THORPEX Pacific Asian Regional Campaign (TPARC) 2008 Quality Controlled DLR Falcon Dropsonde Data Set

Contents:

11/12/2009 - Four Falcon dropsonde sounding files (D20080902_011036, D20080903_233007, D20080909_001550 and D20080911_05336) were corrected for missing flight level GPS latitude and longitude and altitude. The flight level data were incorrectly removed from these soundings which experienced problems with the launch detect mechanism. Corrections were also applied to seven soundings (listed in Section VI under number 1) with missing flight level GPS data. The flight level aircraft latitude, longitude and altitude for these were changed from 0 to -999.00 (missing values). Additionally, one sounding contained geopotential altitude values that were equal to the pressure. This sounding file lacks temperature data (needed for the geopotential altitude calculation) so geopotential altitudes were set to missing.

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For more information on the NCAR GPS Dropsonde System please visit the following site:
http://www.atd.ucar.edu/rtf/facilities/dropsonde

I. Dataset Overview

The THORPEX Pacific Asian Regional Campaign (TPARC) was an International project, conducted in the Western Pacific, aimed at collecting measurements to increase understanding of the mechanisms that lead to improved predictive skill of high impact weather events and to provide

data for research to examine typhoon genesis. There were four aircraft used in the project, each equipped for dropsonde deployment. They included the NOAA NRL-P3, the Air Force C-130, the Taiwanese Astra, and the DLR Falcon. The TPARC Falcon final dropsonde data archive contains 321 dropsondes launched between August 25 and October 1, 2008 (Figure. 1).

