NERC
NORTH AMERICAN ELECTRIC RELIABILITY CORPORATION

Calculating Extreme Cold Weather Temperature

RELIABILITY | RESILIENCE | SECURITY




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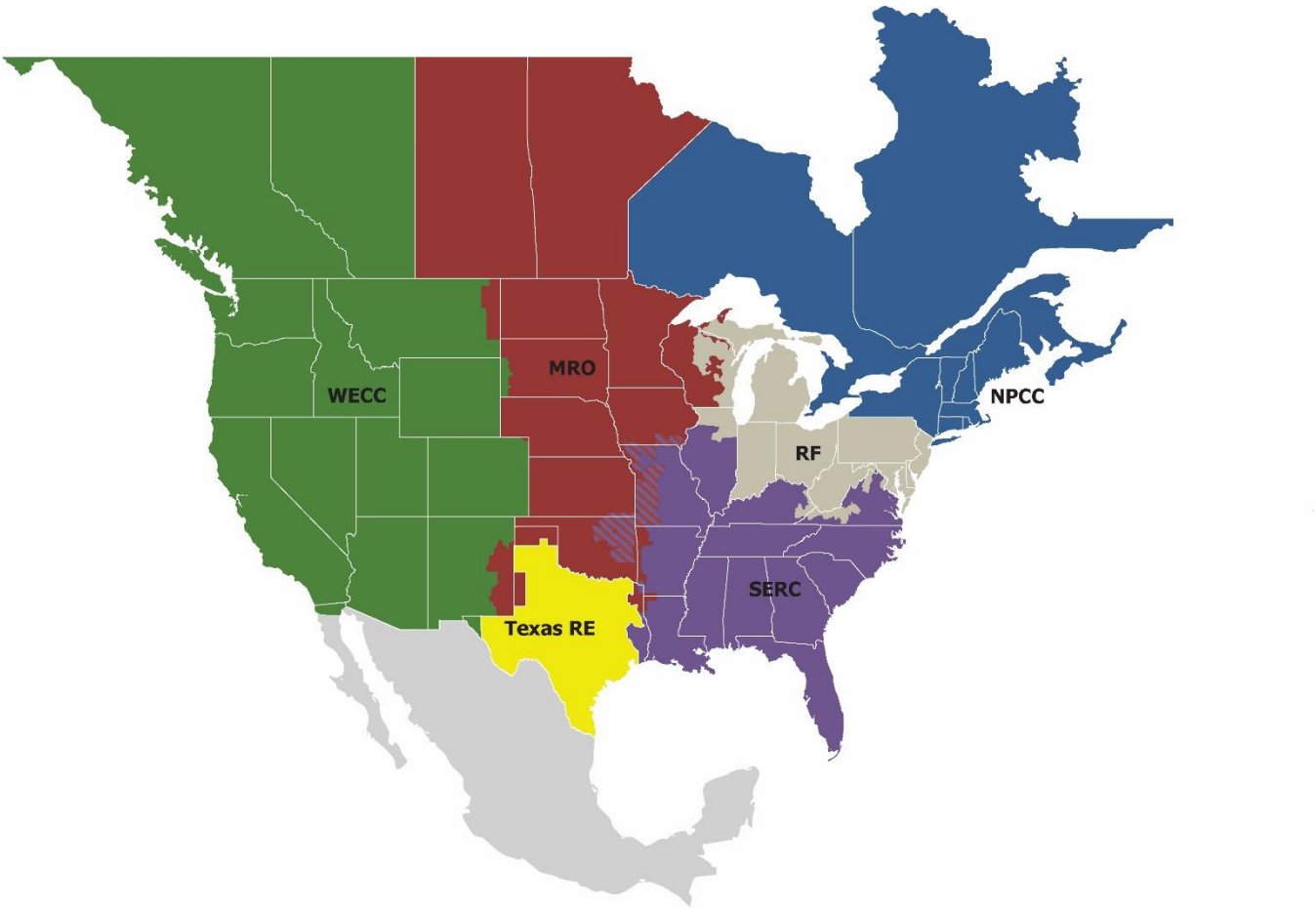
Preface

Electricity is a key component of the fabric of modern society and the Electric Reliability Organization (ERO) Enterprise serves to strengthen that fabric. The vision for the ERO Enterprise, which is comprised of NERC and the six Regional Entities, is a highly reliable, resilient, and secure North American bulk power system (BPS). Our mission is to assure the effective and efficient reduction of risks to the reliability and security of the grid.

Reliability | Resilience | Security
Because nearly 400 million citizens in North America are counting on us

The North American BPS is made up of six Regional Entity boundaries as shown in the map and corresponding table below. The multicolored area denotes overlap as some load-serving entities participate in one Regional Entity while associated Transmission Owners/Operators participate in another.



MRO	Midwest Reliability Organization
NPCC	Northeast Power Coordinating Council
RF	ReliabilityFirst
SERC	SERC Reliability Corporation
Texas RE	Texas Reliability Entity
WECC	WECC

