CHICAGO

Spring 2008

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NWS Forecast Office Chicago

Spring Climate Outlook

By Tim Halbach, Climate Program Leader

With the snow season mainly done, and a decently cold winter that reminded people of what a typical winter used to be like across the Chicago area, most people are looking forward to the warmer conditions that this Spring and Summer will hopefully be bringing us…if temperatures can ever rise up to normal. With the snowiest meteorological winter (Dec/Jan/Feb) on record for Rockford, and the sixth snowiest meteorological winter in the books for Chicago, does this mean anything for our weather this spring? With La Nina conditions in the Pacific Ocean forecast to last through the spring and summer, does that mean anything for us? These questions and more are answered in the following write up.

The first question to be answered is, "What were temperatures like in the spring seasons after the other top 10 snowiest winter seasons?" Well, the answer is that there were a wide variety of spring seasons to follow up those winter seasons. The following table lists the top 10 meteorological winter snowfalls at Chicago (MDW 1980 and before, ORD 1980 and after) and Rockford. The average spring temperature at both CHI and RFD is 47.9°:

Top 10 CHI Winters	Ave Spring Temps	Top 10 RFD Winters	Ave Spring Temps
1.) 80.6" 1978-79	46.6° (-1.3°)	1.) 65.1" 2007-08	??????
2.) 71.2" 1977-78	46.4° (-1.5°)	2.) 63.4" 1978-79	44.4° (-3.5°)
3.) 59.9" 1917-18	50.0° (+2.1°)	3.) 49.9" 1993-94	49.0° (+1.1°)
4.) 58.1" 1966-67	47.9° (0.0°)	4.) 48.9" 1909-10	49.9° (+2.0°)
5.) 54.2" 1973-74	49.3° (+1.4°)	5.) 47.3" 1973-73	47.8° (-0.1°)
6.) 52.1" 2007-08	??????	6.) 46.4" 1917-18	49.4° (+1.5°)
7.) 50.0" 1961-62	50.5° (+2.6°)	7.) 42.8° 1935-36	50.0° (+2.1°)
8.) 48.0" 1884-85	43.6° (-4.3°)	8.) 41.0" 1942-43	46.3° (-1.6°)
9.) 47.3" 1885-86	48.0° (+0.1°)	9.) 40.3" 1987-88	48.8° (+0.9°)
10.) 45.8" 1907-08	49.5° (+1.6°)	10.) 40.2" 1977-78	45.2° (-2.7°)
	5 (+), 3 (-), 1 (N)		5 (+), 4 (-)

You can see by the numbers that there is a fairly decent spread between having warmer than normal, and colder than normal spring seasons after snowy winters. The 1885 spring at Chicago was the 8th coldest on record.

Unfortunately, that doesn't give us much direction. So, the next step is to look at the Pacific Ocean and see how the La Nina is progressing. Climatologists at the Climate Prediction Center indicate that strong La Nina conditions still are present across the eastern equatorial Pacific Ocean. The forecast is for the current strong La Nina to slowly weaken through March, where it should drop to a moderate La Nina, while weak La Nina conditions are expected from April into June.

According to Jim Angel, Illinois State Climatologist, impacts across Illinois from having La Nina conditions in the Pacific have historically lead to warmer than average temperatures from February to May, while precipitation conditions were drier than average from April to June. While the more ominous fact is that other research indicates that there tends to be an increase in tornado activity in the High Plains and Midwest during a La Nina.

Here's a look at past years when La Nina conditions were present in the spring and conditions at O'Hare, Midway and Rockford:

Past La Nina Years	ORD Ave T (47.9°)	MDW Ave T (49.9°)	RFD Ave T (47.9°)
1950	No Data	45.0° (-4.9°)	45.0° (-2.9°)
1954	No Data	48.4° (-1.5°)	45.9° (-2.0°)
1955	No Data	52.6° (+2.7°)	50.0° (+2.1°)
1956	No Data	48.0° (-1.9°)	46.0° (-1.9°)
1964	48.5° (+0.6°)	51.0° (+1.1°)	47.8° (-0.1°)
1968	50.6° (+2.7°)	51.4° (+1.5°)	48.7° (+0.8°)
1971	46.9° (-1.0°)	47.3° (-2.6°)	45.7° (-2.2°)
1974	49.2° (+1.3°)	49.2° (-0.7°)	47.8° (-0.1°)
1975	46.5° (-1.4°)	46.9° (-3.0°)	44.7° (-3.2°)
1976	50.3° (+2.4°)	50.8° (+0.9°)	47.8° (-0.1°)
1985	50.7° (+2.8°)	53.1° (+3.2°)	51.9° (+4.0°)
1989	47.0° (-0.9°)	49.4° (-0.5°)	46.4° (-1.5°)
1999	48.9° (+1.0°)	51.8° (+1.9°)	48.7° (+0.8°)
2000	51.1° (+3.2°)	53.1° (+3.2°)	50.7° (+2.8°)
	7(+), 3(-)	7(+), 7(-)	5(+), 9(-)

