

Are Extreme Weather Events Increasing?

INTRODUCTION

Over 15 years ago, in 1995, Chicago experienced a four-day heat wave with daytime temperatures ranging from 37°C (98°F) to 41°C (106°F). Nighttime temperatures were also usually warm due to the high humidity. More than 700 people died from heat-related causes during this time. So are heat waves and other extreme weather events increasing? Recently, you have probably noticed more extreme weather-related events in the news – from heat waves to droughts or floods or storms. In late June of 2012, more than 2000 record temperatures were recorded across the U.S., and a widespread, long-lived windstorm, known as a “derecho,” moved from Illinois to Virginia leaving massive devastation. “Derecho” is Spanish for straight and first described back in 1888 when a derecho crossed Iowa. Meanwhile 7 major wildfires, fueled by extreme heat and drought, were burning in Colorado.

In this investigation, you will learn how to analyze temperature data so that you can track extreme weather. First, you will obtain temperature data and use Excel to graph and compare some recent heat waves. You will then locate and label several extreme weather-related events that have occurred throughout the world over the past decade. Finally, you will learn to use the National Climatic Data Center (NCDC) to identify and analyze the most recent weather-related events and climate anomalies.

Climate Central is non-profit journalism and research organization that focuses on helping the public understand climate change and make informed decisions. Read the state-by-state analysis extreme weather for 2011 and view the slide show of images. <http://www.climatecentral.org/news/top-ten-states-hit-hardest-by-2011s-extreme-weather/>

What were the top ten states “hit the hardest” by extreme weather in 2011? Which state was most affected? Find a news story about a recent extreme weather event. Before you begin, you may also watch the segment from the CBS Sunday Morning show on the extreme weather of 2011: <http://www.cbsnews.com/video/watch/?id=7379644n>.

Exploration 1: How to Graph Temperature Data and Analyze Recent Heat Waves

A heat wave is generally a period of several days to weeks of abnormally hot weather that may or may not be accompanied by high humidity. The World Meteorological Organization defines a heat wave as five or more consecutive days of temperatures 5°C (9°F) above the average maximum temperature. Because the average maximum temperature varies from one location to another, what is considered a heat wave in one location may not be considered a heat wave in another. For sake of simplicity in this investigation, we will refer to a heat wave as 3 consecutive days over 95°F.

Directions: You will analyze the maximum and minimum temperatures for one city. Follow the directions below to create a graph of the maximum and minimum temperatures for the city you select. Print the answer sheet.

- Go to <http://www.wunderground.com/history/>.
- Under Weather History, in the location field, type in one of the following cities:
 - Niamey, Niger – June 1 – August 31, 2010
 - Sukkur, Pakistan – June 1 – August 31, 2010
 - Guadalupe Pass, Texas – June 1 – August 31, 2011
 - Washington, DC – June 1 – August 31, 2010
 - Baton Rouge, Louisiana – June 1 – August 31, 2010
 - Moscow, Russia – June 1 – August 31, 2010
 - King Khaled, Saudi Arabia – June 1 – August 31, 2010

Leave the date field as the default date. You will edit this in the next step. Click **Submit**.

- Click on the *Custom* tab and then choose the beginning and end month and day. Click **Go**.

- Scroll down to the bottom of the page and right (or ctrl) click on **Comma Delimited File**. Choose **Save Link As** and name your files appropriately (City Name and Year). After the name, type .csv and then under **Save as type**, change to **All Files**. Save the file to a location where you can find it. (MAC USERS: You will not be able to save as a csv file. Save as html and then go to the location where you saved the file. Rename the file changing the .html to.csv.)

Weather History

Location:

Date:

History for Miami, FL
June 1, 2008 through August 31, 2008 — View Current Conditions

