

# SWEX: High Resolution Radiosonde Composite

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## 1.0 Data Set Description

High vertical resolution radiosonde data from research and operational sources during the Sundowner Winds Experiment (SWEX) campaign converted into a common format (EOL Sounding Composite format which is a columnar ASCII format). The composite includes data from radiosondes and dropsondes from locations around the southwestern United States. The radiosondes were released by NCAR/EOL (two sites), University of California, Santa Barbara (2 sites), San Jose State University (1 site), National Weather Service (three sites), and the US Air Force (one site). Additionally, dropsondes released by NCAR/EOL from the NPS CIRPAS Twin Otter are included.

**Data Version:** 1.0

**Data Status:** Final

**Time Period:** 17 March to 17 May 2022

**Physical Location:** 32.84 to 37.74N and 115.18-122.22W

**Data Frequency:** Varies by location

**Vertical Resolution:** 1 second (~5m) except for Vandenberg which is mandatory/significant level

**Data Sources:** NCAR/EOL, UCSB, SJSU, and NOAA/NWS

**Data Restrictions:** Limited to SWEX investigators through 16 July 2023. Open access thereafter.

## 1.1 SWEX Description

Downslope windstorms at the lee of the Santa Ynez Mountains (SYM) in Santa Barbara County are one of the most significant fire weather hazards affecting populated areas. These gusty "Sundowner" winds peak from early evening to mid-morning. The main goal of SWEX was to improve the understanding of the dynamics and predictability of downslope windstorms in coastal Santa Barbara County. An extensive array of weather stations, flux towers, and profiling

instrumentation was deployed over the region for SWEX operations. Additionally, the CIRPAS Twin Otter conducted flights over the region instrumented with Ramen, cloud, and wind lidars. Information on SWEX operations and Intensive Observation Periods (IOPs) can be found in the SWEX Field Catalog (<https://catalog.eol.ucar.edu/swex>) and additional background information can be found at the SWEX website ([https://www.eol.ucar.edu/field\\_projects/swex](https://www.eol.ucar.edu/field_projects/swex)).

## 2.0 Instrument Description

### 2.1 Instrumentation

**NCAR/EOL ISS** used Vaisala RS41-SGP radiosondes which were received and processed by the Vaisala MW41 sounding system using software version 2.17.0.

**UCSB** used GRAW DFM-09 radiosondes which were received and processed by the GRAWMET software version 5.16.4.13

**SJSU** used GRAW DFM-09 radiosondes which were received and processed by the GRAWMET software version 5.15.01.04

**Vandenburg** used radiosondes of an unknown type.

**NWS KNKX (San Diego, California) and KOAK (Oakland, California)** used Vaisala RS41/AUTOSONDE radiosondes (DigiCORA MW41) with a Humicap capacitance humidity sensor with active de-icing method.

**NWS KVEF (Las Vegas, Nevada)** used GRAW DFM-17 radiosondes with a capacitance humidity sensor

**NCAR/EOL Dropsondes** were NCAR Research Dropsonde model NRD41 dropsondes.

### 2.2 Station Locations

Site ID	Source	Site Name	State	Latitude	Longitude	Elev (m)
ISS2	EOL	Rancho Allegre	CA	34.562	-119.951	285
ISS3	EOL	Sedgwick	CA	34.688	-120.038	327
MFDS2	UCSB	Montecito Fire Dept Station 2	CA	34.440	-119.659	59
SBFDHQ	UCSB	Santa Barbara Fire Dept HQ	CA	34.451	-119.770	95

SBFS38	UCSB	Santa Barbara Fire Dept Station 38	CA	34.477	-120.214	60
KNKX	NWS	San Diego	CA	32.845	-117.124	135
KOAK	NWS	Oakland	CA	37.745	-122.224	4
KVEF	NWS	Las Vegas	NV	36.047	-115.185	698
KVBG	USAF	Vandenberg AFB	CA	34.75	-120.57	100
	EOL	Dropsondes		Mobile	Mobile	

