National Weather Service Forecast Office Chicago

Weather Currents

CHICAGO

Fall 2012

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Inside this issue:

NWS Chicago to Host Open House on Saturday, October 13, 2012

by Amy Seeley, HydroMeterological Technician

The National Weather Service Forecast Office in Romeoville will hold an open house on **Saturday October 13, 2012 from 900 a.m. until 300 p.m.**

At the open house visitors will see and learn about:

- NWS surface and upper air weather observations
- Volunteer weather observing networks, including the Coop program, CoCoRaHS, and the Chicago-Rockford Area Snowfall Teams
- The NOAA and NWS organization, the Chicago Weather Forecast Office area of responsibility, and programs
- An overview of NWS web pages and NOAA Weather Radio
- Displays of satellite, Doppler radar, and weather maps
- Forecast operations and the warning decision process
- An overview of computer systems and communications
- Hazards of flooding
- A look at the Doppler radar data acquisition building (sorry, visitors are not permitted inside the radar dome)
- How river levels and flows are measured by the U.S. Geological Survey (USGS)
- Amateur radio operations for severe weather
- Will County Emergency Management Agency incident command vehicle on display
- Tornado machine loaned to NWS by Valparaiso University
- Local colleges/universities with meteorological programs

NWS Chicago to Host Open House on Saturday, October 13, 2012 (cont)

If you have a NOAA Weather Radio and need help programming it for the areas you would like, please bring the radio with you. We will have people there who will be able to assist you.

The Will County Emergency Management Agency and American Red Cross incident command vehicles will be on display. Some other agencies that will be here are the USGS, the Midwest Regional Climate Center, Romeoville Emergency Management Agency, Lockport Township Fire Department, Plainfield Boy Scout Troop 13, Romeoville Boy Scout Troop 22, Valpariaso University, Northern Illinois University, and College of DuPage.

The open house will be held rain or shine. Each tour will take around 30-40 minutes. The first tour will begin at 900 a.m. and the last will begin around 300 p.m. There is no registration. ***People will be taken first come, first served.*** There will be a wait to go on the tour if it gets crowded, so please keep that in mind. The tour is open to all ages – a great outing for Cub Scouts, Boy Scouts, Girl Scouts and other youth groups.

For security reasons – no bags, backpacks, purses are permitted in the building. Please leave them in your car. Cameras are allowed.

Directions;
The National Weather Service is located at the Lewis University Airport in Romeoville, at the corner of George Michas Drive and Don Walden Road. The office is next to, but not part of Lewis University. ***There is no access to the National Weather Service from Lewis University.*** Entrance is through the Lewis University Airport off Renwick Road about midway between Weber Road and Route 53.



Largest Wave Measured on Lake Michigan

by Mike Bardou, Lead Forecaster and Kevin Birk, Forecaster

September 30th marks the one year anniversary of the largest wave measured by the Lake Michigan weather observation buoys. Back on September 30, 2011, the southern Lake Michigan buoy located 43 miles east-southeast of Milwaukee reported 23.1 foot waves during a storm on the lake. These are the largest waves recorded by this buoy going back to 1981 when it was commissioned. This wave height is also larger than those recorded by the northern Lake Michigan buoy since it went into operation in 1979. The tables below display the dates of some of the largest waves reported from the north and the south buoys.

North Buoy			
Year	*Wind Direction Range*	*Max Wind Speed (KT)*	*Max Wave (FT)*
2010	***119-246***	***48***	***21.6***
1991	**Missing**	**Missing**	**19.4**
1979 12/15	**205-226**	**43**	**17.7**
1979 12/3	**194-249**	**44**	**17.1**
1993	**166-232**	**44**	**17.1**
2001	**188-216**	**43**	**16.3**

South Buoy			
Year	*Wind Direction Range*	*Max Wind Speed (KT)*	*Max Wave (FT)*
2011 9/30	***215-351***	***47***	***23.1***
1998	**112-266**	**54**	**20.3**
2011 10/20	**310-37**	**45**	**19.2**
1989	**326-358**	**44**	**18.4**
2005	**176-339**	**42**	**17.4**
1983	**340-36**	**36**	**17.4**
2000	**224-40**	**43**	**17.1**

When considering buoy observations on the Great Lakes, it is important to remember that these buoys are only deployed from mid or late spring until mid or late fall. The buoys are removed during the winter months to prevent damage from ice on the lake or freezing spray and precipitation. This leaves the possibility and probably the likelihood that these buoys would have had an opportunity to record larger waves during some of the strong winter storms that have affected the lake. It is also important to be aware that the wave height reported by the buoy is a mathematically derived measurement based on up and down movement of the buoy itself over a period of time, versus an actual instantaneous wave measurement. In other words, it is likely that there were larger and smaller waves occurring during the time of the 23.1 foot observation. In fact, mathematical formulas suggest that the maximum wave height possible during this event would have been nearly 35 feet, though waves of this size would be rather infrequent. For more information on how buoys determine wave height visit: http://www.ndbc.noaa.gov/wave.shtml.

Largest Wave Measured on Lake Michigan (cont)

So what kind of weather conditions did it take to produce such wave heights? In this particular event, a potent autumn season area of low pressure, known as a clipper system, quickly raced southeastward out of southern Canada and then moved eastward across northern sections of Lake Michigan. The four surface figures below shows that the center of the low moved from western Lake Superior to northern Lake Michigan within a 12 hour period from 6am to 6pm September 29th. During this same period, a potent and expansive area of high pressure quickly pushed eastward from the northern High Plains to the central and Northern Plains. These two pressure systems combined to produce a very strong pressure gradient across Lake Michigan during the night of September 29th into the day of the 30th. So, once the surface low passed across the lake, the winds quickly shifted out of the north and increased dramatically as a much colder air mass moved across the lake. The combination of this much colder air mass and the fact that lake water temperatures were still in the 60s allowed for the development of unstable conditions across the lake, which allowed stronger winds from aloft to be transported down to the water surface. This setup produced a perfect setup for northerly Storm force (48 to 63 kt) winds in excess of 55 KT down the entire 300+ mile stretch of Lake Michigan. Given this incredibly long fetch of strong winds, waves were able to build to these massive heights across the southern section of the Lake. Figure 2 below displays the estimated wave heights during this event based on the wind speeds and directions. Notice the highest waves over 20 feet are along the southern third of the Lake. The stronger the wind, the longer the distance it blows across the lake, and the longer the duration that it is blowing, the larger the waves will be. In fact, a tug boat captain estimated waves

