GPS receiver in the sonde. These raw wind values are subjected to a digital filter to remove low frequency oscillations due to the sonde pendulum motion beneath the balloon when run through ASPEN.

IV. Data Quality Control and Results

1. Profiles of the raw soundings are first examined to determine if there are any errors with the launch detect, or if system lock-up occurred, which could result in a loss of data near the surface and an incorrect launch time.

2. All of the soundings are then subjected to a radiation correction that takes into account the solar angle at time of launch, and removes solar heating that could skew the temperature measurements.

3. Scatter plots (Figure 3 and 4) of the raw data are created to check differences in pressure, temperature and RH between the surface met data and the last available surface radiosonde measurement before launch.

4. The raw soundings are run through EOL's Atmospheric Sounding Processing ENvironment (ASPEN), which analyzes the data, performs smoothing, and removes suspect data points.

5. Profiles of temperature, RH, wind speed and wind direction of the quality controlled soundings are examined. This enables us to visually evaluate the soundings for outliers, or any other obvious problems.

6. Skew-t diagrams are examined to look for anything suspicious.

Performing the QC steps above allows us to identify and, in some cases, correct errors that could potentially impact research performed using these data sets. During processing of the sounding data we found:

1. The GPS and geopotential surface altitudes recorded in the raw soundings, at both sites, were incorrect. The correct GPS altitudes were acquired and were input into the raw sounding files. The geopotential surface altitudes were calculated using these new GPS altitudes, and were input into the raw soundings before they were run through ASPEN.

2. Two soundings were corrected for an inaccurate launch time. This can occur when not enough surface pre-launch radiosonde data is collected, resulting in the sounding system being unable to accurately detect launch. File D20070809_074548 (east site) was changed to D20070809_065538 and D20070824_015706 (west site) was changed to D20070824_005812.

3. Nine soundings needed repair because the sounding system locked up during flight, caused by a weakening of the radiosonde signal. The affected sounding files were not saved in the correct file format. They contained no LAU (launch) or A00 (surface met) data lines, and were missing the standard 19 line tail at the end of the file; all things necessary in order for ASPEN to run properly. Data before the lock-up was preserved. Filenames for these soundings were changed to reflect the actual launch time determined by change in pressure.

East Site	**West Site**
D20070815_035946	D20070805_065848
D20070816_005945	D20070809_010123
D20070816_095601	D20070810_010742
D20070819_035739	D20070815_070027
	D20070820_070001

Table 3. Lists files recreated during post processing after sounding system lock-up.

4. The RS-92 radiosondes are equipped with two hygrometers that measure alternately during the ascent of the radiosonde. These measurements are then merged into one profile. In examining the relative humidity profiles, it was determined that 2 radiosondes had inaccurate measurements collected from one hygrometer during a portion of the flight. These soundings are listed below and skew-t diagrams can be seen in Figure 2.

East Site
D20070806_095829_P.1QC.eol
D20070821_070002_P.1QC.eol

5. Differences between the surface met sensor and the last radiosonde surface measurement before launch (from raw sounding files) can be seen in Figures 3 and 5 below. Plots from the West site show consistently warmer and drier measurements from the radiosondes, indicative of solar heating of the sensor arm prior to launch. Plots from the East site show consistently warmer radiosondes, and more moisture measured by the surface met station, especially during morning hours, resulting from the placement of the sensors among the native vegetation. While these plots are of raw sounding data, to some degree, differences do carry over to the final product. Photos of the East and West sites can be seen in figures 4 and 6.

6. Five soundings from the West site were corrected for errors in time (Table 4). The computer clock was incorrectly set, and was 12 hours off. Launch times were determined from the field log and corrections were applied to the time stamp in the files and to the filenames.

West Site
D20070825_100846
D20070825_130607
D20070825_160227

D20070825_190402
D20070825_215830

Table 4. Soundings listed were corrected for errors in the time stamp. Corrected launch times are listed in the filenames.