Introduction

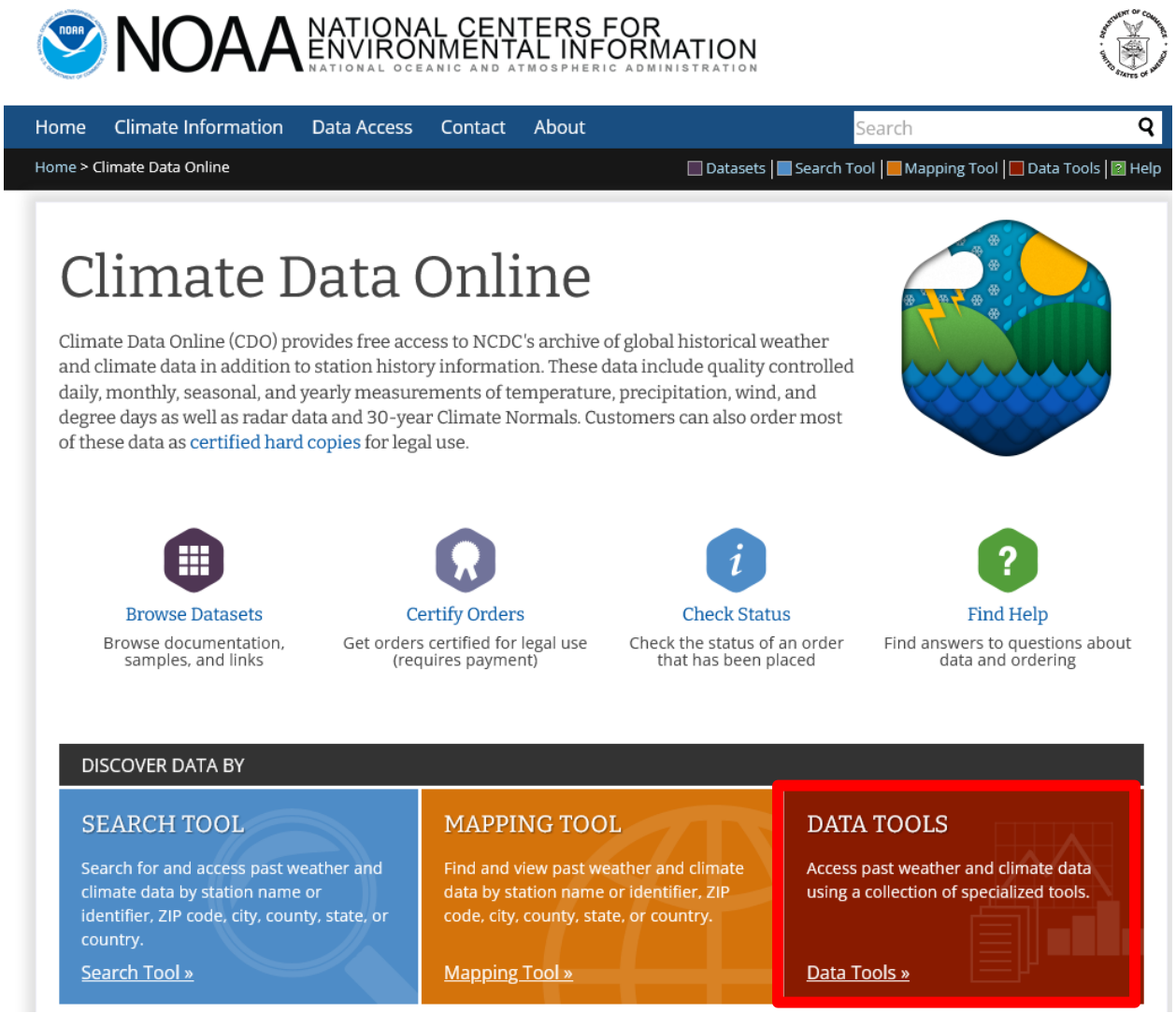
This document will demonstrate one method for acquiring the necessary data for a given location and a method of performing the statistical analysis of the data to determine the Extreme Cold Weather Temperature for a given location. This example is focused on United States and will use data obtained from NOAA's Climate Data Online database and perform the statistical analysis with Microsoft Excel. The method shown in this document only shows the collection of data from a single source and two methods of analyzing this data, both using Microsoft Excel.

Determination of Location's Extreme Cold Weather Temperature

Gathering the Data

Navigate to https://www.ncdc.noaa.gov/cdo-web/

1. Select **Data Tools.**



2. Scroll down if necessary and select **Local Climatological Data (LCD).**

Find a Station

Locate weather observing stations using a variety of parameters such as address, ZIP code, date, and data type with filters by observation type

Select a Location

Order data by weather observing stations or by geographic locations using a simplified drill-down interface with data from U.S. and other countries

Search Within a Single Dataset

The following search tools access data from within a specific dataset. Use these tools to view or order data from within each respectiv dataset. Data will be in a more standard format across stations or locations.

Climate Normals

View temperature and precipitation Climate Normals for over 9,800 stations across the United States and a selection of other territories

Daily Weather Records

Access summaries of recent global and U.S. daily weather records with options to view monthly, annual, all-time or selected records

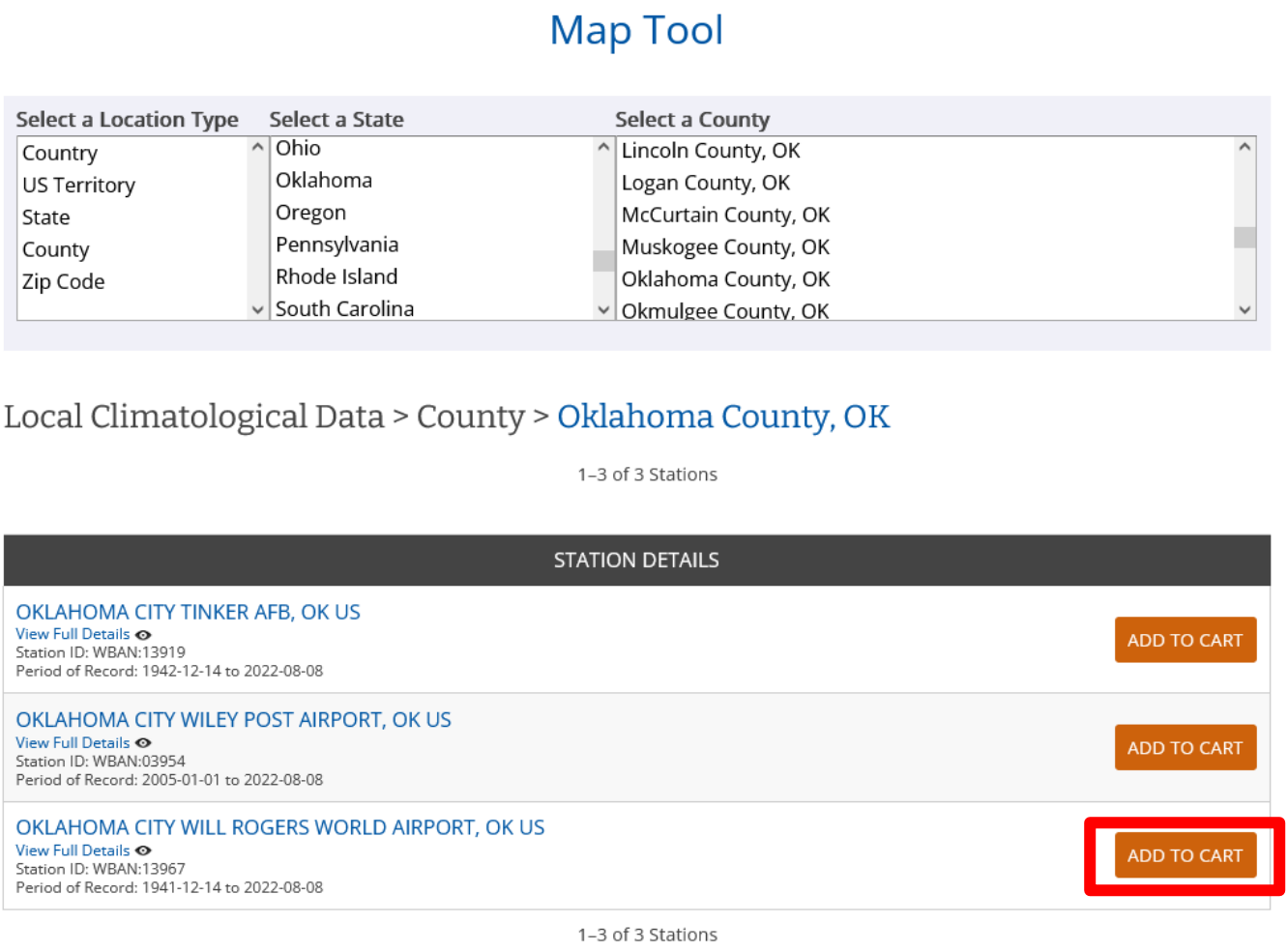
Local Climatological Data (LCD)