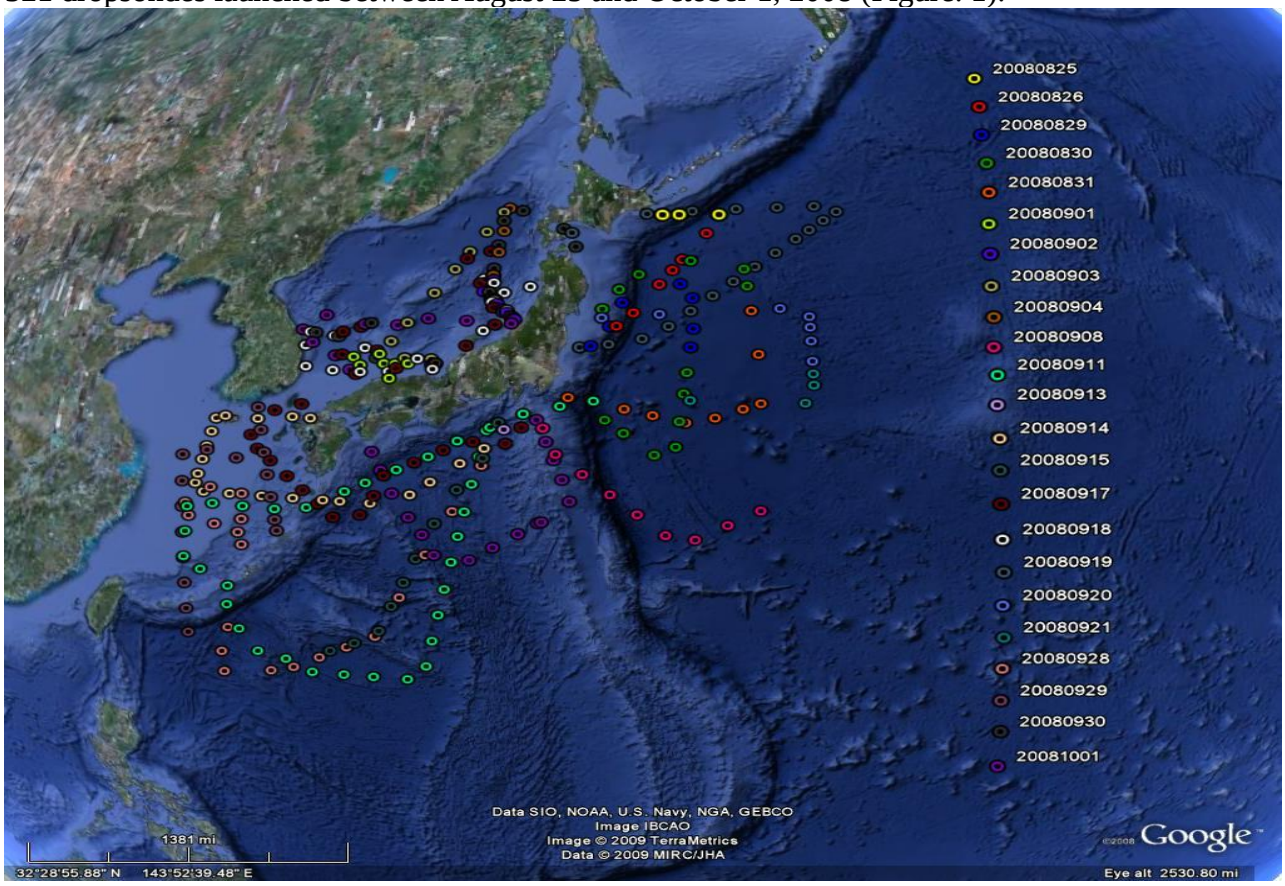

Figure 1 Map of the dropsonde launch locations from the DLR Falcon. Legend indicates the dates during which the launches occurred.

III. Modified EOL Sounding File Format

The EOL format is an ascii text format that includes a header, with detailed project and sounding information, and typically seventeen columns of high resolution data (Table 1). **For the TPARC dropsonde data files, this format has been modified to include two additional columns containing calculated vertical velocity of the air motion**. The "D" files are half-second resolution data files with appropriate corrections and quality control measures applied. The naming convention for these files is - "D", followed by "yyyymmdd_hhmmss_PQC.eol.Wwind" 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.Wwind" refers to the eol file format type, and vertical wind component that is included in the data files.

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.

