CFACT: 5hPa Resolution Radiosonde Composite

Author: UCAR/NCAR - Earth Observing Laboratory

Processing and Quality Control: Scot Loehrer, Linda Cully, and Linda Echo-Hawk (NCAR/EOL)

Dataset Contact: Scot Loehrer (loehrer@ucar.edu)

1.0 Data Set Description

Interpolated 5hPa vertical resolution radiosonde data from research and operational sources during the CFACT campaign converted into a common format (EOL Sounding Composite format which is a columnar ASCII format). The composite includes radiosondes from the NCAR/EOL Integrated Sounding System (ISS) that was located at the Deer Creek Supersite (near Midway, Utah) as well as radiosondes from the National Weather Service Salt Lake City, Utah; Boise, ID;Elko, NV sites.

Data Version: 1.0

Data Status: Final

Time Period: 4 January to 24 February 2022

Physical Location: Four locations within 40.489 to 43.568N and 111.955 to 116.211W

Data Frequency: Varies by location

Vertical Resolution: 5hPa

Data Source: NCAR/EOL and NOAA/National Weather Service

Data Restrictions: Limited to CFACT investigators through 23 February 2023. Open access thereafter.

1.1 CFACT Description

The CFACT campaign investigated cold fog formation in mountain valleys and environmental conditions in complex terrain with the latest observation technology. Its goal was to improve microphysical parameterizations and visibility algorithms used in numerical weather prediction (NWP) models and to develop data-assimilation and analysis methods for current and next generation (e.g., sub-kilometer scale) NWP models.The CFACT field campaign was conducted in Heber Valley, Utah during January and February 2022.

2.0 Instrument Description

2.1 Instrumentation

NCAR/EOL ISS Deer Creek Supersite used Vaisala RS41-SGP radiosondes processed by the Vaisala MW41 sounding system using software version 2.17.0.

KBOI used Vaisala RS41 radiosondes (DigiCORA MW41) with a humicap capacitance RH sensor with an active de-icing method.

KLKN switched radiosonde systems during CFACT as part of the NWS transitioning from the Radiosonde Replacement System (RRS) to the Manual Radiosonde Observation System (MROS).

5 January and 00 UTC 6 January used the Lockheed Martin Sippican LMS-6 GPS radiosondes with a capacitance RH sensor

After 00 UTC 6 January used the Graw DFM-17 radiosondes with a capacitance RH sensor

KSLC switched radiosonde systems during CFACT also as part of the RRS to MROS transition. 5 January to 12 UTC 11 January and 00 and 12 UTC 12 January used the Lockheed Martin Sippican LMS-6 GPS radiosondes with a capacitance RH sensor

16 and 20 UTC 11 January and after 12 UTC on 12 January used the Graw DFM-17 radiosondes with a capacitance RH sensor

2.2 Station Locations

Site ID	WMO ID	WBAN	Site Name	State	Latitude	Longitude	Elevation (m)
KBOI	72681	24131	Boise	ID	43.568	-116.211	873
KLKN	72582	04105	Elko	NV	40.860	-115.742	1593
KSLC	72572	24127	Salt Lake City	UT	40.773	-111.955	1289
DC	N/A	N/A	Deer Creek Supersite	UT	40.489	-111.470	1662

