Southern Ocean Clouds, Radiation, Aerosol Transport Experimental Study

SOCRATES-2018
NCAR/EOL
Dropsonde Data Quality Report

The dropsonde data for this project were quality controlled and are maintained by the Earth Observing Laboratory at the National Center for Atmospheric Research (NCAR). NCAR is sponsored by the National Science Foundation (NSF). In the event that information or plots from this document are used for publication or presentation purposes, please provide appropriate acknowledgement to NSF and NCAR/EOL and make reference to Young K. and H. Vömel: Socrates 2018 NCAR/EOL Dropsonde Data Quality Report.

In the event that these datasets are used for research resulting in a publication, please include the following citations in your paper:

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SOCRATES 2018 Quality Controlled Dropsonde Dataset

National Center for Atmospheric Research
Earth Observing Lab
Boulder, Colorado

Contacts:

Data Quality
Kate Young (kbeierle@ucar.edu)
Holger Vömel (voemel@ucar.edu)

System & Software Engineering
Terry Hock (hock@ucar.edu)
Mack Goodstein (mack@ucar.edu)
Nick Potts (npotts@ucar.edu)

Mailing Address:
NCAR/Earth Observing Laboratory
P.O. Box 3000
3090 Center Green Dr.
Boulder, CO 80301; USA

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I. Dataset Overview

The Southern Ocean Clouds, Radiation, Aerosol Transport Experimental Study (SOCRATES) was a multi-agency, multi-national NSF funded research campaign conducted in the Southern Ocean between Tasmania and Antarctica (Figure 1). This study was aimed at improving weather and climate model simulations of aerosols, precipitation and radiation by examining cloud-aerosol interactions and air-sea exchanges. The Earth Observing Laboratory (EOL) conducted 15 research flights of the NCAR GV aircraft between January 15 and Feb 24, 2018. Twelve of those flights included the deployment of dropsondes. A total of 109 dropsondes were launched (Table 1), 53 were the new NRD41 dropsondes and 56 were the older NRD94. The NRD41 dropsondes have an improved next generation Vaisala PTU module which have a faster response temperature sensor and an improved RH sensor. Additionally, all of the electronics have been updated, including a new 400 MHz transmitter and next generation GPS receiver for the measurement of winds.

This document contains information on the field project, a link to information on the sounding file format and data parameters, and provides details regarding the quality control procedures performed and corrections applied.