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

```
Data Type/Direction:                    AVAPS SOUNDING DATA, Channel 1/Descending
File Format/Version:                    EOL Sounding Format/1.0
Project Name/Platform:                  T-PARC, T-PARC 2008-08-25/Falcon 20, D-CMET
Launch Site:
Launch Location (lon,lat,alt):          145 43.30'E 145.721608, 42 41.37'N 42.689553, 11209.80
UTC Launch Time (y,m,d,h,m,s):          2008, 08, 25, 23:43:16
Sonde Id/Sonde Type:                    081939107/Vaisala RSS903 & Ublox TIM-Lx
Reference Launch Data Source/Time:      IWGADTS Format (IWG1)/23:43:16.00
System Operator/Comments:                r b/none, No Winds
Post Processing Comments:               Aspen Version 2.8.1.8, Configuration mod.editsonde
/
 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
-------  -- -- -----  ------- ------- ------- ------- -------  -------  ------ ------- --------- ---------- ------- --------
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Table 2 Lists data fields provided in the modified EOL format ascii soundings.

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	Measured
10	V Wind Component	Meters/Second	Measured
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
18	Vertical Wind	Meters/Second	Calculated
19	Filtered Vertical Wind	Meters/Second	Calculated

IV. Data File Specifics

The files contain data collected at half-second intervals. The variables pressure, temperature, and relative humidity are calibrated values from measurements made by the dropsonde. The dew point is calculated from the temperature and relative humidity. The geopotential altitude value is calculated from the hydrostatic equation using first available pressure, temperature, and relative humidity. For the dropsondes specifically, if the sonde is launched over water and transmits data to the surface, the height is calculated by integrating from the surface (sea level) upward. However, if the sonde failed to transmit data to the surface or if the dropsonde is launched over land, because of unknown surface elevations, we integrate altitude from the flight level down. The descent rate of the dropsonde is computed using the time-differentiated hydrostatic equation. All wind and position (lat, lon and alt) data are computed from GPS navigation signals received from the sonde. At the request of the PIs', the vertical wind velocity was added to the data files. It was calculated from the pressure-calculated and theoretical dropsonde fall rates. The filtered vertical wind is the calculated vertical wind subjected to a 20 second low pass filter. The algorithm for calculating the vertical wind is described in detail in Wang et al. (2009, Wang, J., J. Bian, W. O. Brown, H. Cole, V. Grubisic, and K. Young, 2009: Vertical air motion from T-REX radiosonde and dropsonde data. J. Atmos. Oceanic Technol., 26, 928-942).

V. Data Quality Control

1. We first identified dropsondes used that were manufactured in 2008. The GPS receivers for these soundings were incorrectly configured to ground-based mode rather than aircraft mode. We evaluated the data files to determine the impact this configuration error would have on the GPS data and the results are presented below in section VI.
2. Temperature, relative humidity and wind profiles from the raw soundings were examined to determine if all of the files contained data, and to ensure that nothing looked suspicious. Doing this allows us to determine if there were any errors with the automatic launch detect, if a sounding was started up but not launched, and to check for an absence of GPS data.