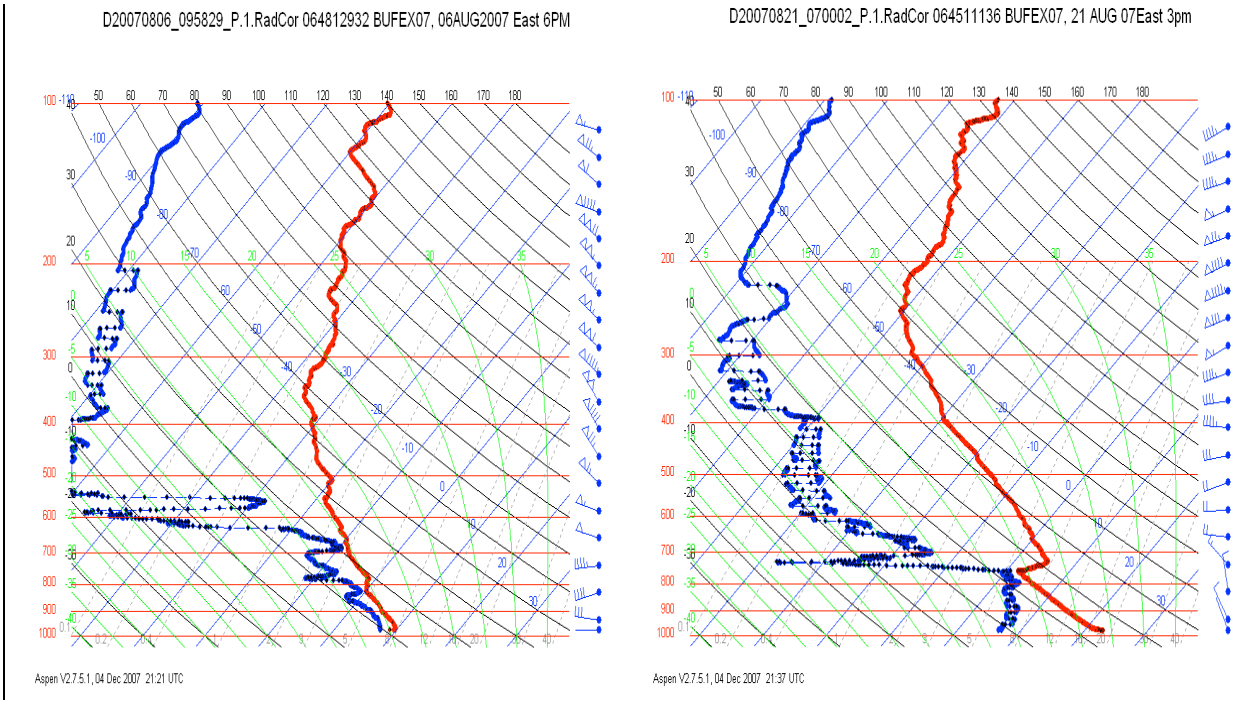

Figure 2 Two sounding profiles show inaccurate measurements from one of two hygrometers. Temperature is shown in red. Dew point, calculated from relative humidity, is shown in blue.

