THORPEX Pacific Asian Regional Campaign (TPARC) 2008 Quality Controlled Air Force C-130 Dropsonde Data Set

Contents:

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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 Airforce C-130, the Taiwanese Astra, and the DLR Falcon. The TPARC C-130 final dropsonde data archive contains 620 dropsondes launched between August 15 and September 27, 2008 (Figure. 1).

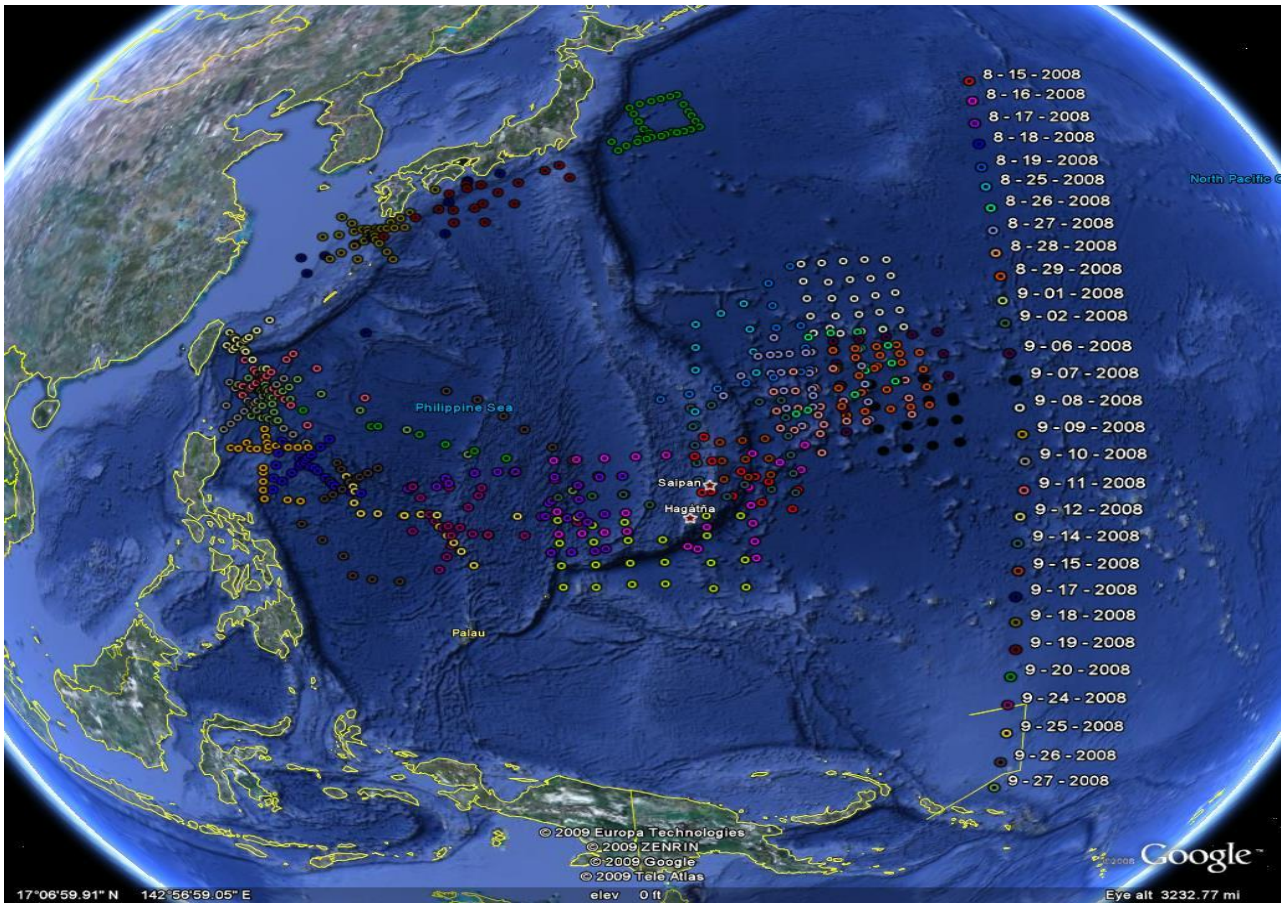

Figure 1 Map of the dropsonde launch locations from the AF-C130. Different dates are distinguished by different colors.

