THORPEX Pacific Asian Regional Campaign (T-PARC) 2008 Quality Controlled Driftsonde Data Set

Contents:

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Version	Date	Author	Change Description
1.0	2011	*J. Wang*	Initial Document Release
2.0	04-12-2017	*K. Young*	A dry bias in the RD94 dropsonde and driftsonde, and mini-dropsonde (NRD94) relative humidity measurements was discovered in data collected from 2010 to present. The dry bias is strongly temperature dependent. It is considered small at warm temperatures and it becomes stronger at cold temperatures. The RH dry bias has been corrected for, and the dewpoint has been recomputed. The data files that have received this correction contain an indicator in the header of the file, 'TDDryBiasCorrApplied'.

UCAR/NCAR - Earth Observing Laboratory. 2009. NCAR/EOL Driftsonde Data. Version 1.0. UCAR/NCAR - Earth Observing Laboratory. https://doi.org/10.5065/D64J0C98. Accessed 13 Apr 2017.

For more information on the NCAR Driftsonde System please visit the following site: http://www.eol.ucar.edu/instrumentation/sounding/driftsonde

I. Dataset Overview

The THORPEX Pacific Asian Regional Campaign (T-PARC) 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. T-PARC was the second deployment of the NCAR/EOL driftsonde system which was developed in an effort to produce a low-cost measurement system capable of capturing vertical profiles of in-situ measurements in forecast sensitive regions, and filling critical gaps in data coverage over remote locations.

The development and deployment of the driftsonde system was a collaborative effort between the Earth Observing Laboratory (EOL/NCAR) and the French Space Agency (CNES). The driftsonde system consists of a zero-pressure polyethylene balloon attached to a gondola that houses up to 50 Miniature In-situ Sounding Technology (MIST) dropsondes. The balloon floats along with the wind currents in the lower stratosphere or upper troposphere between 16-30 kilometers, and can remain airborne for between 5-7 days. The MIST sondes are released upon command via the ground operations center. During T-PARC, total 339 MIST soundings were collected during 14 research flights launched from Kona, Hawaii between August 1 and September 30, 2008; 268 of them are good soundings (Figure 1).

Figure 1 Map of the MIST sonde launch locations from the driftsonde. Different flights are distinguished by different colors.

III. EOL 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). 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.TFxxdyy_zzzzzzzzQC.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), TFxxdyy = driftsonde flight number, zzzzzzzz is the MIST sonde ID, and "QC.eol" refers to the eol 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.

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

Data Type/Direction: DRIFTSONDE SOUNDING DATA, Channel 1/Descending File Format/Version: EOL Sounding Format/1.0
Project Name/Platform: T-PARC Driftsonde, TF01d10/DRIFTSONDE, drift10
Launch Site:
Launch Location (lon,lat,alt): 157 28.70'W -157.478414, 18 56.44'N 18.940643, 29081.34
UTC Launch Time (y,m,d,h,m,s): 2008, 08, 19, 18:39:16
Sonde Id/Sonde Type: 081654182/Mistsonde
Reference Launch Data Source/Time: Sonde/None/
System Operator/Comments: Remote Launch/None/
Post Processing Comments: Aspen Version 2.8.1.5, 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
-1.0	18	39	15.00	13.65	-25.00	-68.23	1.00	-23.22	-0.12	23.22	89.70	-999.00	29248.36	-157.478414	18.940643	29081.34
1.0	18	39	17.00	-999.00	-999.00	-999.00	1.00	-999.00	-999.00	-999.00	-999.00	-999.00	-999.00	-999.000000	-999.000000	-999.00
1.5	18	39	17.50	-999.00	-999.00	-999.00	1.00	-999.00	-999.00	-999.00	-999.00	-999.00	-999.00	-999.000000	-999.000000	-999.00
2.0	18	39	18.00	-999.00	-999.00	-999.00	1.00	-999.00	-999.00	-999.00	-999.00	-999.00	-999.00	-999.000000	-999.000000	-999.00

Table 2 Lists data fields provided in the 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	Calculated
10	V Wind Component	Meters/Second	Calculated
11	Wind Speed	Meters/Second	Measured
12	Wind Direction	Degrees	Measured
13	Descent Rate	Meters/Second	Calculated
14	Geopotential Altitude	Meters	Calculated
15	Longitude	Degrees	Measured
16	Latitude	Degrees	Measured
17	GPS Altitude	Meters	Measured

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 relative humidity and temperature. 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. The position (lat, lon) and wind data comes directly from the GPS sensor.