View and order hourly, daily, and monthly data from nearly 2400 locations within the U.S., surrounding territories, and other selected areas

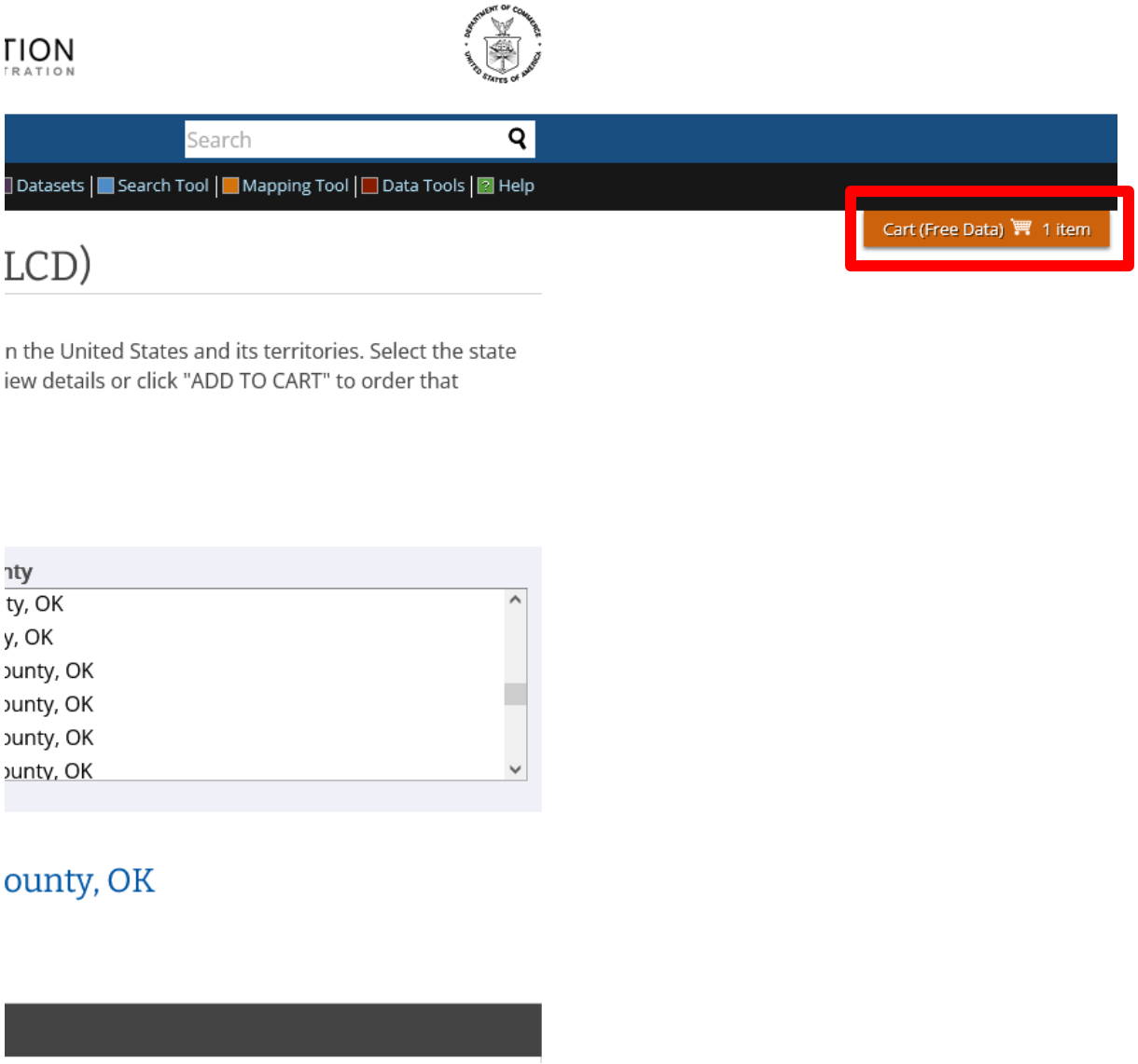
Marine Data

View and order historical marine data which is comprised of ship, buoy, and platform observations from 1662 to present.

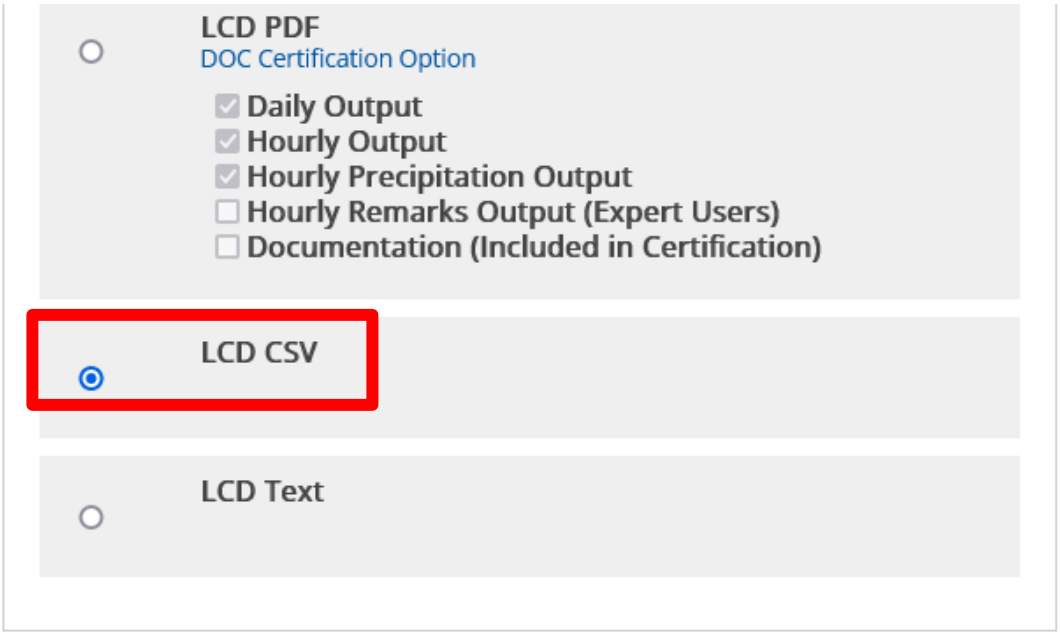
3. Use the selection tool to find a weather station appropriate for your location and click ADD TO CART.

