Second version of Quality Controlled Driftsonde Data Set from African Monsoon Multidisciplinary Analysis (AMMA) 2006

Contents:

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

2. Differences between the first and second versions of the QCed dataset

The second version of AMMA quality-controlled driftsonde data is different from the first version that was released on January 26, 2007 in the following ways:
(1) The 1st version of quality controlled (QC) data does not contain any calculated pressure values. Note that the Miniature In-situ Sounding Technology (MIST) dropsonde carried by the driftsonde did not have a pressure sensor. In the 2nd version of the QCed data, pressure was calculated and stored in the final dataset (see details in Section 6).
(2) During this second phase of the data QC, the soundings (with calculated pressure included) were run through the Atmospheric Sounding Processing ENvironment (ASPEN) software, which analyzes the data, performs smoothing, and removes suspect data points. Additional QC procedures are also applied to the 2nd version of the QCed data (see Section 6).
(3) The 2nd version of QCed data is in the EOL sounding format (see Section 4), while the 1st version was in original D file format.

The readme file for the 1st version of QCed data has been included with the release of the 2nd version of the data.

3. Project/Instrument Overview

The African Monsoon Multidisciplinary Analysis (AMMA) project was an international collaboration aimed at improving our knowledge and understanding of the West African Monsoon and its variability. The AMMA field campaign was the first deployment of the 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 60 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 deployed either at regularly timed intervals, or they can be released upon command.

During AMMA, a total of 171 MIST soundings were collected during 8 research flights launched from Niger, Africa between August 29 and September 22, 2006; 124 of them were deemed good soundings, and are included in the final archive (Figure 1). For more information on the AMMA project please visit: http://amma.mediasfrance.org/about/index

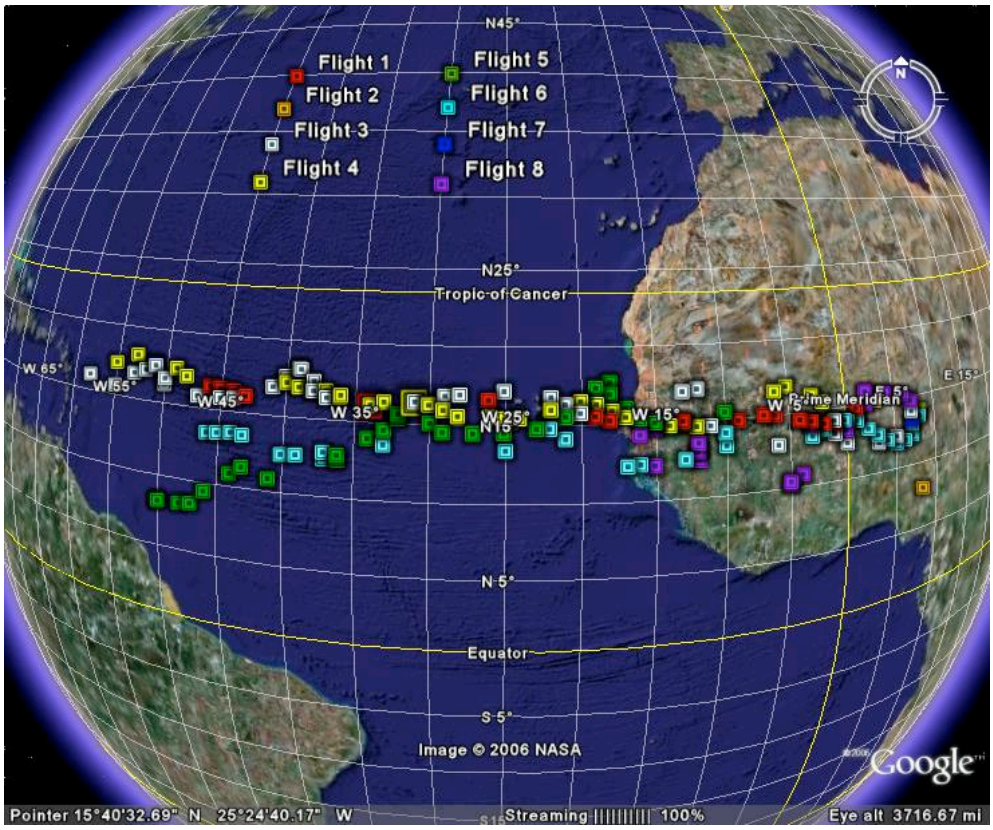

Figure 1 Map of AMMA flight tracks. Different flights are distinguished by different colors, and individual squares represent the MIST sonde launch locations.