June 1, 2008 through August 31, 2008

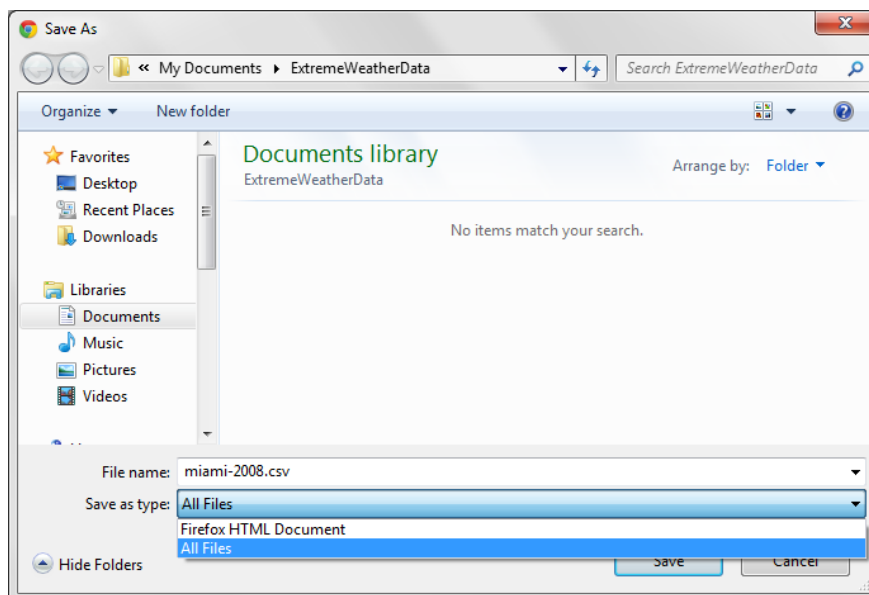
June 1 - TO - August 31 - Go

Temperature

	Max	Avg	Min	Sum
Max Temperature	93 °F	90 °F	84 °F	
Mean Temperature	87 °F	84 °F	78 °F	
Min Temperature	83 °F	77 °F	71 °F	

00	86	71	29.95	29.76	29.59	6	6	3	16
00	74	44	30.15	30.09	29.98	6	6	0	11

Comma Delimited File



Open the spreadsheet in Excel. This spreadsheet gives us far more information than we are going to use. For this graphing activity, we are only going to examine the first three columns: the date, the maximum temperature and the minimum temperature.

5. Your data will now be imported into Excel. You may see ##### instead of a date in column A. If so, you will need to expand the width of the column for the date to display correctly in all cells.
6. Right click on column C and select *Hide*.
7. If Row 1 is empty (no data), right click on 1 to highlight the row and choose delete. All of your data should move up.

	A	B	D
1	DATE	MAX TEMP	MIN TEMP
2	6/1/2008	90	85
3	6/2/2008	87	82
4	6/3/2008	90	83
5	6/4/2008	90	82
6	6/5/2008	90	86
7	6/6/2008	90	85
89	8/27/2008	92	86
90	8/28/2008	92	85
91	8/29/2008	90	85
92	8/30/2008	87	83
93	8/31/2008	88	84

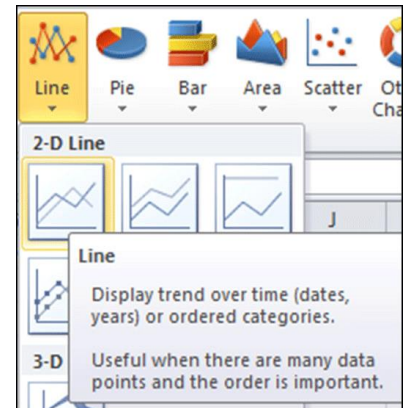
8. Change the labels in the column headings as you see in the graphic (on right): Column A – DATE, Column B – MAX TEMP, Column D – MIN TEMP.

	A	B	D
1	DATE	MAX TEMP	MIN TEMP
2	6/1/2008	90	85
3	6/2/2008	87	82
4	6/3/2008	90	83

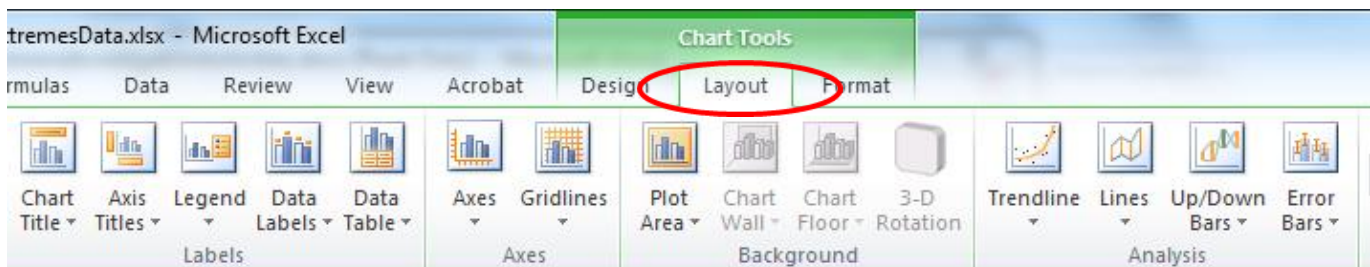
9. Select all of the data in columns A, B, and D by clicking in cell A1 and dragging to the last cell in D with data. The area should be highlighted blue. (See graphic on left.)