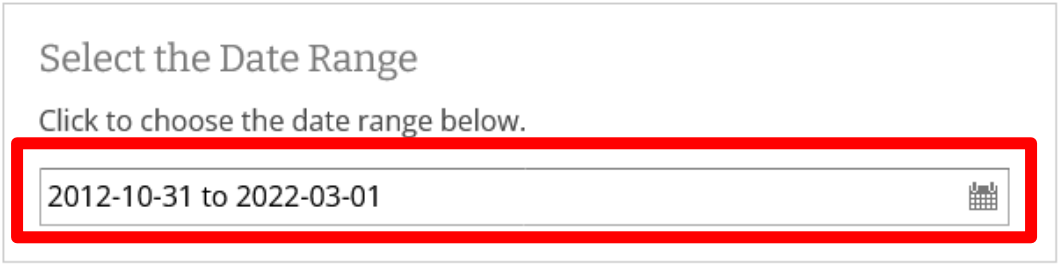


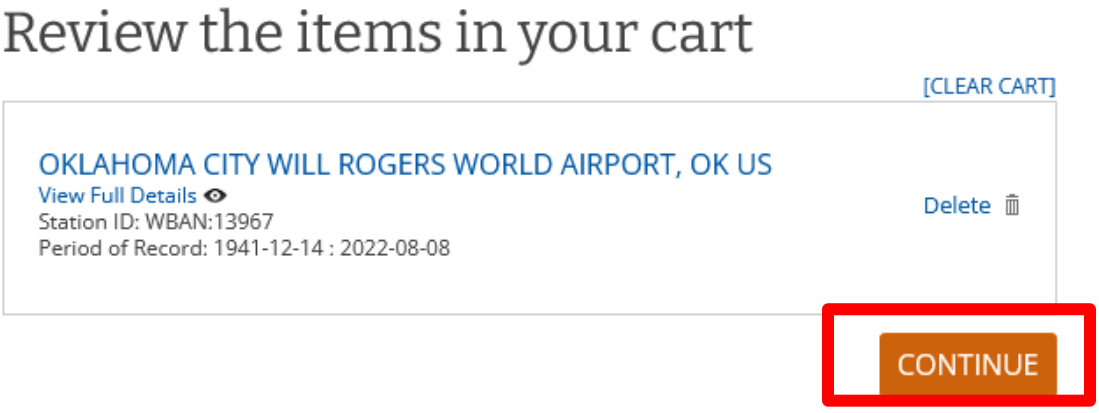
4. Click on the **cart icon** in the upper right-hand portion of the page.



5. Select LCD CSV, your desired date range, and then click continue. (Note: date ranges must be less than 10 years, so this process might have to be repeated several times and multiple files combined into one in order to get all data necessary to perform the analysis to determine the Extreme Cold Weather Temperature)







6. Enter and verify your email address and click **Submit Order.** You will receive an email when your request has been processed and is ready to download.

REQUESTED DATA REVIEW	
Dataset	Local Climatological Data
Order Start Date	2012-10-31 00:00
Order End Date	2022-03-01 23:59
Output Format	LCD CSV
Stations/Locations	OKLAHOMA CITY WILL ROGERS WORLD AIRPORT, OK US (Station ID: WBAN:13967)

Enter email address

Please enter your email address. This is the address to which your data links and information regarding this order will be sent. Please read NOAA's Privacy Policy if you have any concerns.

Email Address

email@address.com

Verify Email Address

email@address.com

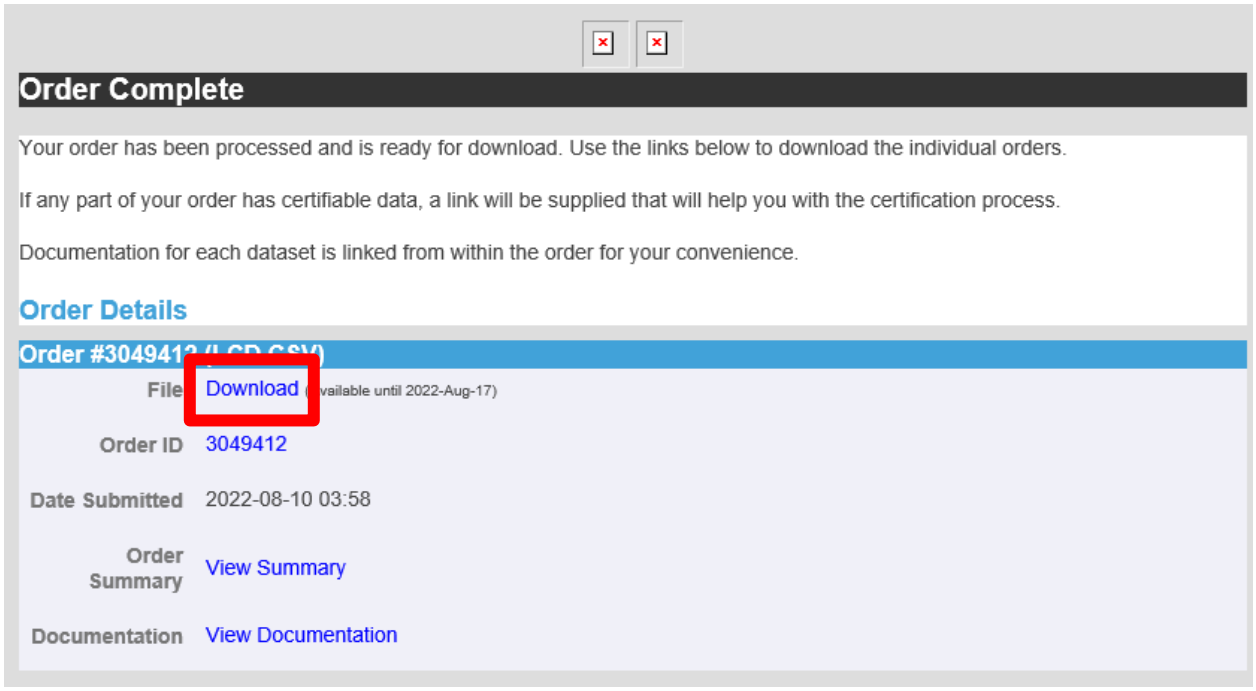
Remember my email address

[Uncheck to forget]

NOAA will not share your email address with anyone. The email address will not be used for any purpose other than communicating the order status.

