Stable Atmospheric Variability and Transport (SAVANT) National Weather Service Radiosonde Data Set

1.0 Contacts:

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NOAA/NWS

2.0 Dataset Overview

The National Weather Service (NWS) routinely releases radiosondes at 00 and 12 UTC with occasional special releases at sites throughout the United States. This data set includes the quality controlled NWS soundings released at five sites (Figure 1) throughout the Midwestern United States during the SAVANT field phase (15 September – 15 November 2018). One station in the region was only available at mandatory/significant level resolution (KDVN – Davenport, IA) and is available in a separate data set. A total of 648 quality-controlled, high vertical resolution (1-second) soundings are contained in the final SAVANT data set.



Figure 1. Location of SAVANT NWS radiosonde sites.

3.0 **Project Overview**

The Stable Atmospheric Variability and Transport (SAVANT) field campaign was aimed at guantifying the effects of converging shallow cold air drainage and background flow on aerosol transport and dispersion. SAVANT was held near Mahomet, Illinois from 15 September to 15 November 2018. Information on SAVANT operations is available SAVANT Field Catalog: http://catalog.eol.ucar.edu/savant. from the Further site: information on SAVANT is available at the SAVANT web https://www.eol.ucar.edu/field projects/savant.

4.0 EOL Sounding Composite (ESC) File Format Description

The ESC is a columnar ASCII format consisting of 15 header records for each sounding followed by the data records with associated data quality flags.

4.1 Header Records

The header records (15 total records) contain a variety of metadata about the sounding (i.e. location, time, radiosonde type, etc). The first five header lines contain information identifying the sounding, and have a rigidly defined form. The following 7 header lines are used for auxiliary information and comments about the sounding, and may vary from dataset to dataset. The last 3 header records contain header information for the data columns. Line 13 holds the field names, line 14 the field units, and line 15 contains dashes ('-' characters) delineating the extent of the field.

The file standard header lines are as follows:

Line	Label (padded to 35 char)	Contents
1	Data Type:	Description of the type and resolution
		of data
2	Project ID:	Short name for the field project
3	Release Site Type/Site ID:	Description of the release site.
4	Release Location (lon,lat,alt):	Location of the release site.
5	UTC Release Time (y,m,d,h,m,s):	Time of release.

The release location is given as:

lon (deg min), lat (deg min), lon (dec. deg), lat (dec. deg), alt (m)

Longitude in deg min is in the format: ddd mm.mm'W where ddd is the number of degrees (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 time of release is given as: yyyy, mm, dd, hh:nn:ss.

Where yyyy is the year, mm is the month, dd is the day of month, and hh:nn:ss are the UTC hour, minute, and second respectively.

The seven non-standard header lines may contain any label and contents. The labels are padded to 35 characters to match the standard header lines. Records for this data set include the following non-standard header lines:

Line	Label (padded to 35 char)	Contents
6	Ascension Number	Number sounding this year
7	Radiosonde Serial Number	
8	Balloon Manufacturer/Type	
9	Balloon Lot Number/Weight	
10	Radiosonde Type/RH Sensor Type	
11	Surface Observations	

4.2 Data Records

The data records each contain time from release, pressure, temperature, dew point, relative humidity, U and V wind components, wind speed and direction, ascent rate, balloon position data, altitude, and quality control flags (see the QC code description). Each data line contains 21 fields, separated by spaces, with a total width of 130 characters. The data are right-justified within the fields. All fields have one decimal place of precision, with the exception of latitude and longitude, which have three decimal places of precision. The contents and sizes of the 21 fields that appear in each data record are as follows:

Field	Width	Format	Parameter	Units	Missing	
					Value	
1	6	F6.1	Time since release	Seconds	9999.0	
2	6	F6.1	Pressure	Millibars	9999.0	
3	5	F5.1	Dry-bulb Temperature	Degrees C	999.0	
4	5	F5.1	Dew Point Temperature	Degrees C	999.0	
5	5	F5.1	Relative Humidity	Percent	999.0	
6	6	F6.1	U Wind Comp	m/s	9999.0	
7	6	F6.1	V Wind Comp	m/s	9999.0	
8	5	F5.1	Wind speed	m/s	999.0	
9	5	F5.1	Wind direction	Degrees	999.0	
10	5	F5.1	Ascent Rate	m/s	999.0	
11	8	F8.3	Longitude	Degrees	9999.0	
12	7	F7.3	Latitude	Degrees	999.0	
13	5	F5.1	Elevation Angle	Degrees	999.0	
14	5	F5.1	Azimuth Angle	Degrees	999.0	
15	7	F7.1	Geopotential Altitude	Meters	99999.0	
16	4	F4.1	QC for Pressure	Code	99.0	
17	4	F4.1	QC for Temperature	Code	99.0	
18	4	F4.1	QC for Humidity	Code	99.0	
19	4	F4.1	QC for U Wind	Code	99.0	
20	4	F4.1	QC for V Wind	Code	99.0	
21	4	F4.1	QC for Ascent Rate	Code	99.0	