4. EOL Sounding File Format

The EOL sounding file format is described in detail in Table 1. The files are approximately half-second data files with appropriate corrections and quality control measures applied (see Section 6). The naming convention for these files is DRIFT#, followed by "-yyyymmdd-hhmmss-##-QC.eol" where yyyy = year, mm = month, hh = hour of the day GMT, mm = minute of the hour, ss = second of the hour, ## = 1, 2 or 3 digit sonde ID, QC refers to Quality Controlled, and ".eol" refers to the file format type.

The header records consist of 14 lines which contain information such as data type, project name, site location, actual release time, and other specialized information (see Table 1). 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). The following three header lines contain information about the flight level 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:              T-REX, RF1/Gulfstream V, N677F
Launch Site:
Launch Location (lon,lat,alt):      118 14.04'W -118.234000, 36 46.04'N 36.767400, 12439.20
UTC Launch Time (y,m,d,h,m,s):      2006, 03, 02, 18:00:30
Sonde Id/Sonde Type:                053116003/Vaisala RSS903 & Ublox TIM-Lx
Reference Launch Data Source/Time:  NCAR G-V (ADS)/18:00/29
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
  sec  hh mm ss    mb     C       C      %    m/s   m/s    m/s   deg    m/s     m       deg        deg        m
------- -- -- -----  ------- ------- ------- ------ ------ ------ ------ ------ -------- ---------- ---------- ---------
-1.0 18  0  29.00  178.80 -61.10  -61.10  100.00 28.44  23.18  36.69 230.81 -999.00 12439.20 -118.234000 36.767400 12446.20
 0.0 18  0  29.00  178.80 -61.10  -61.10  100.00 28.44  23.18  36.69 230.81 -999.00 12439.20 -118.234000 36.767400 12446.20
 0.5 18  0  30.40 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.00 -999.000000 -999.0000 12416.27
```

Table 1 Example of new EOL format used for dropsonde, radiosonde and MIST sonde 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	Calculated
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	Ascension Rate	Meters/Second	Calculated
14	Geopotential Altitude	Meters	Calculated
15	Longitude	Degrees	Measured
16	Latitude	Degrees	Measured
17	GPS Altitude	Meters	Measured

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

5. Data File Specifics

The files contain data collected at approximately half-second intervals. The first data line in the sounding file, denoted by a timestamp equal to -1.0 second, is the flight level data from the NCAR Gondola, with the exception of pressure and temperature which came from one minute resolution CNES Gondola sensors after smoothing of the data was applied. The CNES temperature data were corrected for solar radiation errors. The second line in the file, denoted by a timestamp of 0.0 seconds, is basically a duplicate of the first line, with the exception that pressure is a calculated value, used for comparison with the CNES pressure flight level measurement to help verify that our pressure calculation was correct.

For soundings that transmitted data to the surface, atmospheric pressure is a derived value calculated from the surface up to flight level. Extensive analyses have been done to evaluate the pressure calculation method employed here. We found that it is best to use surface pressure values from the 4-DVAR ECMWF analysis as a starting point for the pressure calculations. Temperature, and relative humidity are calibrated values from measurements made by the sonde. The dew point is calculated from the relative humidity. The descent rate of the dropsonde is computed using the time-differentiated hydrostatic equation. The position (lat, lon, GPSalt) and winds come directly from the GPS measurements. The geopotential altitude value is calculated from the hydrostatic equation using first available pressure, temperature, and relative humidity. 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 was launched over land, because of unknown surface elevations, we integrate geopotential altitude from flight level down. Sixty-four MIST sondes were dropped over the ocean, while forty-five drops were made over land. **If the sonde failed to transmit data to the surface, as was the case with 15 soundings (see the list in Section 6), it will not contain pressure, descent rate, or geopotential altitude data.**

6. Data Quality Control and Important Information for Users

A series of QC procedures were applied to the 1st version of the data (see its readme file). The following additional QC procedures were applied to the 2nd version of the data.