EDIT ORDER SUBMIT ORDER

7. Click **Download** in the email that you will receive from NOAA to download your dataset.



Analyzing the Data

Option 1

1. Open the .csv file that was downloaded using the previous steps (and combine with other .csv files as necessary to cover the required date range).

2. Add filters to the first row and filter on "Report Type", column C, to only show report type FM-15, this is the standard METAR data.

STATION	DATE	REPOR	SOURCI	AWND	Backup	Backup	Backup	Backup	Backup	Backup	Backup	Backup
72353013967	2012-10-31T00:52:00	FM-15	7									
72353013967	2012-10-31T01:52:00	FM-15	7									
72353013967	2012-10-31T02:52:00	FM-15	7									
72353013967	2012-10-31T03:52:00	FM-15	7									
72353013967	2012-10-31T04:52:00	FM-15	7									
72353013967	2012-10-31T05:52:00	FM-15	7									
72353013967	2012-10-31T06:52:00	FM-15	7									
72353013967	2012-10-31T07:52:00	FM-15	7									
72353013967	2012-10-31T08:52:00	FM-15	7									
72353013967	2012-10-31T09:52:00	FM-15	7									
72353013967	2012-10-31T10:52:00	FM-15	7									
72353013967	2012-10-31T11:52:00	FM-15	7									
72353013967	2012-10-31T12:52:00	FM-15	7									
72353013967	2012-10-31T13:52:00	FM-15	7									
72353013967	2012-10-31T14:52:00	FM-15	7									
72353013967	2012-10-31T15:52:00	FM-15	7									
72353013967	2012-10-31T16:52:00	FM-15	7									
72353013967	2012-10-31T17:52:00	FM-15	7									
72353013967	2012-10-31T18:52:00	FM-15	7									
72353013967	2012-10-31T19:52:00	FM-15	7									
72353013967	2012-10-31T20:52:00	FM-15	7									
72353013967	2012-10-31T21:52:00	FM-15	7									
72353013967	2012-10-31T22:52:00	FM-15	7									
72353013967	2012-10-31T23:52:00	FM-15	7									
72353013967	2012-11-01T00:52:00	FM-15	7									
72353013967	2012-11-01T01:52:00	FM-15	7									
72353013967	2012-11-01T02:52:00	FM-15	7									
72353013967	2012-11-01T03:52:00	FM-15	7									
72353013967	2012-11-01T04:52:00	FM-15	7									
72353013967	2012-11-01T05:52:00	FM-15	7									

3. Select the Date column, column B, by clicking on the column, scroll over to the HourlyDryBulbTemperature column, column AS, and holding down the CTRL key, select that column. Copy and paste both columns into a new sheet named "Clean and Filter".

DATE	HourlyDryBulbTemperature		
2012-10-31T00:52:00	52		
2012-10-31T01:52:00	51		
2012-10-31T02:52:00	50		
2012-10-31T03:52:00	47		
2012-10-31T04:52:00	46		
2012-10-31T05:52:00	46		
2012-10-31T06:52:00	44		
2012-10-31T07:52:00	48		
2012-10-31T08:52:00	52		
2012-10-31T09:52:00	57		
2012-10-31T10:52:00	61		
2012-10-31T11:52:00	65		
2012-10-31T12:52:00	67		
2012-10-31T13:52:00	68		
2012-10-31T14:52:00	71		
2012-10-31T15:52:00	71		
2012-10-31T16:52:00	70		
2012-10-31T17:52:00	66		
2012-10-31T18:52:00	62		
2012-10-31T19:52:00	59		
2012-10-31T20:52:00	54		
2012-10-31T21:52:00	51		
2012-10-31T22:52:00	52		
2012-10-31T23:52:00	52		
2012-11-01T00:52:00	53		

4. Using the data on the "Clean and Filter" sheet, type **Month** in column C1, type the formula "=mid(A2,6,2)" in cell C2, and copy that formula in column C to the last row of the data set. Then Filter month to only show months 1, 2, 12 (January, February, and December).

5. You can then filter by HourlyDryBulbTemperature (Column B) to find and address bad data as appropriate. Now Select, Copy, and Paste the remaining data to a new sheet named ECWT.

	A	B	C	D
1	DATE	HourlyDryBulbTemperatur	Month	
747	2012-12-01T00:52:00	58	12	
748	2012-12-01T01:52:00	58	12	
749	2012-12-01T02:52:00	59	12	
750	2012-12-01T03:52:00	59	12	
751	2012-12-01T04:52:00	58	12	
752	2012-12-01T05:52:00	59	12	
753	2012-12-01T06:52:00	58	12	
754	2012-12-01T07:52:00	60	12	
755	2012-12-01T08:52:00	61	12	
756	2012-12-01T09:52:00	63	12	
757	2012-12-01T10:52:00	66	12	
758	2012-12-01T11:52:00	71	12	
759	2012-12-01T12:52:00	74	12	
760	2012-12-01T13:52:00	75	12	
761	2012-12-01T14:52:00	77	12	
762	2012-12-01T15:52:00	76	12	
763	2012-12-01T16:52:00	73	12	
764	2012-12-01T17:52:00	67	12	
765	2012-12-01T18:52:00	64	12	
766	2012-12-01T19:52:00	63	12	
767	2012-12-01T20:52:00	58	12	
768	2012-12-01T21:52:00	61	12	
769	2012-12-01T22:52:00	52	12	
770	2012-12-01T23:52:00	50	12	
771	2012-12-02T00:52:00	48	12	
772	2012-12-02T01:52:00	46	12	
773	2012-12-02T02:52:00	45	12	
774	2012-12-02T03:52:00	43	12	
775	2012-12-02T04:52:00	44	12	
776	2012-12-02T05:52:00	43	12	

6. Using Excel's built in Percentile function, the Extreme Cold Weather Temperature (ECWT) can now be determined. While on the ECWT sheet, in a blank cell use the function "=PERCENTILE.INC()" and select all temperature data in Column B (HourlyDryBulbTemperature) on the "ECWT" sheet and use 0.002 for the percentile value. The formula will look similar to this, "=PERCENTILE.INC(B:B,0.002)" (using 0.002 for the second argument in this function returns the two-tenths percentile temperature of the hourly temperatures measured in the dataset used).

