BEACHON 2010 Quality Controlled Radiosonde Data Set

Contents:

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For more information on the NCAR Earth Observing Laboratory Integrated Sounding System (ISS), or on the GPS Advanced Upper-Air Sounding System (GAUS), please visit:
ISS: http://www.eol.ucar.edu/instrumentation/sounding/iss
GAUS: http://www.eol.ucar.edu/instrumentation/sounding/iss/gaus

I. ISS Project/Dataset Overview

The Bio-hydro-atmosphere interactions of Energy, Aerosols, Carbon, H2O, Organics and Nitrogen (BEACHON) is a project aimed at examining the evolution of thermodynamic structures in the boundary layer above the Manitou Experimental Forest located Colorado. BEACHON included the use of two stationary GPS Advanced Upper-Air Sounding (GAUS) systems at two separate sites, the Hayman site and the Manitou site (Figure 1). These sounding systems were set up to collect radiosonde data for two intensive operations periods (IOPs). The project targeted one "wet episode", between Aug 12-14, which followed a major rain event, and one "dry" episode, one week later, from Aug 21-23. A total of 147 quality controlled radiosonde soundings are contained in the final archive.

The NCAR/EOL GPS Advanced Upper-air Sounding system (GAUS) incorporates Vaisala RS92 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 reduces missing data due to noise and increases overall reliability of the system. The Vaisala RS92 provides much better humidity measurements with a heated twin-sensor design and incorporates a reconditioning procedure before launch.

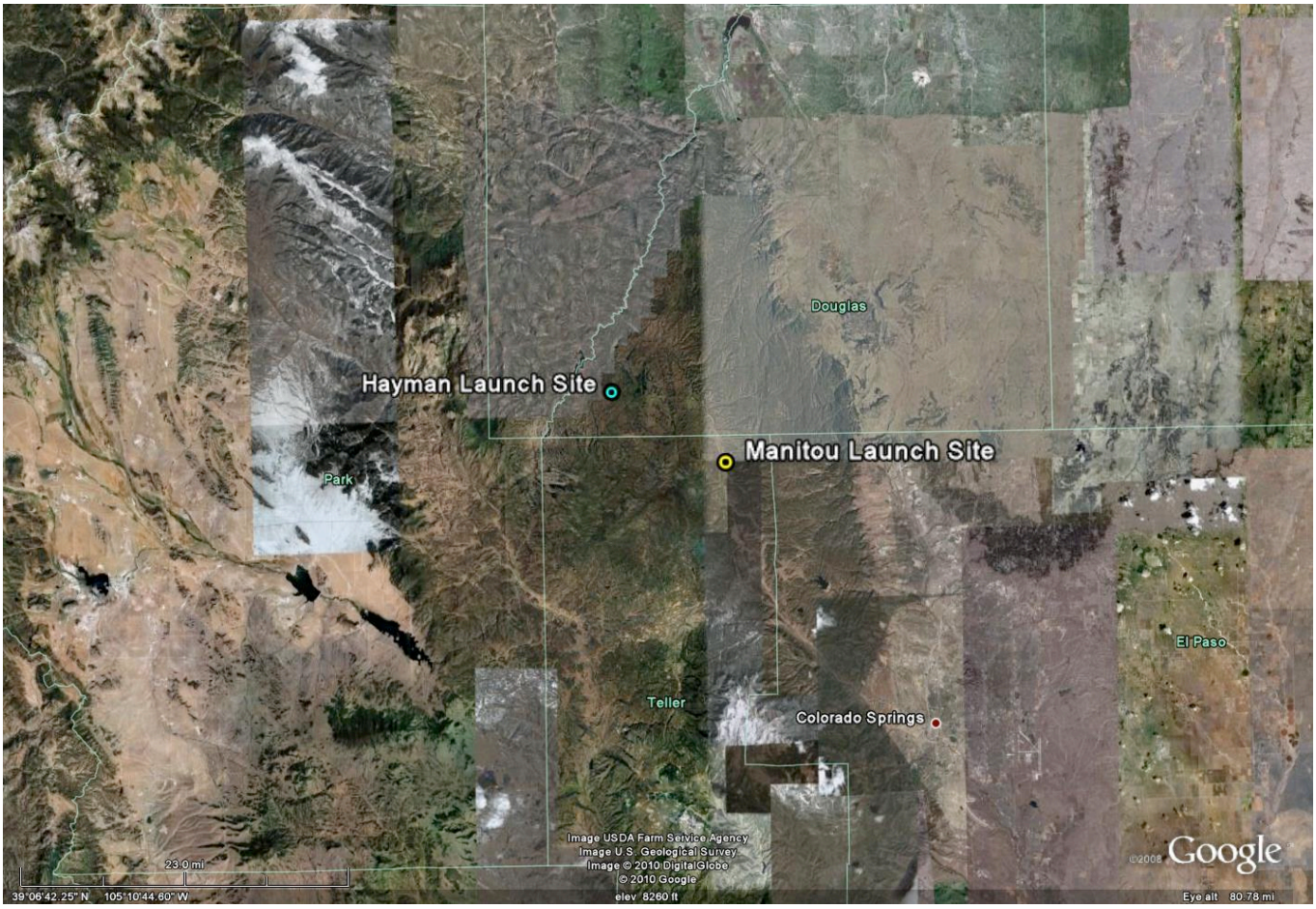

Figure 1. Radiosonde launches performed by two sounding systems, one at the Manitou Site, and second system at the Hayman site. Both systems were operated by NCAR during two intensive operations periods (IOPs).

