REFRACTT 2006 Quality Controlled Radiosonde Data Set

Contents:

Contacts: **Data Quality**
Kate Young
kbeierle@ucar.edu

Junhong (June) Wang
junhong@ucar.edu

System/Software
Dean Lauritsen
lauritsn@ucar.edu

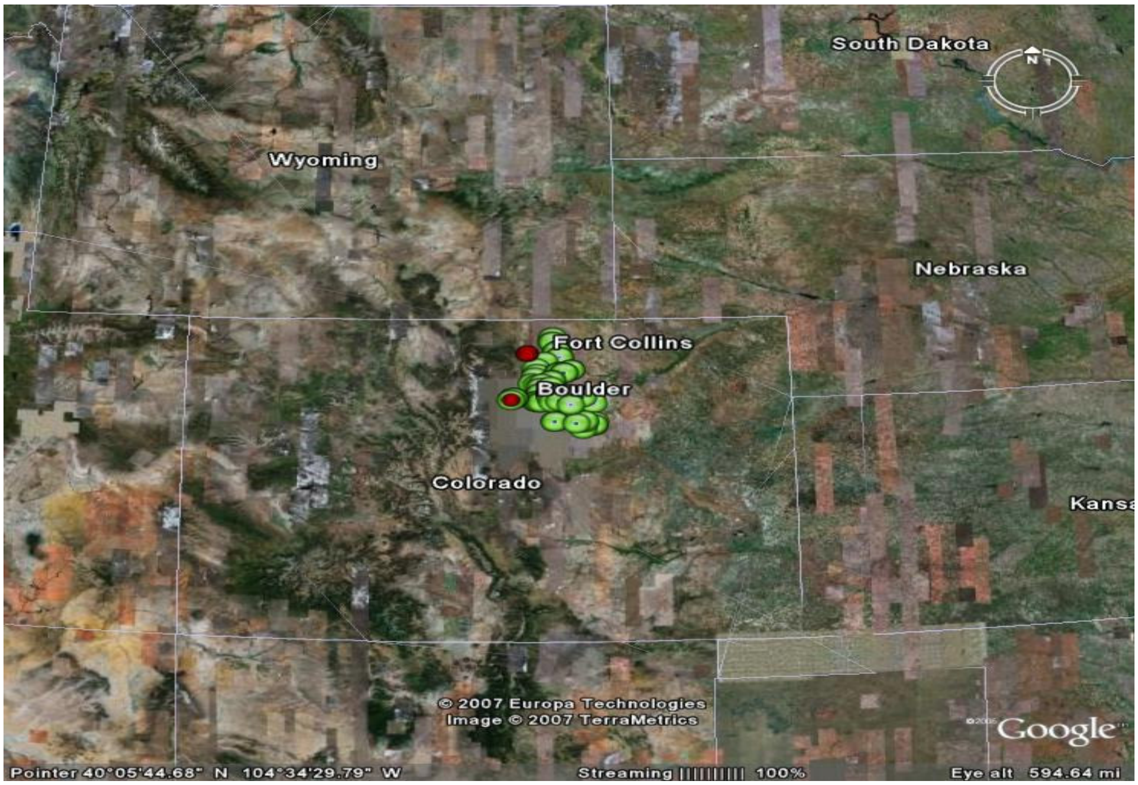
Mailing Address: NCAR/Earth Observing Laboratory
P.O. Box 3000
1850 Table Mesa Drive
Boulder, CO 80307; USA

For more information on the NCAR Earth Observing Laboratory GAUS System (formally GLASS) please visit the following site:
http://www.eol.ucar.edu/facilities/gaus.html

I. GAUS Project/Dataset Overview

The goal of the Refractivity Experiment For H2O Research And Collaborative operational Technology Transfer (REFRACTT) project was to obtain high resolution measurements of water vapor variability and transport, in the convective boundary layer, in order to assess the improvements these measurements have in numerical model forecasts of quantitative precipitation. An additional goal of this project was to demonstrate the usefulness of using the NEXRAD radar to collect refractivity measurements for forecasting purposes.
For this experiment, NCAR/EOL deployed one mobile sounding system to various locations along the front of Central and Northern Colorado (Figure 1). Seventy-six radiosonde launches were performed between June 5, 2006 and Sept 2, 2006. For more information on the REFRACTT project please visit:
http://www.eol.ucar.edu/projects/refractt/

The sounding system used was the NCAR/EOL GPS Advanced Upper-air Sounding system (GAUS). It 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.