The results show that there really isn't much of a trend temperature wise during the spring. While ORD seems to have a warm trend, the 4 years between 1950 and 1956 (for which data isn't available) appear to have been colder than normal across the region. Also, at first glance, Rockford would appear to have a cold trend during La Nina spring seasons, but three of the colder than normal years were only colder by 0.1°. So, based on this data, there is not much long term temperature correlation during La Nina spring seasons with a wide range of possible outcomes, which is also evident from the Climate Prediction Center's three month forecast: http://www.cpc.noaa.gov/products/predictions/long_range/seasonal.php?lead=1

As for precipitation/rainfall, here are the stats for ORD/MDW/RFD in La Nina Springs:

Past La Nina Years	ORD Ave T (9.71")	MDW Ave T (10.51")	RFD Ave T (10.04")
1950	No Data	7.46" (-3.05")	7.78" (-2.26")
1954	No Data	11.18" (+0.67")	10.57" (+0.53")
1955	No Data	7.59" (-2.92")	8.68" (-1.36")
1956	No Data	8.81" (-1.70")	11.02" (+0.98")
1964	10.93" (+1.22")	10.51" (0.00")	15.22" (+5.18")
1968	6.20" (-3.51")	5.28" (-5.23")	9.70" (-0.34")
1971	4.74" (-4.97")	5.73" (-4.78")	5.73" (-4.31")
1974	11.76" (+2.05")	13.16" (+2.65")	12.42" (+2.38")
1975	10.54" (+0.83")	15.59" (+5.08")	8.23" (-1.81")
1976	13.99" (+4.28")	14.15" (+3.64")	10.92" (-0.88")
1985	9.00" (-0.71")	10.24" (-0.27")	8.19" (-1.85")
1989	4.63" (-5.08")	6.18" (-4.33")	6.33" (-3.71")
1999	13.70" (+3.99")	12.65" (+2.14")	12.27" (+2.23")
2000	10.35" (+0.64")	12.39" (+1.88")	11.33" (+1.29")
	6(+), 4(-)	6(+), 7(-), 1(N)	6(+), 8(-)

The precipitation data doesn't show strong trends either way, with all of the stations showing both fairly dry springs as well as fairly wet springs. The 15.59" at MDW in 1975 was the third wettest spring on record, while the 5.28" in 1968 was the 10th driest year for Chicago. Meanwhile, the 15.22" in 1964 at Rockford was the third wettest spring in their history, while the 6.33" in 1989 was the 11th driest on record. Going back and comparing the Palmer Drought Index with these years shows a fairly similar situation, with multiple years having excess rainfall and other years with drought conditions.

So, it appears that there is not much to take away from this data except for knowing that anything is possible this spring.

It's Not Over 'Till It's Over – Big Spring Snows

By Jim Allsopp, Warning Coordination Meteorologist

Meteorologists and climatologists consider the months of December, January, and February to be the winter months, with the spring season beginning March 1. For astronomers, winter ends with the equinox on March 20. However, sometimes Mother Nature has her own timetable for when winter ends. Historically, some big snow storms have occurred during the first couple weeks of spring.

- March 23-24, 1897 – 10.0 inches of snow fell in Chicago.
- March 30-31, 1926 – A snowstorm dumped 12.6 inches in Chicago and 16.0 inches in Rockford. This was Rockford's second biggest snowstorm of all-time.
- March 25-26, 1930 – A snowstorm dumped 19.2 inches in Chicago. This was Chicago's third biggest snowstorm.
- March 20-23, 1932 – Snow fell again with 8.9 inches in Chicago and 15.0 inches in Rockford. It was Rockford's third heaviest snow.
- March 25-26 and April 1-2, 1970 – Back to back snowstorms a week apart. The March storm produced 14.3 inches in Chicago, but only 3.5 inches in Rockford. The April snow was 10.7 inches in Chicago and 6.7 inches in Rockford. Both storms were accompanied by lightning and thunder
- March 29, 1972 – Rockford had a 10.4 inch snow.
- April 2-3, 1975 – Chicago recorded 9.8 inches.
- April 5, 1982 – 9.4 inches in Chicago.

Many of the late season snows are heavy, wet snow. They are often accompanied by thunder.

The Dismal Winter of 2007-2008 – By the Numbers

by Jim Allsopp, Warning Coordination Meteorologist

The winter of 2007-2008 was one of the wettest and snowiest winters in recent memory for much of northern Illinois and northwest Indiana. So just how bad was it?

