Profiling of Winter Storms (PLOWS) 2009 Quality Controlled Radiosonde Data Set

Contents:

Contacts:

Data Quality
Kate Young
kbeierle@ucar.edu

Junhong (June) Wang
junhong@ucar.edu

ISS Group Leader
Bill Brown
wbrown@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 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 PLOWS project is a study conducted in Illinois, and nearby states, aimed at examining fronts and other structures (e.g. precipitation bands) around winter storm systems. The project includes two field phases. The first phase, during February and March of 2009, included the use of one Mobile Integrated Sounding System (MISS), which is a suite of instruments that includes a GPS Advanced Upper-air Sounding System (GAUS). During PLOWS, the GAUS was used to launch 14 radiosondes. This document contains information on the sounding file format, data parameters included in each of the files, and details regarding the quality control measures applied to the sounding data set. The second phase of PLOWS is scheduled to take place in the winter of 2009-2010.

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.

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:                        PRE-PLOWS/NCAR GAUS
Launch Site:                                  IOP 3
Launch Location (lon,lat,alt):                90 29.60'W -90.493405, 44 01.30'N 44.021598,
305.30
UTC Launch Time (y,m,d,h,m,s):                2009, 02, 26, 19:07:08
Sonde Id/Sonde Type:                          082033957/Vaisala RS92-SGP (ccGPS)
Reference Launch Data Source/Time:            Campbell Scientific CR10/19:07:26.00
System Operator/Comments:                     lou/lost everything at approx 675mb, No PTH
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 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. 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 NCAR's Atmospheric Sounding Processing ENvironment (ASPEN) software.

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 weaken 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.

6. Lastly, we examine skew-t diagrams from each sounding.

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. One sounding file (D20090308_160054_P.1) included data collected after icing occurred on the balloon, causing it to descend for a period of time. After the ice melted, the balloon continued its ascent. The portion of the sounding during descent was removed and is not contained in the quality controlled sounding file.