V. Data Quality Control

The procedures for quality-controlling driftsonde data are summarized in Fig. 2. It includes three steps. The first step is to convert raw binary files to ASCII D files and fix any special problems in D files. The second step involves quality-controlling the ASCII files using ASPEN, and using additional tools to evaluate data quality. The final step includes summarizing the results, and archival and release of the data.

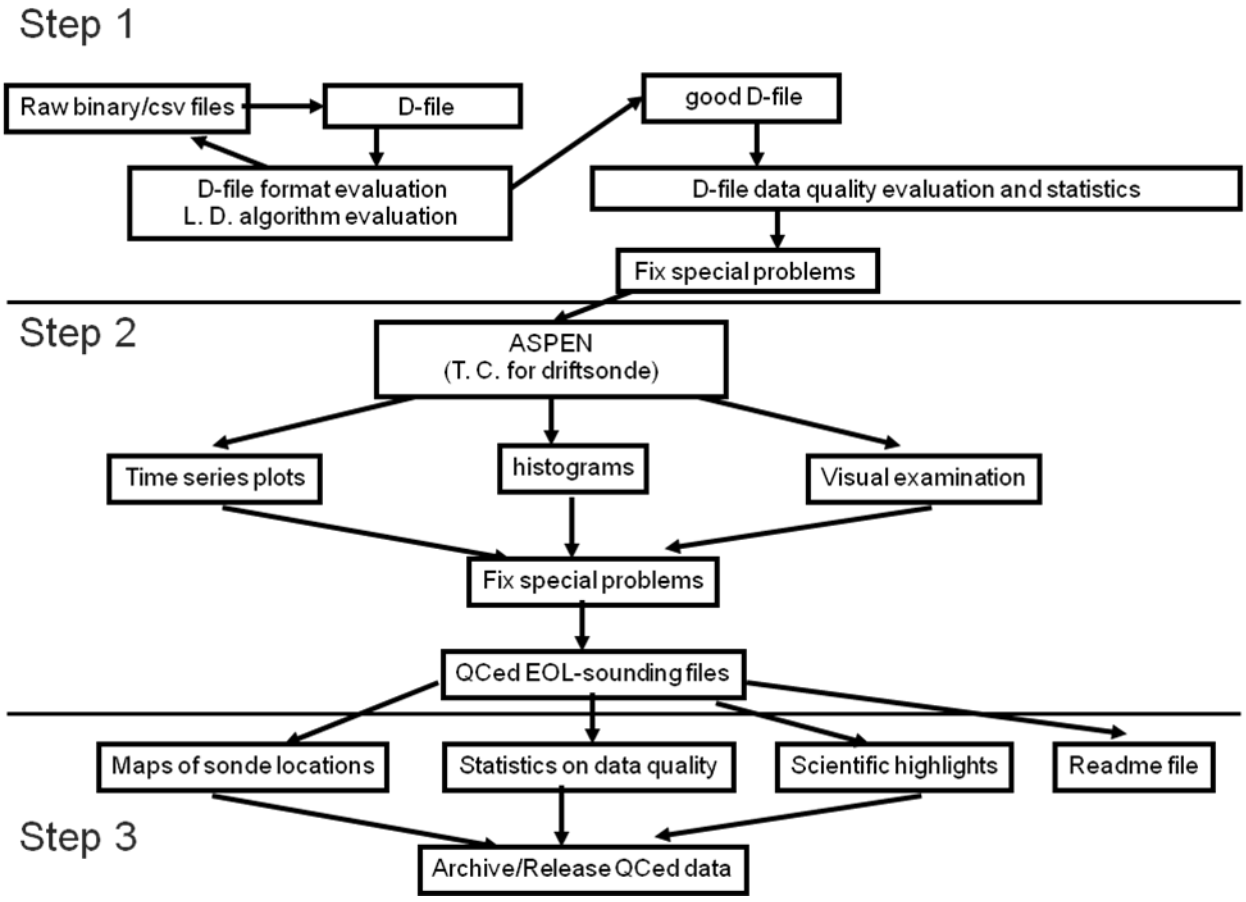

Fig. 2 Schematic diagram showing procedures of driftsonde data QC/QA. It includes three steps separated by horizontal lines.