Chicago-O'Hare

Month	Nov	Dec	Jan	Feb	Mar	Total
Days with at least a trace of precipitation	17	25	22	24	16	104
Days with Measurable precipitation (.01 inch or more)	10	7	16	10	10	75
Total Precipitation	1.26	3.49	1.93	3.53	2.63	12.84
Days with at least a trace of snow	6	17	18	22	12	75
Days with measurable snow (.1 inch or more)	2	10	11	14	7	44
Total snowfall	0.3	17.6	12.7	21.8	7.9	60.3
Days with at least 1 inch of snow cover on the ground	0	19	12	23	7	61
Days with sleet	1	1	0	3	3	8
Days with freezing rain or drizzle	0	7	0	0	2	9
Days with max temperature less than 32F	1	13	16	17	4	51
Days with min temperature less than 0F	0	1	6	2	0	9

- Normal snowfall for the entire season in Chicago is 38.0 inches. The 60.3 inches of snow that has fallen through March 31 makes this the seventh snowiest season ever in Chicago, and the most in 31 years. Snowfall was 159% of normal.
- Normal precipitation during the winter months of December-February is 5.81 inches in Chicago. This winter's 8.95 inches make this the 9th wettest winter on record. This was 154% of normal.
- The City of Chicago's Department of Streets and Sanitation used more than 450,000 tons of salt in 45 operations this season.

Rockford

Month	Nov	Dec	Jan	Feb	Mar	Total
Days with at least a trace of precipitation	14	26	20	20	17	97
Days with Measurable precipitation (.01 inch or more)	5	15	13	15	11	59
Total Precipitation	0.40	3.27	1.14	3.05	2.44	10.30
Days with at least a trace of snow	6	22	17	19	12	76
Days with measurable snow (.1 inch or more)	1	12	13	15	7	48
Total snowfall	1.0	21.7	17.6	25.8	6.8	72.9
Days with at least 1 inch of snow cover on the ground	1	23	18	28	13	83
Days with sleet	1	5	1	2	2	11
Days with freezing rain/drizzle	0	5	2	3	1	11
Days with max temperature less than 32F	1	19	17	18	5	60
Days with min temperature less than 0F	0	1	9	7	0	17

- Normal snowfall for the entire season in Rockford is 38.7 inches. The 72.9 inches of snow that has fallen through March 31 makes this the second snowiest season ever at Rockford, and the most in 31 years. Snowfall was 188% of normal.
- Normal precipitation during the winter months of December-February is 4.81 inches in Rockford. This winter's 7.47 inches makes this the 6th wettest winter on record. This was 155% of normal.

Flash Flood Forecasting and the Challenges Involved

By Christopher Gitro, Meteorologist Intern

With the arrival of spring comes the common sound of thunder and rain. Often thunderstorms move overhead before passing off on the distant horizon. But sometimes these thunderstorms develop and move very slowly, or subsequent thunderstorms form and move over areas that have already received heavy rainfall. Situations like these promote the development of flash flooding, and unfortunately many people caught in flash flood conditions underestimate the power of rushing water and fall victim to rising flood waters.

Each year, flood related fatalities remain the number one storm-related killer across the US. In fact, half of all flood-related drownings occur in vehicles simply because people feel they can make it through flooded roadways with relative ease. Taking this into account and knowing the risks involved with flooding, much has been learned in recent years regarding the meteorological conditions which promote such occurrences.

The following article will highlight some of the meteorological parameters a forecaster may look at to determine whether or not flash flooding will be a concern. Once it is determined that such conditions exist, the forecaster will then make the necessary decisions to issue a flash flood warning or other type of flood statement. The following discussion involves the heavy rainfall event that impacted the Keith Creek Watershed on the southeast side of Rockford on Labor Day, 2006. The discussion is by no means all inclusive but will serve as a quick example as to some of the tools and parameters a forecaster may be looking for when a heavy rainfall/flooding event may be lurking.

The Event

On Monday September 4th, 2006, thunderstorms developed during the afternoon hours across the metro Rockford area. When the event was over, unofficial reports of up to 10 inches of rain were received across southeast Rockford, particularly near the Keith Creek Watershed. The area impacted by the heaviest rainfall was highly urbanized and residential, meaning the water had very little place to go because very little soil existed for water absorption. Up to 70 businesses had water damage and numerous water rescues had to be made by the Rockford Fire Department. In addition, 15 basements suffered structural damage due to the force of the rushing water.