II. EOL File Format

The EOL format is an ascii text format that includes a header, with detailed project and sounding information, and seventeen columns of high resolution data (Table 1). The "D" files are one second resolution data files with appropriate corrections and quality control measures applied. The naming convention for these files is - "D", followed by "yyyymmdd_hhmmss_P.1QC.eol" where yyyy = year, mm = month, hh = hour of the day GMT, mm = minute of the hour, ss = second of the hour (which refer to the launch time of the sonde) and ".eol" refers to the file format type.

The header records contain information including 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 SOUNDING DATA/Ascending
File Format/Version:                    EOL Sounding Format/1.0
Project Name/Platform:                  BEACHON/GAUS
Launch Site:                            Hayman
Launch Location (lon,lat,alt):          105 14.20'W -105.236667, 39 10.57'N 39.176170, 2389.00
UTC Launch Time (y,m,d,h,m,s):          2010, 08, 13, 01:00:02
Sonde Id/Sonde Type:                    094644027/Vaisala RS92-SGP (ccGPS)
Reference Launch Data Source/Time:      Vaisala WXT510/01:00:02.69
System Operator/Comments:               Mike & Lou/sun setting, Good Sounding
Post Processing Comments:               Aspen Version 2.8.1.8, Configuration upsonde-1s
/
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 the 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. The 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 NCAR's Atmospheric Sounding Processing ENvironment (ASPEN) software. The quality of the GPS altitude is somewhat questionable. The accuracy of the sensor is typically +/-30 m, and may show large variability. For this reason, investigators are encouraged to use geopotential altitude over GPS altitude.

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, as a result of weakening of the sonde signal, which could result in a loss of data 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 of the raw data are created to check differences in pressure, temperature and RH between the surface met and the last available surface radiosonde measurement before launch.

4. The raw soundings are run through ASPEN, which analyzes the data, performs smoothing, and removes suspect data points.

5. 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.

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 the following issues were found, and where possible, corrections were applied:

1. The following soundings were removed from the final archive because they either contained little or no data.

Manitou
D20100812_024712_P.1
D20100821_234916_P.1

2. One sounding from the Hayman site, D20100822_000225_P.1, contains no GPS data. The signal was lost before the flight began and it was never reacquired. The file does contain pressure, temperature, relative humidity and geopotential altitude.

3. The soundings listed below experienced strong vertical winds that caused the radiosonde to descend for a brief period of time during its ascent. These files were processed through ASPEN, however because ASPEN can only handle monotonically changing pressure, it removes any portion of the file where the radiosonde experiences increasing changes in pressures. In order to include these unique features in the final sounding file, we used the raw data from the descending portion and copied it into the quality controlled file. Data obtained during these downdraft events have not been quality controlled, however based on visual examination the data do look clean and free of significant errors.

Hayman	Manitou
D20100812_195627_P.1	D20100812_230002_P.1
D20100813_020002_P.1	
D20100813_200002_P.1	

4. The soundings listed below experienced errors with the automatic launch detect. Late launch detect occurs most often when the sonde is not able to collect a sufficient amount of surface data prior to launch, causing a delay in the launch detect mechanism which relies on change in pressure to determine when the balloon release occurs. No data is lost when this occurs, however data recorded prior to launch detect is recorded as "pre-launch" rather than "in-flight", and the filenames and launch times are incorrect. These soundings have all been corrected for delays in the launch detect and the original and new filenames are listed below.

Hayman Original Filename	Corrected Filename
D20100813_132848_P.1	D20100813_130002_P.1
Manitou **Original Filename**	**Corrected Filename**
D20100813_024552_P.1	D20100813_021522_P.1
D20100821_143626_P.1	D20100821_140651_P.1
D20100822_123329_P.1	D20100822_120319_P.1

5. The following sounding files needed repair because they experienced sounding system lock-up, caused by weakening or loss of the radiosonde signal. The affected sounding files were not saved in the correct file format or to the correct file names. They contained no LAU (launch) or A00 (surface met) data lines, and were missing the standard 19 line tail at the end of the raw data file; all things necessary in order for ASPEN to run properly. Data before the lock-up 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 pressure change and GPS dz/dt.

Hayman	**Manitou**
D20100812_170020_P.1	D20100813_180000_P.1
D201000812_110002_P.1	D20100822_050005_P.1
D20100821_200001_P.1	
D20100822_180003_P.1	
D20100823_110020_P.1	