10. On the Insert menu, click on Line>2D Line>Line. (See graphic on right.)

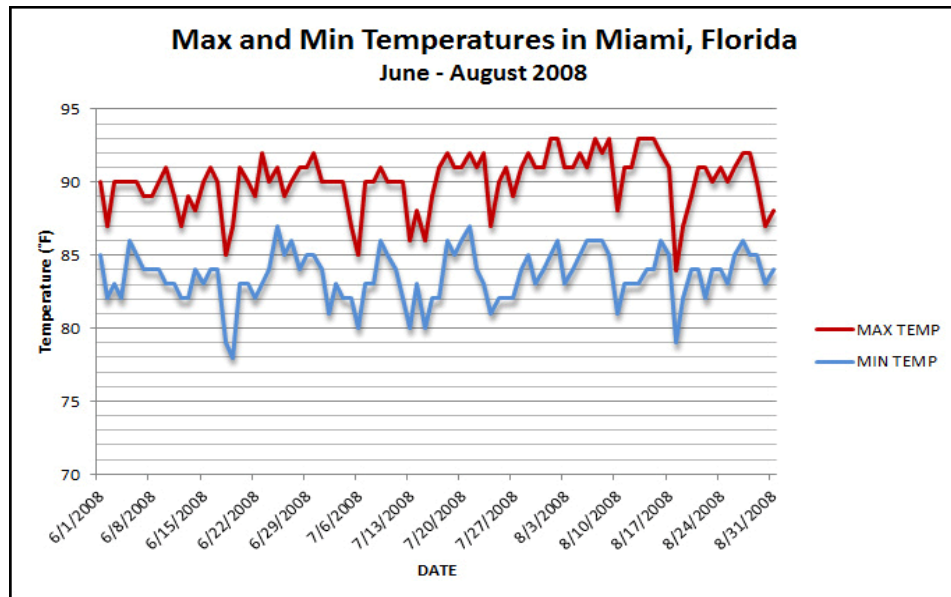
11. You can edit your graph to change the line colors, include a title, add minor gridlines, etc.



- a. **Change line colors** – Let's make the max temp *red* and the min temp *blue*. Right click (Ctrl+Click on Mac) on the line>Format data series>Select Line color>Solid line>Select your color. You can choose to add other effects here as well.
- b. **Chart, axis titles and gridlines** – Click on your graph and click on the *Layout* tab under *Chart Tools* (Excel 2010).
 - i. Choose *Chart title*>*Above Chart* and add the title **Max and Min Temperatures in <City Name, Country Name> June - August 2010**
 - ii. Choose *Axis Titles*>*Primary Horizontal Axis Title*>*Title Below Axis*. Add the axis title **Date**.
 - iii. Choose *Axis Titles*>*Primary Vertical Axis Title*>*Rotated Title*. Add the axis title **Temperature (°F)**.
 - iv. Choose *Gridlines*>*Primary Horizontal gridlines*>*Major & Minor Gridlines*.
 - v. Choose *Gridlines*>*Primary Vertical gridlines*>*Major & Minor Gridlines*.



12. Your completed graph should look similar to the graph below. Right click on the graph in the Excel spreadsheet and select copy. Open a Microsoft Office Word document and use the Page Layout to change orientation to Landscape. Right click and select paste. Add your name to the word document and print it to turn in.
13. Answer the questions on the answer sheet as you analyze your findings.



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Analysis of Findings

What location did you analyze? _____

Use your Excel spreadsheet to answer the following questions.

1. What was the highest maximum temperature recorded over the 3 months at your location? _____
2. Identify the number of days throughout the three-month period where temperatures were 95°F or above. Color those cells green and count the green cells. How many days did you identify in the three-month period? _____
3. For this analysis, we will define a heat wave as a period of 3 or more consecutive days of a maximum temperature greater than 95°F. How many heat waves did your location experience? _____

How many days did each heat wave last?

Heat Wave	Length of Heat Wave (Days)
1	
2	
3	
4	
5	
6	
7	
8	

Use your graph to answer the following questions.

4. Examine the maximum and minimum temperatures for the location. What trends do you observe for these data?
5. Why do you think that heat-related mortality can be greater in cities at higher latitudes than in more tropical cities?