Southeast Atmosphere Study (SAS) 2013
High Resolution Radiosonde Composite Data Set

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2.0 Dataset Overview

This data set contains a composite of the highest resolution (i.e. the "native" resolution) upper air sounding data from all sources for the Southeast Atmosphere Study (SAS). Sounding data is included from two sources: the National Weather Service (16 sites and 1438 soundings) and the NCAR/EOL ISS GAUS radiosonde site near the SOAS Centreville site in central Alabama (1 site and 105 soundings). Included are soundings from 30 May to 15 July 2013.
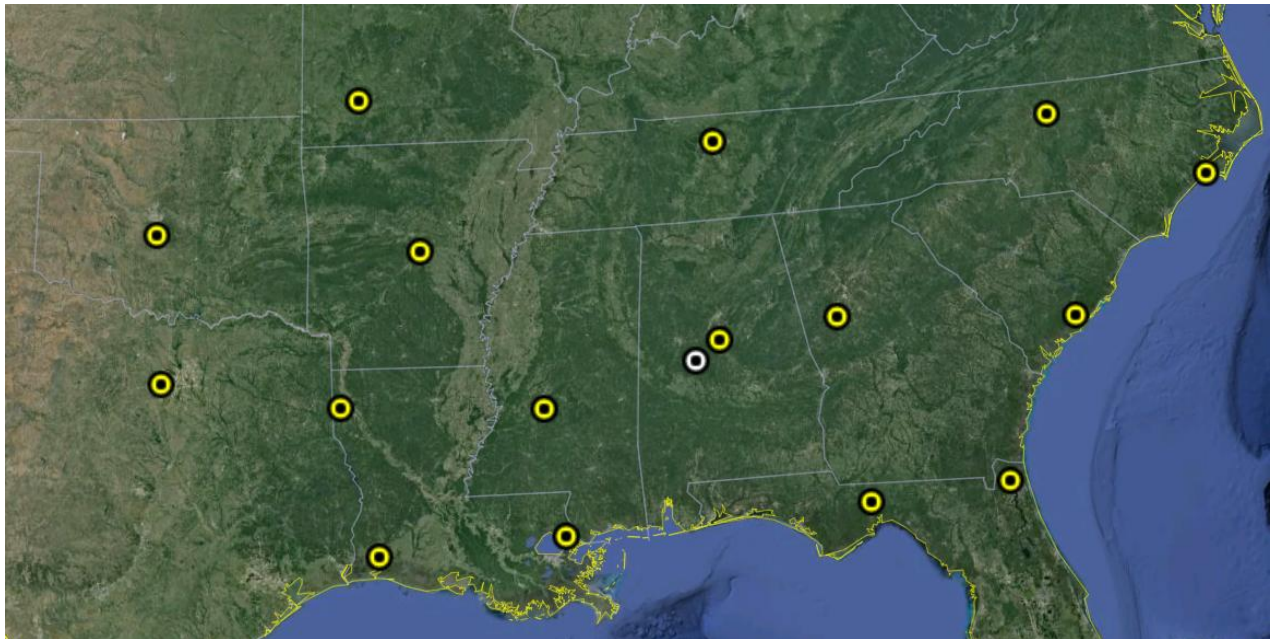

Figure 1. Locations of the 16 NWS (yellow) and NCAR/EOL ISS (white) release locations included in the SAS composite data set.

The Southeast Atmosphere Study (SAS) was a collaborative field campaign that brought together resources and facilities from NSF, NOAA, EPA and EPRI and was the umbrella for the NOMADSS, SOAS, NAAMEX, TROPHONO, and SENEX projects. The projects used four aircraft (the NSF/NCAR C-130, NOAA P-3, University of Purdue Duchess and the Stonybrook Long-EZ) as well as ground based facilities at several locations in Alabama, Tennessee, and North Carolina to study an assortment of research goals related to biosphere-atmosphere fluxes, mercury emissions, HONO budgets, and aerosol composition and distribution. Further information on SAS is available at the SAS web site: https://www.eol.ucar.edu/field_projects/sas and information on SAS operations are available at the SAS Field Catalog: http://catalog.eol.ucar.edu/sas/.

3.0 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.

3.1 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 vary based on the source. See the original readme files for details.

3.2 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	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	Description
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")

3.3 Data Specifics

Data from both sources contain observations at one-second intervals.