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.

```
Data Type/Direction:                AVAPS SOUNDING DATA, Channel 4/Descending
File Format/Version:                EOL Sounding Format/1.0
Project Name/Platform:              TPARC RF1/NRL P3,  N677F
Launch Site:
Launch Location (lon,lat,alt):      127 11.70'E 127.195000, 20 59.33'N 20.988800, 3789.50
UTC Launch Time (y,m,d,h,m,s):      2008, 09, 11, 02:10:12
Sonde Id/Sonde Type:                053116003/Vaisala RSS903 & Ublox TIM-Lx
Reference Launch Data Source/Time:  IWADTS/02:10/13
System Operator/Comments:           emk/none, Good Drop
Post Processing Comments:           Aspen Version
/
Time    UTC     Press Temp Dewpt  RH  Uwind Vwind Wspd Dir  dZ  GeoPoAlt Lon     Lat    GPSAlt Wwind Wwind_f
 sec  hh mm ss  mb    C    C     %   m/s   m/s   m/s  deg  m/s     m      deg     deg      m     m/s    m/s
------- --  --  -- ----- ------- ------- ----- ------- ------- ----- ---- ---- -------- ------- ------ --------- -------- ----------
```

Table 1 Example of 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	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

Table 2 Lists data fields provided in the modified EOL format ascii soundings.

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., in press).

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 and relative humidity 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, or if a sounding was started up, but not launched.
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 1), 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, or if a dropsonde was launched over land. 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. Nineteen soundings 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 only one sounding (D20080920_093544_P.1) 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. Eight sounding files contained no GPS data. For the one sounding file where calculated and measured DZ/DT did not agree well, all data measured from the GPS were set to missing. The remaining ten 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.

2. Sixty seven 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, many of these soundings 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 the aircraft data from time of launch was retrieved and entered into the soundings as well.

Original Filename	**Filename with Corrected Launch Time**
D20080816_210356.3	D20080816_210319_P.3
D20080816_213336.1	D20080816_213317_P.1
D20080816_224828.4	D20080816_224814_P.4
D20080817_015418.2	D20080817_015048_P.2
D20080817_020914.4	D20080817_020516_P.4
D20080817_234039.2	D20080817_234021_P.2
D20080818_212627.2	D20080818_213110_P.2
D20080818_215428.4	D20080818_215416_P.4
D20080818_232748.3	D20080818_232656_P.3
D20080818_233118.4	D20080818_233022_P.4
D20080818_234139.1	D20080818_234126_P.1
D20080829_042252.2	D20080829_041933_P.2
D20080907_001041.1	D20080907_001017_P.1
D20080909_044649.3	D20080909_044619_P.3
D20080909_061149.2	D20080909_062917_P.2
D20080909_071040.3	D20080909_071011_P.3
D20080910_053933.2	D20080910_053922_P.2
D20080910_055231.2	D20080910_055451_P.2

D20080910_061010.2	D20080910_060959_P.2
D20080910_075326.4	D20080910_075312_P.4
D20080910_075633.2	D20080910_075622_P.2
D20080910_082636.4	D20080910_082614_P.4
D20080911_114622.4	D20080911_114531_P.4
D20080911_121812.3	D20080911_122509_P.3
D20080911_124416.1	D20080911_125001_P.1
D20080911_133626.3	D20080911_134415_P.3
D20080911_134159.4	D20080911_134731_P.4
D20080911_140405.3	D20080911_140347_P.3
D20080911_143645.4	D20080911_144942_P.4
D20080911_143815.3	D20080911_143801_P.3
D20080912_163026.1	D20080912_163835_P.1
D20080912_164001.4	D20080912_163941_P.4
D20080912_171605.3	D20080912_171523_P.3
D20080912_174431.1	D20080912_175110_P.1
D20080912_174609.2	D20080912_175827_P.1
D20080914_212248.3	D20080914_215131_P.3
D20080914_225913.1	D20080914_225859_P.1
D20080914_224752.4	D20080914_224740_P.4
D20080915_013710.2	D20080915_013653_P.2
D20080917_234542.3	D20080917_234511_P.3
D20080918_005451.1	D20080918_011115_P.1
D20080918_010258.4	D20080918_010236_P.4
D20080918_043547.4	D20080918_043520_P.4
D20080920_070930.4	D20080920_070850_P.4
D20080920_074831.1	D20080920_074815_P.1
D20080920_080746.2	D20080920_080930_P.2
D20080924_195949.4	D20080924_200738_P.4
D20080924_205513.4	D20080924_211028_P.4
D20080924_214111.1	D20080924_215225_P.1
D20080924_215356.2	D20080924_215826_P.2
D20080924_223037.1	D20080924_223001_P.1
D20080924_231556.3	D20080924_231540_P.3
D20080925_000511.3	D20080925_000411_P.3
D20080925_005434.3	D20080925_005422_P.3
D20080925_224456.1	D20080925_224426_P.1
D20080925_233108.1	D20080925_233053_P.1
D20080925_235712.2	D20080925_235651_P.2
D20080926_004620.2	D20080926_004608_P.2
D20080926_005440.1	D20080926_010932_P.1
D20080926_010349.3	D20080926_012433_P.3
D20080927_034819.2	D20080927_034740_P.2
D20080927_060950.3	D20080927_061733_P.3
D20080927_063828.1	D20080927_063741_P.1
D20080927_071702.1	D20080927_071819_P.1
D20080927_071813.4	D20080927_071740_P.4
D20080927_074317.3	D20080927_075237_P.3
D20080927_081509.3	D20080927_081447_P.3