1) Temperature and relative humidity profiles of the soundings were first examined to determine if all of the files contained data, and to ensure that nothing looked suspicious.
2) The soundings were then run through the Atmospheric Sounding Processing ENvironment (ASPEN) software, which analyzes the data, performs smoothing, and removes suspect data points
3) Time series plots of temperature (over land Figure 2, over ocean Figure 5), RH (over land Figure 3, over ocean Figure 6) and wind speed (over land Figure 4, over ocean Figure 7), with regard 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 the sonde was launched over land.
4) Profiles of temperature, RH, wind speed and vertical velocity versus pressure from the quality controlled soundings were visually evaluated for outliers or “fast fall” soundings, which can occur if the parachute fails to properly deploy.
5) Skew-t diagrams are examined to look for anything suspicious.
6) Histograms of pressure, temperature, relative humidity, wind speed and wind direction (Figure 8) are created to examine the distribution, range, and characteristics of each parameter.

In performing the QC procedures described above, we found that:

- Fifteen soundings failed to transmit data to the surface (Table 3). **These soundings do not contain pressure, descent rate, or geopotential altitude data.**

Data Not to Surface
DRIFT3-20060908-124621-112
DRIFT4-20060908-114259-210
DRIFT4-20060908-141502-246
DRIFT5-20060911-090459-268
DRIFT5-20060911-233410-261
DRIFT5-20060913-164456-256
DRIFT6-20060909-205558-331
DRIFT6-20060909-233922-336
DRIFT6-20060915-235531-2
DRIFT6-20060916-175358-363
DRIFT6-20060917-000339-212
DRIFT8-20060916-114850-402
DRIFT8-20060917-000337-342
DRIFT8-20060917-110705-424