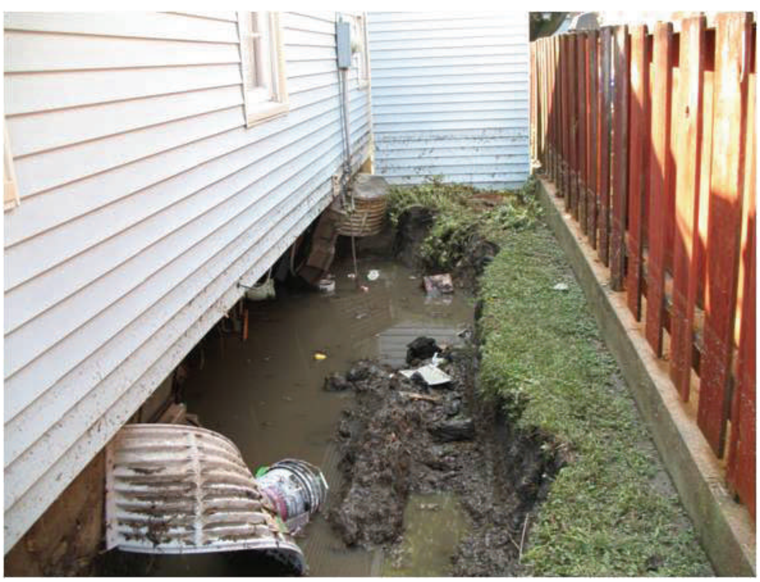


Figure 1: An example of a caved in basement wall due to the force of the rushing water.

Meteorological Clues/Conditions

Weather conditions near the onset of thunderstorm development showed temperatures in the lower 70s with dew points in the lower 60s. A small occluded frontal boundary resided to the south of Rockford, with a mid level low pressure system centered to the west across northwest Iowa.

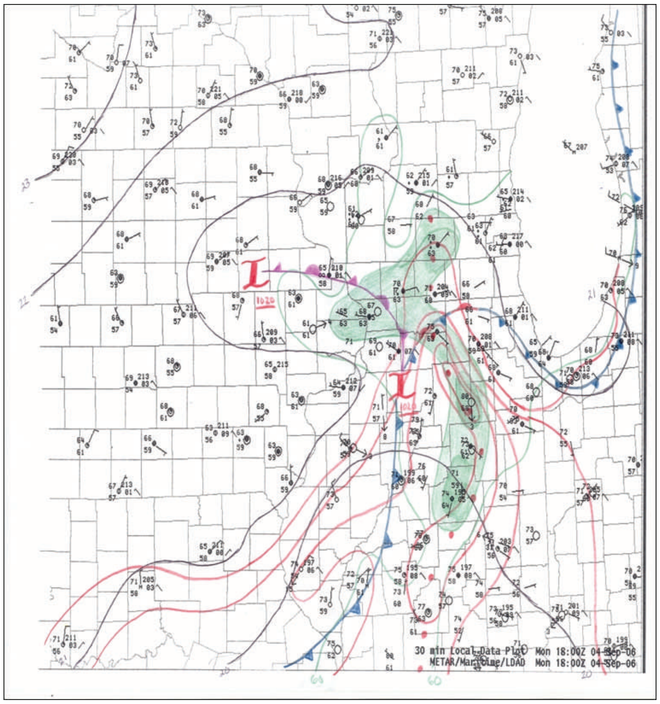


Figure 2: Surface analysis at 1 PM on 04 Sep 06.