3. The raw soundings files were run through the Atmospheric Sounding Processing ENvironment (ASPEN) software. This tool quality-controls and analyzes the data, performs smoothing, and removes suspect data points.
4. Time series plots of temperature (Figure 2), RH, wind speed, and fall rate with respect to geopotential altitude, were used to examine the consistency of soundings launched during each flight, and to show the variability of soundings from different missions. These plots are also used to determine if the sounding did not transmit data to the surface. In these cases, when aircraft data is available, the soundings are re-run through ASPEN with geopotential altitude calculated from flight level downward.

5. Profiles of temperature, RH, wind speed and vertical velocity from the quality controlled soundings are visually evaluated for outliers, and are used to determine if there was a "fast fall" caused by failure of the parachute to properly deploy, in which case all winds measurements are changed to missing values.
6. Histograms of pressure, temperature, relative humidity, wind speed and wind direction were then created to examine the distribution, range, and characteristics of each parameter.

VI. Results

1. None of the soundings contain flight pressure, temperature or RH. All but seven soundings (listed below) do contain flight level latitude, longitude and GPS altitude.

Files with no F.L. GPS data
D20080830_225951_PQC
D20080830_230902_PQC
D20080830_231632_PQC
D20080830_233146_PQC
D20080830_234955_PQC
D20080830_235636_PQC
D20080831_000615_PQC

2. All of the dropsondes used by the Falcon aircraft were manufactured in 2008 and contained a GPS receiver configuration error. They were incorrectly set to ground-based mode rather than aircraft mode. The incorrectly configured soundings were thoroughly evaluated to determine how this error would affect data quality. Based on comparisons between pressure calculated and GPS measured descent rate (DZ/DT), we determined that 17 soundings contained questionable GPS data (including latitude, longitude, GPS altitude, wind speed and wind direction). The configuration error appears to have reduced the number of satellites the dropsondes were able to lock on to during flight. For these soundings, where calculated and measured DZ/DT did not agree well, all data measured from the GPS were set to missing. All other soundings had good agreement between the calculated and GPS measured DZ/DT and the data files contain GPS data where satellite lock was greater than five.

GPS data was removed due to a sonde configuration error	
D20080831_012414_P.2	D20080914_010736_P.4
D20080902_011036_P.3	D20080914_024334_P.1
D20080902_011812_P.1	D20080917_095140_P.3
D20080904_003630_P.1	D20080918_044828_P.1
D20080904_001701_P.3	D20080918_060307_P.4
D20080909_011544_P.1	D20080918_063140_P.4
D20080911_051332_P.1	D20080928_094835_P.4

D20080911_092339_P.1	D20080928_095836_P.1
D20080914_010134_P.3	

3. Five dropsondes experienced delays or failure of the launch detect. Launch detect errors result from the launch detect mechanism (a pin inserted in the sonde) failing to disengage at the time the dropsondes are released. Additionally, these soundings may have had failure of the parachute to properly deploy prior to the time launch was detected. Failure of the parachute to deploy results in dropsondes falling at a faster rate (and sometimes tumbling) causing wind speed and direction to be unreliable. Wind data recorded during the fast fall portion of the soundings and associated vertical velocities have been set to missing. The soundings listed below have all been corrected for delays or failures in the launch detect. The filenames have been changed to reflect the actual launch time and available aircraft data from time of launch was retrieved and entered into the soundings as well.