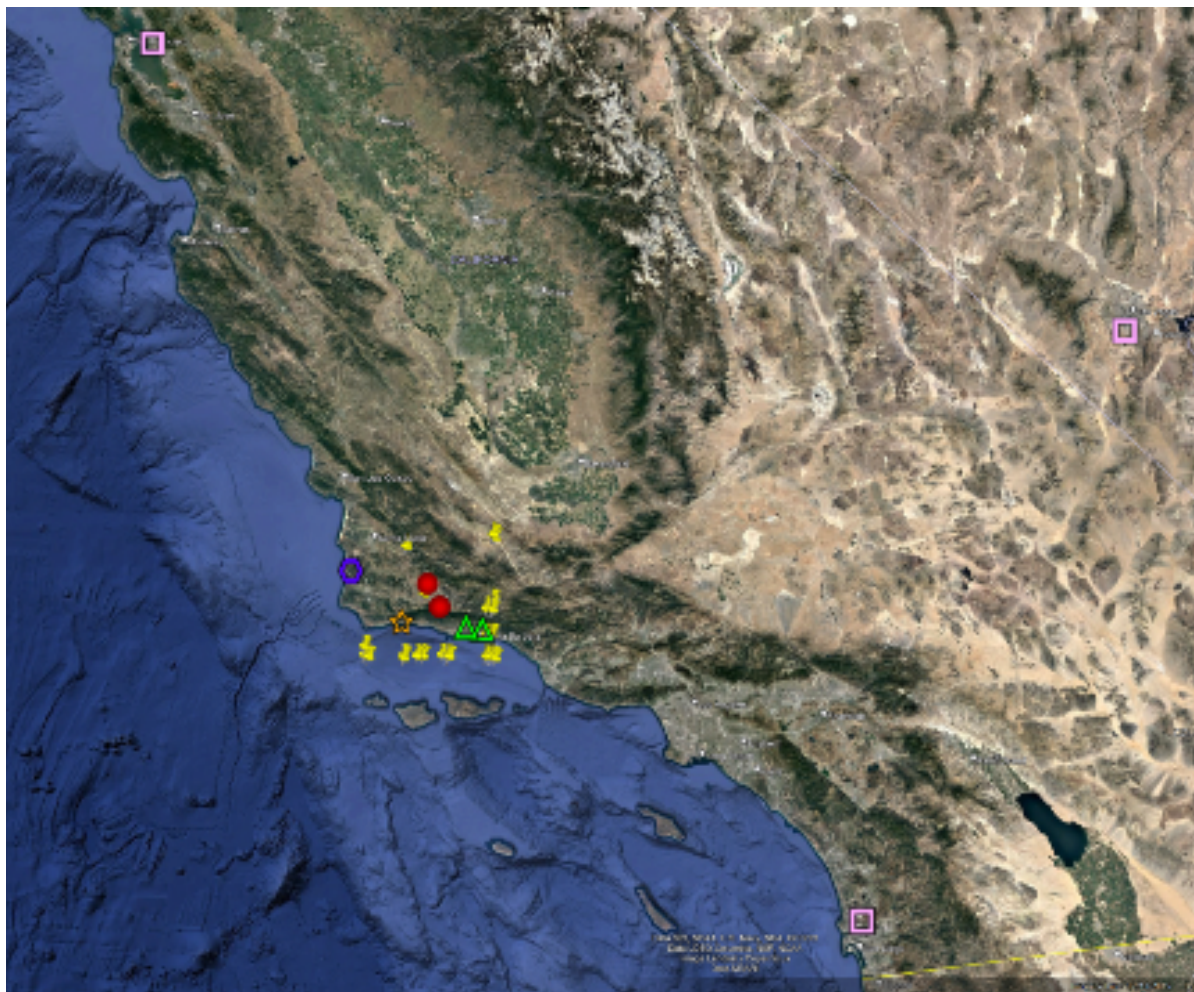


Figure 1. Map of SWEX radiosonde composite locations. Red circles are EOL ISS sites, the orange star is a SJSU site, the green triangles are UCSB sites, the purple hexagon is the USAF site, the pink squares are the NWS sites, and the yellow pins are the dropsonde locations.

The NCAR ISS sites operated only during SWEX IOP/EOP operations. Soundings were typically at 1.5 or 3 hourly intervals. A total of 187 soundings are included in the dataset with 99 from Rancho Alegre and 88 from Sedgwick.

The NCAR/EOL dropsondes were released only during SWEX IOP/EOP operations with drops released at standard locations along the Twin Otter flight path. A total of 159 soundings are included in the dataset.

The SBFDHQ site operated only during SWEX IOP/EOP operations through 11 May 2022. Soundings were typically released at three hourly intervals. A total of 91 soundings are included in the dataset.

The MFDS2 site operated only during SWEX IOP10 on 12-13 May 2022. Soundings were released at three hourly intervals. A total of five soundings are included in the dataset.

The SBFS38 site operated only during SWEX IOP/EOL operations. Soundings were typically released at three hourly intervals. A total of 91 soundings are included in the dataset.

Vandenburg typically released one radiosonde per day at 12 UTC. A total of 44 soundings are included in the dataset.

The NWS stations typically released two radiosondes per day at 00 and 12 UTC. A total of 293 NWS soundings are included in the dataset, with 97 from KNKX, 99 from KOAK, and 97 from KVEF.

## **3.0 Data Collection and Processing**

### **3.1 Data Collection**

Complete information on the collection procedures at each site can be found in the documentation at their respective dataset pages in the NCAR/EOL Field Data Archive:

NCAR/EOL ISS Rancho Alegre Site: <https://doi.org/10.26023/J6P8-7SYD-XP0M>

NCAR/EOL ISS Sedgwick Site: <https://doi.org/10.26023/H5TV-Y54J-R010>

NCAR/EOL Dropsondes: <https://doi.org/10.26023/AGME-MF19-NJ0A>

UCSB Sites: <https://data.eol.ucar.edu/dataset/600.025>

UCSJ Site: <https://data.eol.ucar.edu/dataset/600.027> These data were collected using a GRAW ground station.

