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SAVANT 2018
Radiosonde Data Quality Report

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Integrated sounding system home page: https://www.eol.ucar.edu/content/savant-iss

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Document Version Control

Version	Date	Author	Change Description
1.0	21 Dec 2018	H. Vömel	Initial Data Release

1 Table of Contents

2 Dataset Overview

The Stable Air Variability and Transport (SAVANT) field campaign investigated the effects of converging shallow cold air drainage and background flow on aerosols transport and dispersion. From 15 September to 15 November 2018 two integrated sounding systems (ISS) were deployed at two locations near Champaign, IL. This document describes the quality of the data obtained from the NCAR/EOL radiosonde launches at the Homestead site.

At the Homestead site (ISS1), 41 successful radiosondes were launched during the campaign. Soundings were launched on select days for the duration of the campaign, with up to five soundings, which were typically launched in 2-hour intervals.

Figure 1 shows the flight tracks of the ascending part of all soundings. The distance between the radiosonde launch site and the second ISS site (Farm Field site) is approximately 4.5 km.

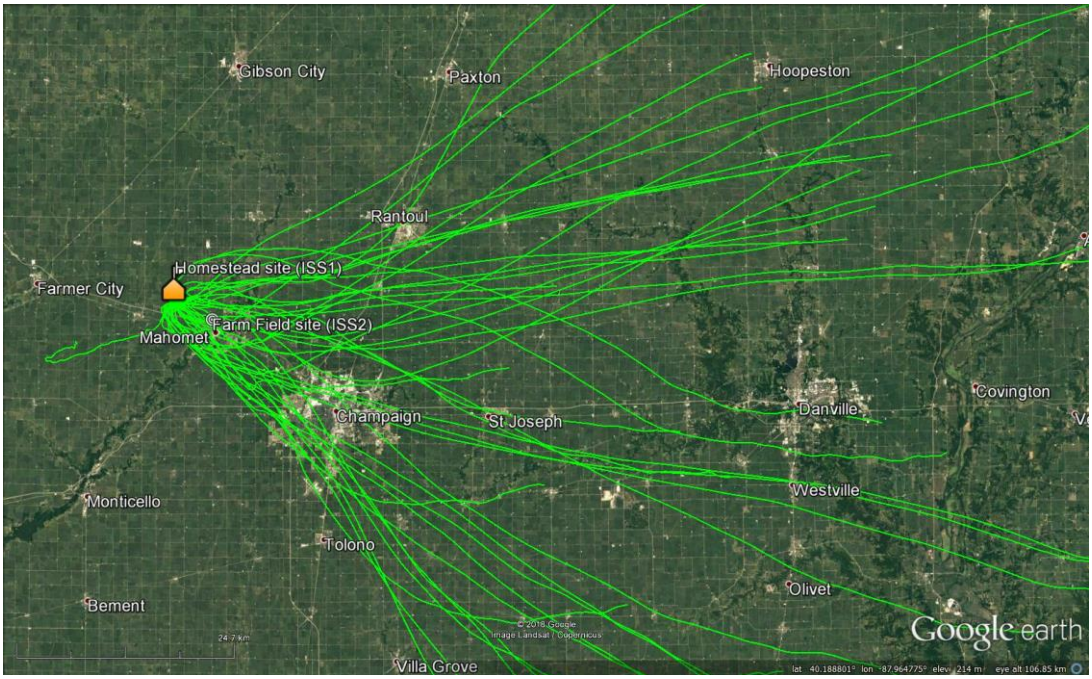

Figure 1: Location of the ISF sites during SAVANT and flight tracks of all ascending radiosonde profiles. The sounding location was at the Homestead site (ISS1). The second ISS site was located at the Farm Field site about 4.5 km to the East-southeast and did not launch radiosondes.

3 Radiosonde sounding system

This campaign used Vaisala RS41-SGP radiosondes, which were received and processed by the Vaisala MW41 sounding system using software version 2.5.0. The radiosondes used by NCAR/EOL include a pressure sensor, which provides a better altitude and pressure determination in the boundary layer and is more suitable for unstable conditions in convective environments. The sounding system was configured to meet the needs of NCAR for high-resolution data and complete metadata description. All sondes were launched using 100 g balloons supplied by Scientific Sales.

The MWX raw data files from the sounding system were saved along with the ASCII output files, which contained the initially processed profiles.

High-resolution BUFR messages and low-resolution TEMP messages were transmitted to the WMO Global Telecommunication System (GTS) in real time to provide operational data for weather prediction by the international weather forecasting centers.