DRIFT8-20060919-180344-422

Table 3 Lists MIST dropsondes that did not transmit data to the surface.

- Twelve soundings (Table 4) have geopotential altitudes that are offset because of very large gaps of missing data in the soundings between the flight level and first available data points. The gaps range from 5.4 km to 16 km and also result in calculated flight level pressures larger than CNES-measured flight level pressures (see Table 4). The geopotential altitude offsets can be seen in the temperature time series plots (Figure 2 and Figure 5), indicated by the black arrows. In Figures 2 and 5, a linear interpolation has been applied to fill the large gaps of missing data.

Geopotential altitude offsets	FL Press Diff (mb) (CNES – Calculated)	GPS Alt Diff (m) (FL – First Avail)
DRIFT1-20060829-100805-11	-4.27	6708.37
DRIFT3-20060902-121318-87	-5.46	9053.43
DRIFT3-20060902-180250-76	-4.98	8895.11
DRIFT3-20060903-184429-81	-3.66	5403.31
DRIFT3-20060906-113951-65	-2.45	7313.69
DRIFT4-20060906-141844-205	-6.02	8561.88
DRIFT4-20060906-173709-230	-6.96	9952.14
DRIFT5-20060909-174941-307	-5.79	9642.65
DRIFT5-20060910-114220-306	-4.31	7753.24
DRIFT6-20060910-113849-304	-9.35	16377.62
DRIFT6-20060913-113546-316	-3.84	8183.31
DRIFT6-20060914-113853-350	-2.59	6807.04

Table 4 Lists MIST dropsondes with geopotential altitude offsets caused by large gaps of missing data. Column 2

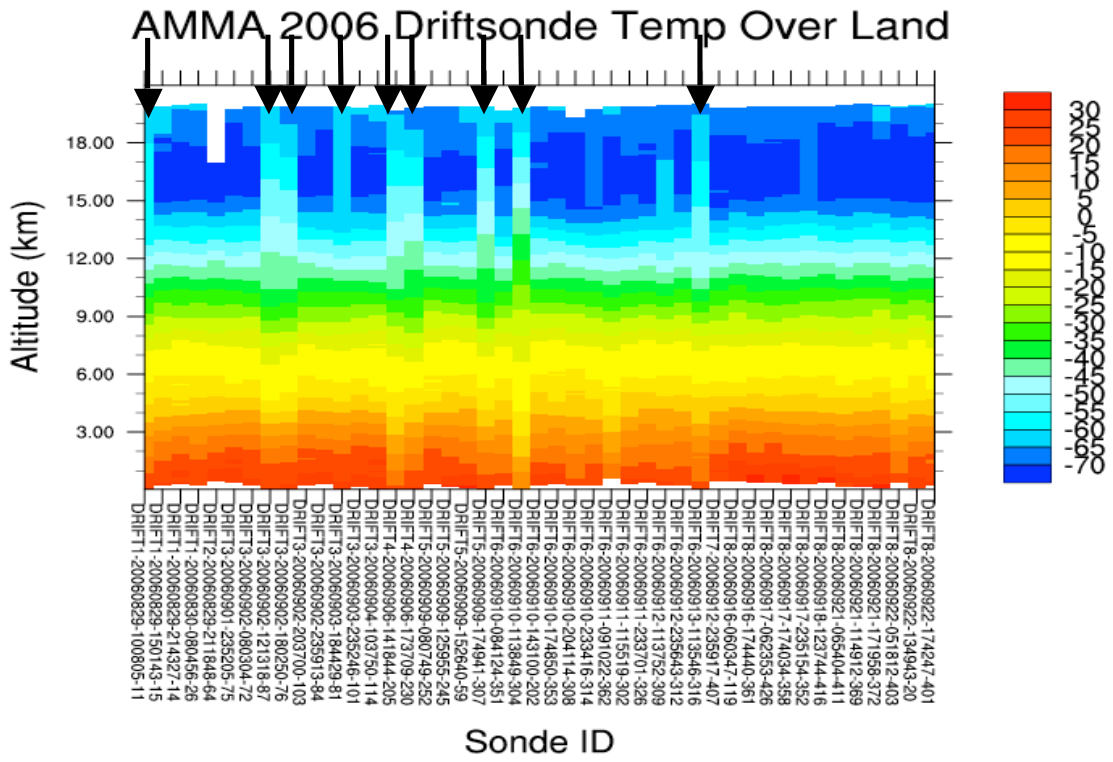

Figure 2 – Time series of temperature (deg C) profiles from sondes launched over land. Sounding files are labeled along x-axis.

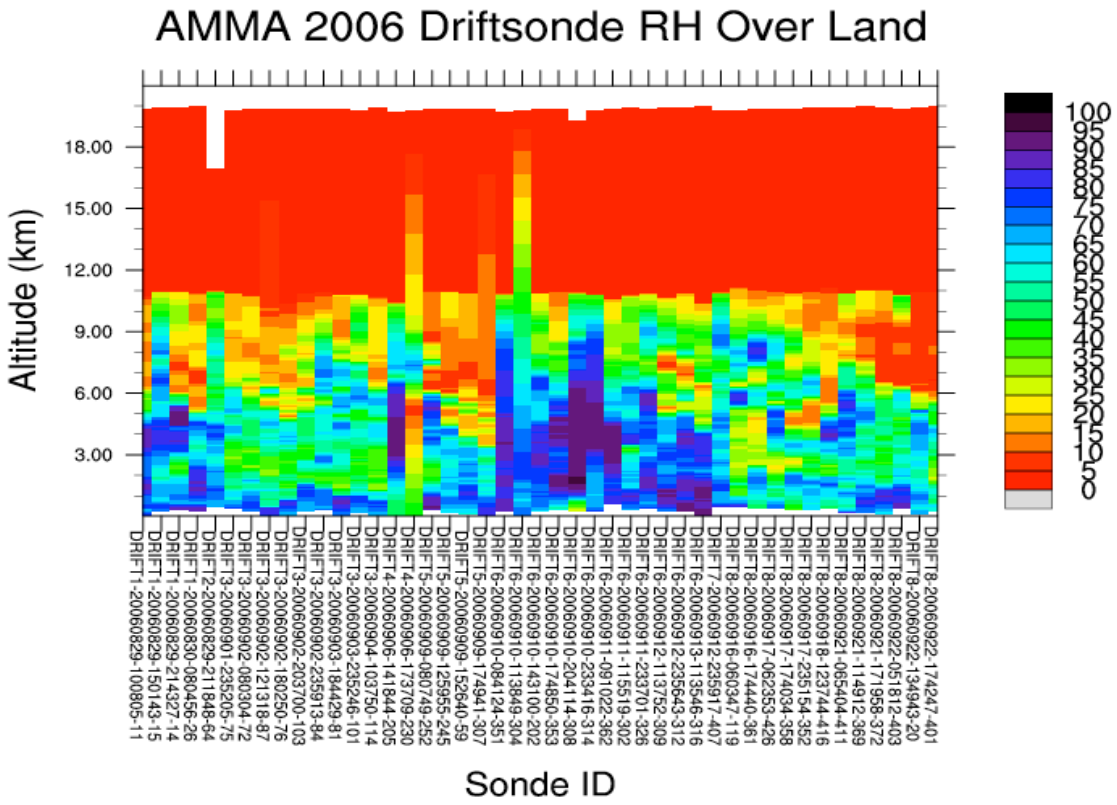

Figure 3 –Time series of relative humidity (%) profiles from sondes launched over land. Sounding files are labeled along x-axis.

