

Great Plains Irrigation Experiment (GRAINEX) 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 GRAINEX NWS soundings released at nine sites (Figure 1) throughout the Upper Midwestern United States during the GRAINEX field phase (30 May – 31 July 2018). Two stations in the region were only available at mandatory/significant level resolution (KDVN – Davenport, IA and KTOP – Topeka, KS) and are available in a separate data set. A total of 1173 quality-controlled, high vertical resolution (1-second) soundings are contained in the final GRAINEX data set.

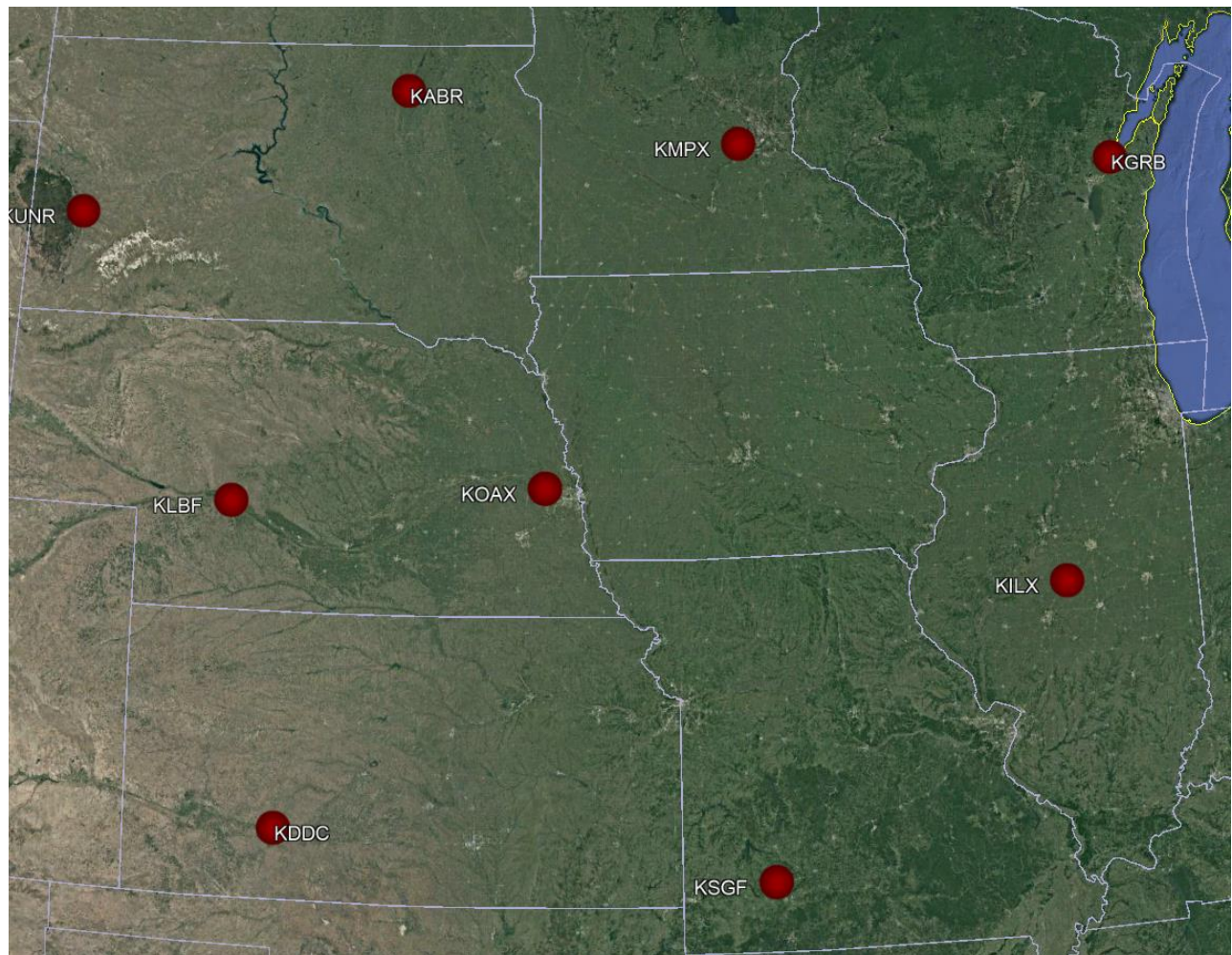


Figure 1. Location of GRAINEX NWS radiosonde sites.