NWS: <https://doi.org/10.26023/H82Q-C6R8-WX0V>

USAF Vandenberg Site: <https://doi.org/10.26023/AJWX-KGPP-MS08>

## 3.2 Data Processing

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NCAR/EOL ISS Rancho Alegre Site: <https://doi.org/10.26023/J6P8-7SYD-XP0M>

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NCAR/EOL Dropsondes: <https://doi.org/10.26023/AGME-MF19-NJ0A>

UCSB Sites: <https://data.eol.ucar.edu/dataset/600.025>

UCSJ Site: <https://data.eol.ucar.edu/dataset/600.027> These data were processed by the GRAWMET software.

NWS: <https://doi.org/10.26023/H82Q-C6R8-WX0V>

USAF Vandenberg Site: <https://doi.org/10.26023/AJWX-KGPP-MS08>

## 3.3 Quality Control Processing

Each sounding underwent initial quality control processing by their respective radiosonde systems described above.

In addition to the quality control procedures conducted by the data source, each sounding was passed through a two-step quality control process. First a series of automated data quality checks were conducted including basic gross limit checks as well as rate of change checks as described in section 3.3.1. Second, each sounding was visually examined utilizing the NCAR/EOL XQC sounding QC software as described in section 3.3.2.

### 3.3.1 Automated Data Quality Checks

Each sounding in this dataset was passed through a set of automated data quality checks. This procedure includes both gross limit checks (section 3.3.1.1) on all parameters as well as rate-of-change checks (section 3.3.1.2) on temperature, pressure, and ascent rate. A version of these checks is described in Loehrer et al. (1996) and Loehrer et al. (1998).

#### 3.3.1.1 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 were 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 > T	RH T, RH	Q Q
Wind Speed	< 0 or > 100 > 150	U, V U, V	Q B
U Wind	< 0 or > 100 > 150	U U	Q B
V Wind	< 0 or > 100 > 150	V V	Q B
Wind Direction	< 0 or > 360	U, V	B
Ascent Rate	< -10 or > 10	P, T, RH	Q

### 3.3.1.2 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 were then summarized statistically and examined to determine any consistent issues.

Parameter	Check	Parameter(s) Flagged	Flag Applied
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Time	Decreasing/Equal	None	None
Altitude	Decreasing/Equal	P, T, RH	Q
Pressure	Increasing/equal	P, T, RH	Q
	> 1mb/s or < -1mb/s	P, T, RH	Q
	> 2mb/s or < -2mb/s	P, T, RH	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

### 3.3.2 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.

## 4.0 Data Format

The data are in files by day and include radiosonde data from all sites for the day concatenated into a single file. The file naming convention is: SWEX\_HighRes\_yyyymmdd.cls where yyyymmdd is the UTC year, month, and day of month.

The final dataset is in the EOL Sounding Composite (ESC) format. ESC is a columnar ASCII format that consists of 15 header records for each sounding with the remaining records containing the radiosonde data and their 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	Contents
1	Data Type:	Description of the type and resolution of data
2	Project ID:	Short name for the field campaign
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. They typically include things such as radiosonde type, radiosonde serial number, sensor information, balloon information, and/or ground station software.

## 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:

<b>Field</b>	<b>Width</b>	<b>Format</b>	<b>Parameter</b>	<b>Units</b>	<b>Missing Value</b>
1	6	6.1	Time since release	Seconds	9999.0
2	6	6.1	Pressure	hPa	9999.0
3	5	5.1	Temperature	°C	999.0
4	5	5.1	Dew Point Temperature	°C	999.0
5	5	5.1	Relative Humidity	Percent	999.0
6	6	6.1	U Wind Component	m/s	9999.0
7	6	6.1	V Wind Component	m/s	9999.0
8	5	5.1	Wind Speed	m/s	999.0
9	5	5.1	Wind Direction	Degrees	999.0
10	5	5.1	Ascent Rate	m/s	999.0
11	8	8.3	Longitude	Degrees	9999.0
12	7	7.3	Latitude	Degrees	999.0
13	5	5.1	Elevation Angle	Degrees	999.0
14	5	5.1	Azimuth Angle	Degrees	999.0
15	7	7.1	Geopotential Altitude	Meters	99999.0
16	4	4.1	QC code for Pressure	Code	99.0
17	4	4.1	QC Code for Temperature	Code	99.0
18	4	4.1	QC Code for Humidity	Code	99.0
19	4	4.1	QC Code for U Wind	Code	99.0
20	4	4.1	QC Code for V Wind	Code	99.0
21	4	4.1	QC Code 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:

<b>Code</b>	<b>Description</b>
1.0	Checked, datum seems physically reasonable. (“GOOD”)
2.0	Checked, datum seems questionable on a physical basis. (“QUESTIONABLE”)
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”)

## 5.0 Data Remarks

See the respective FDA dataset pages linked in Section 3.1 for any details on data quality issues.

## 6.0 References

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