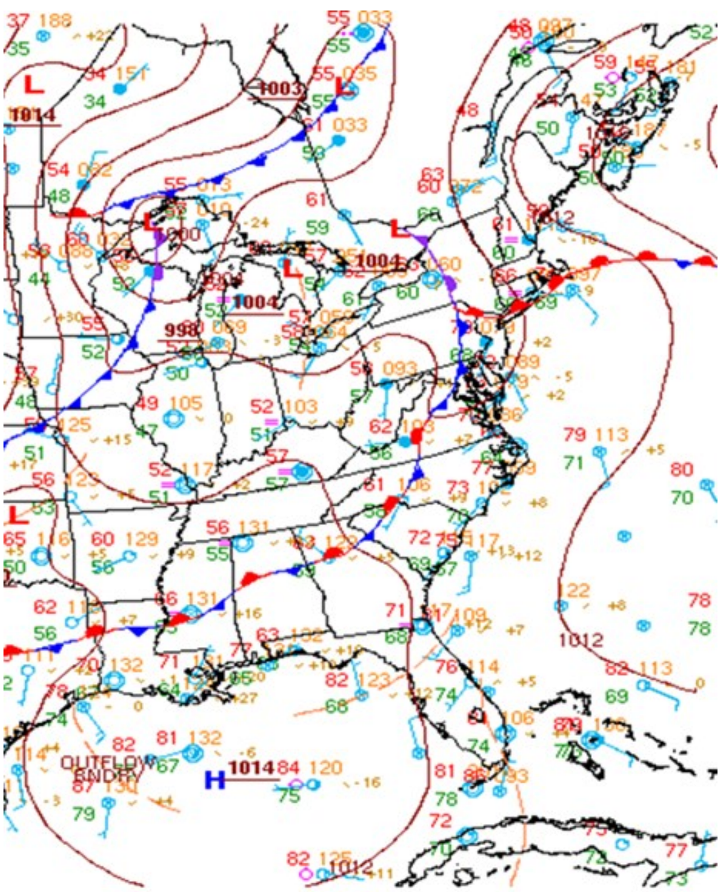

Figure 1. Surface pressure analysis at 7am on September 29th.

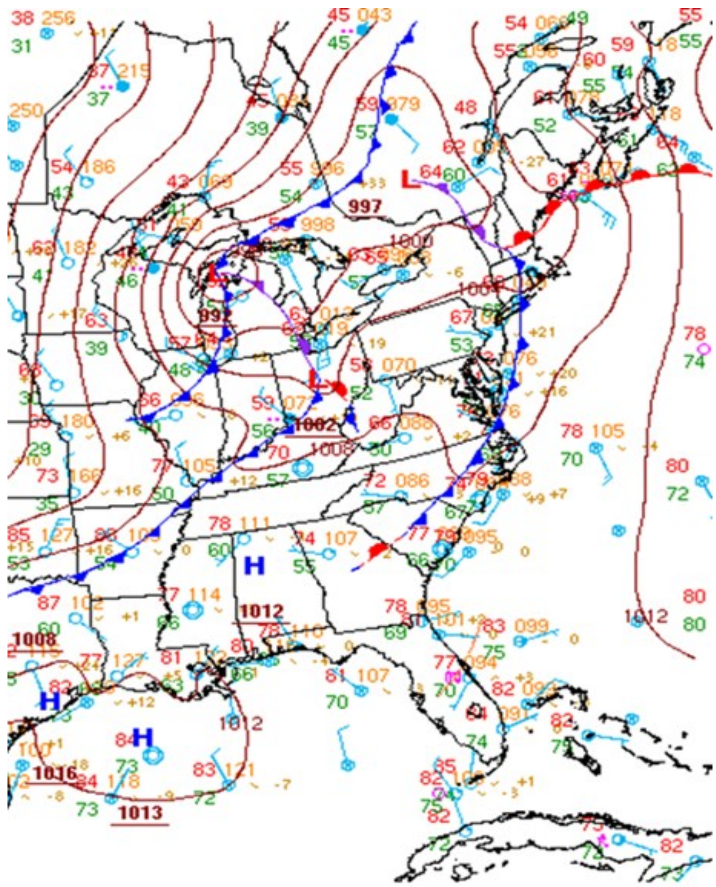

Figure 1b. Same as 1a except at 7pm on September 29th.

Largest Wave Measured on Lake Michigan (cont)

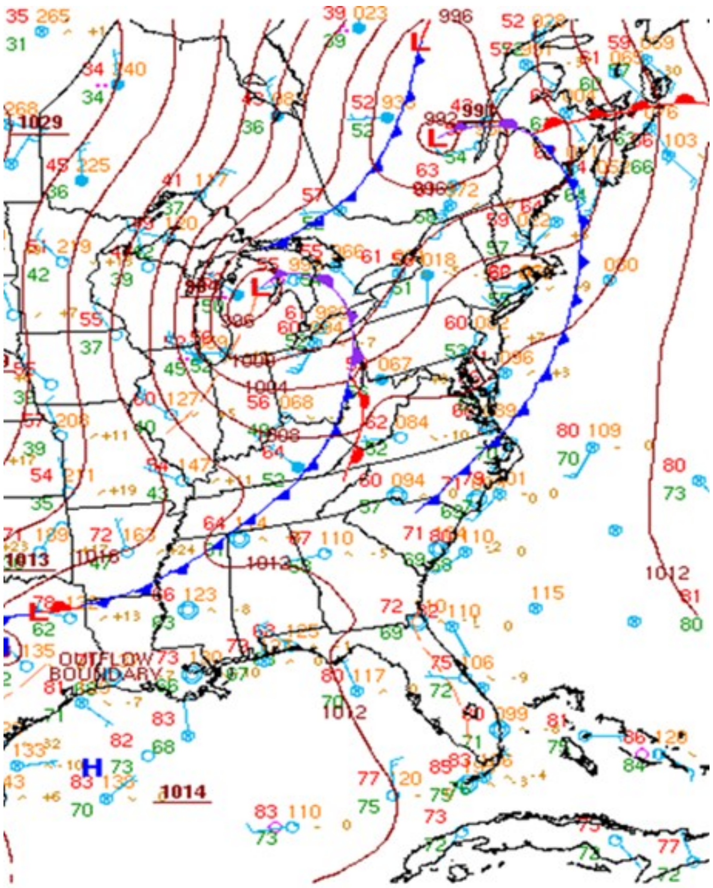

Figure 1c. Same as 1a except at 1am on September 30th.