Data for many, but not all soundings were recorded also on descent; however, these data are not analyzed or archived and can be made available only upon request.

The sounding systems automatically ingest surface reference observations, which are provided by sets of reference sensors near each launch site. These observations are stored in the surface observations metadata fields of the sounding files and used in the quality control procedures of the sounding data.

The reference sensors used for the radiosonde system during SAVANT are listed in Table 1.

Table 1: Surface reference observations provided by the ISS meteorological reference sensors during SAVANT.

Parameter	Location	Sensor
Pressure	The reference pressure was installed on a mast at 2 m height near the launch site.	Vaisala PTB210
Temperature and humidity	The reference sensors for temperature, humidity, wind speed, and wind direction were installed on a mast at 2 m height near the launch site.	Lufft WS300
Wind	The reference sensor for wind speed and wind direction was installed on a mast at 10 m height near the launch site.	Gill Wind Observer (2D sonic)

4 Quality control procedures

4.1 Standard quality control

The Vaisala system performs a sequence of standard quality control procedures and corrections for all radiosonde data:

- Applies a ground check correction for pressure using the pressure correction measured during the sonde preparation to compensate for small biases inherent in this type of pressure sensor.
- Performs a coarse outlier check for all measurement parameters
- Automatically detects launch based on change in pressure
- Performs a radiation correction for the temperature measurement using the radiation correction lookup table for the Vaisala RS41 radiosonde
- Corrects for response time lag of the temperature sensor
- Smooths the temperature profile
- Corrects for response time lag of the humidity sensor
- Filters out the balloon pendulum effect in the calculation of winds
- Calculates geopotential altitude based on the measured pressure profile

4.2 Custom quality control

In addition to the standard Vaisala procedures, all metadata are verified, and all measured parameters including reference measurements are checked for consistency and for any previously unidentified issue. The radiosonde measurements before launch are compared against the reference measurements and the causes for early termination are investigated. In the SAVANT data set, the following issues were identified and corrected:

a. The sounding 20181103_033313 was launched 15 s earlier than the launch was detected. The missing data have been reprocessed from raw data and the launch time stamp has been properly adjusted. Note that the file name was not changed, only the metadata inside the file.

b. The sounding 20180924_040100 used a defective balloon and only reached an altitude of 200 m above ground. This sounding was excluded from the archive and was not included in the statistics below.

The final quality controlled data are provided in NetCDF format following the CF-1.6 metadata convention for climate and forecasting. For a detailed description of the data format, refer to Vömel et al., 2018, https://doi.org/10.5065/D65X27SR.

5 Sounding metrics

At the Homestead site near about 20 km northeast of Champaign, IL, 41 successful radiosondes were launched between 15 September and 14 November 2018. Soundings were mostly launched on intensive days, with up to four launches, typically in two-hour intervals. Nine soundings were launched during daytime, 5 during the startup phase, and 4 during the latter half of the campaign. Thirty-two soundings were launched at nighttime.

No sounding was launched in strong winds or rain; and no radiosonde failed during a sounding. All scheduled launches were met.

Balloons were nominally filled with 23 ft3 of helium. The distribution of ceiling heights is shown in Figure 2. The soundings with the three lowest ceiling altitudes were stopped manually for operational reasons. In 13 out of 15 soundings with ceiling altitudes between 10 and 16 km, data reception was lost before balloon burst. For these, the direction of the last data received was between 53° and 86° from north, where a building was blocking telemetry reception. The other 23 soundings reached a median ceiling height 17.4 km. The maximum altitude reached was 20.1 km. These ceiling altitudes are consistent with nighttime ceiling altitudes in previous campaigns.

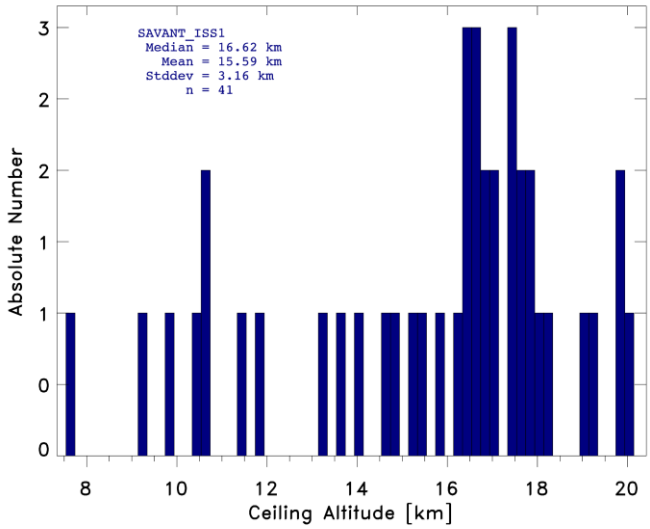

Figure 2: Distribution of ceiling heights for all radiosondes launched at the Homestead site during SAVANT.