VI. Special problems to note

During the postprocessing, we encountered various problems. Only those need the users' attentions are summarized in Table 3. They have been corrected if possible. For those not correctable and not usable based on our best knowledge, values were changed to missing. For files containing questionable data, they were kept in the final archive, but we caution the users about them below. The following problems were found:

1. **Broken temperature sensor:** TF09d20_04E1E7A1 had a broken temperature sensor, so no T data were recorded at all.

2. **Suspiciously warm T:** Temperatures in two soundings are warmer than other soundings from the same flight by ~5°C, although the structures of the T profile look reasonable (Fig. 3). They are included in the final data set. But the users should use their own judgment to determine whether they are correct or not.
3. **Suspicious temperature and RH data:** Three soundings have suspicious T/RH profiles. It was clear that RH were not correct, so they were changed to missing values in the final QCed files. The T data look reasonable, although they are too smooth and too warm in the tropopause layer, and in the stratosphere (Fig. 4). The T data were kept, but should be used with caution.
4. **Smooth, near saturation RH profiles:** Thirteen soundings show increasing RH at ~220 mb as the sondes were descending. They then exhibit smooth, near-ice-saturation and similar RH profiles until the 0°C level (Fig. 5). After inspecting the satellite cloud images, we confirmed that all these soundings went into clouds. It is unclear why the humidity sensor behaves in this way. Caution should be taken when using these data.
5. **Pressure offset:** Forty-five soundings had small pressure offsets (a few mb) for intermittent periods of time (Fig. 6). It is unknown what caused this problem. We developed a scheme to correct the pressure offset and resulting spikes in pressure-derived fall rate.
6. **Fast fall:** Two soundings were classified as "fast fall", meaning they fell at twice the expected speed, likely due to failure of the parachute to properly deploy. Their wind data were not reliable and were changed to missing values.
7. **Not reaching surface:** Fourteen soundings stopped transmitting data before they splashed into the ocean. For those soundings, the geopotential height was calculated by integrating pressure from the flight level downward.
8. **Dry Bias:** A dry bias in the relative humidity measurements was discovered, in the Spring of 2016, in all RD94 dropsondes from 2010 to present and all mini-dropsondes (NRD94) collected. This dry bias is strongly temperature dependent and most significant at cold temperatures. It is considered small at warm temperatures. All sounding files undergoing post-processing have been corrected for this error and contain the flag, 'TDDryBiasCorrApplied', in the last line of the header to confirm that this correction has been applied. For more information on the dry bias, please access the technical note, linked below, which contains information on the origin, magnitude and impact of the dry bias.

   NCAR/EOL Technical Note: Dropsonde Dry Bias
   http://opensky.ucar.edu/islandora/object/technotes:542

Table 3: Special problems in the data. They are either corrected or need to take precautions when they are used. See the text for more details.

Problems	**#**	**Corrections**	**Notes**
Broken T sensor	1	none	No T data (TF09d20_04E1E7A1)
Suspicious warmer T	2	None (see Fig. 3)	Take caution TF01d10_04EDDB5 TF04d13_04E37256
Suspicious T/RH data	3	RH removed, T kept (see Fig. 4)	Take caution when using T data TF03d12_04DF4DE5 TF03d12_04E08A83 TF03d12_04E1E797
Smooth, near-saturation RH profiles	13	None (see Fig. 5)	Take caution when using RH data
Pressure offset	44	Corrected (Fig. 6)	
Fast fall	2	Wind data are set to missing	TF16d27_04E1E7D6 TF15d26_04DDC944 (< 800mb)
Not reaching surface	14	Geopotential height integrated from flight level	D20080822_001953.TF01d10_04E3721F.1 D20080826_222110.TF04d13_04E1E9E7.1 D20080829_083332.TF04d13_04E1E713.1 D20080901_001400.TF06d17_04E0B010.1 D20080906_103231.TF09d20_04E36EFA.1 D20080907_090036.TF09d20_04E1E7A8.1 D20080907_124603.TF09d20_04E1E8F8.1 D20080909_054930.TF11d22_04E0AFE9.1 D20080910_075638.TF10d21_04E1E9DD.1 D20080911_083327.TF11d22_04E1E71B.1 D20080911_235452.TF11d22_04E1E9DA.1 D20080921_055032.TF13d24_04E1E722.1 D20080922_195324.TF14d25_04E0B01E.1 D20080927_085516.TF16d27_04E36EC4.1