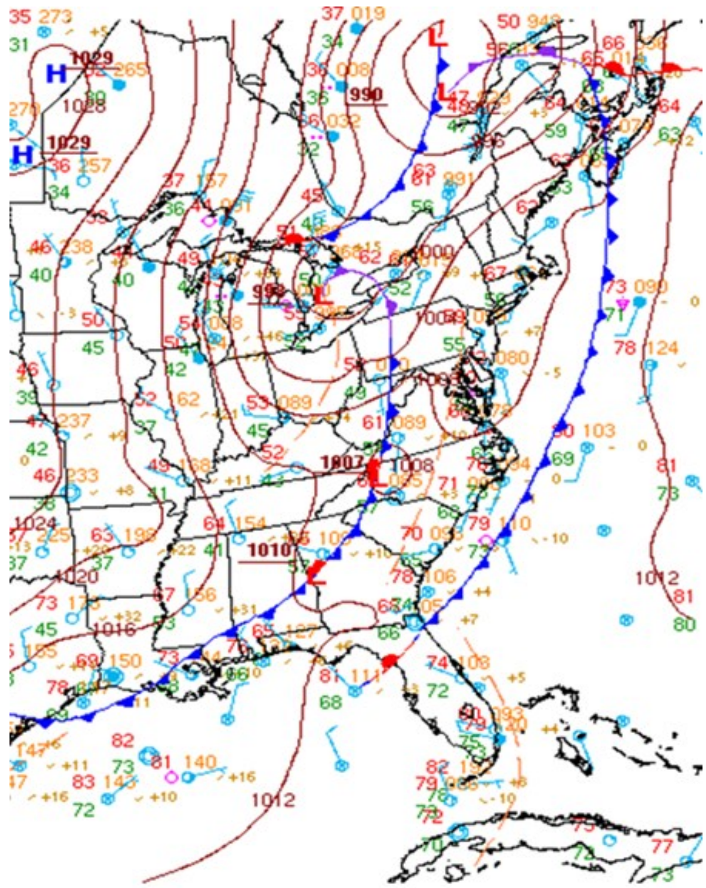

Figure 1d. Same as 1a except at 7am on September 29th.

Largest Wave Measured on Lake Michigan (cont)

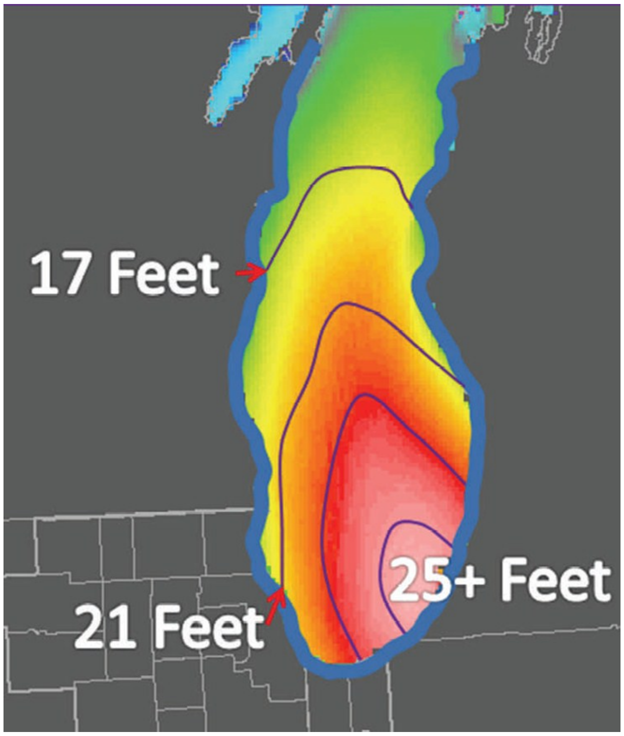

Figure 2 displays the estimated wave heights during this event based on the wind speeds and directions. Notice the highest waves over 20 feet are along the southern third of the Lake. The stronger the wind, the longer the distance it blows across the lake, and the longer the duration that it is blowing, the larger the waves will be. In fact, a tug boat captain estimated waves of 24 to 27 feet coming over the breakwall at Burns Harbor, Indiana!

Figure 2. Estimated Wave Heights.

Figure 3 displays the hour by hour wind and wave height observations from the south buoy. Notice that the time of the peak wave height lags the time period of the onset of the strongest wind by a few hours. This is due to the fact that it takes several hours of strong winds in excess of 45 knots to produce waves of over 20 feet. Waves of this magnitude have a range of impacts from physical damage caused by coastal flooding and beach erosion to damage to boats moored in marinas to economic effects due to delays to maritime transportation. In addition, the bike path along the Chicago lakefront needed to be shut down because of large waves crashing onto portions of its route posing a significant hazard to people using it.

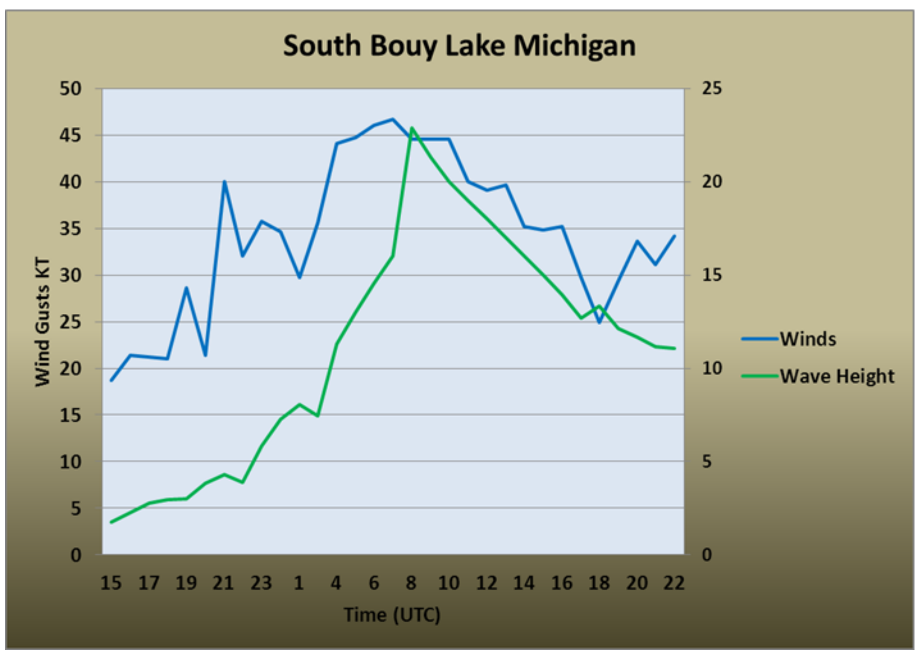

Figure 3. Chart of the hourly wind speed and wave heights reported by the south buoy. Winds are in knots and wave heights are in feet.