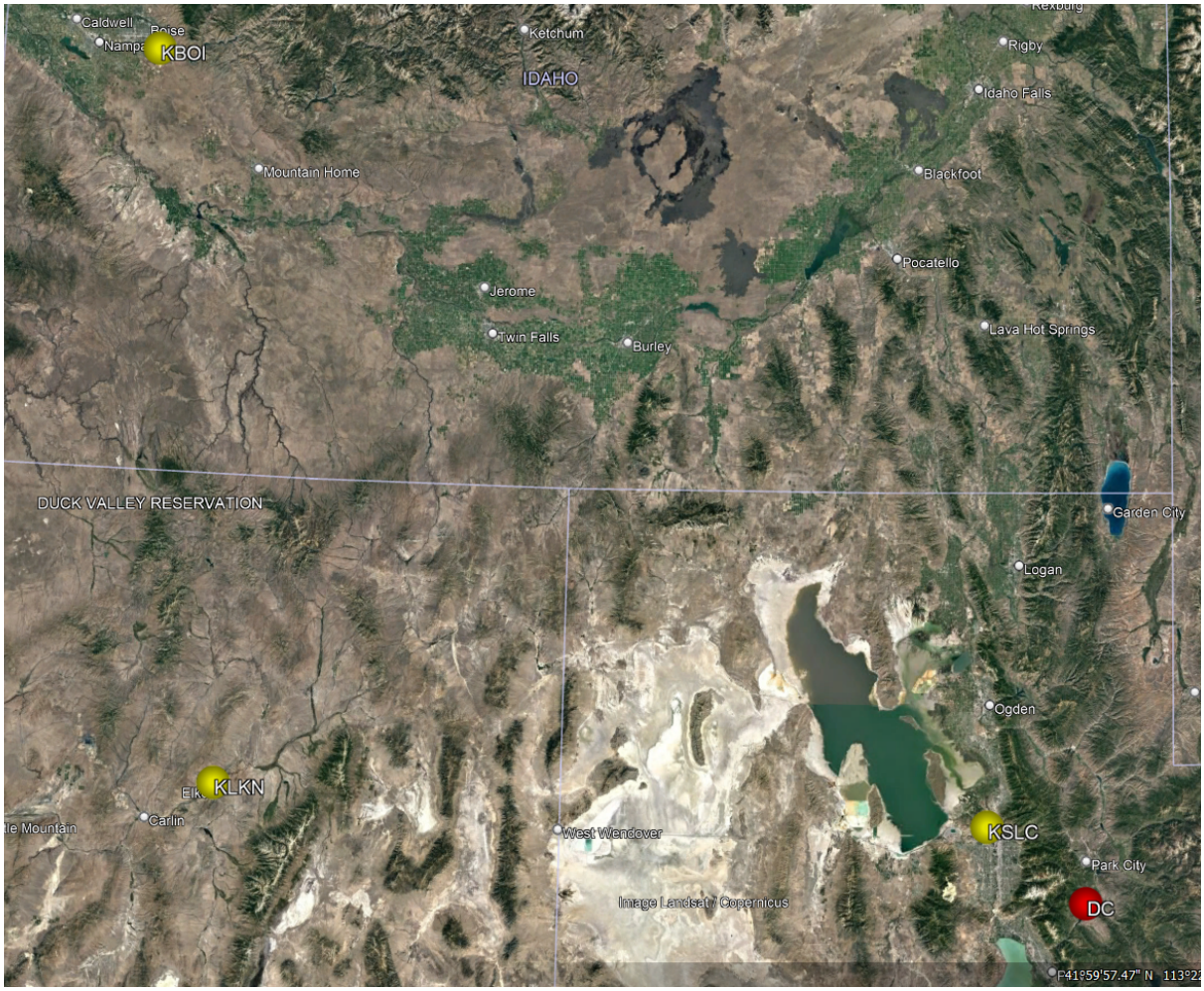

Figure 1. Map of CFACT radiosonde composite locations. Yellow circles are NWS sites and the red circle is the NCAR/EOL Deer Creek Supersite location.

3.0 Data Collection and Processing

This dataset takes the data from the CFACT High Resolution Radiosonde Composite and interpolates the data to a consistent 5hPa vertical resolution. A total of 434 soundings are included in this dataset.

Details of the collection, processing and quality control of these data are available at their respective dataset pages in the NCAR/EOL Field Data Archive:

High Resolution Composite: https://doi.org/10.26023/SPSS-HFJS-Q10B

NWS: https://doi.org/10.26023/NVPB-HBK5-2S0G

NCAR/EOL: https://doi.org/10.26023/6S3T-8RV0-WD07

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: CFACT_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.

6.0 References

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