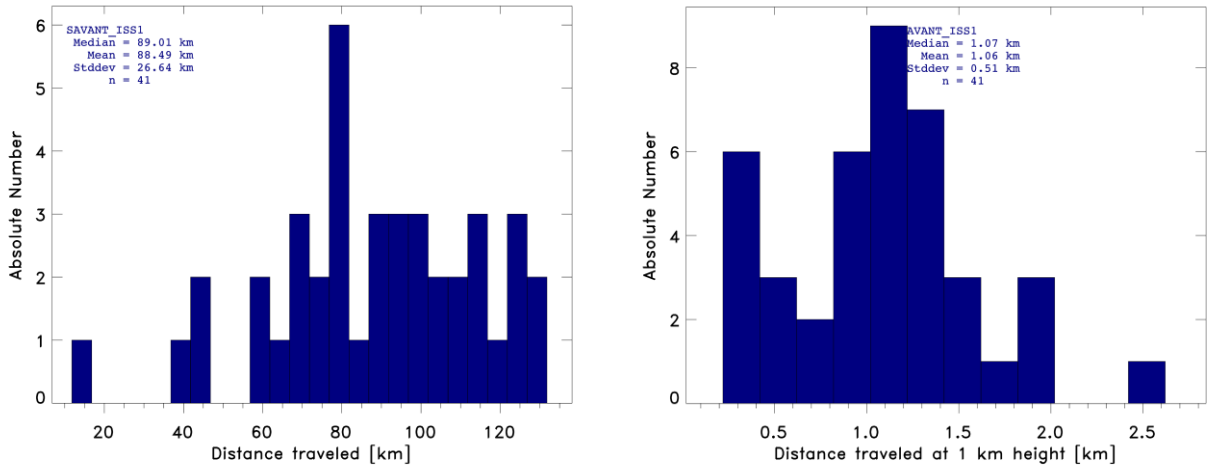

Figure 3: Distribution of balloon distance at end of data recording (left panel) and at 1 km above ground (right panel).

At burst, data were received up to a distance of 130 km. The distribution of balloon distances at ceiling altitude and at 1 km above ground is shown in Figure 3. The median distance at which a sounding was terminated was 88 km and the smallest distance was 12 km. At 1 km above ground, the median distance was 1 km from the launch site and all balloons but one were closer than 2 km at that altitude.

The median rise rate over the entire profile varied typically between 3.7 m/s and 4.9 m/s with a mean value of around 4.1 m/s. The distribution of rise rates for all soundings is shown in Figure 4.

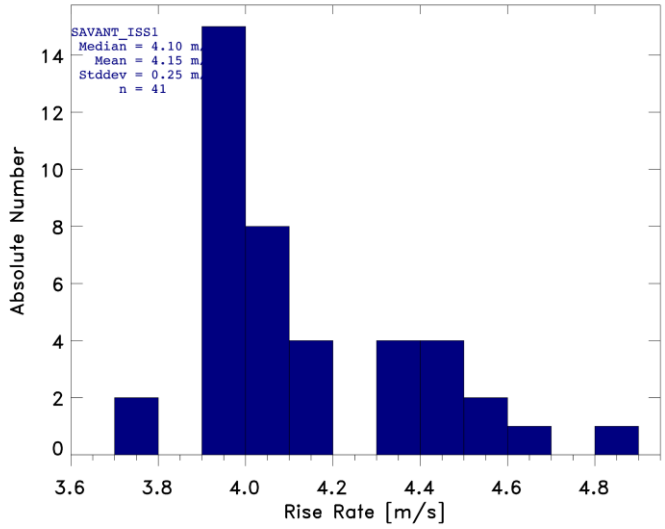

Figure 4: Distribution of rise rates for all radiosondes launched at the Homestead site during SAVANT.

The sequence of all balloon rise rates (Figure 5) shows that during SAVANT this type of balloon rises faster in the lowest 1 km with an average rise rate of about 5.6 m/s. Therefore, the vertical resolution of measurements in the lowest troposphere is about 5.6 m; and about 4.1 m above that.