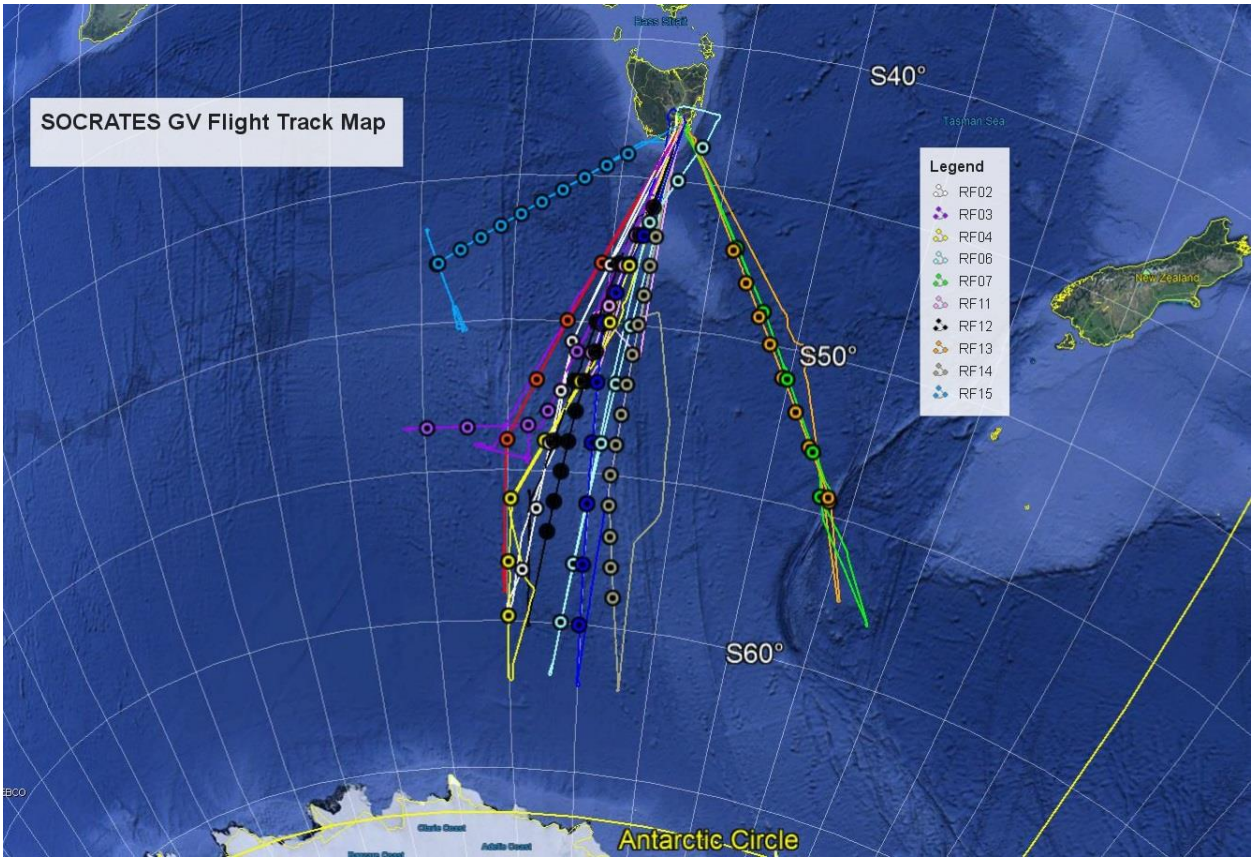

Figure 1 - Map of the NCAR GV Flight Tracks and Dropsonde Launch Locations.

Table 1 - Total Dropsonde Counts for each Dropsonde Type based on Research Flight

Research Flight	2018 Dates (UT)	NRD41 Sondes Deployed	NRD94 Sondes Deployed
RF02	01/19	4	3
RF03	01/22	3	3
RF04	01/23 – 01/24	4	4
RF05	01/25 – 01/26	3	2
RF06	01/28 – 01/29	5	5
RF07	01/31	3	3
RF10	02/07	5	5
RF11	02/17	7	-
RF12	02/18	7	7
RF13	02/19 – 02/20	5	5
RF14	02/21 – 02/22	4	10
RF15	02/24	3	9
	Total	**53**	**56**

II. EOL Sounding File Format and Data Specifics

https://www.eol.ucar.edu/system/files/files/observing_facility/AVAPS%20Dropsonde%20System/Vaisala%20Dropsonde%20ASCII%20Sounding%20File%20Format%20v1.pdf

III. Data Quality Control Process

1) Profiles of pressure, temperature, RH, wind speed and descent rate from the raw data files are examined to determine if all contain data and to identify features that may warrant further investigation.

2) A plot of the last available pressure from each of the dropsondes is examined to determine if all instruments transmitted useful data to the surface. In cases where they did not, the aircraft flight level GPS altitude data is used as a starting point for the calculation of the geopotential altitude integration downward. Figure 2 shows that all soundings successfully transmitted data to the surface.

