VAMOS Ocean-Cloud Atmosphere-Land Study (VOCALS) 2008 Quality Controlled Radiosonde Data Set

The VOCALS radiosonde data sets were re-released on June 24, 2009. A correction was made to remove a .4 mb offset incorrectly applied to the pressure data during post-processing.

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

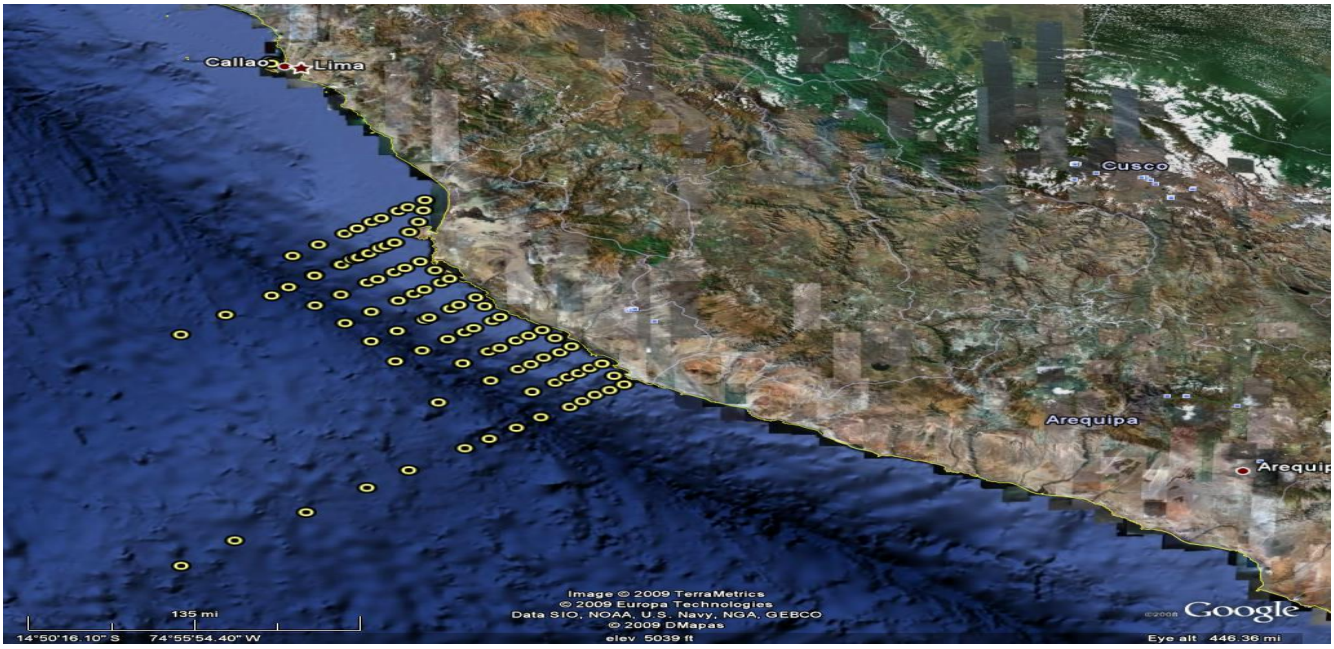
For more information on the NCAR Earth Observing Laboratory Integrated Sounding System (ISS), or on the GPS Advanced Upper-Air Sounding System (GAUS), please visit:
ISS: http://www.eol.ucar.edu/instrumentation/sounding/iss
GAUS: http://www.eol.ucar.edu/instrumentation/sounding/iss/gaus