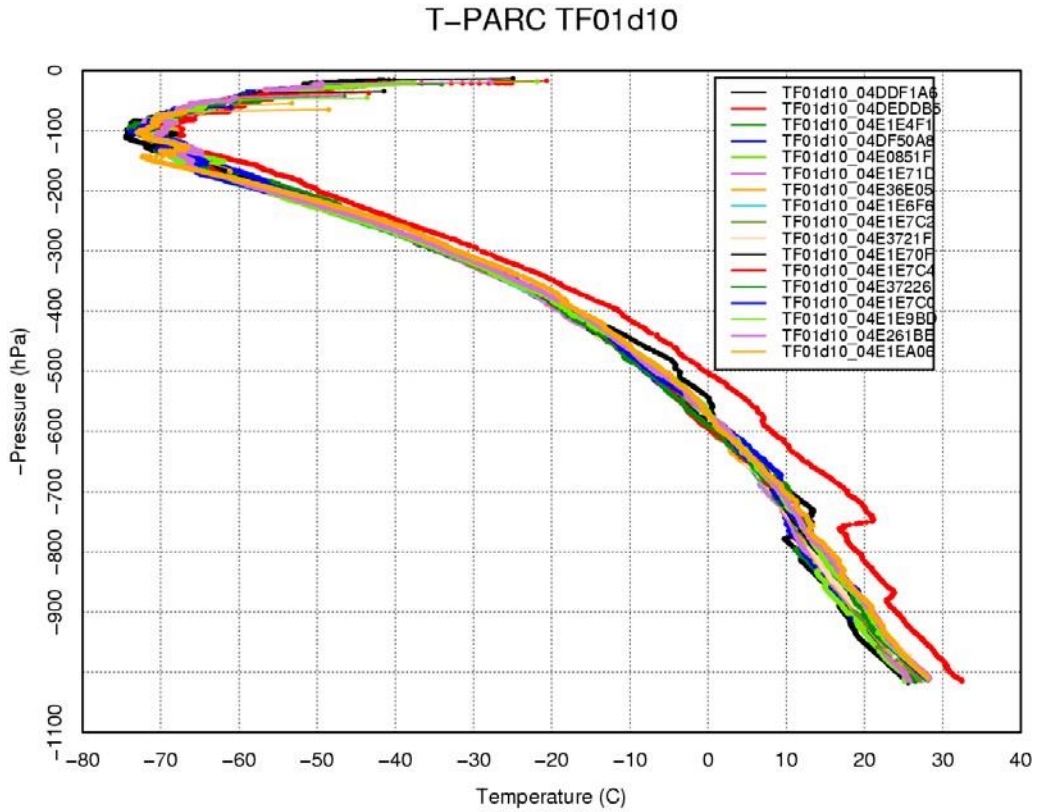

Fig. 3. Temperature profiles for TF01d10. It shows the warmer T in TF01d10_04EDDB5.