Very few cases were observed, where the balloon encountered faster updrafts in some layers. These cases are shown in lighter colors in the middle and upper troposphere. Most soundings that encountered faster rise rates are daytime soundings. Notable exceptions are the soundings on 20181112_052653, 20181114_083309, and 20181114_102436.txt, which encountered significant layers of updraft.

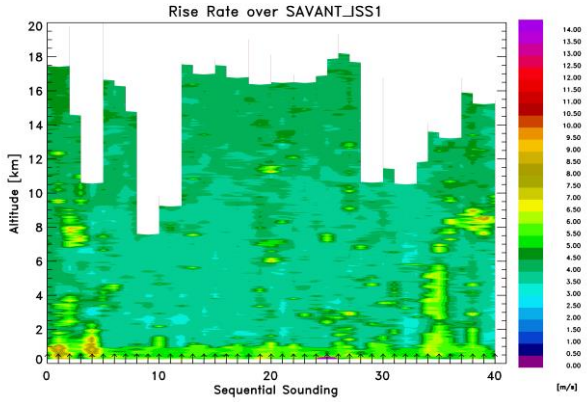

Figure 5: Sequence of rise rate profiles for all radiosondes launched at the Homestead site during SAVANT. Each launch is indicated by a small arrow at the bottom of the diagram. For a list of all soundings, see Section 7.

6 Atmospheric Measurements

Air temperature and relative humidity measurements from all radiosondes are shown in Figure 6. The soundings that did not reach to the typical 17 km altitude are clearly indicated and correlate to strong winds taking the balloon to northeastern directions. The soundings span a period of two months, during which surface temperatures changed from warmer than +30°C to nearly -10°C. The tropopause could not be determined in all profiles and is not included. It ranged between about 8 and 16 km with the most common altitude around 11 km. The tropopause can be seen by the rapid drop of relative humidity to values of less than 5%. As is customary, all relative humidity profiles are clipped at 100 % relative humidity over liquid.

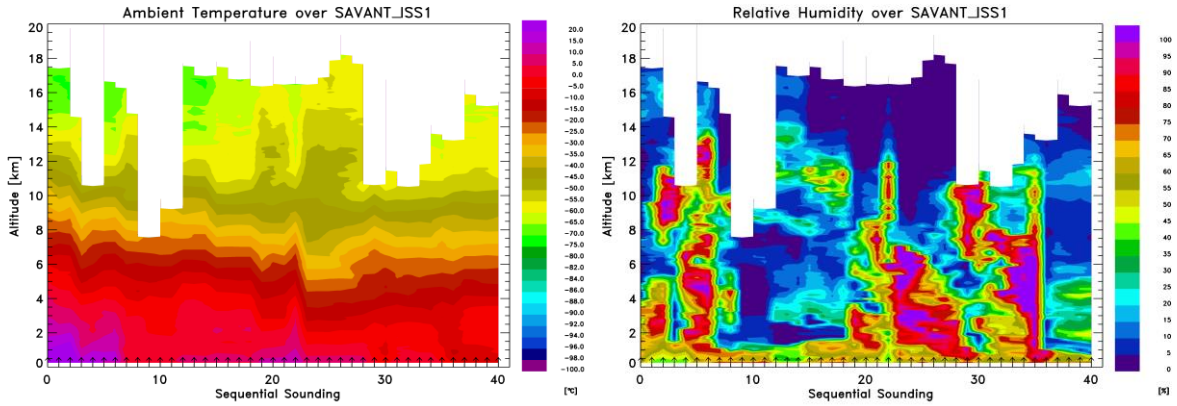

Figure 6: Sequence of temperature profiles (top) and relative humidity profiles (bottom) from all radiosondes launched at both sites. Note that the discontinuity between the two observation periods occurs at sounding number 120.

The zonal wind speed measurements at both sites are shown in Figure 7. The proximity of the jet stream is indicated by high wind speeds in the upper troposphere in excess of 50 m/s.