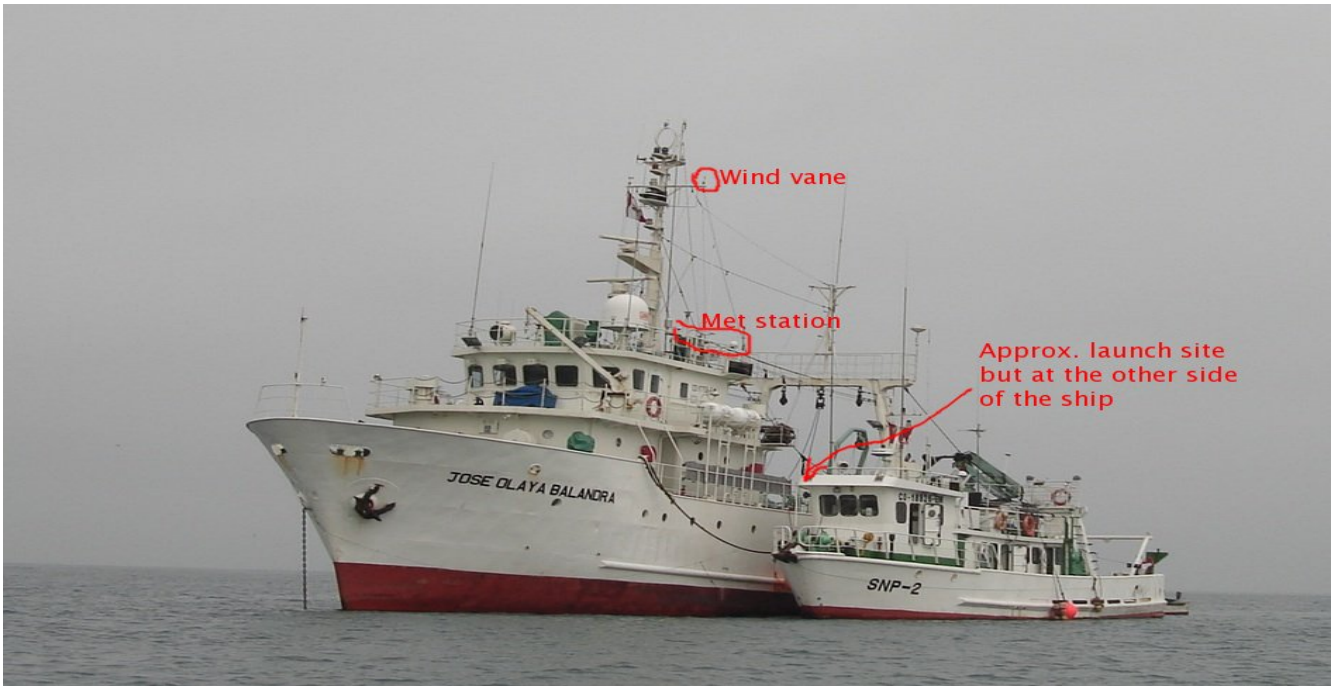
I. ISS Project/Dataset Overview

The VAMOS Ocean-Cloud Atmosphere-Land Study (VOCALS) campaign is a project aimed at gaining a better understanding of the primary physical and chemical processes present in the Southeast Pacific region, which impact climate. During the VOCALS field campaign two GPS Advanced Upper-Air Sounding (GAUS) systems were deployed. One system was located in Iquique, Chile, the other was set up onboard a ship named the Olaya. The project was conducted from October 1 to November 15, 2008, during which time a total of 325 high quality radiosonde soundings were collected. One hundred ninety

two soundings came from the Iquique site, and one hundred thirty three soundings were collected by the Olaya, along the coast of Peru (Figure 1).

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.





