THORPEX Pacific Asian Regional Campaign (TPARC) 2008 Quality Controlled NRL-P3 Dropsonde Data Set

Contents:

A re-release of the data was done on Aug 28, 2009 after corrections were applied to 12 sounding files. The follow lists provide information on the errors detected and the files corrected.

Corrected for error in the surface pressure value that affected the geopotential altitude calculation:
D20080828_032033_PQC.eol.Wwind
D20080828_051037_PQC.eol.Wwind
D20080829_012525_PQC.eol.Wwind
D20080908_060956_PQC.eol.Wwind
D20080909_051836_PQC.eol.Wwind
D20080919_030615_PQC.eol.Wwind
D20081004_055149_PQC.eol.Wwind

Soundings did not transmit to surface which caused and error in geopotential altitude.
D20080816_225236_ PQC.eol.Wwind
D20080916_212734_ PQC.eol.Wwind

Sounding files did not contain aircraft flight level latitude and longitude. This information was retrieved from the last dropsonde record prior to launch and entered in as the flight level location in the first line of the sounding file.
D20080919_012013_PQC.eol.Wwind
D20080922_012102_PQC.eol.Wwind
D20081004_015111_PQC.eol.Wwind

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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 separate aircraft used in the project, each equipped for dropsonde deployment, the NOAA NRL-P3, the Airforce C-130, the Taiwanese Astra, and the DLR Falcon. The TPARC NRL-P3 final archive contains 475 dropsondes launched between August 12 and October 4, 2008 (Figure. 1).

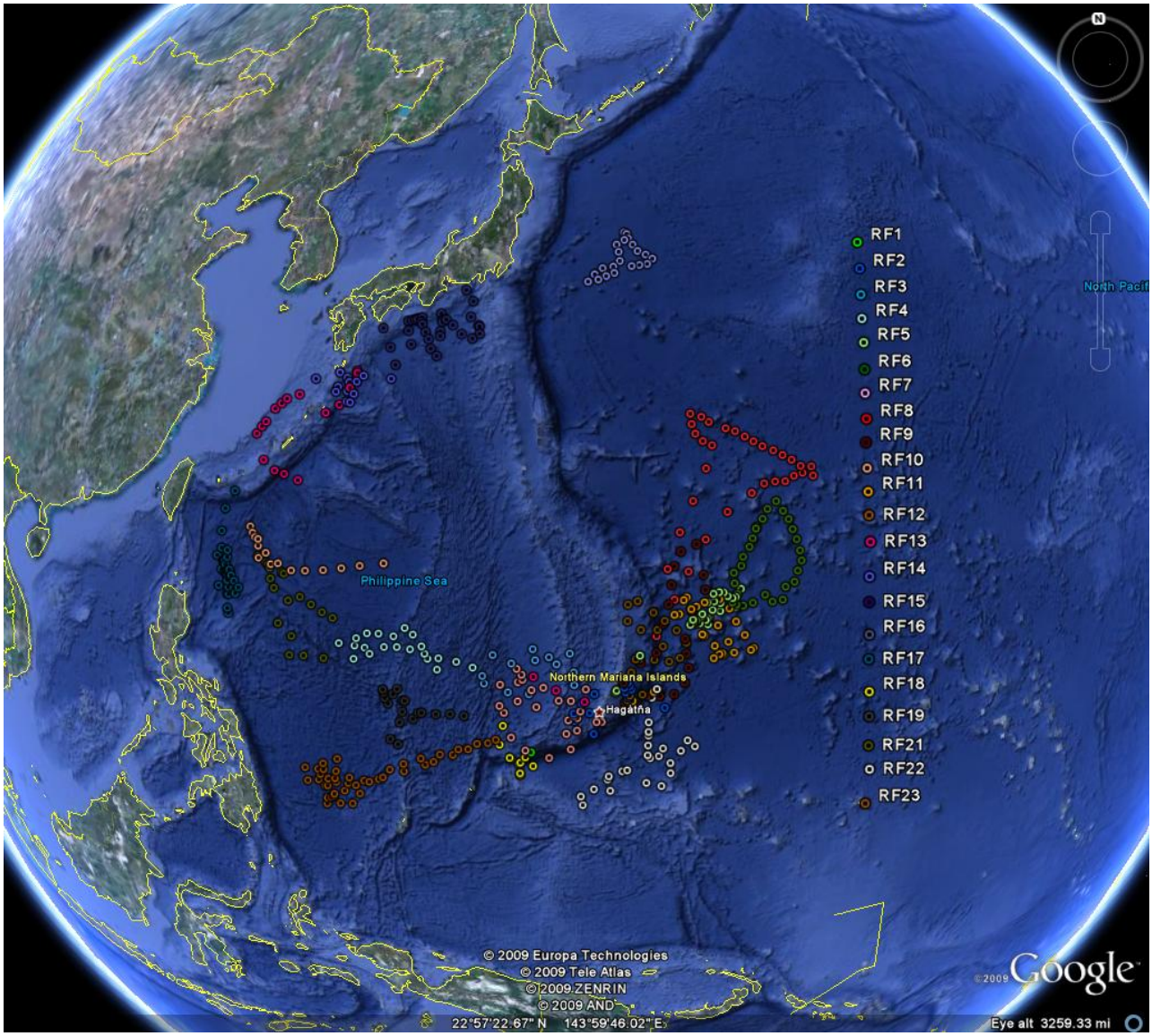

Figure 1 Map of the dropsonde launch locations from the NRL-P3. Different flights are distinguished by different colors.

