CAESAR: 5hPa Resolution Sounding Composite

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1.0 Data Set Description

Interpolated 5hPa vertical resolution sounding data from research and operational sources during the Cold Air Outbreak Experiment in the Sub-Arctic Region (CAESAR) campaign converted into a common format (EOL Sounding Composite format which is a columnar ASCII format). The composite includes data from 568 radiosondes and 116 dropsondes from locations around the Norwegian Sea. The radiosondes were released by the Norwegian Meteorological Institute from four sites and the dropsondes were released by NCAR/EOL from the NSF NCAR C-130 aircraft in ten research flights.

Data Version: 1.0

Data Status: Final

Time Period: 21 Feb to 5 April 2024

Physical Location: 69.2-79.0N and 17.1W to 23.1E

Andenes typically released at 00 and 12 UTC and Ny-Alesund typically released at 12 UTC. Bjornoya and Jan Mayen typically released at 00, 06, 12, and 18 UTC with special observations at 08, 10, 14, and 16 UTC during some CAESAR flight days. The NCAR/EOL dropsondes were released at various intervals during the NSF NCAR C-130 flights.

Vertical Resolution: 5 hPa

Data Sources: Norwegian Meteorological Institute and the NCAR Earth Observing Laboratory.

Data Restrictions: Limited to CAESAR investigators through 7 April 2025. Open access thereafter.

1.1 CAESAR Description

CAESAR was proposed to examine the structure of marine boundary layer clouds during cold air outbreaks (CAOs). CAESAR deployed the NSF NCAR C-130 aircraft, with a suite of in situ and remote sensors sampling Arctic air masses from the CAO origin at the ice edge throughout their transformation downstream. The rich array of instrumentation on-board the NSF NCAR C-130 included airborne radars and lidars, aerosol, cloud, precipitation, and trace gas probes, all deployed during CAO events over the open waters between northern Sweden and the Arctic

ice edge for 45 days in early 2024 in order to provide a detailed characterization that will form the backbone of modeling studies across a range of scales and form a long-lasting legacy dataset. Information on CAESAR operations and Intensive Observation Periods (IOPs) can be found in the CAESAR Field Catalog (https://catalog.eol.ucar.edu/caesar) and additional background information can be found at the CAESAR website (https://www.eol.ucar.edu/field_projects/caesar).

2.0 Instrument Description

2.1 Instrumentation

Andenes used Vaisala RS41/AUTOSONDE / Humicap capacitance sensor with active de-icing method

Bjornoya used a mix of Vaisala RS41/AUTOSONDE and Vaisala RS41/DigiCORA MW41 both with Humicap capacitance sensor with active de-icing method

Jan_Mayen used a mix of Vaisala RS41/DigiCORA MW41 (Finland) / Humicap capacitance sensor with active de-icing method and Modem M20 radiosonde w/thermistor sensor, capacitance relative humidity sensor, and derived pressure from GPS height (France) / Capacitance sensor

Ny-Alesund used Vaisala RS41/DigiCORA MW41 (Finland) / Humicap capacitance sensor with active de-icing method

NSF NCAR C-130 used NCAR Research Dropsonde NRD41 mini-dropsondes.

2.2 Station Locations

Site ID	Source	Site Name	Latitude	Longitude	Elev (m)
N130AR	EOL	NSF NCAR C-130	mobile	mobile	
01001	NMI	Jan Mayen, Norway	70.940	-8.669	10
01004	NMI	Ny-Alesund, Svalbard, Norway	78.923	11.923	17
01010	NMI	Andenes, Andoya, Norway	69.315	16.131	3
01028	NMI	Bjornoya, Norway	74.503	19.003	22