Largest Wave Measured on Lake Michigan (cont)

Some photos taken along the south shores of Lake Michigan during the event are shown in figure 4.

Figure 4. Pictures take along the south shores of Lake Michigan during the storm. Downtown Chicago can be seen in the background of the top two images.

Gale (34 to 47 kt) and Storm force winds are a fairly regular occurrence across the Great Lakes during the fall and winter months. This particular storm illustrates the fury that can result when extreme winds are aligned down the long axis of Lake Michigan, aided by cold air passing over the relatively warm waters, over a long period of time. The buoy wave data provides a valuable basis for evaluating the magnitude of these weather systems and determining what they are capable of. However, it is important to remember that wave heights vary and that larger and smaller waves are occurring at the time of a peak wave observation by the buoy. Waves larger than the 23.1 foot value observed were likely occurring on this day.

First Snowfall Data for Chicago and Rockford

by Jim Allsopp, Warning Coordination Meteorologist

As the seasons transition from summer to fall to winter, the prospects of snow grow greater and greater. While most snowfall in the Midwest is concentrated in the December through March timeframe, on occasion we do experience some early season snow in Chicago and Rockford. There are a few different ways to look at snow observations.

First observed snow. This is falling snow that is reported in an official weather observation (human or automated). The snow may or may not stick to and accumulate on the ground.

First measurable snow. Snowfall that accumulates on the ground is measured by human observers to the nearest tenth of an inch. Snow that melts as it falls, or a light dusting of snow on the ground that is less than one tenth of an inch, is considered a “trace” of snow. The first measurable snow is the date when at least one tenth of an inch of snow is measured.

First inch of snow. The first time in the season when at least one inch of snow is measured.

First heavy snow. In this part of the country, snowfall of 6 inches or more in 12 hours or less is defined as a “heavy snow”. Since snowfall records are listed by calendar day, and because a heavy snow event may span two or more calendar days in some cases, for simplicity we examined the dates of the first 6 inch snow recorded for a calendar day.

Chicago snowfall data goes back to 1884 and Rockford snowfall data goes back to 1905.

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Date	Trace	.1 inch or greater	1 inch or greater	6 inches
Average first occurrence	October 30	November 16	December 2	January 23*
Earliest	September 25, 1928 and 1942	October 12, 2006	October 19, 1989	November 6, 1951**
Latest	December 5, 1999	December 16, 1965	January 17, 1899	Many years with no occurrence

First Snowfall Data for Chicago and Rockford (cont)

ROCKFORD

Date	**Trace**	**.1 inch or greater**	**1 inch or greater**	**6 inches or greater**
Average first occurrence	November 2	November 20	December 1	January 23*
Earliest	October 3, 1951	October 12, 1909	October 23, 1917	November 6, 1951**
Latest	December 19, 1999	January 7, 1940	February 7, 1921	Many years with no occur-rence

*average date of years with an occurrence of 6 inches of snow in a calendar day.

** On November 3, 1951, 4.4 inches of snow fell in Chicago, and 3.4 inches fell at Rockford. Then Chicago was hit with another 8.0 inches on the 6th and 1.3 inches on the 7th, while Rockford received 6.4 inches of snow on the 6th and 3.1 inches on the 7th.

To really appreciate the rarity of this event, there have only been 2 other occasions when at least 6 inches of snow has fallen in Chicago in the month of November, and they were both much later in the season. On November 25, 1895, 5.0 inches fell, with another 7.0 on the 26th – a two day total of 12 inches. In November, 1975, there was 1.4 inches on November 25th, 7.5 inches on the 26th, and 1.1 inches on the 27th – a three day total of 10 inches. Likewise, in Rockford, heavy snow is extremely rare in November. The only other 6 inch snow in November was 6.6 inches on November 27, 1995.

A Look Back at the Hot and Dry Summer of 2012

by Kevin Birk, Forecaster, and Matt Friedlein, Lead Forecaster

This past summer will be remembered for the extremely hot and dry conditions across much of the country. The most noteworthy warm months were June and July. Figure 1 below displays the observed state rankings compared to the past 117 summers for temperatures over the entire summer, along with just June and July. What makes this past summer so impressive was the vastness of hot and dry conditions across the country. Notice that during June nearly all states across the central portion of the country reported above average temperatures for the month, with record warmth observed across Colorado. These warm conditions quickly spread east across the rest of the country during July as the "Heat dome" built eastward. In July nearly every state east of the Rockies experienced near record warmth during the month, with many states ranked within the top five warmest Julys on record.