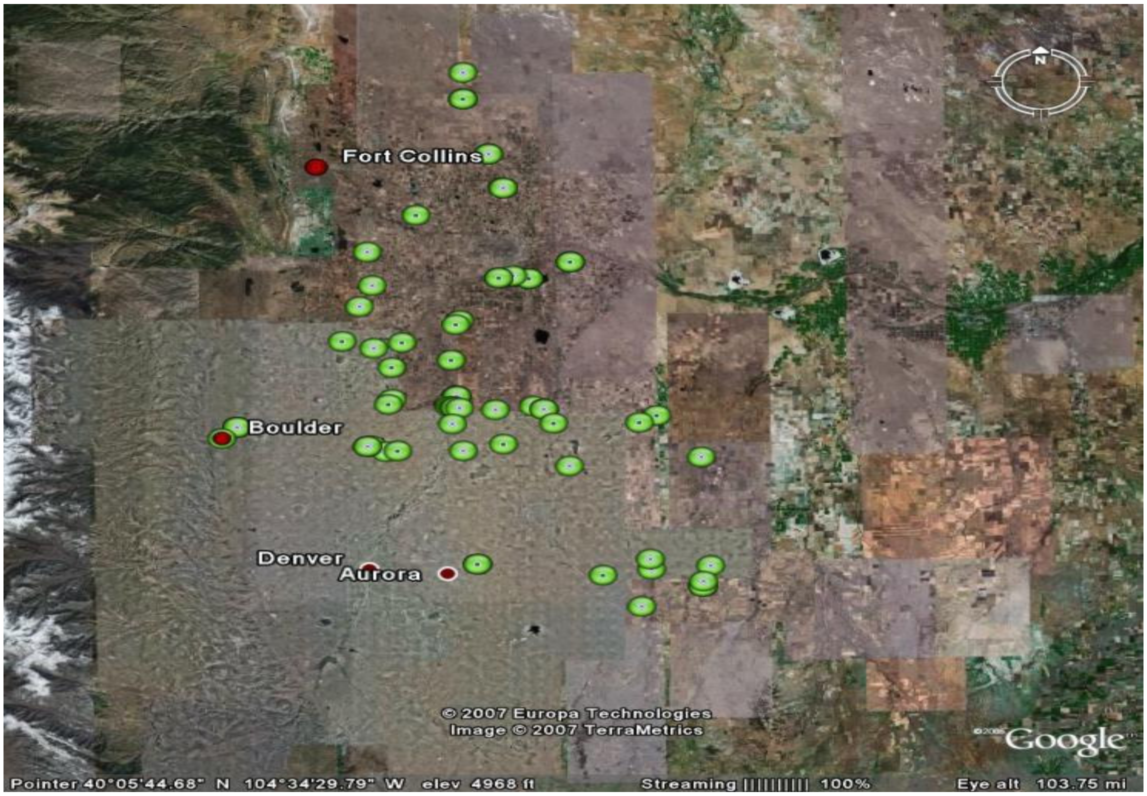


Figure 1 Mobile GAUS launch locations during REFRACTT are shown by the green dots. Figures show the region of Colorado where launches occurred (top) and the proximity of launch locations to major cities (bottom).

II. ***New 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.QC.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 Important Information for Users

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

2. Profiles of the raw soundings are 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.

3. Scatter plots (Figure 3) 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. Lastly, we create profiles of temperature, RH, wind speed and wind direction of the quality controlled soundings which enable us to visually evaluate the soundings for outliers, or any other obvious problems.

V. Results of Data Quality Control

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 that:**

1. Two soundings needed repair because the system locked up during the flight of the sonde when the signal weakened, as a result of the distance of the sonde from the surface. The affected sounding files were not saved in the correct format in order for ASPEN to be able to run properly. Data before the lockup was preserved, however anything measured after the lock-up has been lost.

Filenames for these soundings were changed to reflect the actual launch time determined by the pressure change.