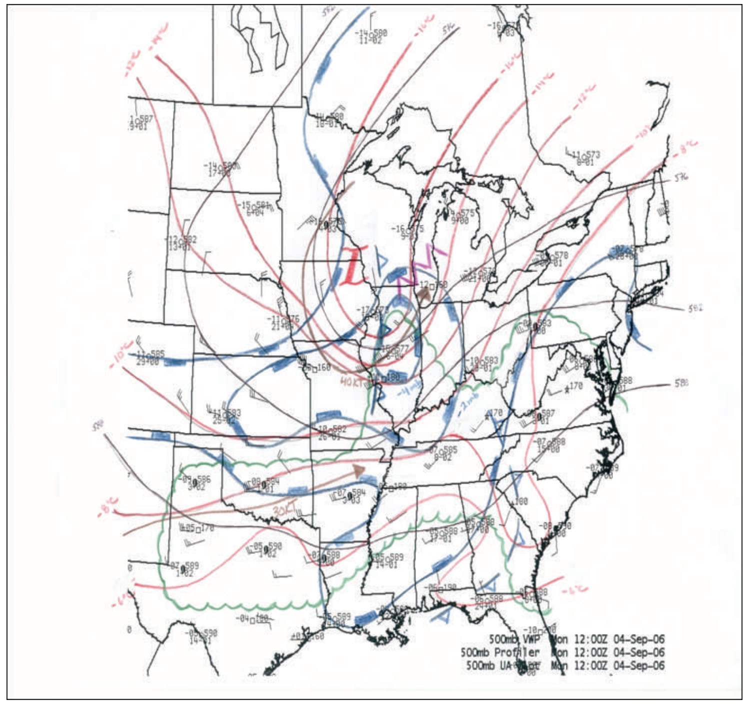
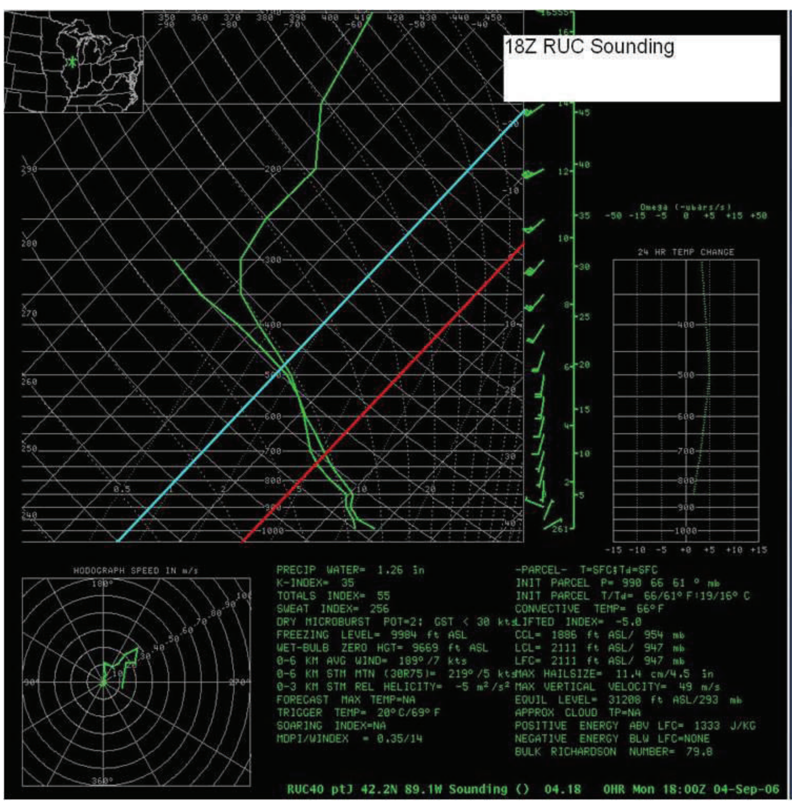


Figure 3: 500mb height field at 7 AM on 04 Sep 06.



Winds through the atmosphere were marked as rather light, with little change in direction or increase in speed with height. Situations like these are referred to as weak vertical wind shear environments. The image to the left shows a forecast thermodynamic sounding valid at 1 PM from the RUC forecast model. The green line to the right represents the forecasted temperature through the depth of the atmosphere while the green line to the left represents the forecast dew point temperatures. Based on this sounding the atmosphere is rather saturated through its entire depth; that is the temperature and dew point lines are in rather close proximity to one another.

Figure 4: RUC forecast sounding from the greater Rockford area, valid 1 PM 04 Sep 07.

Also readily apparent on the diagram is the strength of the vertical wind speeds. Notice the little green wind barbs on the right. They represent the strength of the winds through the depth of the atmosphere. Also notice that near the middle portions of the atmosphere what we usually term as the 500 mb level, that winds are only forecasted to be roughly 20 knots or so. These are very weak winds that would promote very slow storm movement if storms were to develop during the afternoon hours.

One final characteristic from this diagram also is worthy of mentioning. Notice the red and blue horizontal lines. They represent the 0°C and -20°C lines. The freezing level, where the right green line finally falls below 0°C was roughly 10 thousand feet above the surface. When freezing levels are near this level, precipitation growth can be dominated by warm rain processes as opposed to cold precipitation growth processes. Warm precipitation growth is a much more efficient method for raindrop production, meaning that the highest precipitation efficiencies can be being achieved.

Storm Motion and the Effects of Slow Moving Thunderstorms

It has been noted by many different researchers that slow moving and back building thunderstorms are notorious heavy rainfall and flash flood producers. In the most recent research, new methods have been devised to help quantify the movement of individual thunderstorm clusters. In this method, the actual storm movement can be assessed by taking the negative of the low level inflow, or the negative of the low level jet. The low level jet is often a well pronounced low level stream of warm moist unstable air from the Gulf of Mexico. The actual storm motion or advection vector can effectively be cancelled by the low level inflow, otherwise known as the propagation vector, as thunderstorms continuously form upstream. In situations like this, storm motion is very slow and heavy rainfall is likely.

Below is a diagram showing how this concept works. The actual mean cloud layer winds or advection vector is largely offset by the negative of the low level inflow, or propagation vector.