3. 15 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"
D20080816_024636
D20080818_213110
D20080901_195048
D20080907_024416
D20080909_062917
D20080911_122509
D20080911_125001
D20080911_134731
D20080912_175110
D20080912_175827
D20080924_200738
D20080924_211028
D20080924_215826
D20080926_010932
D20080926_012433

4. Five soundings contain neither temperature nor relative humidity data, but they do contain pressure and GPS wind data and therefore are included in the final archive

Dropsondes with missing temperature and RH
D20080825_005843
D20080908_033606
D20080908_035810
D20080908_040917
D20080909_051747

5. Nine 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
D20080817_232852
D20080828_004419
D20080906_215329
D20080910_053950

D20080910_060721
D20080910_061732
D20080910_080558
D20080912_175049
D20080915_011642

6. Thirty-four 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			
D20080815_224925	D20080827_012219	D20080910_060102	D20080917_013719
D20080815_232648	D20080828_004623	D20080911_121026	D20080918_011115
D20080816_021248	D20080828_005820	D20080911_125001	D20080920_065001
D20080818_204413	D20080828_013240	D20080911_130551	D20080924_200738
D20080818_213110	D20080828_015503	D20080911_131820	D20080926_010932
D20080818_215416	D20080829_003825	D20080911_134415	D20080926_012433
D20080826_200319	D20080829_013506	D20080911_151800	D20080927_071819
D20080826_222200	D20080907_000756	D20080912_163835	
D20080827_003055	D20080910_054809	D20080914_231043	

7. Two soundings experienced interference from another dropsonde started up on the same frequency. Measurements collected during interference from the other dropsondes were removed from the dropsonde files.

Interference with another dropsonde on the same frequency
D20080816_021248
D20080816_211646

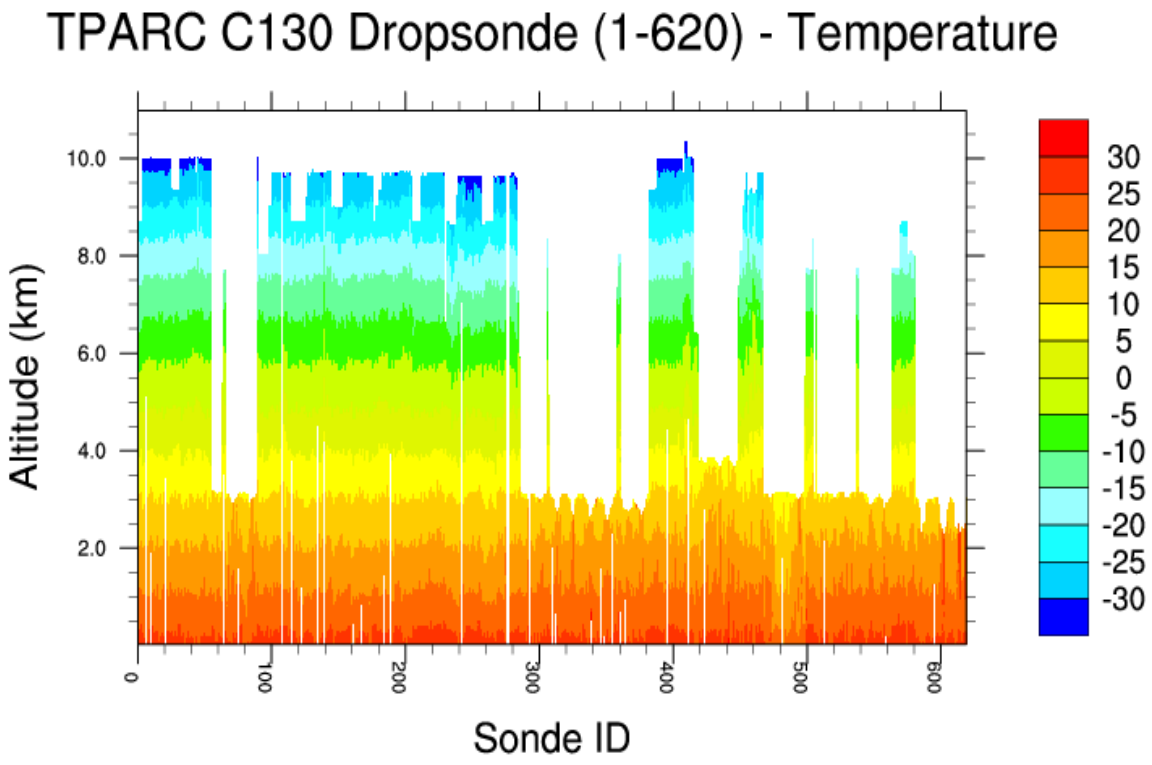

Figure 1. Time series of all temperature profiles collected by the C130. Plot shows consistency of soundings during the same missions and variability over time.