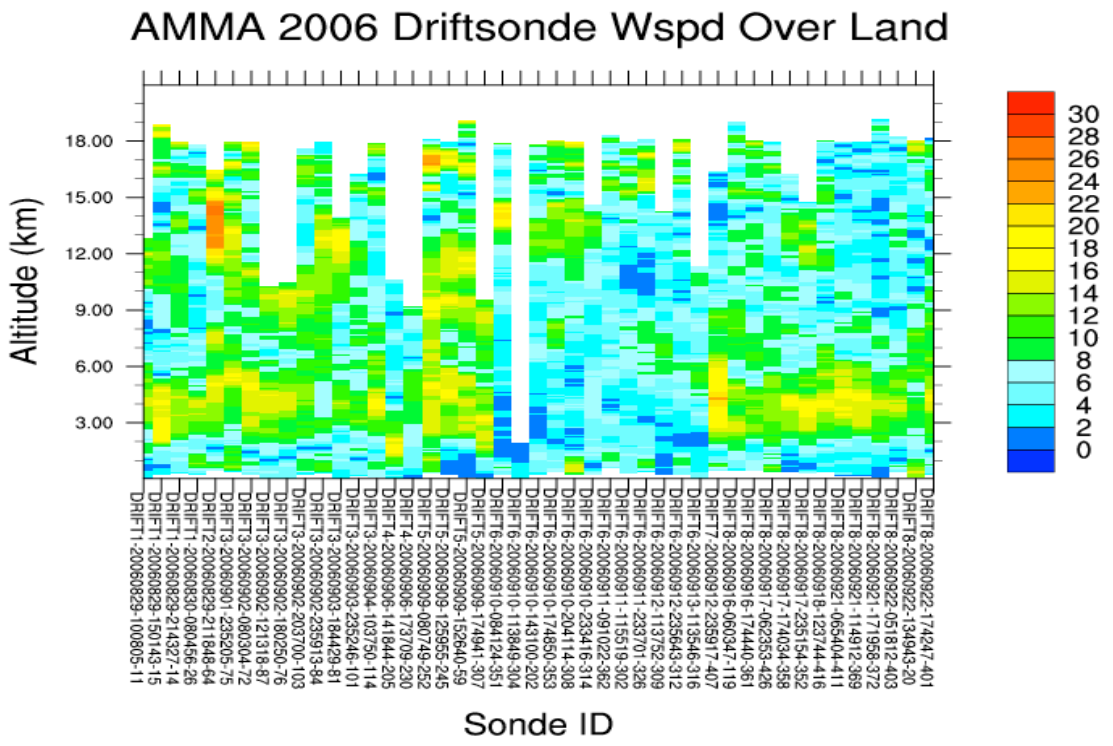

Figure 4 –Time series of MIST sonde wind speed profiles (m/s) from sondes launched over land. Sounding files are labeled along x-axis.