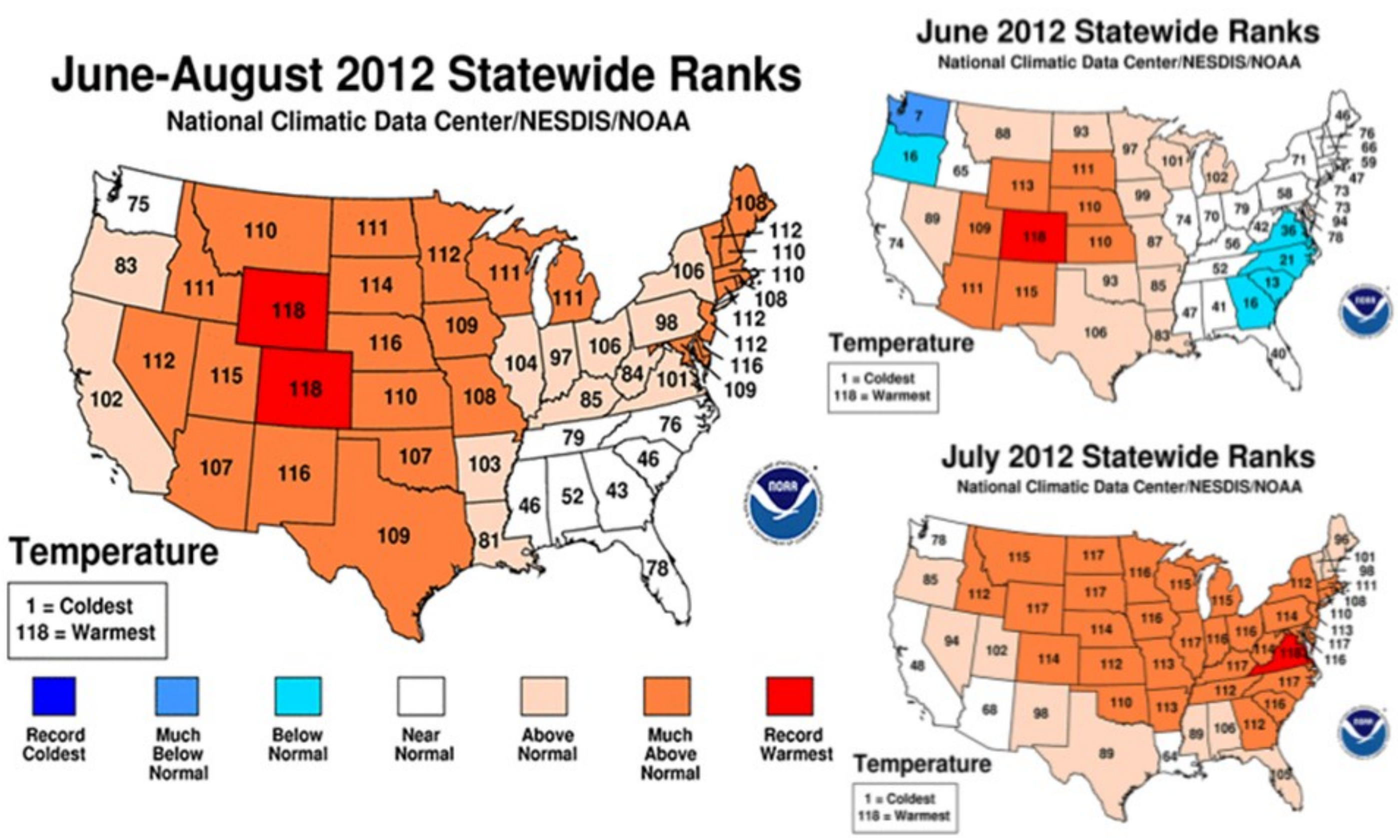

Figure 1. State rankings for temperatures for Summer 2012 (left) and for June (top right) and July (bottom right) 2012.

A Look Back at the Hot and Dry Summer of 2012 (cont)

Some of the magnitude of this extreme heat was likely a result of the very dry conditions across the country. Many states reported much below to near record dryness, especially during June. The combination of this along with the relatively dry conditions experienced earlier in the year led to the rapid development of severe to exceptional drought conditions across a large portion of the Corn Belt. The rapid loss of soil moisture due to evaporation, and the lack of substantial crop growth allowed things to heat up more so than if the antecedent conditions had been wetter. Typically it takes more energy from the sun to warm a wet ground than ground that is dry and void of vegetation. Therefore, the lack of substantial cloud cover allowed the full force of the mid-summer sun to quickly warm the ground and led to numerous 90°+ temperatures across the region. These conditions continued day after day in most of June and into July with little to no relief as the hot and dry conditions fed off one another. Figure 2 below depicts the precipitation rankings by state for the entire summer and the months of June and July.

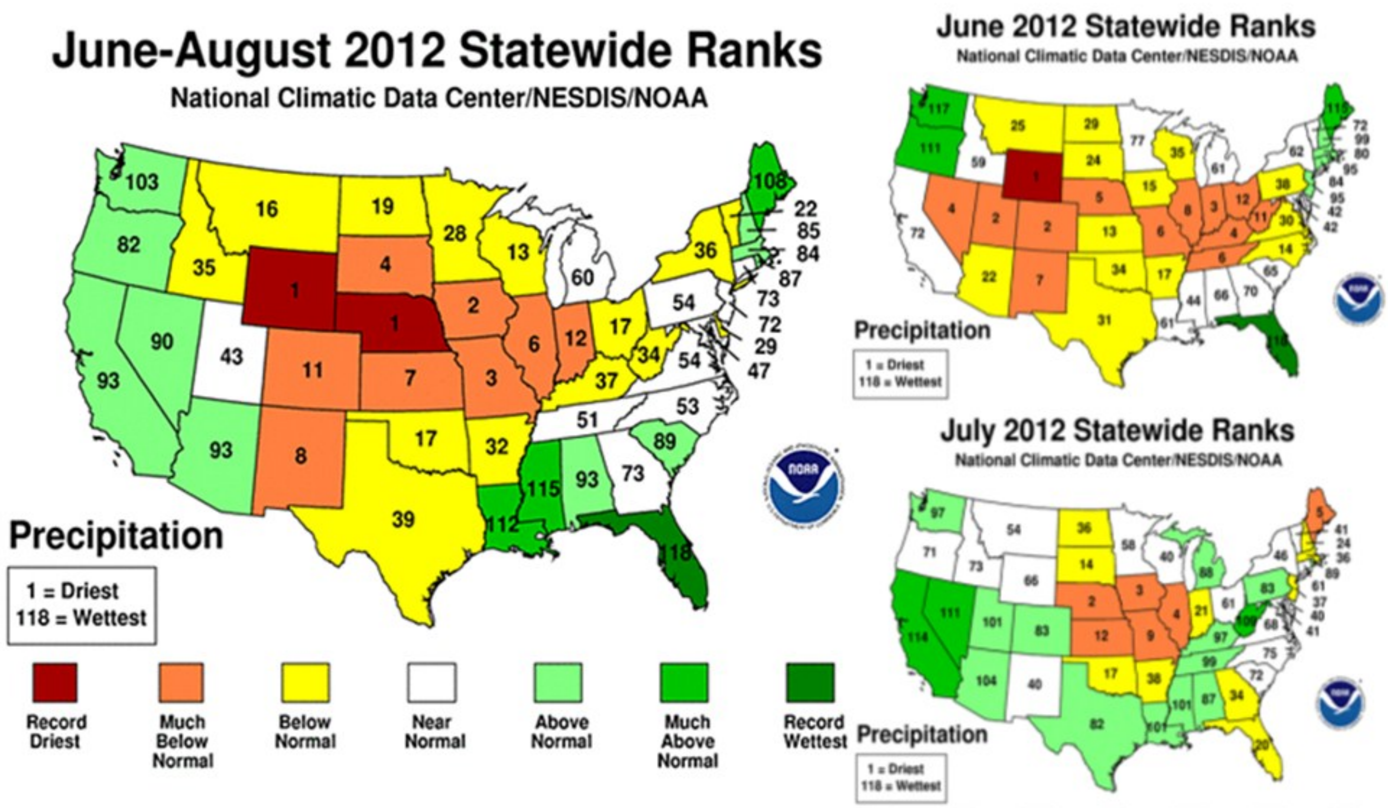

Figure 2. State rankings for precipitation for Summer 2012 (left) and for June (top right) and July (bottom right) 2012.