3.0 Project Overview

The Great Plains Irrigation Experiment (GRAINEX) field campaign was aimed at investigating the impacts of the rapid commencement irrigation and subsequent sustained irrigation on the evolution of planetary boundary layer atmosphere in a region of the Central Great Plains, specifically in Nebraska. GRAINEX had two Intensive Observing Periods (IOPs), the first from 30 May to 13 June 2018 during the period of the rapid commencement of irrigation in the spring and the second from 16-30 July 2018 the period of sustained irrigation during the summer. Further information on GRAINEX is available at the GRAINEX web site: https://www.eol.ucar.edu/field_projects/grainex.

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	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")

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 KABR, KDDC, KGRB, KILX, KLBF, KMPX, KOAX, and KUNR stations utilized the Lockheed Martin Sippican LMS-6 Radiosonde with the capacitance RH sensor and GPS windfinding during GRAINEX.

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

4.4 Sample Data

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

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Data Type: National Weather Service Sounding/Ascending
Project ID: GRAINEX_2018
Release Site Type/Site ID: KABR Aberdeen, SD / 72659
Release Location (lon,lat,alt): 098 24.85'W, 45 27.27'N, -98.414, 45.455, 398.0
UTC Release Time (y,m,d,h,m,s): 2018, 05, 29, 23:02:37
Ascension Number: 299
Radiosonde Serial Number: 88221399
Balloon Manufacturer/Type: Totex / GP26
Balloon Lot Number/Weight: 2017 / 0.600
Radiosonde Type/RH Sensor Type: Lockheed Martin Sippican LMS-6 GPS Radiosonde / Capacitance sensor
Surface Observations: P: 957.9, T: 19.8, RH: 33.0, WS: 10.3, WD: 191.0
Nominal Release Time (y,m,d,h,m,s): 2018, 05, 30, 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 C C % m/s m/s m/s deg m/s deg deg deg m code code code code code code
-----
0.0 957.8 30.8 12.7 33.0 2.4 7.3 7.7 198.2 999.0 -98.414 45.455 999.0 999.0 398.0 3.0 3.0 3.0 1.0 1.0 99.0
1.0 957.8 30.6 11.7 31.2 2.5 7.4 7.8 198.7 0.0 -98.414 45.455 999.0 999.0 398.0 3.0 3.0 3.0 1.0 1.0 99.0
2.0 957.5 30.5 11.4 30.8 2.6 7.5 7.9 199.1 4.0 -98.414 45.455 999.0 999.0 402.0 2.0 3.0 1.0 1.0 1.0 99.0

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4.5 Station List

Site ID	WMO ID	Site Name	State	Latitude	Longitude	Elev (m)
KABR	72659	Aberdeen	SD	45.455	-98.414	398
KDDC	72451	Dodge City	KS	37.762	-99.969	790
KGRB	72645	Green Bay	WI	44.498	-88.112	209
KILX	74560	Lincoln	IL	40.151	-89.338	179
KLBF	72562	North Platte	NE	41.134	-100.70	849
KMPX	72469	Minneapolis	MN	44.849	-93.564	290
KOAX	72558	Omaha	NE	41.320	-96.366	351
KSGF	72440	Springfield	MO	37.236	-93.402	391
KUNR	72662	Rapid City	SD	44.073	-103.210	1029

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 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

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

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.

KABR 201806161103 – temperature bad above 393mb
KABR 201807171105 – wetbulbing ~648mb
KABR 201807190017 – no data above 658mb, temperature data bad above 681mb
KDDC 201806211100 – wetbulbing ~500mb
KBMX 201804142314 – no data above 710mb
KGRB 201807082309 – no GPS or wind data
KILX 201806052306 – no GPS or wind data
KILX 201807061110 – wetbulbing ~668mb
KLBF 201806192302 – wetbulbing ~666mb
KMPX 201806271123 – no GPS or wind data
KSGF 201807041107 – temperature and humidity data bad below 350mb
KLIX 201804131107 – little GPS/wind data above 683mb
KLZK 201804061107 – no data above 512mb
KLZK 201804141105 – wetbulbing ~770mb
KOHX 201804011100 – temp data questionable 679-635mb
KSGF 201803271110 – winds questionable 200-172mb
KUNR 201806252320 – no GPS or wind data
KUNR 201806292314 – no data above 623mb; no data below 800mb; temperature data bad
KUNR 201807282304 – no GPS or wind data above 597mb

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.