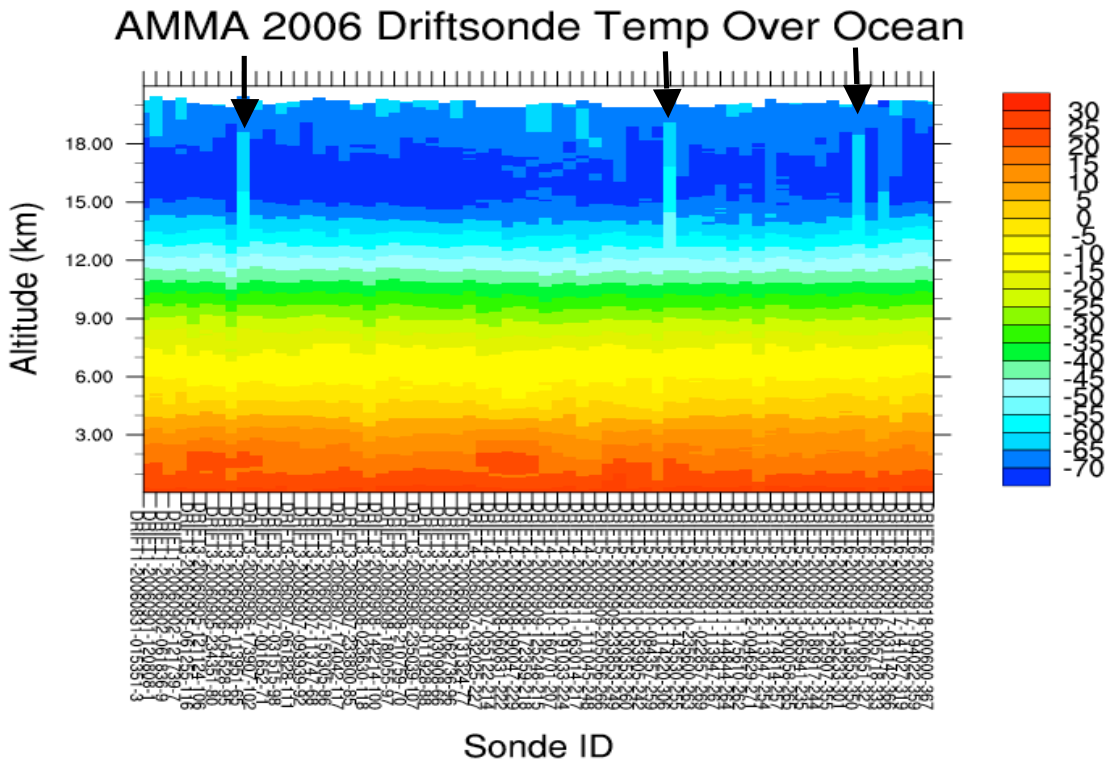

Figure 5 –Time series of MIST sonde temperature profiles (m/s) from sondes launched over the ocean. Sounding files are labeled along x-axis

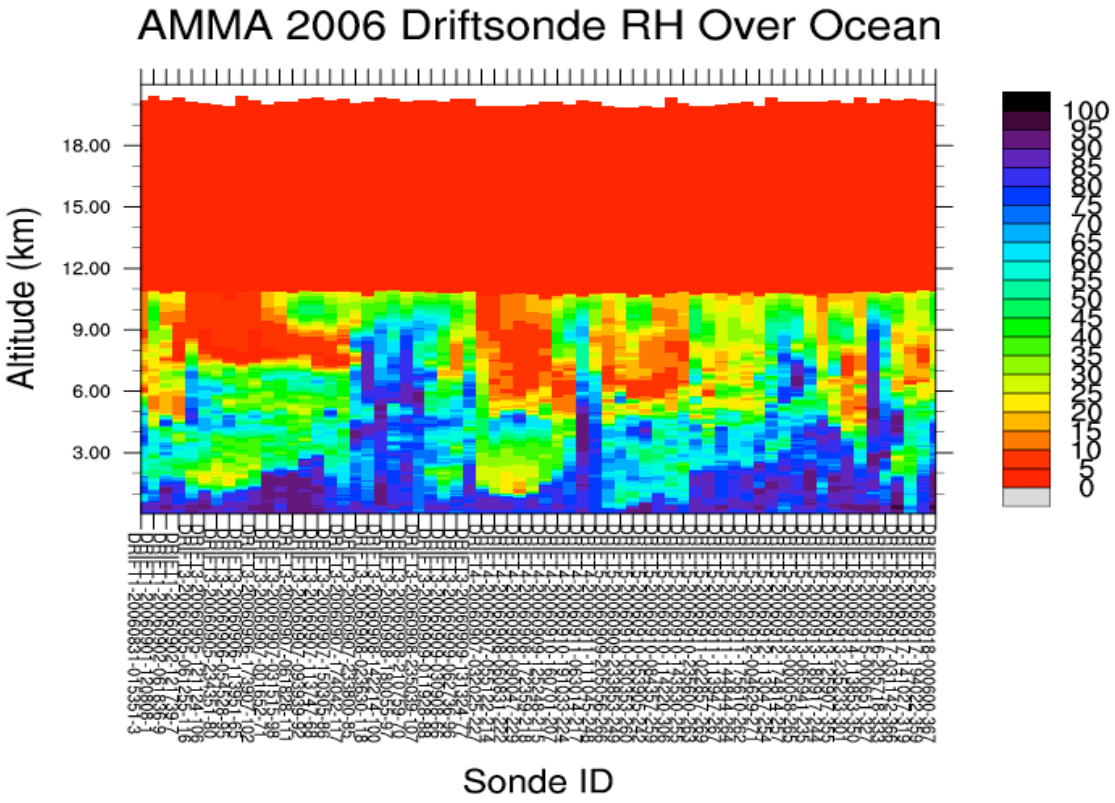