Fields 16 through 21 contain the data quality flags from the NCAR/Earth Observing Laboratory (EOL) sounding quality control procedures. The data quality flags are defined as follows:

Code

1.0	Checked, datum seems physically reasonable. ("GOOD")
2.0	Checked, datum seems questionable on a physical basis. ("MAYBE")
3.0	Checked, datum seems to be in error. ("BAD")
4.0	Checked, datum is interpolated. ("ESTIMATED")
9.0	Checked, datum is missing. ("MISSING")
99.0	Unchecked (QC information is "missing".) ("UNCHECKED")

4.3 Data Specifics

The files contain data at one-second intervals.

The data are in files by day, so all soundings for a particular day are concatenated into a single file ordered by time. The file naming convention is:

NWS_yyyymmdd.cls where yyyy is the year, mm is the month, and dd is the day of the month.

The KILN, KILX, KLZK, and KOHX stations utilized the Lockheed Martin Sippican LMS-6 Radiosonde with the capacitance RH sensor and GPS windfinding during SAVANT.

The KSGF station utilized the Vaisala RS92-NGP radiosonde with twin alternatively heated Humicap capacitance RH sensors and GPS windfinding during SAVANT.

4.4 Sample Data

The following is a sample of the SAVANT NWS high resolution radiosonde data in ESC format.

Data Tv	me:				Nati	onal We	eather	Servio	ce Soun	ding/Asce	ending									
Project ID:						SAVANT														
Release	Site 1	Type/S:	ite ID:		KILN	KILN Wilmington(Cincinnati), OH / 72426														
Release	Locat:	ion (lo	on,lat,	alt):	083	49.27'0	1, 39 2	5.27'1	1, -83.	821, 39.4	21, 323.	. 0								
UTC Rel	ease T	ime (y	,m,d,h,	m,s):	2018	, 09, 1	4, 23:	02:38												
Ascensi	on Numl	ber:			529															
Radioso	onde Sea	rial Nu	umber:		8823	0485														
Balloon	Manufa	acture:	r/Type:		Tote	Totex / GP26														
Balloon	Lot N	umber/V	Weight:		2017	2017 / 0.600														
Radioso	onde Typ	pe/RH :	Sensor	Type:	Lock	Lockheed Martin Sippican LMS-6 GPS Radiosonde / Capacitance sensor														
Surface Observations:				P: 9	P: 980.0, T: 18.2, RH: 59.0, WS: 2.6, WD: 59.0															
Nominal	. Relea:	se Time	e (y,m,	d,h,m,	s):2018	, 09, 1	5, 00:	00:00												
Time	Press	Temp	Dewpt	RH	Ucmp	Vcmp	spd	dir	Wcmp	Lon	Lat	Ele	Azi	Alt	Qp	Qt	Qrh	Qu	Qv	QdZ
sec	mb	С	С	do	m/s	m/s	m/s	deg	m/s	deg	deg	deg	deg	m	code	code	code	code	code	code
0.0	980.0	28.7	20.4	61.0	-1.4	-0.6	1.5	66.8	999.0	-83.821	39.421	999.0	999.0	323.0	1.0	1.0	1.0	1.0	1.0	9.0
1.0	979.9	28.8	20.2	59.9	-1.5	-0.6	1.6	68.2	1.0	-83.821	39.421	999.0	999.0	324.0	2.0	1.0	1.0	1.0	1.0	99.0
2.0	979.3	28.8	20.1	59.2	-1.6	-0.6	1.7	69.4	5.0	-83.821	39.421	999.0	999.0	329.0	2.0	1.0	1.0	1.0	1.0	99.0

4.5 Station List

Site	WMO	Site Name	State	Latitude	Longitude	Elev
ID	ID					(m)
KILN	72426	Wilmington	ОН	39.421	-83.821	323
KILX	74560	Lincoln	IL	40.151	-89.338	179
KLZK	72340	Little Rock	AR	34.836	-92.260	173
KOHX	72327	Nashville	TN	36.247	-86.562	180
KSGF	72440	Springfield	MO	37.236	-93.402	391

5.0 Data Quality Control Procedures

- 1. Each sounding was converted from its original format into the ESC format described above.
- 2. Each sounding was passed through a set of automated data quality checks which included basic gross limit checks as well as rate of change checks. This is further described in Section 4.1.
- 3. Each sounding was visually examined utilizing the NCAR/EOL XQC sounding quality control software. This is further described in Section 4.2.