Original Filename	**Filename with Corrected Launch Time**
D20080902_011051_P.3	D20080902_011036_P.3
D20080903_233024_P,2	D20080903_233007_P.2
D20080909_001727_P.3	D20080909_001550_P.3
D20080911_053355_P.3	D20080911_053336_P.3
D20080911_062453_P.4	D20080911_062333_P.4

4. 47 soundings were classified as “fast fall drops” meaning the parachute failed to deploy, however launch was accurately detected. Fast fall dropsondes have a descent rate of almost twice the normal speed. With fast fall drops, the wind measurements are unreliable so for these cases, wind speed, wind direction and vertical velocity were set to missing.

Parachute Failure - “Fast Fall Dropsondes”	
D20080825_234733_P.2	D20080918_050839_P.4
D20080826_002317_P.	D20080918_232124_P.2
D20080826_000919_P.4	D20080919_025554_P.1
D20080829_225304_P.2	D20080919_031235_P.3
D20080830_002936_P.4	D20080919_033301_P.1
D20080830_235636_P.2	D20080919_035241_P.3
D20080831_005652_P.3	D20080919_041235_P.1
D20080831_010600_P.4	D20080919_042314_P.2
D20080908_224540_P.2	D20080921_000807_P.2
D20080911_060401_P.2	D20080928_051619_P.1
D20080913_235753_P.1	D20080928_053611_P.3
D20080914_013846_P.3	D20080928_060819_P.3
D20080914_020836_P.4	D20080928_103843_P.1
D20080914_021405_P.1	D20080929_045530_P.3
D20080914_023337_P.4	D20080929_225335_P.2
D20080915_222235_P.2	D20080929_233718_P.3
D20080915_230737_P.1	D20080930_053152_P.3
D20080916_004749_P.3	D20081001_061639_P.4
D20080917_043712_P.3	D20081001_063828_P.3

D20080917_053544_P.2	D20081001_072455_P.3
D20080917_054159_P.3	D20081001_075249_P.2
D20080917_060834_P.2	D20081001_121237_P.4
D20080918_040347_P.1	D20081001_123204_P.2
D20080918_045612_P.2	

5. One sounding (D20080918_041830_PQC) contains neither temperature nor relative humidity data, but does contain pressure and GPS wind data. This sounding is included in the final archive
6. 17 soundings contained no GPS (lat, lon, alt, or wind) data.

Soundings with no GPS	
D20080826_002847_P.1	D20080911_104328_P.1
D20080826_003601_P.3	D20080915_225238_P.4
D20080830_005950_P.3	D20080918_060857_P.1
D20080903_223303_P.1	D20080918_061947_P.2
D20080903_231922_P.1	D20080920_233135_P.4
D20080903_235553_P.1	D20080928_040118_P.1
D20080911_035301_P.1	D20080929_043527_P.1
D20080911_084327_P.1	D20080930_045031_P.3
D20080911_100636_P.1	

7. 18 soundings were removed from the final archive because they contained very little data (of poor quality), or the dropsondes were started up, but never launched.

Files not included in the final archive	
D20080829_231249_P.4	D20080928_063301_P.2
D20080830_010335_P.4	D20080928_100833_P.2
D20080903_054815_P.3	D20080928_103304_P.1
D20080903_230839_P.1	D20080929_060841_P.3
D20080903_230926_P.1	D20080929_061408_P.3
D20080904_004849_P.3	D20080929_223707_P.1
D20080918_050152_P.3	D20080930_000413_P.4
D20080920_231248_P.3	D20080930_002039_P.2
D20080928_060043_P.2	D20081001_110656_P.1

8. Twelve dropsondes did not transmit to the surface. The geopotential altitudes for these soundings were calculated from flight level downward.

Geopotential Altitude calculated from Flight Level downward
D20080830_005950_P.3

D20080831_010600_P.4
D20080901_235211_P.1
D20080903_230926_P.1
D20080911_062333_P.4
D20080914_002935_P.4
D20080914_021405_P.1
D20080917_043712_P.3
D20080921_000807_P.2
D20081001_061639_P.4
D20081001_063828_P.3
D20081001_070749_P.2

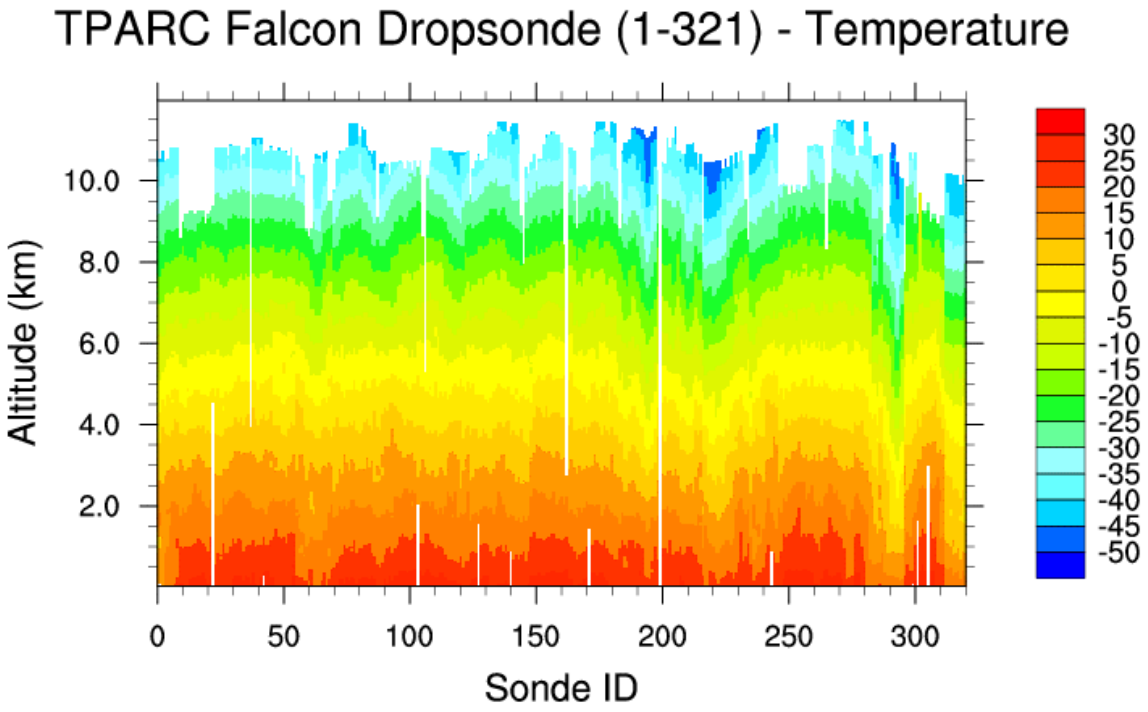

Figure 2. Time series of all temperature profiles collected by the Falcon. The plot shows variability over time.