Figure 6 –Time series of relative humidity (%) profiles from sondes launched over land. Sounding files are labeled along x-axis.

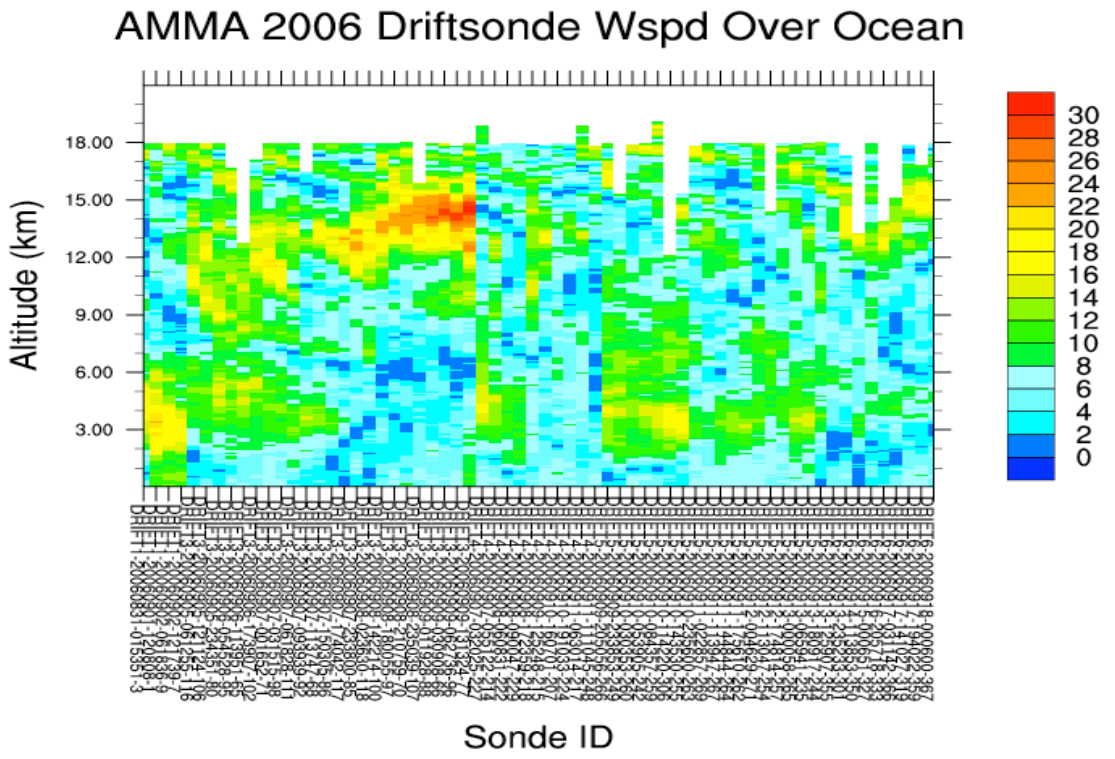

Figure 7 –Time series of MIST sonde wind speed