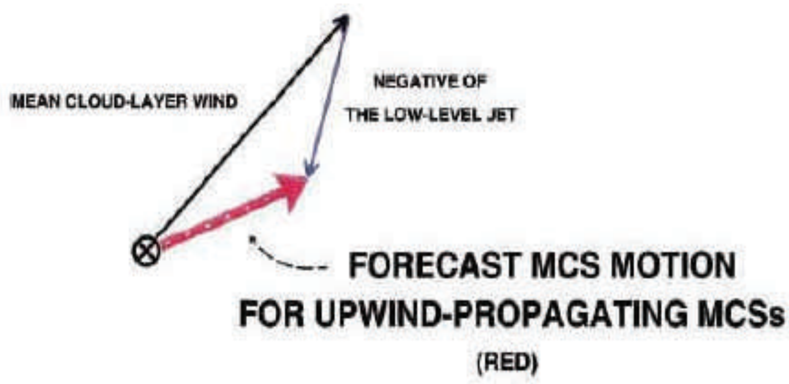


Figure 5: Diagram showing the resultant storm motion for upward developing storms. From Corfidi 2003.

Below is an image taken from the NAM Bufkit forecast program, valid at 1 PM on 04 Sep 06 from the Rockford area. This image represents a forecast for what the thermodynamic profile is expected to look like based on what the forecast model believes will happen. Two rather important features can be discerned from this image with the first being the very weak winds expected through the lower and middle portions of the atmosphere, as noted by the yellow wind barbs on the far right. The second, and of most importance is the storm propagation vectors noted on the upper left image. This image suggests that any storms that may form will only move at roughly 8 knots, a very slow speed with respect to thunderstorm movement. In fact, when speeds are forecasted to be less than 10 knots, the actual center ring turns red as a warning that very slow movement is expected, which of course is present in this case.

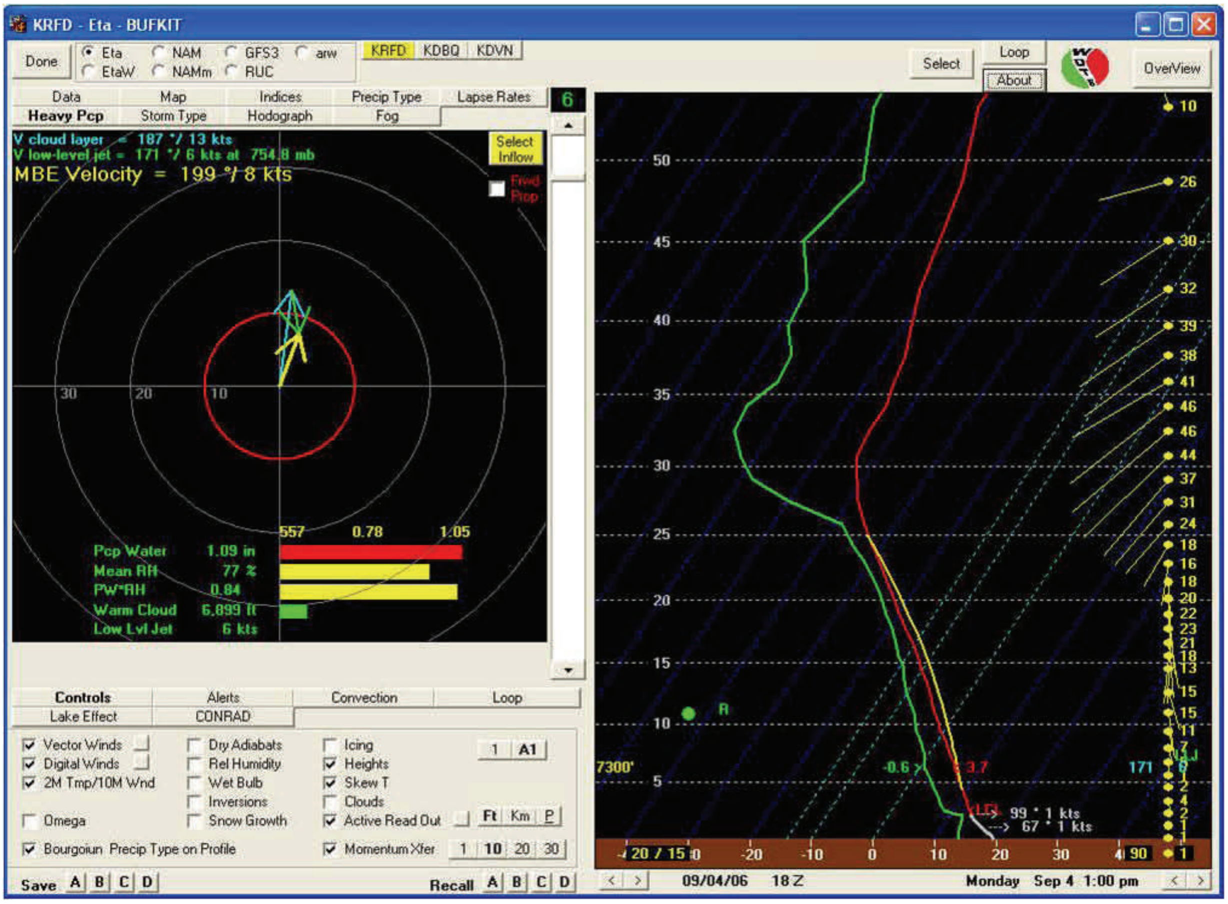


Figure 6: NAM Rockford Bufkit profile valid at 1 PM 04 Sep 06.