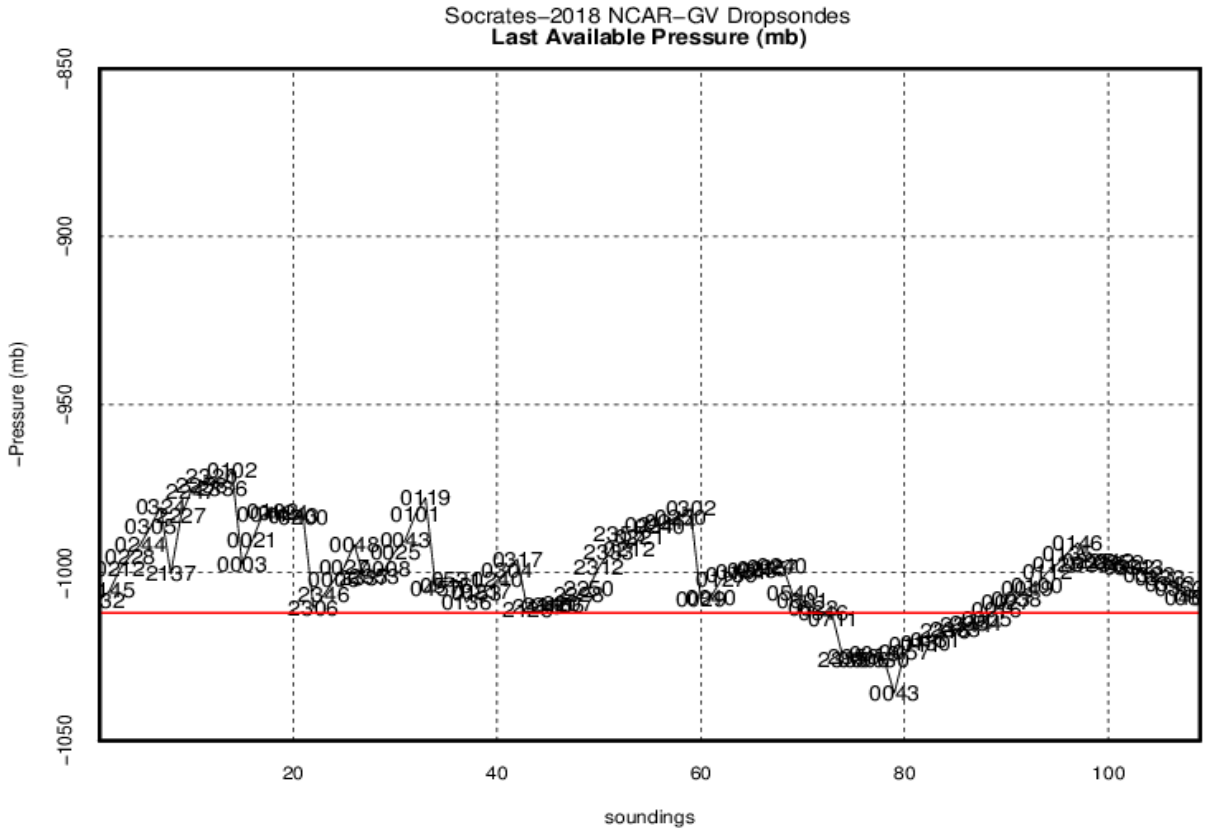

Figure 2 - Scatter plot of the sounding sequence versus the last available pressure measurement.

3) A pressure calibration correction is applied to the entire profile for each sounding during the QC process. The pressure correction value is unique for each dropsonde and is determined in the final production testing of the dropsonde. An independent reference pressure sensor is used to determine a constant pressure offset correction. The corrected pressure $P = P_{DS} + (P0_{REF} - P0_{DS})$, where P_{DS} is the pressure measured by the dropsonde, $P0_{REF}$ is the pressure as indicated by the reference pressure sensor and $P0_{DS}$ is the dropsonde pressure during calibration testing. The median pressure correction is +0.95 hPa (Figure 3). This correction is not implemented in real-time during the field campaign.