2. One sounding was saved under three separate files when it appears the operator shut the system down in order to avoid lock-up. Each time the system was started back up, and the sonde signal reacquired, the data were stored in a new sounding file. The three files were merged into one, with some data lost between shut down and restart. (Figure 2)

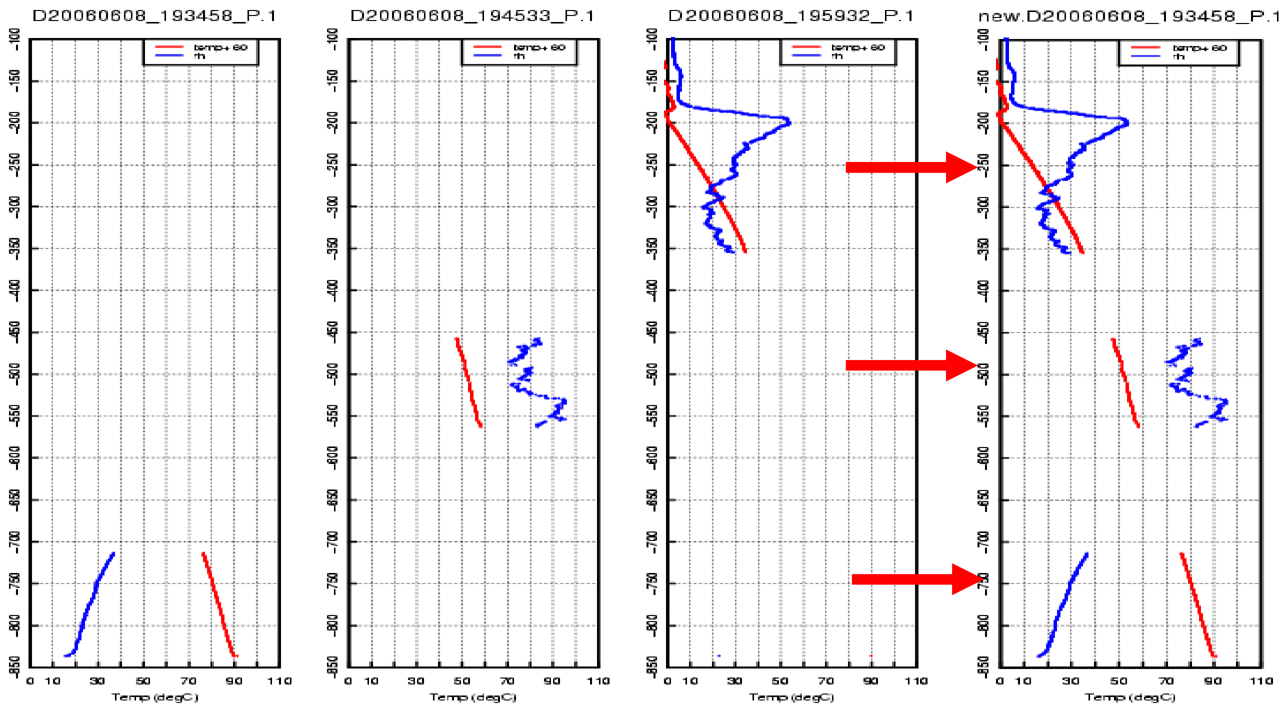


Figure 2. Shows merge of three sounding files into one, when sonde system was shut down and restarted to avoid lock-up caused by weakening signal.

3. Two soundings were affected when one radiosonde was started up on the same frequency as another that was in flight. The sounding in flight (D20060804_212319_P.QC.eol) was cut off at approximately 490 mb. The radiosonde on the ground, transmitted surface data that was recorded as flight data rather than pre-launch. This file was repaired and the filename was changed from D20060804_**224003**_P.QC.eol to D20060804_ **215747**_P.QC.eol to reflect the accurate launch time.

4. Two soundings (D20060701_000412_P.QC.eol and D20060825_202133_P.QC.eol) lost data for a time after launch. It appears that the launch may have been rushed, causing the automatic launch detect to fail. This data could not be recovered.

5. Differences between the last radiosonde surface measurement before launch and the surface met sensor measurement (from raw sounding files) can be seen in Figure 3 below. While these plots are of raw sounding data, to some degree, differences do carry over to the final product. Consistent differences in pressure be seen in the bottom left-hand plot. Based on this, and similar

findings from a previous field experiment, it is believed that the surface met pressure sensors measurement is slightly off. The problem is being investigated.