The End Result

Thunderstorms did in fact form during the afternoon hours mainly along the occluded front noted in the surface analysis above. As the mid-level low moved closer, mid-level temperatures likely cooled resulting in moderately unstable conditions. Very heavy rainfall ensued as a result of the very slow storm movement.

Below is an image from the FFMP program utilized by forecasters to monitor the amount of water falling over a particular river basin. Although the image may seem a bit confusing to those not familiar with its output, it is rather easy to see the Keith Creek Watershed which is colored bright white as the radar is indicating that flash flood guidance has been exceeded by more than 220%.

The next image shows the storm total precipitation estimation from the KLOT radar in Romeoville. Notice the bright red dot centered across southeast Rockford. In this area, the radar is estimating that as much as 10 to 12 inches of rain fell across the area. Although this may be a bit high due to possible hail contamination, the estimation serves as a very good indicator of the actual amount of rain that did indeed fall across southeast Rockford based on local reports.

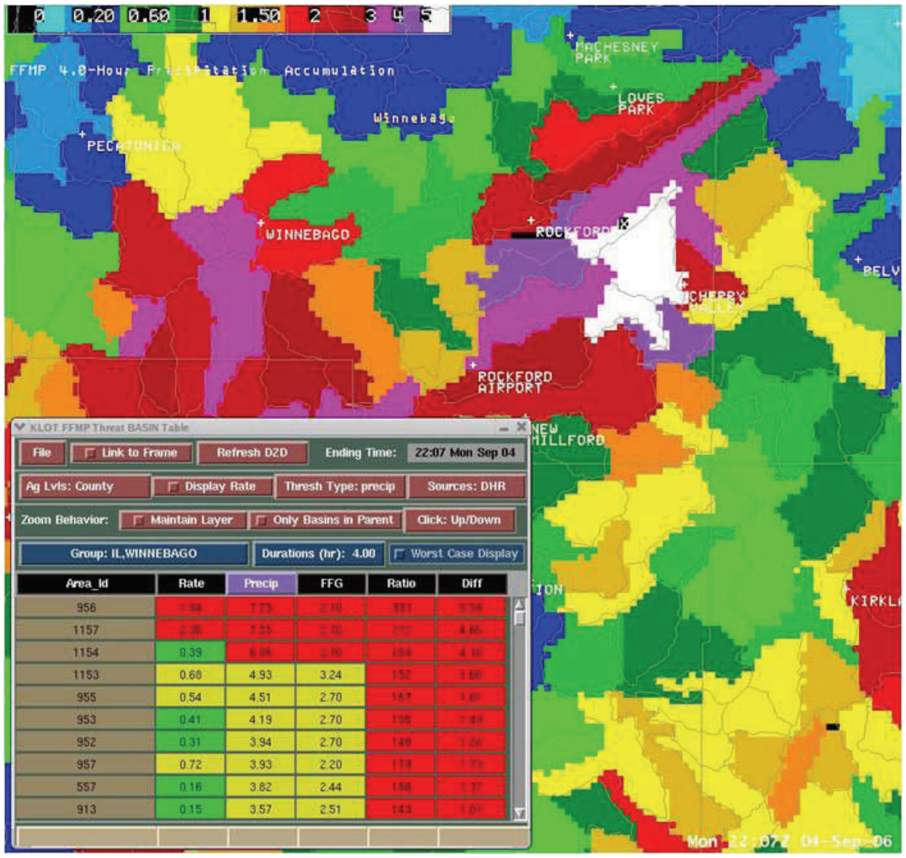


Figure 7: FFMP output valid at 407 PM on 04 Sep 06.