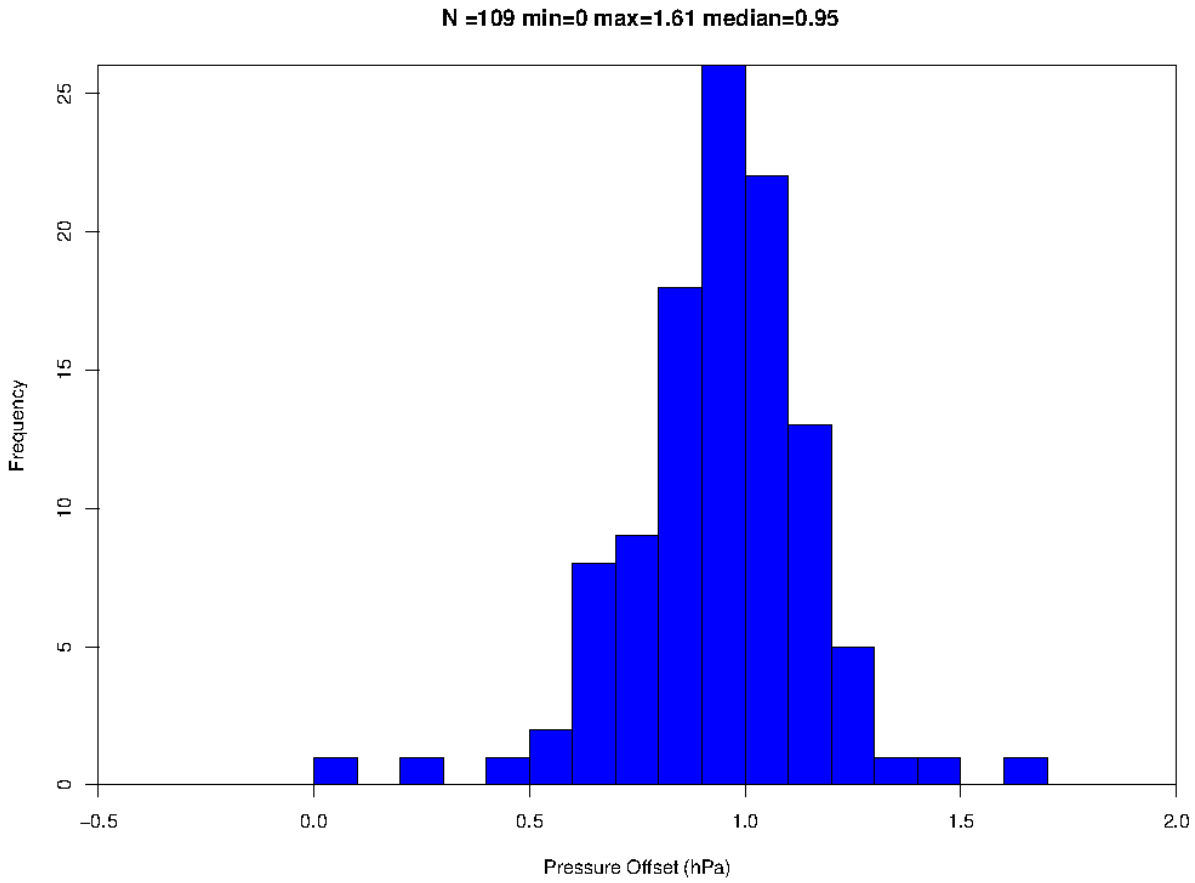

Figure 3 - Frequency histogram of pressure corrections applied to the dropsondes.

4) The sounding files with the corrected pressure offset are then processed through the Batch Atmospheric Sounding Processing ENvironment (ASPEN) software which:

   i) Applies a dynamic correction for temperature and wind

   ii) Separates wind speed and direction into *u* and *v* components and individually applies QC. If one of the two components fails a test, then the components as well as speed and direction are removed from the QC data.

   iii) Removes suspect data points in pressure, temperature and relative humidity.

   iv) Filters the GPS latitude, longitude and altitude to remove spikes introduced by telemetry errors.

   v) Performs smoothing.

The ASPEN software version and configuration file used for this program are included in the header of each "QC.eol" sounding file. There were no configuration changes made to account for the faster response of the NRD41 dropsonde because the aircraft was flying at a relatively low altitude, below 8 km. For more information on ASPEN or to download the software please visit: http://www.eol.ucar.edu/software/aspen

5) Time series plots of quality controlled temperature, RH, wind speed, and fall rate, are used to examine the consistency of soundings launched during each flight, and to show the variability of soundings from different missions.

IV. Results

The following issues were found in Table 2. Corrections applied are detailed below.

Table 2 - Summary of data quality issues.

Data Quality Issue	# of soundings
Fast Fall	1
Partial Fast Fall	4
GPS Issues	2

1. **Fast Fall and Partial Fast Fall -** One sounding was classified as a 'fast fall', meaning the parachute failed to properly deploy resulting in the dropsonde falling at an accelerated rate. Four soundings were classified as 'partial fast falls' which occurs when the parachute fails to open properly at launch however, it recovers at some point during the descent and the fall speed slows. When a fast fall occurs, GPS wind measurements can be unreliable (due to irregular motion of the dropsonde) and a lag in the response of the T/RH and sensors may occur. A time-series plot, Figure 4, shows the soundings that fell at an accelerated rate.

Table 3 - Soundings with parachute deployment issues resulting in accelerated fall rates.

Sounding Filename	Issue
D20180129_002520	Fast fall
D20180218_020346	Partial fast fall
D20180218_022756	Partial fast fall
D20180220_003030	Partial fast fall
D20180224_040428	Partial fast fall