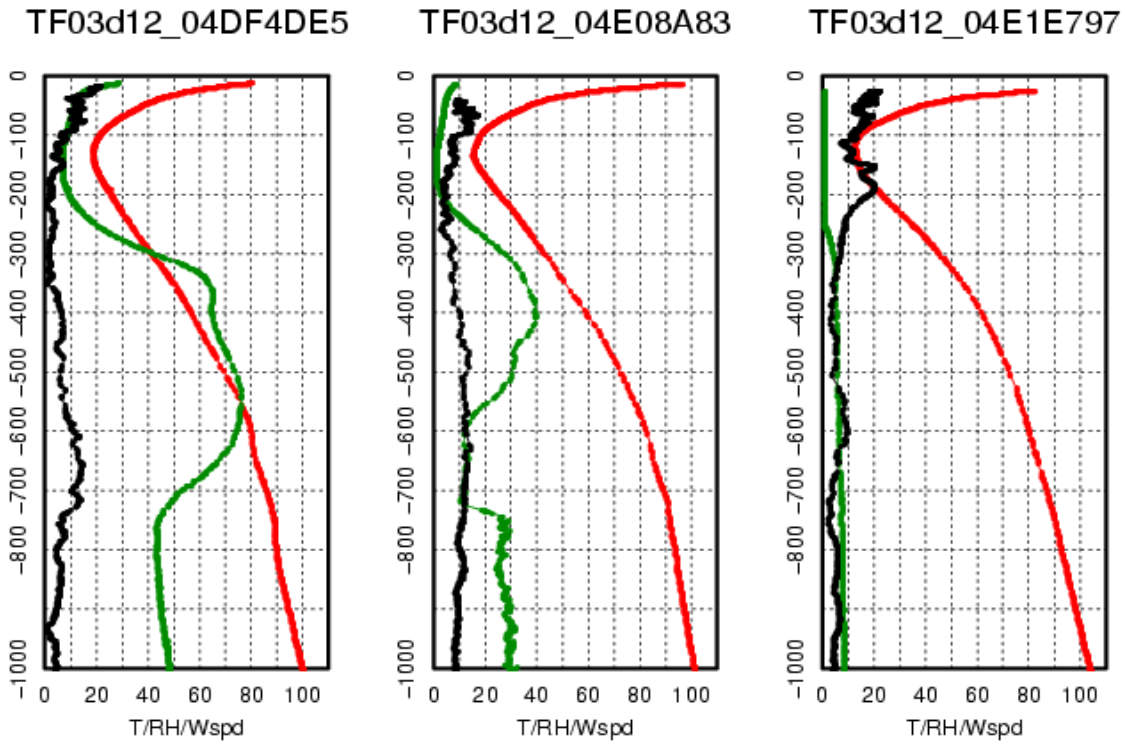

Fig. 4 Temperature (red, +80°C), RH (green, %) and wind speed (black, m/s) profiles for three soundings with suspicious RH/T data. Vertical axis is pressure in hPa.