Research Flight Numbers – Dates of Flight (mm/dd)		
RF01 – 08/12	RF09 - 09/09	RF17 - 09/21-09/22
RF02 – 08/15-08/16	RF10 - 09/11	RF18 – 09/23
RF03 - 08/16-08/17	RF11 - 09/13-09/14	RF19 - 09/24-09/25
RF04 – 08/17-08/18	RF12 - 09/14-09/15	RF21 - 09/26-09/27
RF05 – 08/28	RF13 - 09/16-09/17	RF22 - 10/02-10/03
RF06 - 08/29	RF14 - 09/18	RF23 - 10/03-10/04
RF07 - 09/01	RF15 - 09/19	
RF08 - 09/08	RF16 - 09/20	

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
------- --  --  -- ----- ------- ------- ----- ------- ------- -----  ---- ----  -------- ------- ------ --------- --------- ----------
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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 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 details 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 manufactured in 2008 that were deployed before September 12, 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, which 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 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.
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. One hundred soundings (collected before September 12, 2008) contained a GPS receiver configuration error. They were incorrectly set to ground-based mode rather than aircraft mode. After September 11, 2008 dropsondes were reconfigured prior to use. 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), calculated and GPS measured position, and based on evaluation of GPS altitude, we determined that 31 soundings contained questionable GPS data (including latitude, longitude, GPS altitude, wind speed and wind direction). Additionally, the configuration error appears to have reduced the number of satellites the dropsondes were able to lock on to during flight. For the 31 soundings where calculated and measured DZ/DT did not agree well, all data measured from the GPS were set to missing. Twenty-two soundings with the configuration error contained no GPS data. The remaining 47 soundings had good agreement between the calculated and GPS measured DZ/DT and the data files still contain GPS data where satellite lock was greater than five.

2. Twenty six 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 velocity have been set to missing. The soundings listed below have all been corrected for delays 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	**Corrected Filename**
D20080816_005735.3	D20080816_005907_P.3
D20080816_011620.4	D20080816_011544_P.4
D20080816_035914.3	D20080816_035857_P.3
D20080816_221948.1	D20080816_223756_P.1
D20080817_015804.4	D20080817_015729_P.4
D20080817_021026.1	D20080817_021804_P.1
D20080818_002324.2	D20080818_002302_P.2
D20080818_005111.4	D20080818_004954_P.4
D20080828_030442.4	D20080828_030432_P.4
D20080901_195107.4	D20080901_195046_P.4
D20080901_233339.2	D20080901_233318_P.2
D20080908_045535.4	D20080908_045506_P.4
D20080908_050301.2	D20080908_050236_P.2
D20080909_023621.4	D20080909_023609_P.4
D20080909_042713.1	D20080909_042648_P.1
D20080909_044756.4	D20080909_044745_P.4
D20080909_051857.4	D20080909_051836_P.4
D20080919_011200.2	D20080919_012013_P.2
D20080922_011622.4	D20080922_012102_P.4
D20081003_003411.4	D20081003_003354_P.4
D20081003_005510.4	D20081003_005431_P.4
D20081003_010434.2	D20081003_010419_P.2
D20081003_030900.2	D20081003_030845_P.2
D20081004_013604.2	D20081004_015111_P.2
D20081004_023333.2	D20081004_023316_P.2
D20081004_051911.2	D20081004_051857_P.2
D20081004_070052.4	D20081004_070031_P.2

3. Seven 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_005907_P.3
D20080816_223756_P.1
D20080817_234308_P.2
D20080818_030631_P.1
D20080911_013242_P.4

D20080917_014102_P.2
D20080917_015209_P.3

4. 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 final archive
D20080816_005236_P.1
D20080816_005435_P.2
D20080818_013438_P.4
D20080829_010236_P.1
D20080908_024556_P.1
D20080911_020404_P.4
D20080922_010341_P.2
D20081003_030223_P.4
D20081003_015832_P.2

5. Five dropsondes were launched with the protective temperature and relative humidity cap left on. These caps are meant to protect the sensors before flight. The following sounding files were deleted from the final archive

Cap left on dropsonde
D20080829_030904_P.4
D20080909_031848_P.4
D20080914_020331_P.1
D20080918_004734_P.2
D20080922_011455_P.2

6. Six dropsondes did not transmit to the surface. The geopotential altitude in these soundings was calculated from flight level downward.