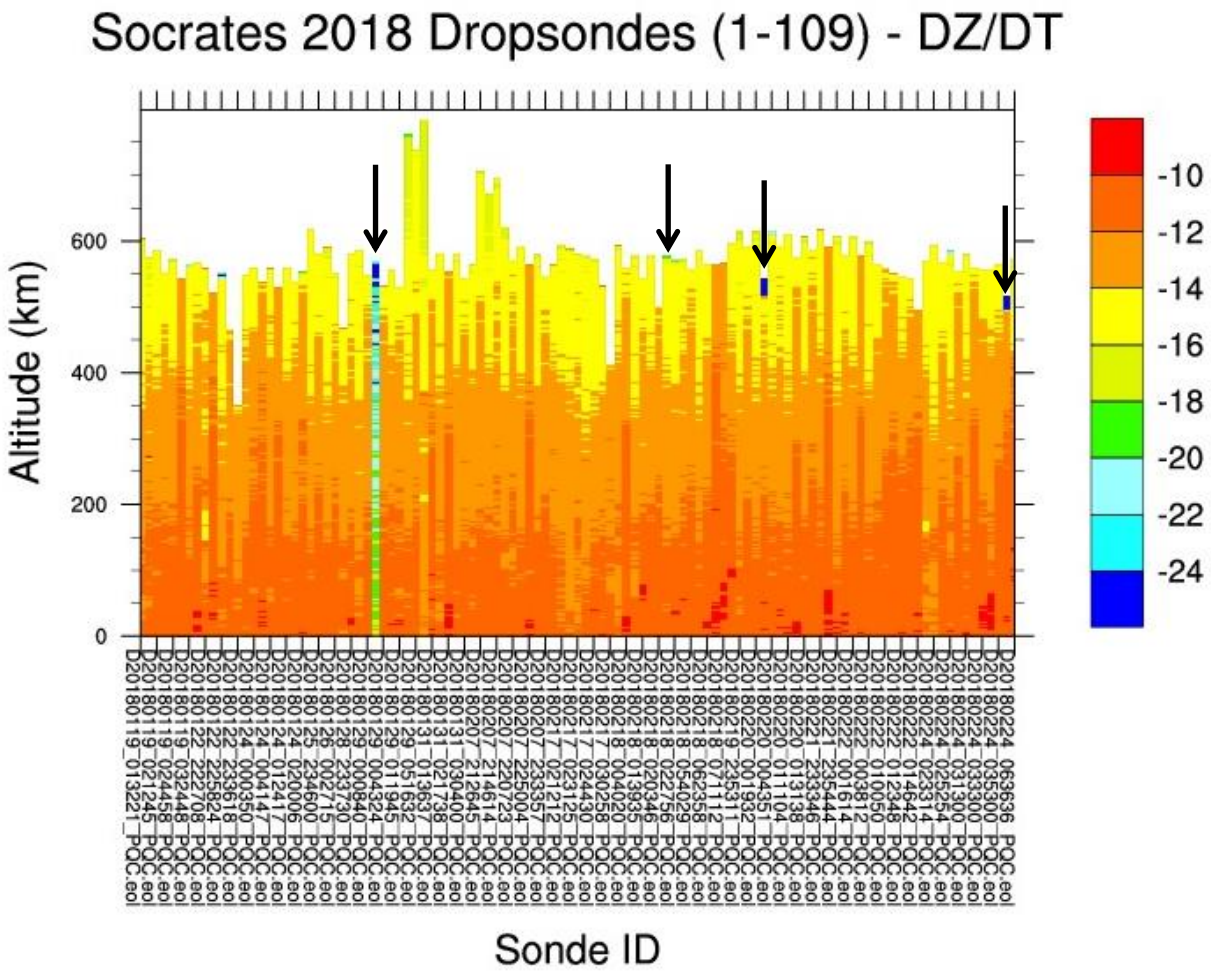

Figure 4 Sounding profiles of descent rates versus calculated geopotential altitude, shows accelerated fall speeds in four profiles indicated by the black arrows. The x-axis provides a label of every other sounding collected, however the contours represent every sounding made during the project.

2. GPS Issues – The following soundings experienced problems with the GPS receiver in the dropsonde that resulted in some loss of GPS altitude, latitude, longitude, wind speed and wind direction.

Table 4 Soundings that experienced loss of GPS data at the top of the profiles.

Sounding Filename	
D20180124_020006	No no GPS data above 1,968 meters
D20180220_013138	No no GPS data above 2,116 meters

V. References

Young, K., Vömel, H. (2016, Dec. 09). *EOL Sounding File Format.* Retrieved from https://www.eol.ucar.edu/system/files/files/observing_facility/AVAPS%20Dropsonde%20System/EOLSoundingDataFileFormat.v2_0.pdf

Vömel, H., K. Young, and T. F. Hock, 2016: *NCAR GPS Dropsonde Humidity Dry Bias*. NCAR Technical Note NCAR/TN-531+STR, 8 pp, doi:10.5065/D6XS5SGX. (http://opensky.ucar.edu/islandora/object/technotes:542)