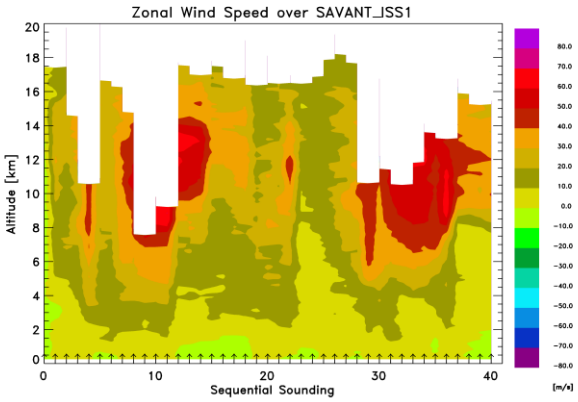

Figure 7: Sequence of zonal wind speed profiles for all radiosondes launched at the Homestead site during SAVANT.

7 List of all soundings

#	Date [UTC]	Time [UTC]	Radiosonde serial number	Ceiling altitude [km]	Rise rate [m/s]	Duration [min]
1	15-Sep-2018	15:28:44	P1020126	19.9	4.4	73.8
2	18-Sep-2018	15:52:11	P1020043	17.4	4.6	61.6
3	18-Sep-2018	20:21:22	P0940725	19.8	4.6	71.0
4	27-Sep-2018	19:06:50	P1020348	14.6	4.5	52.9
5	28-Sep-2018	18:59:00	P0940739	10.6	4.2	41.4
6	30-Sep-2018	3:30:14	P1020346	20.1	4.3	77.8
7	30-Sep-2018	5:28:26	P0940744	16.6	4.1	67.1
8	12-Oct-2018	6:42:00	P0940741	16.3	3.9	67.7
9	12-Oct-2018	10:00:39	P0940743	14.7	4.1	59.2
10	16-Oct-2018	4:42:31	P0940674	7.5	3.9	31.4
11	16-Oct-2018	7:30:26	P0940736	9.8	4.0	39.4
12	16-Oct-2018	9:29:29	P1030263	9.2	3.9	38.3
13	18-Oct-2018	6:10:22	P0940734	17.7	3.9	73.8
14	18-Oct-2018	7:40:27	P0940729	17.5	4.1	70.2
15	18-Oct-2018	9:30:15	P0940727	17.0	4.0	70.3
16	24-Oct-2018	4:17:19	P0940740	17.8	3.9	74.7
17	24-Oct-2018	6:23:50	P0940730	17.4	4.0	72.4
18	24-Oct-2018	8:31:58	P0940735	16.7	4.0	69.1
19	24-Oct-2018	10:00:33	P0940728	19.0	4.0	77.8
20	27-Oct-2018	22:35:58	P0940721	16.3	4.3	62.9
21	28-Oct-2018	1:30:06	P0940490	18.1	4.3	69.5
22	28-Oct-2018	3:30:38	P1020345	16.4	4.0	67.5
23	30-Oct-2018	3:07:37	P1020344	17.0	4.2	67.1
24	2-Nov-2018	23:59:49	P1020343	16.4	4.0	67.7
25	3-Nov-2018	1:43:38	P0940733	16.8	4.0	68.8
26	3-Nov-2018	3:33:13	P0940723	17.9	4.1	72.5
27	3-Nov-2018	5:29:37	P0940681	19.3	4.1	76.9
28	3-Nov-2018	7:17:23	P0940683	18.2	4.3	69.3
29	3-Nov-2018	9:39:19	P0940684	17.7	4.0	72.5
30	8-Nov-2018	3:28:25	P0940677	10.6	4.1	42.2
31	10-Nov-2018	23:25:34	P0940676	16.7	4.1	66.6
32	11-Nov-2018	18:34:32	N4440156	11.4	4.1	45.2
33	12-Nov-2018	1:24:15	N4440157	10.5	3.7	45.8
34	12-Nov-2018	3:26:12	N4440158	11.8	3.8	50.5
35	12-Nov-2018	5:26:53	N4510858	14.1	4.4	52.4
36	12-Nov-2018	20:03:37	N4440159	13.6	4.8	46.0
37	13-Nov-2018	18:30:47	N4440154	13.2	4.5	48.2
38	14-Nov-2018	6:26:03	N4510857	16.8	4.2	66.3
39	14-Nov-2018	8:33:09	N4440155	15.9	4.7	55.3
40	14-Nov-2018	10:24:36	N4440152	15.2	4.2	59.9
41	14-Nov-2018	12:31:55	N4440162	15.5	3.9	64.8

8 References

Vömel, H., G. Granger, and I. Suhr, 2018, NCAR/EOL/ISF Radiosonde NetCDF Data Files, UCAR/NCAR - Earth Observing Laboratory. https://doi.org/10.5065/D65X27SR.