THORPEX Pacific Asian Regional Campaign (TPARC) 2008 Quality Controlled Taiwanese ASTRA 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 Air Force C-130, the Taiwanese ASTRA, and the DLR Falcon. The TPARC ASTRA final dropsonde data archive contains 161 dropsondes launched between July 16 and September 28, 2008 (Figure. 1).

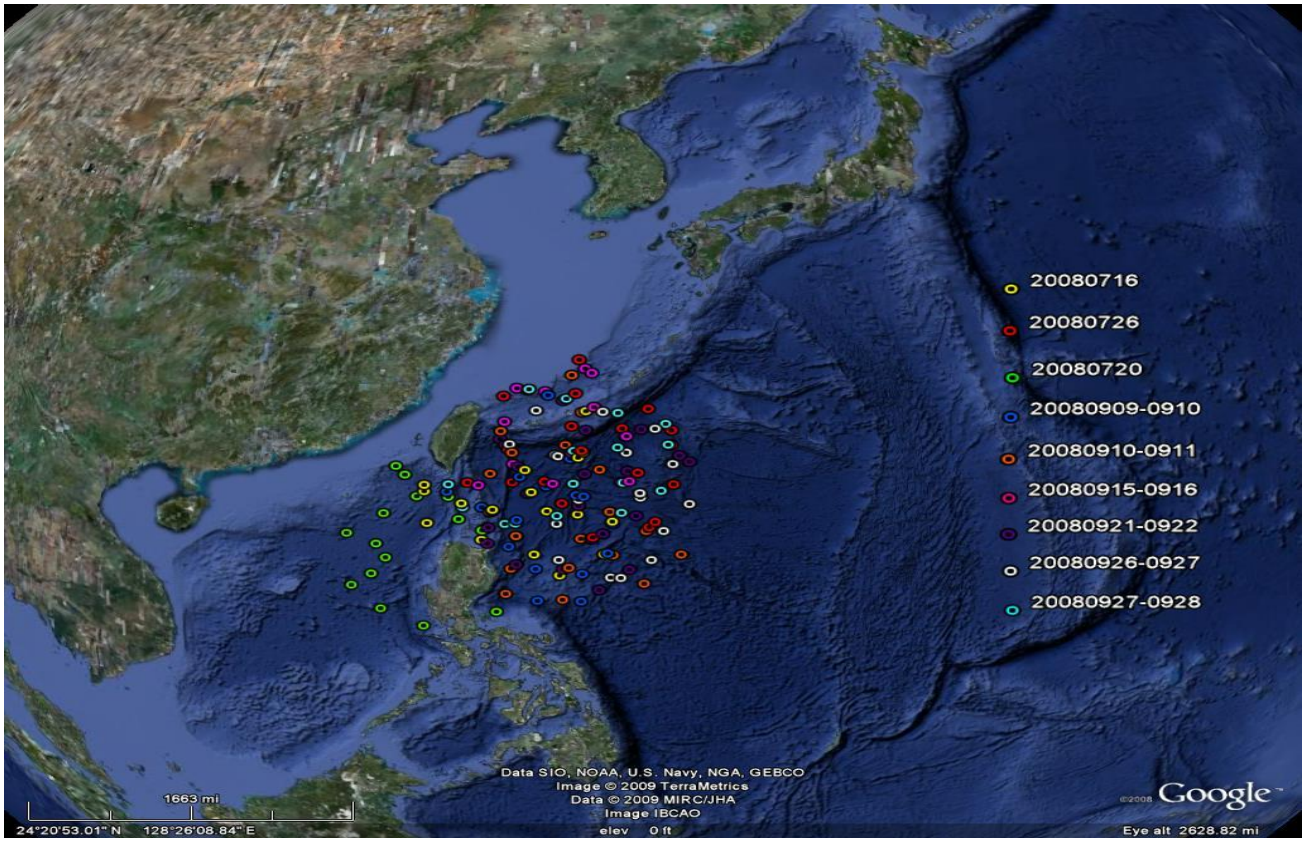

Figure 1 Map of the dropsonde launch locations from the Taiwanese Astra. Legend indicates the dates during which the launches occurred (4-digit year followed by month(s) and day(s))