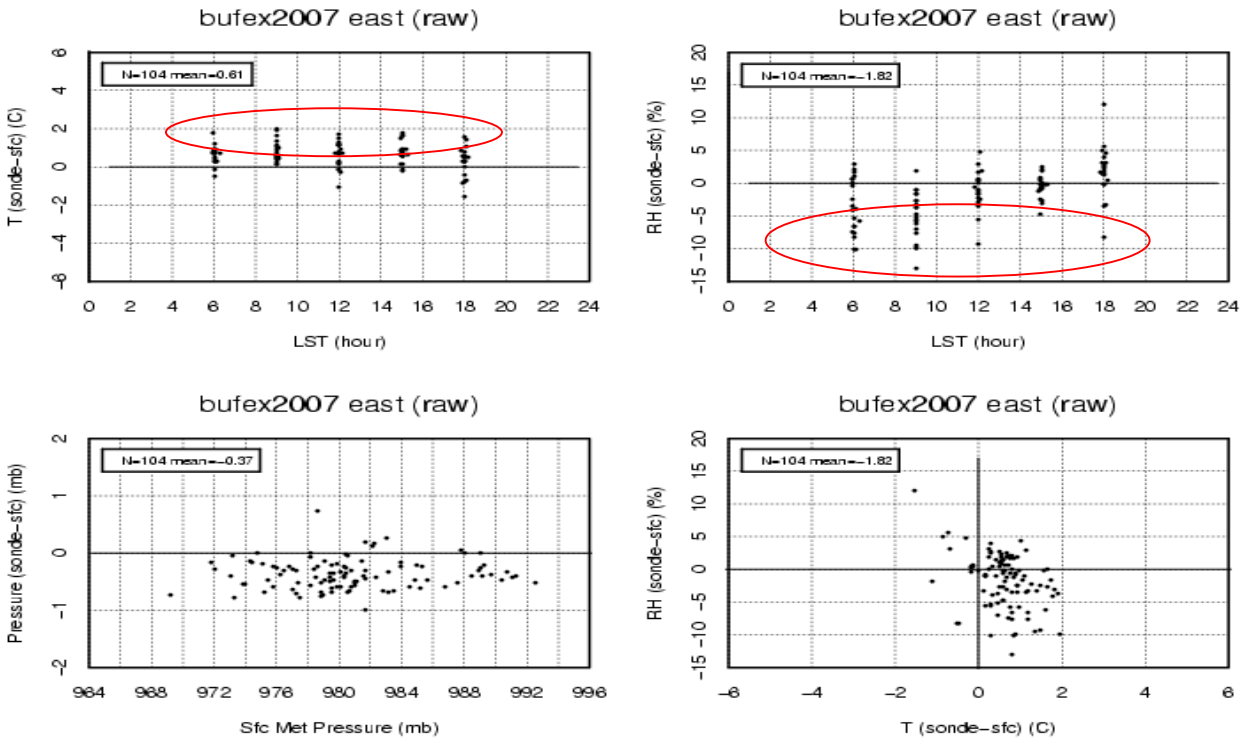

Figure 3 Differences between surface met sensor measurements and the last surface radiosonde measurement before launch at East site. Red circles show consistently warmer radiosonde

measurements, and show more moisture measured by the surface met sensor as a result of its placement among the native vegetation.

Figure 4 photo of East site GAUS system among natural vegetation.