A Look Back at the Hot and Dry Summer of 2012 (cont)

To show how abnormally warm conditions were day after day this summer consider Tables 1 and 2 below. These tables display the probability of exceedance for both daily high and low temperatures during each summer month at Chicago and Rockford. For the most part there is not much of a difference between the two cities. Notice that typically only 20 percent of days during the month of June exceed a high temperature of 88 degrees, with a similar distribution exceeding 90 degrees in July. In Chicago there was a total of 16 days this past June and 18 days in July when the high temperatures exceeded these thresholds. This equates to 53% of the days in June and 58% of the days in July with temperatures above what climatology says only would occur 20 percent of the time, or about six days each month. Even more interesting is the fact that of the 18 (16) days in July (June) 2012 that exceeded the 20th percentile, 14 (10) days, or 45% (33%), actually even exceeded the 10th percentile. Conditions in Rockford were even slightly more impressive in July as a total of 22 days (71%) exceeded the 20th percentile of 89 degrees, and as many as 16 of these days even exceed the 10th percentile of 92 degrees. These abnormally warm conditions caused the summer season of 2012 to rank as the 3rd warmest on record at both Chicago and Rockford.

Table 1. Probability of exceedance for daily high and low temperatures during each summer month at Chicago.

Chicago , IL						
Probability of Exceedance	High Temperature			Low Temperature		
	June	July	August	June	July	August
90%	67	75	73	48	55	54
80%	72	78	76	51	58	57
70%	76	81	78	54	60	59
60%	78	82	80	56	62	61
50%	81	84	82	58	64	63
40%	83	86	84	60	65	65
30%	85	88	85	63	67	67
20%	88	90	87	66	69	68
10%	92	93	90	69	72	71

Table 2. Same as Table 1 only for Rockford.

Rockford, IL						
Probability of Exceedance	High Temperature			Low Temperature		
	June	July	August	June	July	August
90%	70	76	73	49	55	52
80%	74	79	77	52	57	55
70%	77	81	79	54	59	58
60%	79	82	80	57	61	59
50%	82	84	82	59	63	61
40%	83	85	83	60	64	63
30%	86	87	85	63	66	65
20%	88	89	87	66	68	67
10%	91	92	90	68	70	69

A Look Back at the Hot and Dry Summer of 2012 (cont)

The peak of the extreme heat occurred from July 2nd through the 7th. Excessive Heat Warnings were issued by the NWS for much of the Midwest during this period. At Chicago there were three consecutive days with 100°+ temperatures and four in a row at Rockford. Rockford reached 105° on the 7th, their warmest reading since the Dust Bowl era. Figure 3 below shows the upper level (about 17,000 feet AGL) atmospheric pressure anomalies (left) and the surface temperature anomalies (right) across the country during this five day period. Notice the strong positive upper level pressure anomalies across the central portion of the country, with the peak values located across the upper Mississippi valley and the Great Lakes region. Strong positive pressure anomalies such as these during July indicate that a very hot summertime air mass resides in the lower portions of the atmosphere. Sure enough, the surface temperature anomalies in the right hand figure indicate that the average temperature during this five day period was in excess of six to seven degrees warmer than average for early July across the region. More information on this heat wave period can be found on our web page here.

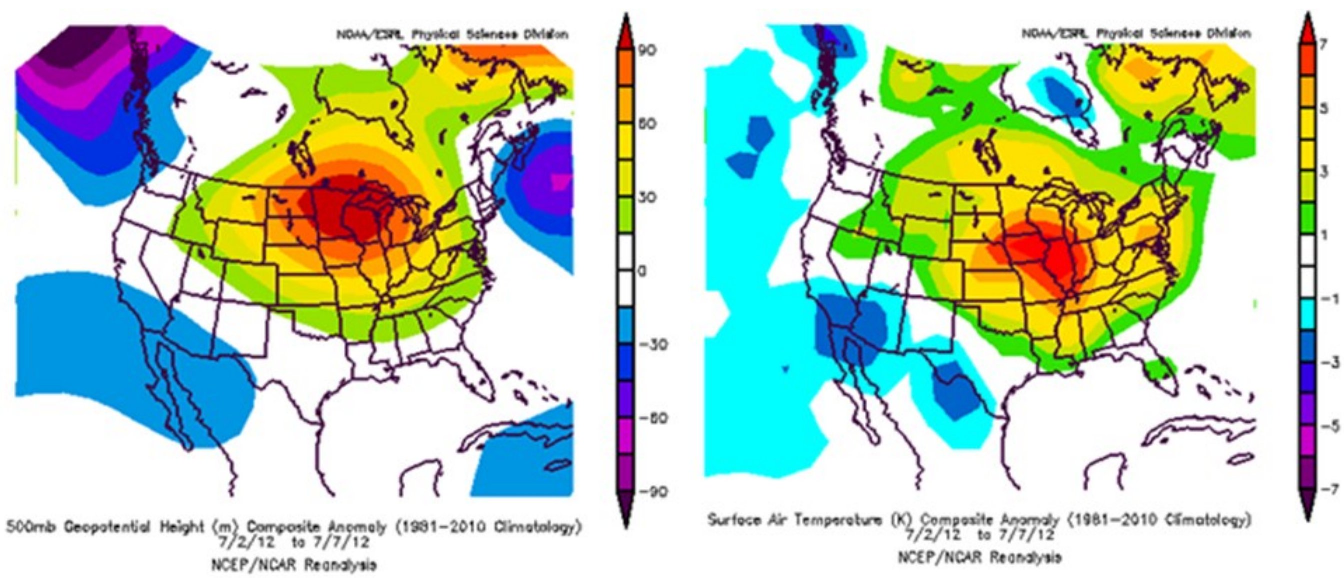

Figure 3. Mid-level atmospheric pressure anomalies (left) and surface temperature anomalies (right) during the 5 day period of July 2nd through July 7th 2012. Cool colors represent negative anomalies while warm colors represent positive anomalies.