Geopotential Altitude calculated from Flight Level downward
D20080816_225236_PQC.eol
D20080818_034605_PQC.eol
D20080913_202306_PQC.eol
D20080914_014949_PQC.eol
D20080917_014102_PQC.eol
D20080919_012013_PQC.eol

7. Eleven sounding experienced interference from another dropsonde started up on the same frequency. This most often occurred just before the NRL-P3 dropsondes hit the surface, and did result in a loss of some data. Measurements collected during interference from the other dropsondes were removed from the NRL-P3 dropsonde files.

Interference with another dropsonde on the same frequency
D20080818_034605_P.2
D20080901_213511_P.2
D20080908_044950_P.1
D20080908_040220_P.1
D20080913_202306_P.1
D20080913_202525_P.4
D20080914_014949_P.1
D20080914_020331_P.1
D20080917_014102_P.2
D20081002_222431_P.2
D20081004_054149_P.4

8. One hundred ten soundings contained bad flight level temperature and relative humidity collected from the aircraft. The aircraft temperature sensor broke, during a ferry trip, when icing occurred and these incorrect measurements were transferred to the aircraft data line of the dropsonde files. The incorrect temperature measurements were also used to calculate the relative humidity entered into the soundings. Corrections were applied to the aircraft data and those new values were entered into the dropsonde sounding files.

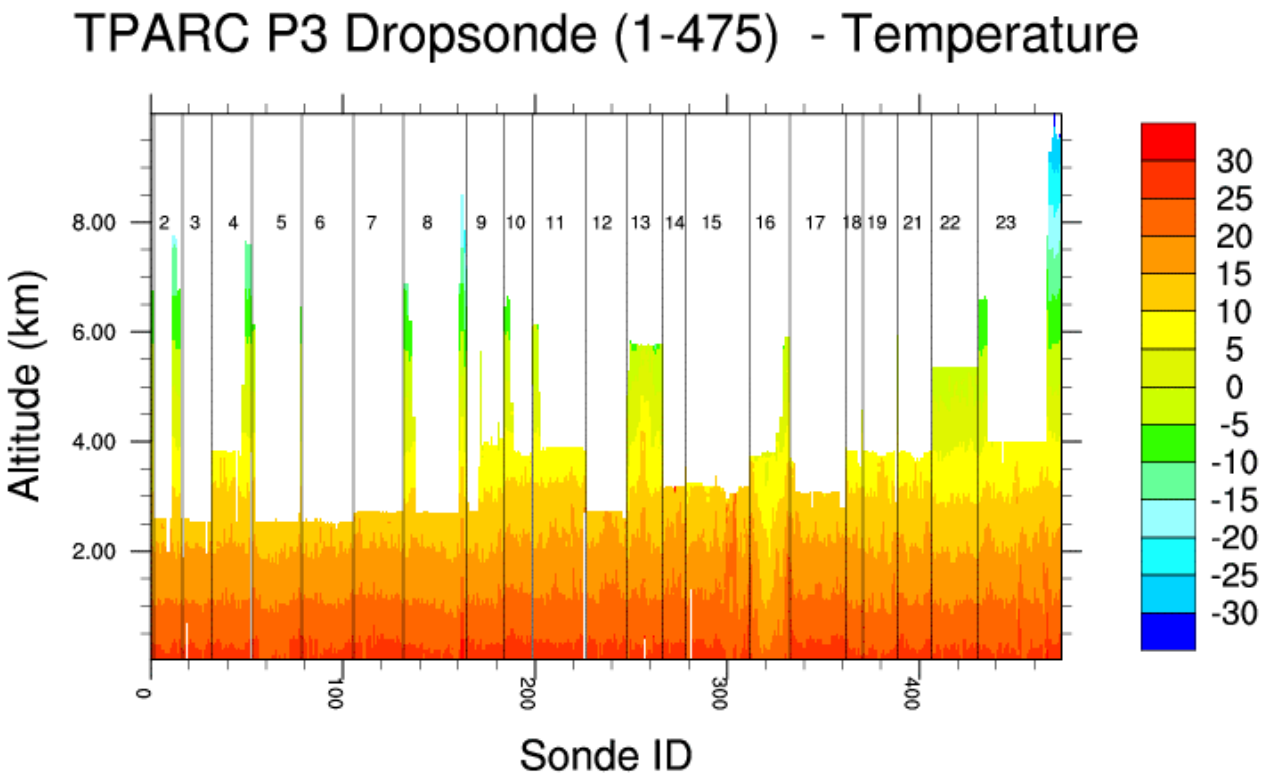

Figure 1. Time series of all dropsondes made from the NRL-P3. Plot shows consistency of soundings during the same flight and some variability between flights. Numbers on the plot represent the Research Flight number.