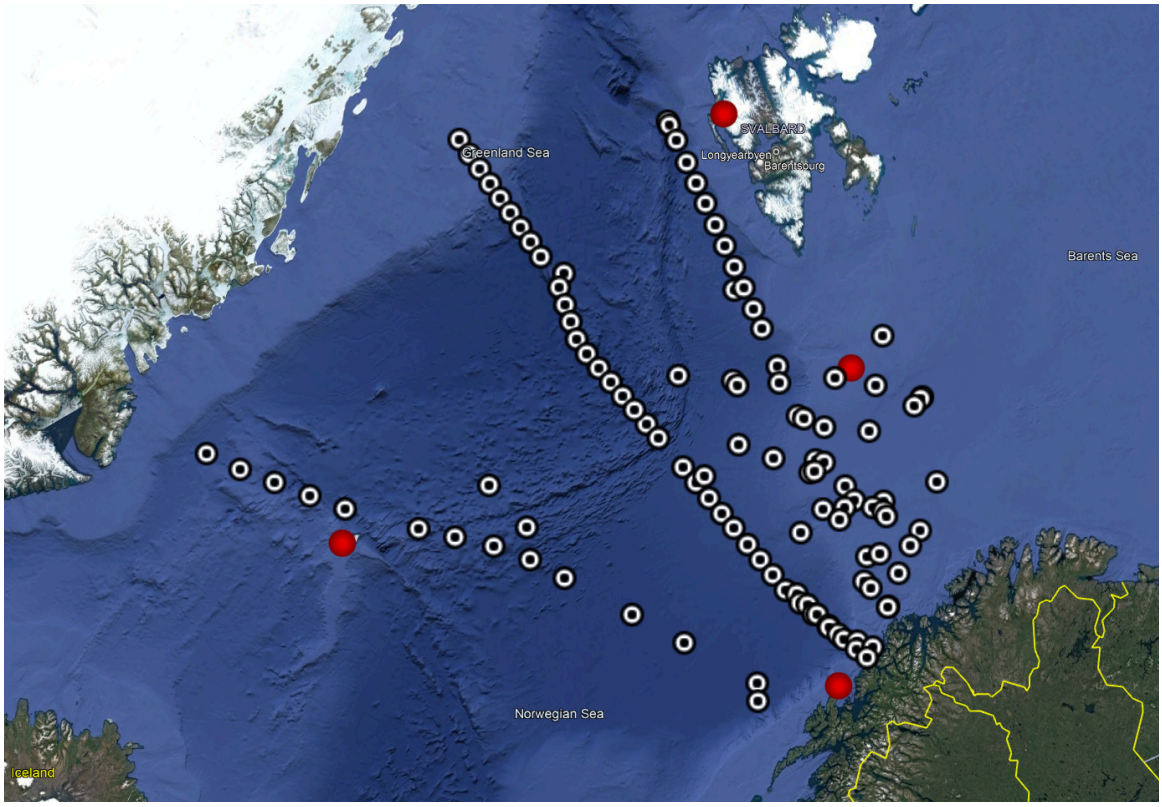

Figure 1. Map of CAESAR radiosonde composite locations. Red circles are NMI radiosonde sites and white circles are NSF NCAR C130 dropsonde locations.

The NSF NCAR dropsondes were released only during CAESAR research flights and at varying intervals during flights. A total of 116 dropspondes are included in this dataset.

The NMI stations standard releases varied by station as follows: Andenes 00 and 12 UTC, Ny-Alesund at 12 UTC, and Bjornoya and Jan Mayen at 00, 06, 12, and 18 UTC with special releases during some CAESAR operations at 08, 10, 14, and 16 UTC. A total of 568 NMI radiosondes are included in this dataset as follows: Andenes (88), Bjornoya (233), Jan Mayen (205), Ny-Alesund (42).

3.0 Data Collection and Processing

This dataset takes the data from the CAESAR High Resolution Radiosonde Composite and interpolates the data to a consistent 5hPa vertical resolution. A total of 684 soundings are included in this dataset.

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:

NSF NCAR C-130 Dropsonde: https://doi.org/10.26023/4KSV-GMKT-AT0R

The procedures used to develop the High Resolution Radiosonde Composite upon which these data are based can be found in the documentation at its dataset page in the NCAR/EOL Field Data Archive:

High Resolution Composite: https://doi.org/10.26023/4WB4-0WPN-6T01

3.1 5hPa Interpolation Procedures

The surface data point was kept as the initial level in each sounding. The first interpolated data point was at the next lowest pressure evenly divisible by 5 and then every 5 hPa pressure level beyond that point to either 50 hPa or the lowest pressure level reached by the radiosonde, whichever came first. The first 15 lines of each file (the header information) were kept without change.

For the interpolation, the software searched for two data points around the desired pressure level. The search was conducted by looking for two valid (i.e. non-missing) data points around the desired pressure level, while also paying attention to the time difference between the two data points as well as their quality control flags. There was a search for the two best possible data points to use in the interpolation. If the desired pressure level was within the original dataset, that data point was used without interpolation.

There was first a search for values flagged as good within some time range (50 sec for temperature, humidity, and wind and 100 sec for pressure; hereafter termed the ARANGE) and the interpolated data point was flagged as good. Failing that, it searched for values flagged as estimated within the same time range and the interpolated data point was flagged as estimated. Then the search went for good values within a wider time range (100 sec for temperature, humidity, and wind and 200 sec for pressure; hereafter termed the BRANGE) the flag for the interpolated data point here was then degraded (even though two `good' data points were used there was a significant time difference between them) to questionable. Then, in turn, estimated values within the BRANGE were used (flag set to questionable), questionable values within the BRANGE (flag set to bad), good values greater than the BRANGE apart (flag set to bad), estimated values greater than BRANGE apart (flag set to bad), questionable values greater than BRANGE apart (flag set to bad), finally any bad values (flag set to bad). This search was conducted separately for each interpolated variable (pressure, temperature, relative humidity, and the u and v wind components.

Thus for each interpolated data point, the quality control flag was set to the worst case among the data points used in the interpolation, except, for each time range apart, the quality control flag was degraded one level (i.e. good to questionable, etc).

The quality control flags should be carefully heeded in these files. While some of the data may look good, it may have been interpolated over large pressure intervals, and thus be suspect.

For each interpolated data point the dew point was calculated from the temperature and relative humidity (Bolton 1980) and the total wind speed and direction were calculated from the interpolated u and v component values. Also, the altitude and time were interpolated using the same data points used for the pressure interpolation. The ascension rate was recalculated based on the time and altitude values from the two data points used to interpolate the 5 hPa data point. Thus the ascension rate values do not reflect the values based on the interpolated data. The latitude and longitude values were interpolated using the same data points used in the wind component interpolation.

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: CAESAR_5mb_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:

Field	Width	Format	Parameter	Units	Missing Value
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:

Code	Description
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.

The GPS sensor completely failed for two dropsonde releases during IOP1 and therefore the release location in the header and any reported lat/lon in the data section are incorrect. The impacted dropsondes are: 1224 and 1409 UTC on 28 February.

6.0 References

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