Following this period of 100°+ temperatures, conditions cooled off slightly across the area, but the warmth and dryness persisted through the middle of the month. Finally by late July and into August some relief finally came as a weather pattern shift allowed the frequency of rainfall events to increase and some cooler weather to move across the region. This cooler weather kept July from becoming the warmest July on record for Chicago, but only falling short of the record by 0.2°F. However, July did still rank as the warmest on record at Rockford.

A Look Back at the Hot and Dry Summer of 2012 (cont)

Even cooler weather arrived during the middle part of August. In fact, temperatures became much cooler than average for a period. Figure 4 below displays the upper level (about 17,000 feet AGL) atmospheric pressure anomalies (left) and the surface temperature anomalies (right) across the country during the period from August 9th through the 21st. Notice that unlike the pattern during early July discussed above, strong negative upper level atmospheric pressure anomalies developed across the eastern half of the county as the large scale weather pattern across North America changed. Accompanying these negative pressure anomalies was a period of much cooler than average temperatures. A total of seven days during this 12 day period ranked within the coldest 20 to 30% of daily maximum temperatures for the middle of August in Chicago. So the area literally went from very warm extremes to a short period of cool extremes.

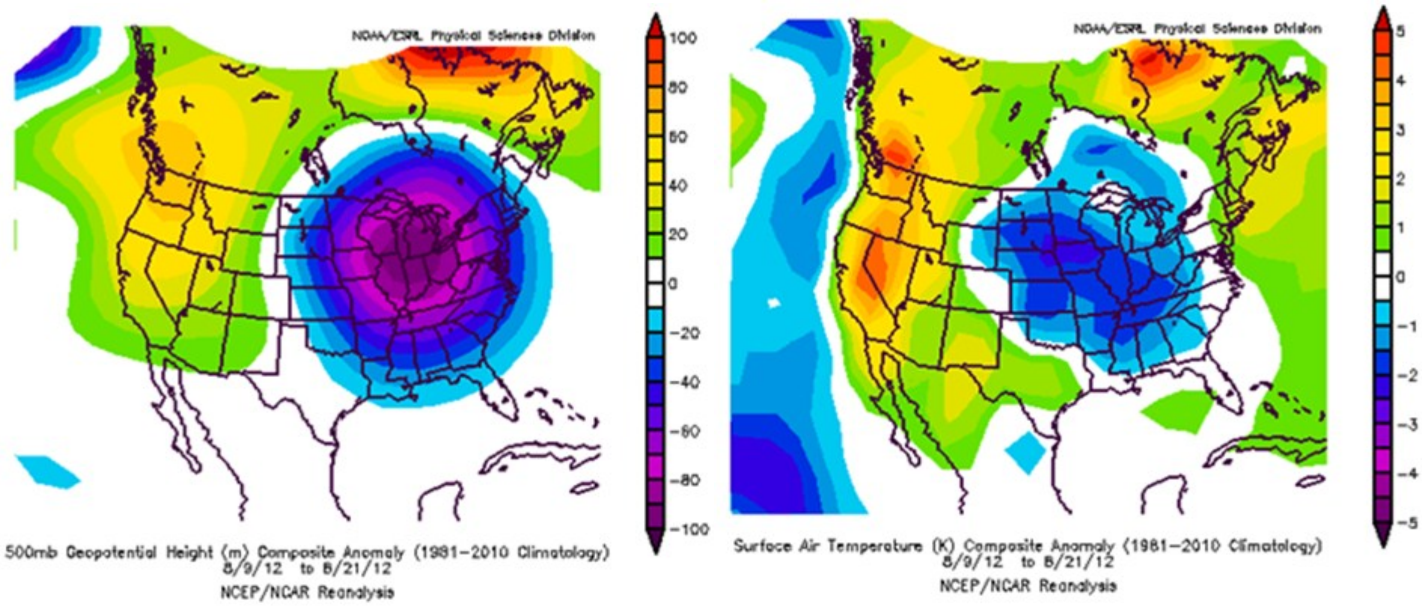

Figure 4. Same as Figure 3 except during the period August 9th through August 21st 2012.

As mentioned earlier, this summer's rainfall, or the lack thereof, was also impressive. Figure 5 below from the Midwestern Climate Center displays the percentage of normal precipitation that occurred for each summer month and for the entire summer season (bottom right figure). Precipitation for the season across northern Illinois and northwestern Indiana ranged from a very dry 25 to 50% of normal across the northwestern and north central sections of Illinois to around 75% of normal across northwestern Indiana. Notice that during the month of June, almost the entire area was very dry, with generally less than 50% of typical rainfall. Rockford (Chicago) only received 0.66 (0.90) inches of rainfall during the month. Conditions did improve some during the later part of July, especially across portions of northeastern Illinois and into northwestern Indiana as the frequency of precipitation events increased. However, areas across central and northwestern Illinois remained extremely dry during July. Finally in August, further improvements in the dryness occurred across central sections of the state. Unfortunately, most of the improvements in the rainfall amounts were too late to save the corn crop across the region. Many parts of Illinois reported total losses of their corn crop due to the drought. These conditions were the worst since the drought of 1988. Overall, the summer season ranked as the 4th driest on record at Rockford and the 13th driest at Chicago.

A Look Back at the Hot and Dry Summer of 2012 (cont)