For additional specifics please see the original readme files associated with each data source:

NWS - http://data.eol.ucar.edu/datafile/nph-get/373.017/readme_SAS_NWS_radiosonde.pdf

ISS - http://data.eol.ucar.edu/datafile/nph-get/373.032/readme_NCAR_GAUS.pdf

3.4 Sample Data

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

```
Data Type:                          National Weather Service Sounding/Ascending
Project ID:                         SAS
Release Site Type/Site ID:          KTAE Tallahassee, FL / 72214
Release Location (lon,lat,alt):     084 17.98'W, 30 26.78'N, -84.300, 30.446, 53.0
UTC Release Time (y,m,d,h,m,s):     2013, 07, 08, 11:08:34
Ascension Number:                   379
Radiosonde Serial Number:           85304808
Balloon Manufacturer/Type:          Totex / GP26
Balloon Lot Number/Weight:          2013 / 0.600
Radiosonde Type/RH Sensor Type:     Sippican Mark IIA with chip thermistor, pressure / Sippican Mark IIA Carbon Hygristor
Surface Observations:               P: 1014.7, T: 999.0, RH: 94.0, WS: 1.0, WD: 63.0
Nominal Release Time (y,m,d,h,m,s):2013, 07, 08, 12:00:00
 Time  Press Temp Dewpt  RH   Ucmp  Vcmp  spd   dir  Wcmp   Lon     Lat    Ele   Azi   Alt    Qp   Qt   Qrh  Qu   Qv   QdZ
 sec    mb    C    C     %    m/s   m/s   m/s   deg  m/s   deg     deg    deg   deg    m    code code code code code code
------ ----- ---- ----- ---- ----- ----- ----- ---- ----- -------- ------ ----- ----- ------- ---- ---- ---- ---- ---- ----
  0.0 1014.7 24.8 23.6  93.0   0.0   0.0   0.0   0.0 999.0 -84.300 30.446 999.0 999.0    53.0 1.0  1.0  1.0  1.0  1.0   9.0
  1.0 1013.9 24.8 23.6  92.8  -0.2   0.0   0.2  90.0   7.0 -84.300 30.446 999.0 999.0    60.0 1.0  3.0  3.0  1.0  1.0  99.0
  2.0 1013.3 24.8 23.5  92.5  -0.4   0.0   0.4  90.0   5.0 -84.300 30.446 999.0 999.0    65.0 1.0  3.0  3.0  1.0  1.0  99.0
```

3.5 Station List

Site ID	WMO ID	Site Name	State	Latitude	Longitude	Elev (m)
KBMX	72230	Birmingham	AL	33.18010	-86.78269	174
KCHS	72208	Charleston	SC	32.89473	-80.02776	13
KFFC	72215	Peachtree City	GA	33.35611	-84.56734	245
KFWD	72249	Fort Worth	TX	32.83508	-97.29794	195
KGSO	72317	Greensboro	NC	36.09813	-79.94300	276
KJAN	72235	Jackson	MS	32.31999	-90.08031	91
KJAX	72206	Jacksonville	FL	30.48332	-81.70111	10
KLCH	72240	Lake Charles	LA	30.12551	-93.21709	5
KLIX	72233	Slidell	LA	30.33763	-89.82507	10
KLZK	72340	Little Rock	AR	34.83640	-92.25976	173
KMHX	72305	Newport	NC	34.77581	-76.87765	11
KOHX	72327	Nashville	TN	36.24694	-86.56178	180
KOUN	72357	Norman	OK	35.18095	-97.43787	345
KSGF	72440	Springfield	MO	37.23583	-93.40216	391
KSHV	72248	Shreveport	LA	32.45176	-93.84169	85
KTAE	72214	Tallahassee	FL	30.44630	-84.29963	53
GAUS	N/A	NWS Site	AL	32.892	-87.249	121.9

4.0 Data Quality Control Procedures

1. Each sounding was converted from its original format (BUFR) 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.

4.1 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).

4.1.1 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	P	B
Altitude	< 0 or >40000	P, T, RH	Q
Temperature	< -90 or > 45	T	B
Dew Point	< -99.9 or > 33	RH	Q
	> T	T, RH	Q
Wind Speed	< 0 or > 100	U, V	Q
	> 150	U, V	B
U Wind	< 0 or > 100	U	Q
	> 150	U	B
V Wind	< 0 or > 100	V	Q
	> 150	V	B
Wind Direction	< 0 or > 360	U, V	B
Ascent Rate	< -10 or > 10	P, T, RH	Q

4.1.2 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	P, T, TH	Q

	> 1mb/s or < -1mb/s	P, T, TH	Q
	> 2mb/s or < -2mb/s	P, T, TH	B
Temperature	< -15°C/km	P, T, RH	Q
	< -30°C/km	P, T, RH	B
	> 50°C/km	P, T, RH	Q
	> 100°C/km	P, T, RH	B
Ascent Rate	> 3m/s or < -3m/s	P	Q
	> 5m/s or < -5m/s	P	B

4.2 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.

4.3 Data Quality Issues of Note

For the data quality issues please see the readme files mentioned in Section 3.3 as well as the readme for the original format NCAR/EOL ISS data set at:
http://data.eol.ucar.edu/datafile/nph-get/373.013/readme.SOAS.ISS.radiosondes.pdf

5.0 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.