   <u>This value should be representative of the Extreme Cold Weather Temperature based on the given dataset.</u>

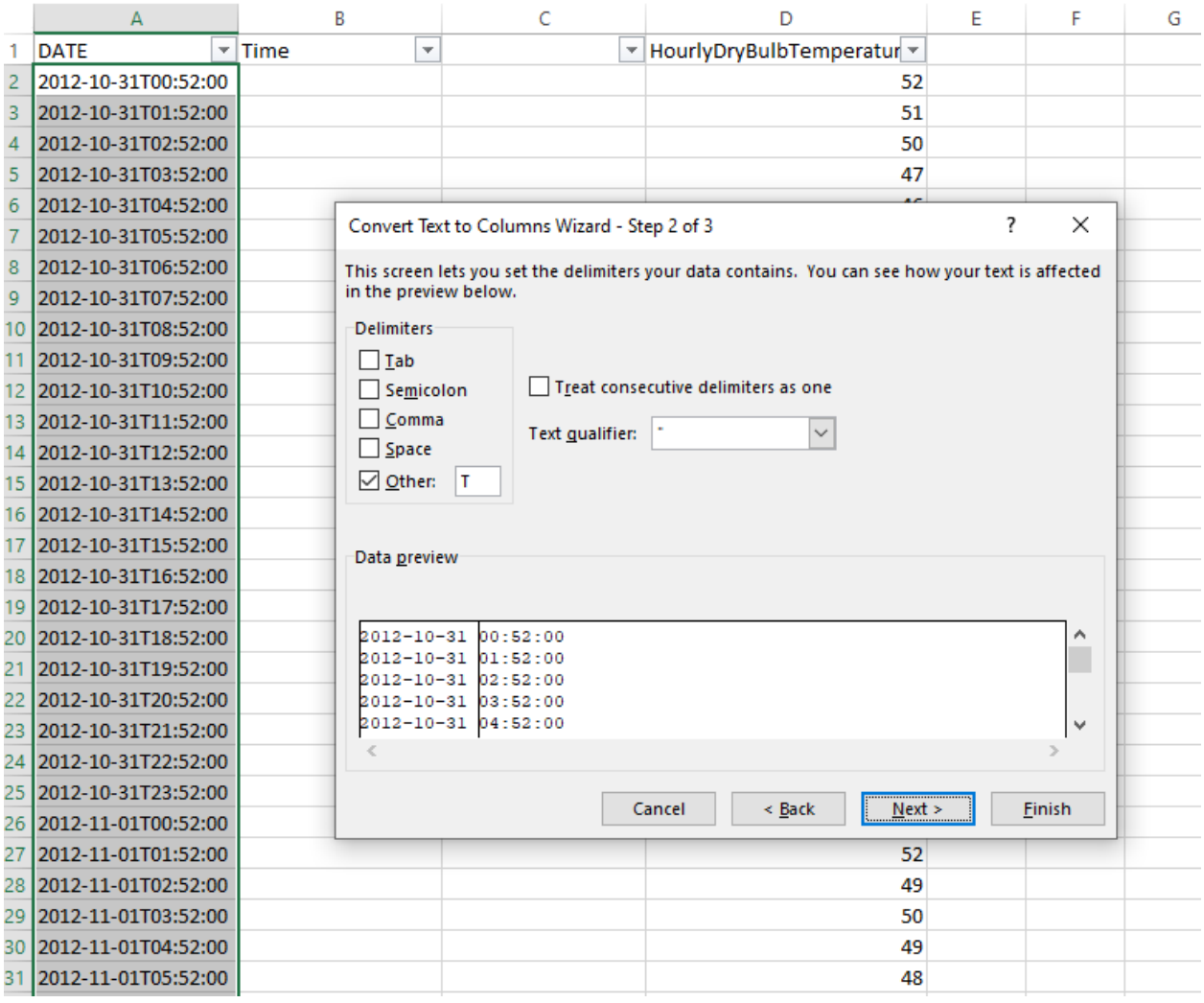
E5 =PERCENTILE.INC(B:B,0.002)

	A	B	C	D	E	F	G
1	DATE	HourlyDryBulbTemperature	Month				
2	2012-12-01T00:52:00	58	12				
3	2012-12-01T01:52:00	58	12				
4	2012-12-01T02:52:00	59	12		ECWT		
5	2012-12-01T03:52:00	59	12		2		
6	2012-12-01T04:52:00	58	12				
7	2012-12-01T05:52:00	59	12				
8	2012-12-01T06:52:00	58	12				
9	2012-12-01T07:52:00	60	12				
10	2012-12-01T08:52:00	61	12				
11	2012-12-01T09:52:00	63	12				
12	2012-12-01T10:52:00	66	12				
13	2012-12-01T11:52:00	71	12				
14	2012-12-01T12:52:00	74	12				
15	2012-12-01T13:52:00	75	12				
16	2012-12-01T14:52:00	77	12				
17	2012-12-01T15:52:00	76	12				
18	2012-12-01T16:52:00	73	12				
19	2012-12-01T17:52:00	67	12				

Option 2

These next few steps demonstrate how to view the distribution of temperatures from the data set and obtain the Extreme Cold Weather Temperature by a slightly different method.

1. On the "Clean and Filter" sheet, insert two new columns between column A and column B. Select column A and use Excel's *Text to Columns* feature and selected the delimited option and use the letter "T" to split the date data into a date component and a time component by hitting "Next" and "Finish".