profiles (m/s) from sondes launched over land. Sounding files are labeled along x-axis

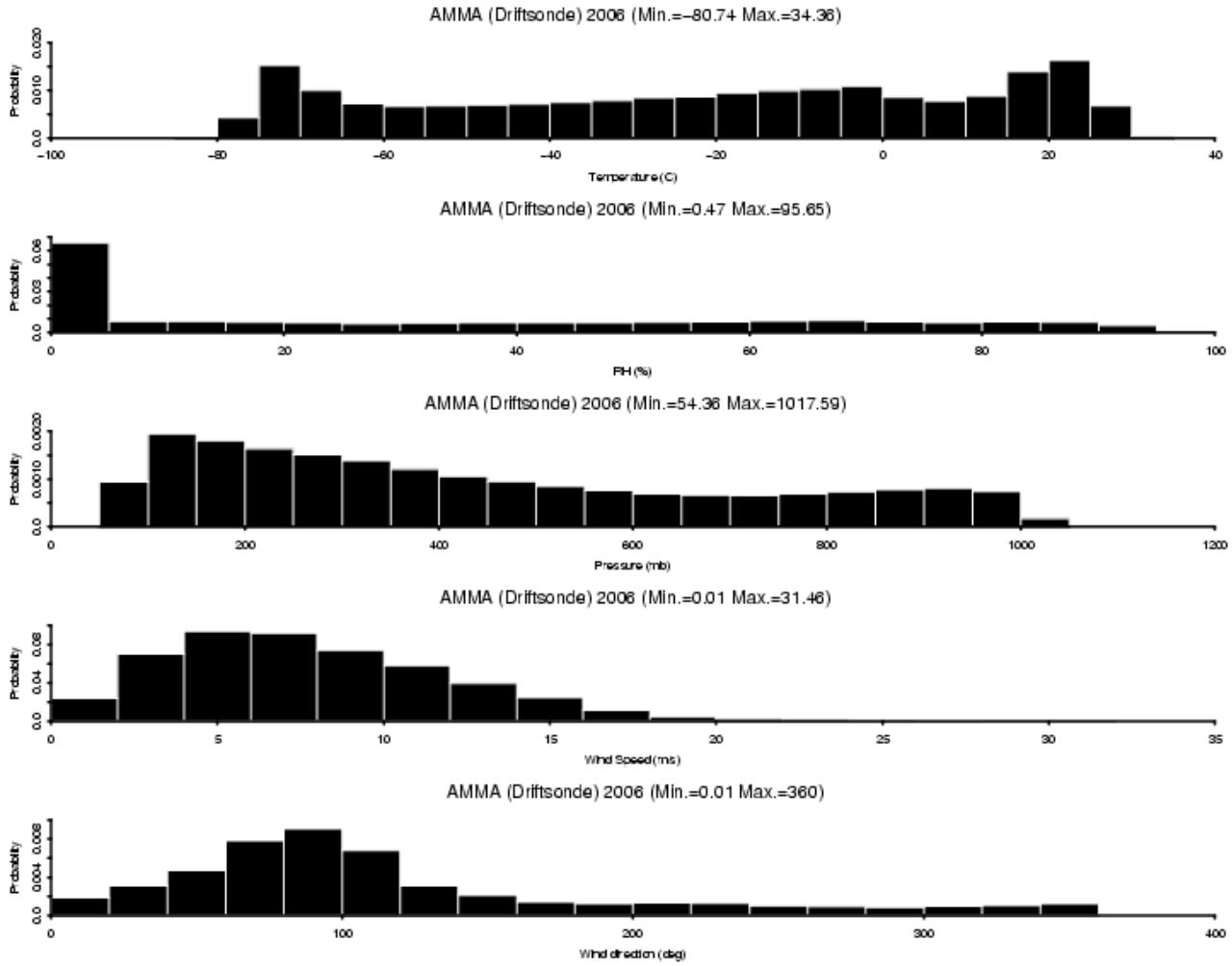

Figure 8 –Histograms of variables Temperature, RH, Pressure, Wind Speed and Wind Direction