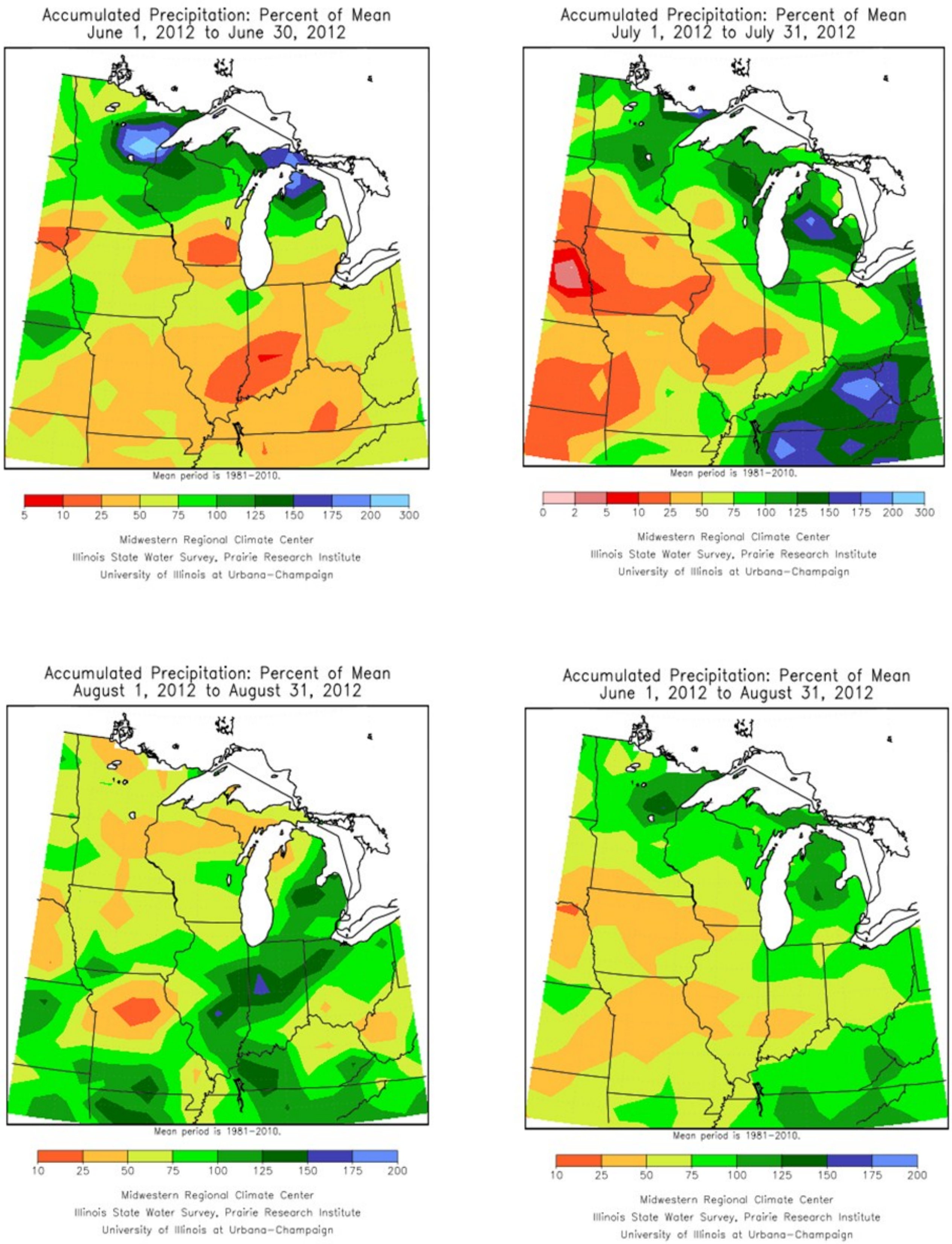

Figure 5. Plots of percent of normal rainfall for each summer month and for the summer season. Warm colors are dry conditions while cool colors represent wet conditions. Figures courtesy of the Midwestern Regional Climate Center.

A Look Back at the Hot and Dry Summer of 2012 (cont)

Finally, another interesting way to consider the extent of the abnormal conditions this past summer is to rank the warmth and dryness together versus summers of the past. We said earlier that the summer of 2012 ranked as being the 3rd warmest and also the 14th driest at Chicago, while Rockford was the 3rd warmest and 4th driest. So the question is how does the summer rank in terms of being both the warmest and driest combined? To answer this question, consider the far right hand side of Tables 3 and 4 below, which display the added rankings for the combined warmest and driest summer seasons. In Chicago this past summer tied the added warmth and dryness ranking for the summer of 2005 at number one. The same can be said in Rockford. Therefore some may consider the summer of 2012 as one of the worst in terms of both heat and dryness on record.

Table 3. Rankings at Chicago for summer season temperatures (left), summer season precipitation (center) and the warmest and driest summers combined (right).

Chicago, IL 1873-2012	
Top Ten Warmest Summers	
1	1955 - 76.4°
2	1995 - 76.3°
3	2012 - 76.1°
4	1921 - 75.9°
5	1959 - 75.5°
	1949 - 75.5°
7	1973 - 75.3°
	1953 - 75.3°
9	2010 - 75.2°
	1954 - 75.2°

Chicago, IL 1871-2012	
Top Thirteen Driest Summers	
1	1894 - 3.16"
2	1991 - 5.08"
3	2005 - 5.18"
4	1936 - 5.54"
5	1922 - 5.57"
6	1918 - 5.62"
7	1910 - 5.78"
8	1886 - 5.85"
	1919 - 5.85"
10	1887 - 6.03"
11	1934 - 6.07"
12	1930 - 6.29"
13	1940 - 6.55"
14	2012 - 6.63"

Chicago, IL 1873-2012			
Top Ten Worst Summers in Terms of Heat and Dryness.			
1	2005	14th warmest	3rd Driest
	2012	3rd warmest	14th Driest
3	1919	18th warmest	8th Driest
4	1991	27th warmest	2nd Driest
5	1995	2nd warmest	29th Driest
6	1988	11th warmest	22nd Driest
7	1973	7th warmest	27th Driest
8	1921	4th warmest	33rd Driest
9	1933	16th warmest	23rd Driest
10	1944	22nd warmest	20th Driest
	1949	5th warmest	37th Driest

A Look Back at the Hot and Dry Summer of 2012 (cont)

Table 4. Same as Table 3 except for Rockford.

Rockford , IL 1905-2012	
Top Ten Warmest Summers	
1	1921 - 76.1°
2	1934 - 75.8°
3	2012 - 75.2°
	1983 - 75.2°
5	1949 - 74.8°
6	1995 - 74.7°
	1988 - 74.7°
8	1936 - 74.5°
	1933 - 74.5°
10	1931 - 74.2°

Rockford , IL 1905-2012	
Top Ten Driest Summers	
1	1927 - 3.82"
2	1988 - 4.81"
3	1948 - 5.57"
4	2012 - 5.72"
5	1991 - 5.77"
6	1922 - 5.83"
7	1917 - 6.24"
8	1976 - 6.25"
9	1910 - 6.29"
10	19.18 - 6.34"

Rockford , IL 1905-2012			
Top Ten Worst Summers in Terms of Heat and Dryness.			
1	2012	3rd warmest	4th Driest
2	1988	6th warmest	2nd Driest
3	1983	3rd warmest	16th Driest
4	1921	1st warmest	20th Driest
	1991	16th warmest	5th Driest
6	1934	2nd warmest	21st Driest
7	1932	18th warmest	17th Driest
	1948	32nd warmest	3rd Driest
9	1995	7th warmest	29th Driest
10	2005	16th warmest	25th Driest