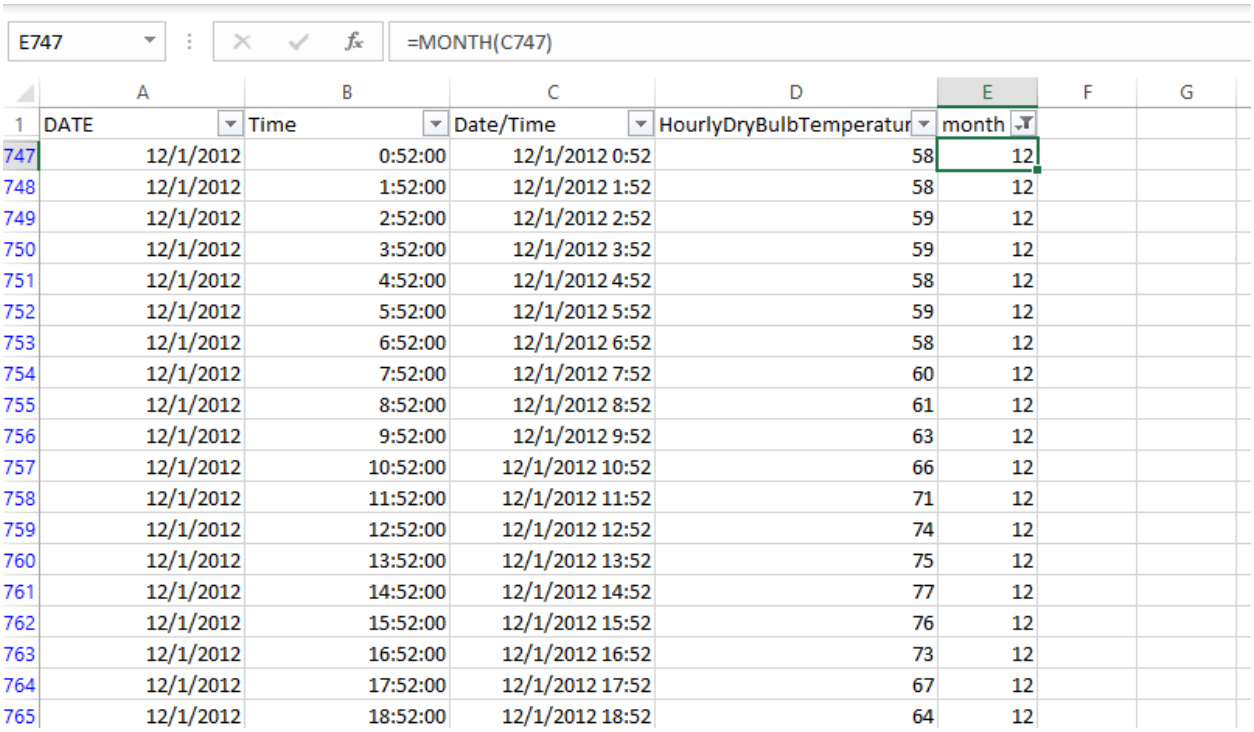


2. Add in column C, add the date in column A to time in column B, and copy this formula for all rows of the data set.

C2 =A2+B2

	A	B	C	D
1	DATE	Time	Date/Time	HourlyDryBulbTemperatur
2	10/31/2012	0:52:00	10/31/2012 0:52	52
3	10/31/2012	1:52:00	10/31/2012 1:52	51
4	10/31/2012	2:52:00	10/31/2012 2:52	50
5	10/31/2012	3:52:00	10/31/2012 3:52	47
6	10/31/2012	4:52:00	10/31/2012 4:52	46
7	10/31/2012	5:52:00	10/31/2012 5:52	46
8	10/31/2012	6:52:00	10/31/2012 6:52	44
9	10/31/2012	7:52:00	10/31/2012 7:52	48
10	10/31/2012	8:52:00	10/31/2012 8:52	52
11	10/31/2012	9:52:00	10/31/2012 9:52	57
12	10/31/2012	10:52:00	10/31/2012 10:52	61
13	10/31/2012	11:52:00	10/31/2012 11:52	65
14	10/31/2012	12:52:00	10/31/2012 12:52	67
15	10/31/2012	13:52:00	10/31/2012 13:52	68
16	10/31/2012	14:52:00	10/31/2012 14:52	71
17	10/31/2012	15:52:00	10/31/2012 15:52	71
18	10/31/2012	16:52:00	10/31/2012 16:52	70
19	10/31/2012	17:52:00	10/31/2012 17:52	66
20	10/31/2012	18:52:00	10/31/2012 18:52	62
21	10/31/2012	19:52:00	10/31/2012 19:52	59
22	10/31/2012	20:52:00	10/31/2012 20:52	54
23	10/31/2012	21:52:00	10/31/2012 21:52	51

3. Type Month in cell E1, and in cell E2 use the formula "=month(C2)". Copy the formula for all rows of the data set, then filter based on month, only selecting 1,2,12 for the desired months. Then copy remaining data from column C and column D to a sheet named Histogram.



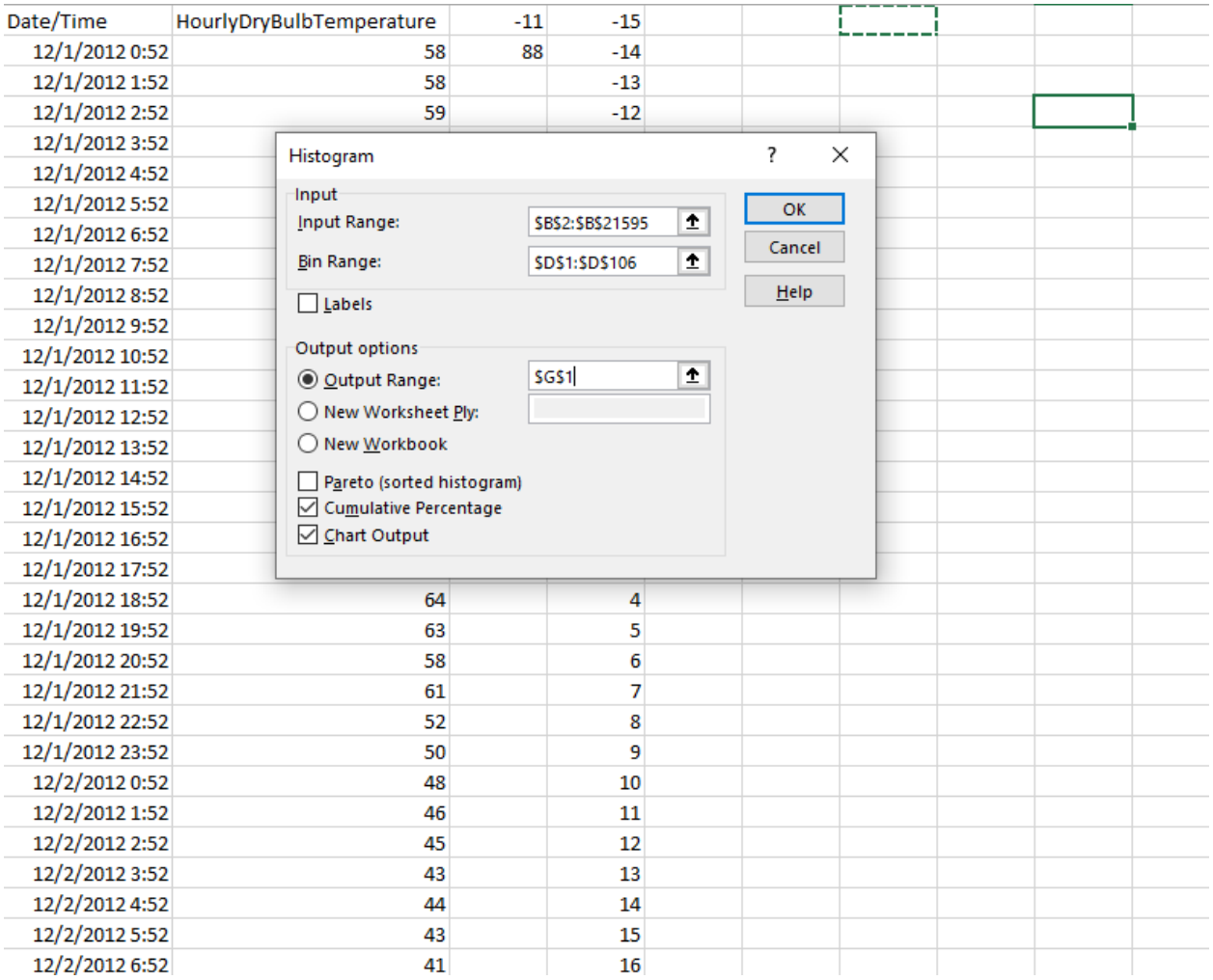
E747 =MONTH(C747)