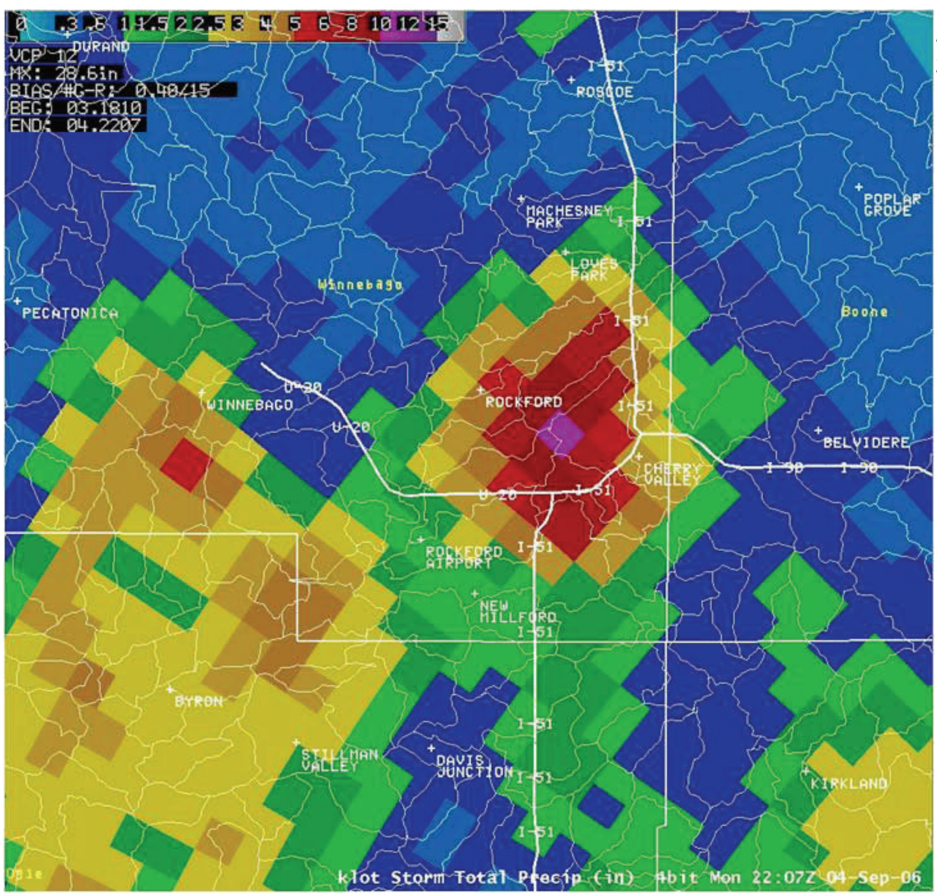


Figure 8: Storm total precipitation image from KLOT radar. Valid at 407 PM on 04 Sep 07.

Conclusion
As a result of this event, roughly 22 blocks in a highly urbanized setting were inundated with water. Numerous water rescues were made along with many victims being sent to shelters because their homes were uninhabitable. The Red Cross was activated to help in relief efforts, as many people required help from outside sources. This was a very challenging event from the aspect that much of the heavy rain fell over a highly urbanized area, and the rainfall had very little place to go.

Although this short article is by no means all inclusive, it serves as a brief introduction to some of the parameters and tools a forecaster will be assessing when dealing with potential flash flooding. These types of events are difficult to handle as so many different aspects need to be assessed, from available ground moisture, surface texture (urbanized vs. rural), to atmospheric conditions. With new radar tools becoming available in future months and years, the ability to help detect these situations will only increase.

Super Resolution – Coming Soon to a Doppler Radar Near You!

By Jim Allsopp, Warning Coordination Meteorologist

The NWS, USAF, and FAA WSR-88D radar systems produce Level II data, the highest resolution digital radar data available. These data contain reflectivity, radial velocity and spectrum width data from all radar scans. Level II data are collected, distributed, and archived in real time from 133 WSR-88D systems via the NWS WSR-88D Level II data collection and distribution network.

Beginning in WSR-88D software Build 10 (beta test at approximately six sites began in January 2008 and deployment to all operational sites begins in April 2008) the data format and content of the Level II data stream will change.

1. The format of the data will change from MSG1 to MSG31. This format change is required to handle the planned additions to the WSR-88D Level II data stream - super resolution data, Build 10, and dual polarization data, Build 11. The local data manager method of distributing Level II data via the NWS WSR-88D Level II data collection and distribution network will not change.

2. The data stream will increase in size due to the planned change to super resolution radar data in build 10. Super Resolution data increase the azimuth resolution from 1 degree to 0.5 degree, the reflectivity data range resolution from 1 km to 0.25 km, and Doppler data range from 230 km to 300 km for split cuts - generally scans at 1.5 degrees or lower elevation. The amount of data collected and transmitted during a volume scan will increase by a factor of approximately 2.3.

It is possible that network-wide transmission of super resolution data will not begin immediately after Build 10 is deployed. In this case the data will be recombined back to the legacy data resolution. The timing of the network-wide transmission of super resolution data will be contingent upon the availability of funds to acquire the required communications bandwidth increase. The format of the data will change to MSG31 with the deployment of Build 10.

Tools will be made available to Level II users to assist their transition to the new data format and content. Information on how to access the tools and other related information will be posted and periodically updated on the Level II website at: http://www.roc.noaa.gov/nws_level_2

Build 10 will be available at NWS Chicago/Romeoville around Mid May. Actual deployment date has not been determined.