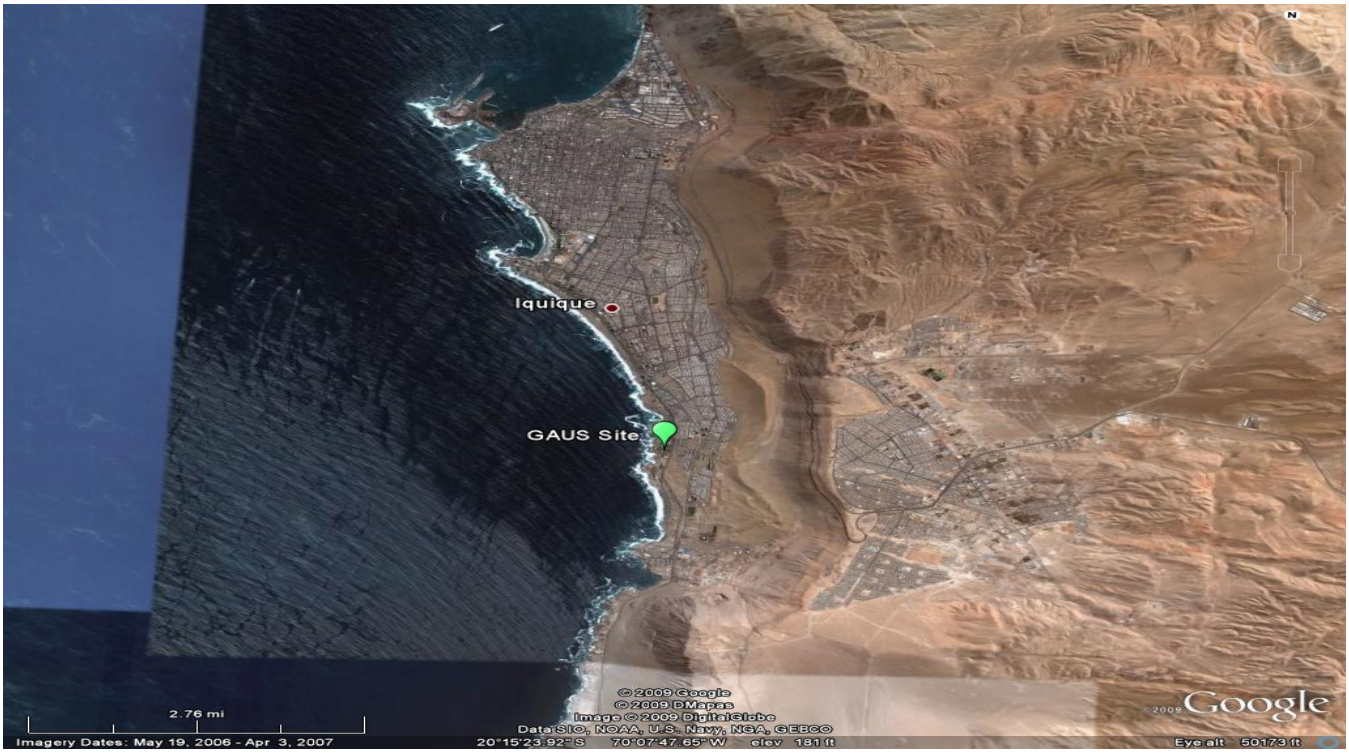


Figure 1 Radiosonde launches were performed from two stations, one at a fixed location in Iquique, Chile and one onboard a ship, the Olaya, off the coast of Peru

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:                        VOCALS/NCAR GAUS
Launch Site:                                  20081027
Launch Location (lon,lat,alt):                70 07.84'W -70.1307, 20 16.25'S -20.2708, 71.71
UTC Launch Time (y,m,d,h,m,s):                2008, 07, 30, 18:03:02
Sonde Id/Sonde Type:                          082033941/Vaisala RS92-SGP (ccGPS)
Reference Launch Data Source/Time:            Campbell Scientific CR10/18:03:03.25
System Operator/Comments:                     Brad & Lou/test flight, 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 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. 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 ENironment (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. The following soundings were removed from the final archive. They either contained little or no data.

Iquique	**Olaya**
D20081107_165344_P.1	D20081005_224706_p.1
D20081108_125519_P.1	

2. One sounding, D20081112_032612_P.1, at Iquique experienced a loss of power to the system during flight. The system was restarted and the signal was reacquired so time later, however some data was lost. As a result this sounding data had been saved into separate files. The two files were merged and assigned the original launch time.

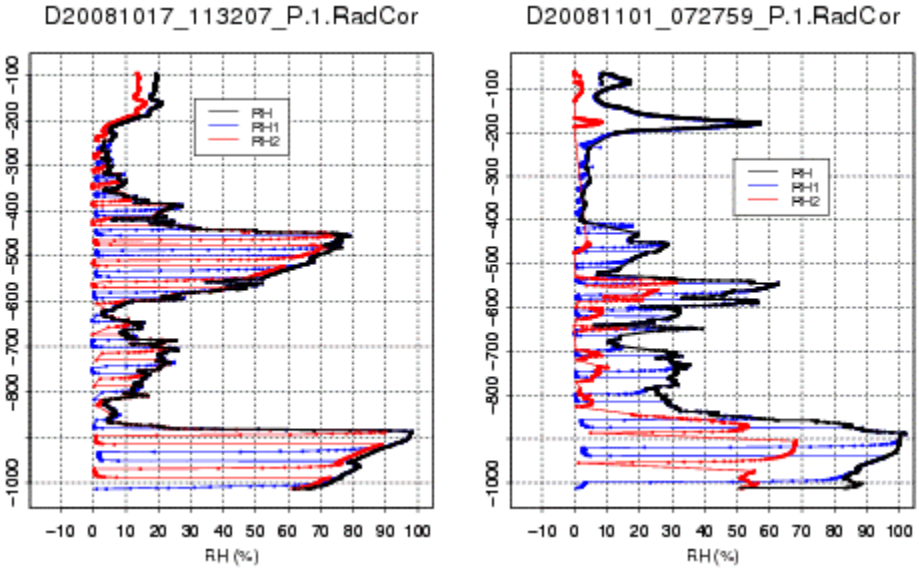
3. Two soundings, one from the Olaya (D20081010_203553_P.QCeol), and one from Iquique (D20081109_040721_P.QCeol) are missing data just above the surface most likely caused by release of the balloon before all steps of the sounding software were complete. The Olaya sounding is missing data between the surface and 973.35 mb. The Iquique sounding is missing data between the surface and 800 mb.