5.1 Automated Data Quality Checks

This data set was passed through a set of automated data quality checks. This procedure includes both gross limit checks on all parameters as well as rate-of-change checks on temperature, pressure, and ascent rate. A version of these checks is described in Loehrer et al. (1996) and Loehrer et al. (1998).

5.1.1 Gross Limit Checks

These checks were conducted on each sounding and the data quality flags in the ESC files were adjusted as appropriate. Only the data point under examination was flagged. All checks also produced warning messages that specified the location of the problem and the severity of the issue. These warning messages where then summarized statistically and examined to determine any consistent issues.

For this data set NCAR/EOL conducted the following gross limit checks. In the table P = pressure, T = temperature, RH = relative humidity, U = U wind component, V = V wind component, B = bad, and Q = questionable.

Parameter	Check	Parameter(s) Flagged	Flag Applied
Pressure	<0 or > 1050	Р	В
Altitude	< 0 or >40000	P, T, RH	Q
Temperature	< -90 or > 45	Т	В
Dew Point	< -99.9 or > 33	RH	Q
	> T	T, RH	Q
Wind Speed	< 0 or > 100	U, V	Q
	> 150	U, V	В
U Wind	< 0 or > 100	U	Q
	> 150	U	В
V Wind	< 0 or > 100	V	Q
	> 150	V	В
Wind Direction	< 0 or > 360	U, V	В
Ascent Rate	< -10 or > 10	P, T, RH	Q

5.1.2 Vertical Consistency Checks

These checks were conducted on each sounding and the data quality flags in the ESC files were adjusted as appropriate. These checks were started at the surface and compared each neighboring data record. In the case of checks that ensured that the values increased/decreased as expected, only the data point under examination was flagged. However, for the other checks, all of the data points used in the examination were flagged. All items within the table are as previously defined. All checks also produced warning messages that specified the location of the problem and the severity of the issue. These warning messages where then summarized statistically and examined to determine any consistent issues.

Parameter	Check	Parameter(s) Flagged	Flag Applied
Time	Decreasing/equal	None	None.
Altitude	Decreasing/equal	P, T, RH	Q
Pressure	Increasing/equal	Р, Т, ТН	Q
	> 1mb/s or < -1 mb/s	Р, Т, ТН	Q
	> 2mb/s or $<$ -2mb/s	Р, Т, ТН	В
Temperature	< -15°C/km	P, T, RH	Q
	< -30°C/km	P, T, RH	В
	> 50°C/km	P, T, RH	Q
	> 100°C/km	P, T, RH	В
Ascent Rate	> 3m/s or < -3m/s	Р	Q
	> 5m/s or < -5m/s	Р	В

5.2 Visual Data Quality Checks

Each sounding was visually examined using the NCAR/EOL XQC sounding data quality control software. This software allows the user to view a skew-t/log-p diagram of each sounding and apply data quality flags as appropriate. The user can zoom in on sections of soundings for detailed examination and can adjust the data quality flags for an individual point, sections of soundings, or entire soundings for each parameter individually. The software also allows the user to override the quality flags applied by the automated procedure.

5.3 Data Quality Issues of Note

The data quality control procedures outlined above allows us to identify and, in some cases, resolve issues that could potentially impact research performed using these data sets. The following issues were noted in these soundings.

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KILN 201810042322 – wetbulbing ~783mb

KILN 201810111108 – no RH data below 714mb

KILN 201810201104 – wetbulbing ~826mb

KILN 201810262308 – no RH data from 890-498mb

KILN 201811151105 – no RH data above 806mb

KILX 201810061203 – no data above 739mb

KILX 201810072307 – no data above 512mb

KLZK 201810192303 – little RH data from 914-597mb

KLZK 201811051753 – no RH data from 881-707mb

KSGF 201809192311 – no GPS or wind data

KSGF 201810092353 – no data above 600mb
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6.0 References

Loehrer, S. M., T. A. Edmands, and J. A. Moore, 1996: TOGA COARE upper-air sounding data archive: development and quality control procedures. Bull. Amer. Meteor. Soc., 77, 2651-2671.

Loehrer, S. M., S. F. Williams, and J. A. Moore, 1998: Results from UCAR/JOSS quality control of atmospheric soundings from field projects. Preprints, Tenth Symposium on Meteorological Observations and Instrumentation, Phoenix, AZ, Amer. Meteor. Soc., 1-6.