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:                  Jangmi, 732/ASTRA SPx, B20001
Launch Site:
Launch Location (lon,lat,alt):          122 58.85'E 122.980789, 23 20.00'N 23.333415, 12668.09
UTC Launch Time (y,m,d,h,m,s):          2008, 09, 26, 21:16:30
Sonde Id/Sonde Type:                    062259039/Vaisala RSS903 & Ublox TIM-Lx
Reference Launch Data Source/Time:      none -/21:06:56.91
System Operator/Comments:               Arthur wu/none, Good Drop
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
------- -- -- -- ------- ------- ------- ------- ------- ------- ------ ------- --------- ------- --------
```

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, 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 level aircraft pressure, temperature or RH, and no sounding files collected in July (before the official start date of the project) contain flight level GPS data (lat/lon/alt). All but one sounding (D20080915_235426_P.2) collected during August and September contain flight level GPS latitude, longitude and altitude.

2. Ninety-eight of the dropsondes used by the ASTRA 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 none of the soundings contained questionable GPS data (including latitude, longitude, GPS altitude, wind speed and wind direction). All soundings from the ASTRA had good agreement between the calculated and GPS measured DZ/DT and the data files contain GPS data where the number of satellite lock was greater than five.

3. Twenty-one 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**
D20080716_091148.2	D20080716_091141_P.1
D20080716_091354.1	D20080716_090834_P.1
D20080716_094341.4	D20080716_094323_P.4
D20080716_095522.1	D20080716_095512_P.1
D20080716_110836.1	D20080716_110833_P.1
D20080716_122951.4	D20080716_122522_P.4
D20080726_125304.2	D20080726_125256_P.2
D20080820_091431.1	D20080820_091422_P.1
D20080820_094451.4	D20080820_094437_P.4
D20080820_120225.1	D20080820_115537_P.1
D20080909_220717.4	D20080909_220711_P.4
D20080909_221958.3	D20080909_221934_P.3

D20080910_214315.4	D20080910_214238_P.4
D20080910_221935.3	D20080910_221931_P.3
D20080916_010931.2	D20080916_010146_P.2
D20080921_221645.2	D20080921_221637_P.2
D20080921_230344.2	D20080921_230327_P.2
D20080922_010109.2	D20080922_010103_P.2
D20080926_234136.1	D20080926_234133_P.1
D20080927_002846.4	D20080927_002838_P.4
D20080910_002627.1	D20080910_005859_P.1

4. Four 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"
D20080820_103042_P.4
D20080820_122545_P.3
D20080909_235500_P.3
D20080910_005859_P.1

5. One sounding (D20080726_121111_P.3) was removed from the archive because the dropsonde was launched with a protective cap on, causing errors in the temperature and RH measurements.

6. Two soundings contained no GPS (lat, lon, alt, or wind) data and are kept in the final archive.

Soundings with no GPS
D20080820_113655_P.4
D200800915_223048_P.2

7. Nine dropsondes did not transmit to the surface. The geopotential altitudes for these soundings were calculated from flight level downward. Since none of the soundings contained flight level aircraft pressure or temperature data, for five of the soundings the first available pressure, temperature and GPS altitude reported from the dropsonde were used in the flight level data line. For the remaining four soundings, retrieval of the GPS altitude was delayed for some time after launch, so the dropsonde GPS could not be used in the flight level data line. Instead, we used flight level altitude reported by the aircraft, the first available pressure from the dropsonde and temperature measured by the sonde after equilibration with the environment had been reached. For these last four cases, calculated geopotential altitudes are questionable, and we caution the users about trusting these values. In the chart below, soundings with first available dropsonde pressure, temperature and GPS

alt used in flight level data line are marked by an asterisk. The sounding names in red contain questionably low geopotential altitudes.

Geopotential Altitude calculated from Flight Level downward
D20080820_094437_P.4
D20080820_123501_P.4*
D20080909_233920_P.2*
D20080909_235500_P.3
D20080909_235720_P.4*
D20080921_214402_P.3*
D20080921_221637_P.2*
D20080927_001311_P.3
D20080927_234924_P.4