4. Five soundings experienced errors with the automatic launch detect. This occurs most often when the sonde is not able to collect 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, but 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

Iquique	
Original Filename	**Corrected Filename**
D20081109_040721_P.1	D20081109_032911_P.1
Olaya	
Original Filename	**Corrected Filename**
D20081012_044946_P.1	D20081012_032858_P.1
D20081015_052803_P.1	D20081015_045452_P.1
D20081016_143020_P.1	D20081016_133353_P.1
D20081017_204701_P.1	D20081017_193508_P.1

5. Four soundings from Iquique reported incorrect measurements, from one of their two hygrometers, indicating a dry bias (Figure 2). Various offsets were added to these soundings to bring the measurements from the drier sensor into agreement with the higher humidities measured by the other sensor. To validate our corrections we applied a linear regression to the data above 200 mb, where both hygrometers were working with no heating be applied. From this we were able to confirm that our corrections were appropriate and qualitatively agreed with the linear fit.

Iquique soundings with problem hygrometers
D20081017_113207_P.QCeol
D20081101_072759_P.QCeol
D20081114_112849_P.QCeol
D20081114_152624_P.QCeol



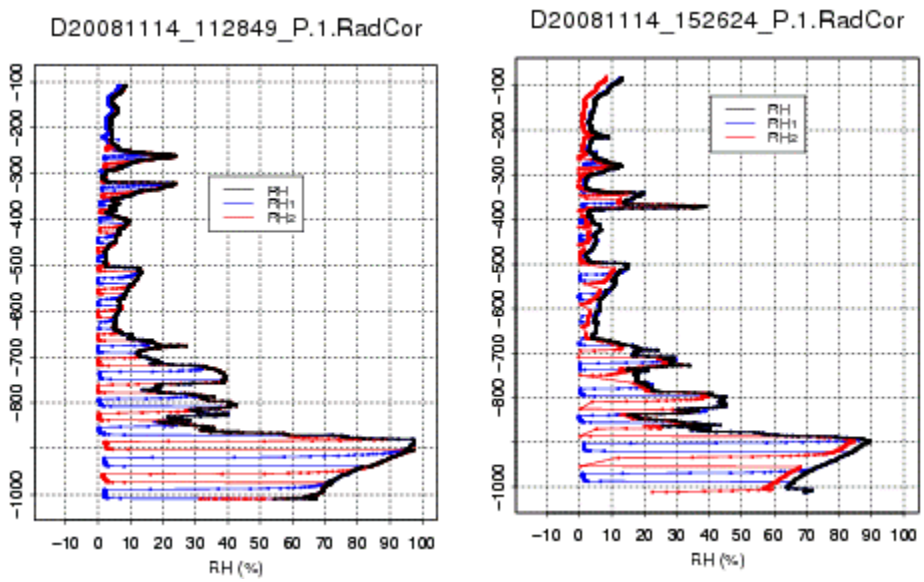


Figure 2 – Shows profiles of RH vs. Pressure. The blue lines show measurements from hygrometer one, the red lines show measurements from hygrometer two. The black lines showed the merged RH measurments from both hygrometers, with corrections applied to the drier of the two measurements.

6. Six soundings (2 from Iquique, 4 from the Olaya), listed below, were found to have suspicious spikes in their RH profiles. After some investigation, the cause was found to be under filling of the balloon with helium, which resulted in a slow ascent rate (< 5 m/s). The hygrometers were not sufficiently ventilated because of the slow ascent, so the temperature of the RH sensors had not reached equilibrium with the environment (after heating) when they were turned back on, thus affecting the measurement. We were unable to correct for this problem, but did remove the spikes by setting the RH values, at the levels affected, to missing.

Iquique	**Olaya**
D20081017_072618_P.QCeol	D20081008_113530_P.QCeol
D20081024_072658_P.QCeol	D20081008_170403_P.QCeol
	D20081008_222034_P.QCeol
	D20091009_002001_P.QCeol

7. All surface met data lines in the raw sounding files, from both stations, were replaced with prelaunch data collected from the radiosondes just prior to launch. At Iquique, the surface met station was located on the roof of a building approximately 5-10 meters above where the radiosondes were launched. This posed a problem because ASPEN can only handle pressure change in one direction and will discard any data where pressures measured by the radiosonde are larger than that measured by the surface met tower. For the Olaya, the surface met station was located two decks above where the radiosondes were launched, however the measurements coming from the surface met were larger than the measurements from the radiosondes.

8. The sounding system at Iquique was set to mobile mode where by it obtained its surface position information (lat, lon, and altitude) from the GPS sensor, rather than used a fixed location. The accuracy of the GPS altitude is +/- 30 meters, so a correct surface altitude was obtained from Google Earth and entered into the raw files. The surface altitudes were then converted to geopotential altitude and entered into sounding data file as well, to be used as a starting point for the geopotential altitude calculation performed by ASPEN.