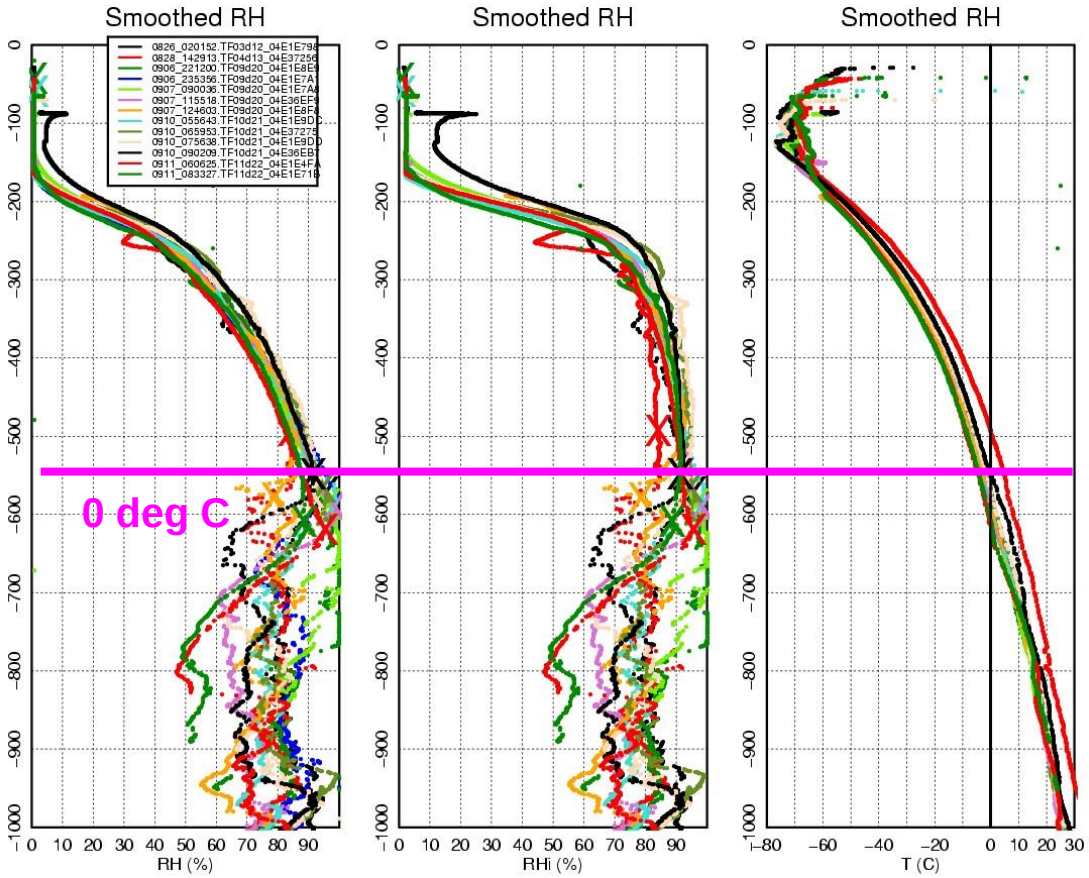

Fig. 5 Thirteen soundings having smooth, near-saturation RH values at 0°C levels. RH with respect water and ice is shown on the left and middle panels, respectively. The right panel is T profile.

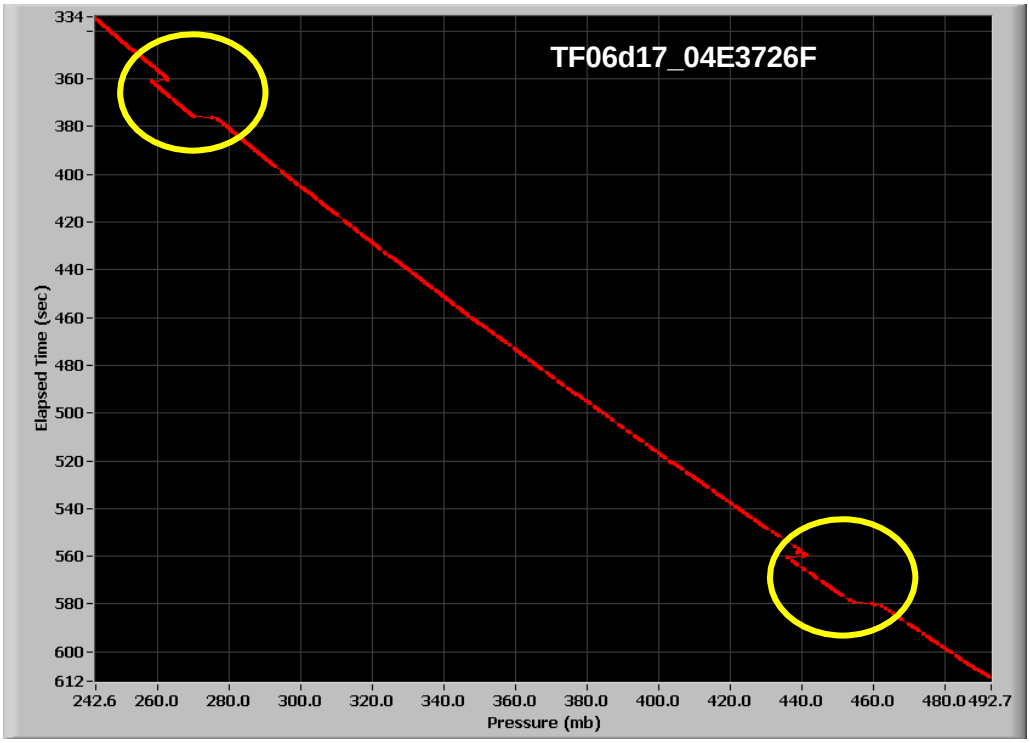

Fig. 6 Two layers with pressure offsets (yellow circles) are shown for TF06d17_04E3726F.