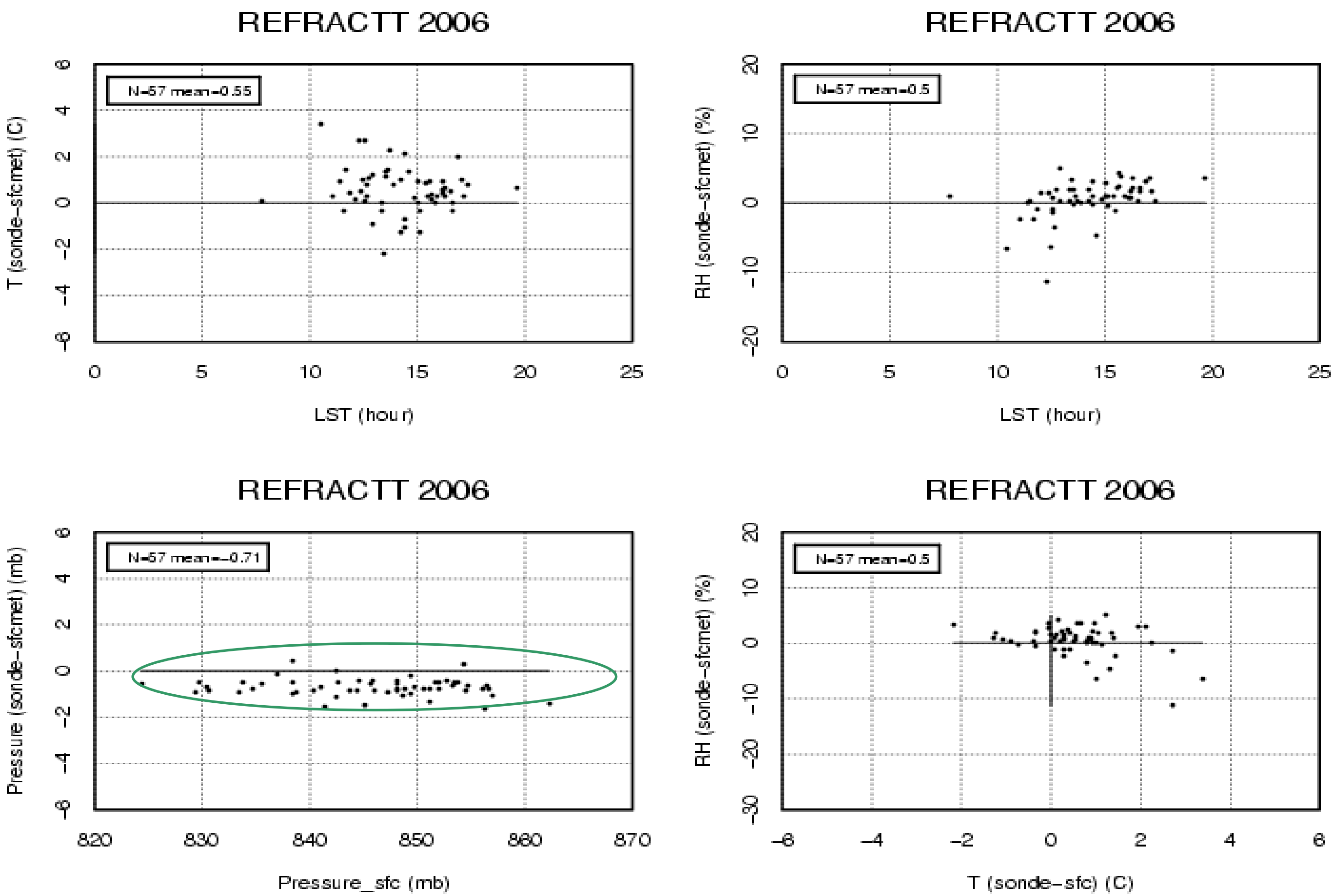


Figure 3 Scatter plots of raw data differences calculated between the last sonde measurement taken at the surface prior to launch and the measurements taken by the surface met station. Green circle shows consistent pressure difference between surface met and sonde believed to be an error with the surface met pressure sensor.