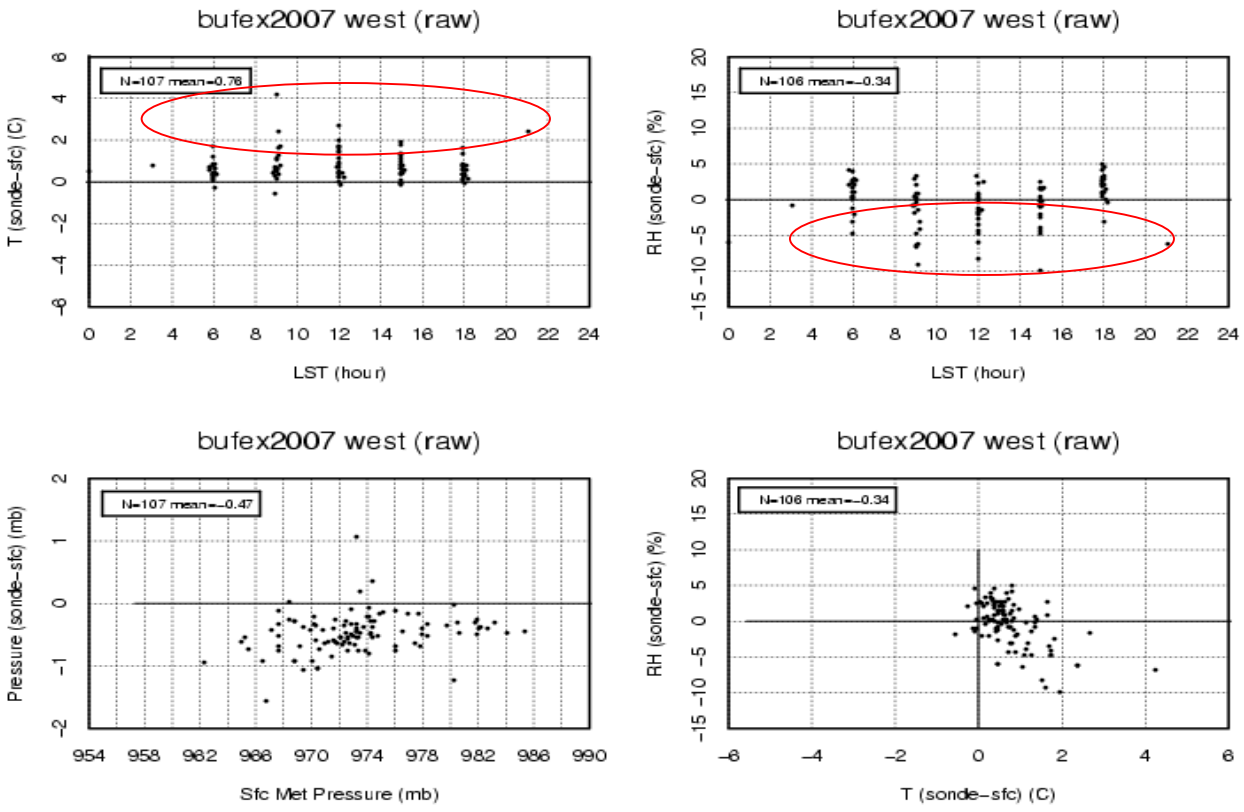

Figure 5 Differences between surface met sensor measurements and last surface radiosonde measurement before launch at West site. Red circles show consistently warmer and drier radiosonde measurements, indicative of solar heating of the sensor arm prior to launch.

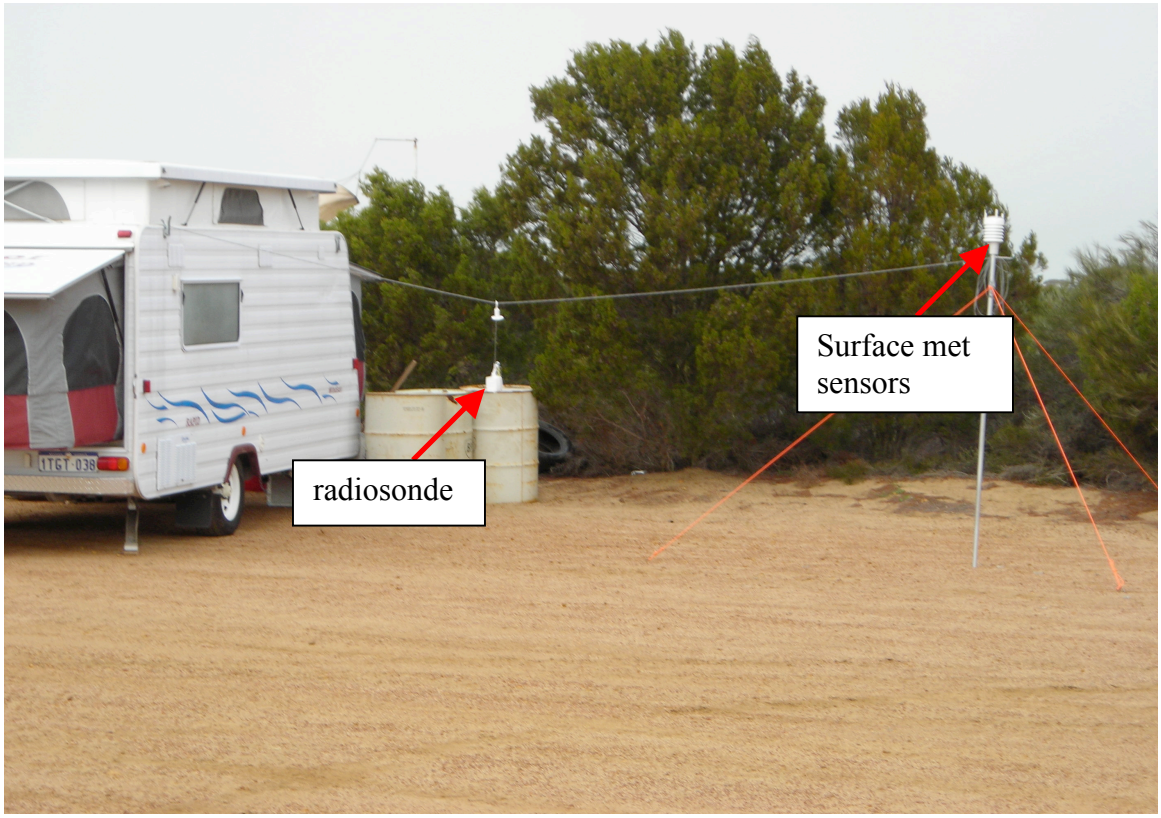

Figure 6 photo of West site GAUS setup including trailer, radiosonde and surface met station, on the cultivated side of the bunny fence.