	A	B	C	D	E	F	G
1	DATE	Time	Date/Time	HourlyDryBulbTemperatur	month		
747	12/1/2012	0:52:00	12/1/2012 0:52	58	12		
748	12/1/2012	1:52:00	12/1/2012 1:52	58	12		
749	12/1/2012	2:52:00	12/1/2012 2:52	59	12		
750	12/1/2012	3:52:00	12/1/2012 3:52	59	12		
751	12/1/2012	4:52:00	12/1/2012 4:52	58	12		
752	12/1/2012	5:52:00	12/1/2012 5:52	59	12		
753	12/1/2012	6:52:00	12/1/2012 6:52	58	12		
754	12/1/2012	7:52:00	12/1/2012 7:52	60	12		
755	12/1/2012	8:52:00	12/1/2012 8:52	61	12		
756	12/1/2012	9:52:00	12/1/2012 9:52	63	12		
757	12/1/2012	10:52:00	12/1/2012 10:52	66	12		
758	12/1/2012	11:52:00	12/1/2012 11:52	71	12		
759	12/1/2012	12:52:00	12/1/2012 12:52	74	12		
760	12/1/2012	13:52:00	12/1/2012 13:52	75	12		
761	12/1/2012	14:52:00	12/1/2012 14:52	77	12		
762	12/1/2012	15:52:00	12/1/2012 15:52	76	12		
763	12/1/2012	16:52:00	12/1/2012 16:52	73	12		
764	12/1/2012	17:52:00	12/1/2012 17:52	67	12		
765	12/1/2012	18:52:00	12/1/2012 18:52	64	12		

4. On the Histogram sheet, enter "=min(B:B)" in cell C1, and "=max(B:B)" in cell C2. This will give you the minimum and maximum temperatures in the dataset. We will use the temperatures to set range for this histogram. In Column D start with a value, a few degrees below the min, then list every degree to a few degrees above the max.

Date/Time	HourlyDryBulbTemperature	-11	-15	
12/1/2012 0:52	58	88	-14	
12/1/2012 1:52	58		-13	
12/1/2012 2:52	59		-12	
12/1/2012 3:52	59		-11	
12/1/2012 4:52	58		-10	
12/1/2012 5:52	59		-9	
12/1/2012 6:52	58		-8	
12/1/2012 7:52	60		-7	
12/1/2012 8:52	61		-6	
12/1/2012 9:52	63		-5	
12/1/2012 10:52	66		-4	
12/1/2012 11:52	71		-3	
12/1/2012 12:52	74		-2	
12/1/2012 13:52	75		-1	
12/1/2012 14:52	77		0	
12/1/2012 15:52	76		1	
12/1/2012 16:52	73		2	
12/1/2012 17:52	67		3	
12/1/2012 18:52	64		4	
12/1/2012 19:52	63		5	
12/1/2012 20:52	58		6	
12/1/2012 21:52	61		7	
12/1/2012 22:52	52		8	
12/1/2012 23:52	50		9	
12/2/2012 0:52	48		10	
12/2/2012 1:52	46		11	
12/2/2012 2:52	45		12	
12/2/2012 3:52	43		13	
12/2/2012 4:52	44		14	
12/2/2012 5:52	43		15	
12/2/2012 6:52	41		16	
12/2/2012 7:52	38		17	
12/2/2012 8:52	44		18	

5. In the Data Analysis ToolPak in excel, select histogram. Select all dry bulb temperatures for your Input Range. Select all the Temperatures in column D for our Bin Range. Select an empty cell for your Output Range. Check the Cumulative Percentage and Chart Output boxes.



Date/Time	HourlyDryBulbTemperature	-11	-15
12/1/2012 0:52	58	88	-14
12/1/2012 1:52	58		-13
12/1/2012 2:52	59		-12
12/1/2012 3:52			
12/1/2012 4:52			
12/1/2012 5:52			
12/1/2012 6:52			
12/1/2012 7:52			
12/1/2012 8:52			
12/1/2012 9:52			
12/1/2012 10:52			
12/1/2012 11:52			
12/1/2012 12:52			
12/1/2012 13:52			
12/1/2012 14:52			
12/1/2012 15:52			
12/1/2012 16:52			
12/1/2012 17:52			
12/1/2012 18:52	64		4
12/1/2012 19:52	63		5
12/1/2012 20:52	58		6
12/1/2012 21:52	61		7
12/1/2012 22:52	52		8
12/1/2012 23:52	50		9
12/2/2012 0:52	48		10
12/2/2012 1:52	46		11
12/2/2012 2:52	45		12
12/2/2012 3:52	43		13
12/2/2012 4:52	44		14
12/2/2012 5:52	43		15
12/2/2012 6:52	41		16

6. The output from this will provide a listing of percentile rankings for the listed temperatures, as well as a graph output of the distribution of temperatures contained in this dataset. The "Bin" column shows the temperature, "Frequency" shows how many times that temperature occurred within he dataset, and "Cumulative %" shows the percentile ranking for each temperature. Choose the temperature at or closest to the 0.2 percentile level.

Bin	Frequency	umulative %
-15	0	0.00%
-14	0	0.00%
-13	0	0.00%
-12	0	0.00%
-11	1	0.00%
-10	0	0.00%
-9	2	0.01%
-8	0	0.01%
-7	1	0.02%
-6	4	0.04%
-5	4	0.06%
-4	4	0.07%
-3	1	0.08%
-2	4	0.10%
-1	6	0.13%
0	5	0.15%
1	3	0.16%
2	11	**0.21%**
3	5	0.24%
4	13	0.30%
5	22	0.40%
6	14	0.46%
7	12	0.52%
8	17	0.60%
9	23	0.70%
10	32	0.85%
11	50	1.08%
12	39	1.26%
13	53	1.51%
14	93	1.94%
15	92	2.37%
16	86	2.76%