NOAA
NATIONAL
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SERVICE
ST. LOUIS, MO

Gateway Observer

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In this issue...

It's That Time of Year!

As the days get shorter and the temperatures get colder, questions begin to arise whenever precipitation is forecast; Will it be rain? Will it be snow? Freezing Rain? Sleet? A combination of the above?

Forecasting winter precipitation is never an easy task, as minor changes in any one of many variables can make the difference between sleet, snow, or freezing rain. As always, we at the forecast office are only a part of the equation. All of you, our trained Co-Operative observers, are another part, a very vital one at that. We rely greatly upon your observations all year-round, and especially during the winter months. When we issue a Winter Storm Warning, or a Winter Weather Advisory, it's your measurements that help to verify our forecasts. Data you provide to us each day is compiled into our database, and used to create maps of snowfall across the region that span not only our county warning area, but also those around us. Your snowfall and snow depth measurements (along with liquid equivalent) are also used by the River Forecast Centers, and are ingested into the models they use to forecast rises on area streams and rivers when all that snow and ice begins to melt. *(For a quick refresher about how to accurately measure snowfall and snow depth, please refer to the guide on the last page of this newsletter.)*

Everything you do as Co-Op observers is incredibly important to us, and we appreciate the time you take each day to provide us with climate data for your location. By volunteering to be observers and diligently performing your task, you are contributing greatly to the National Weather Service's mission, and the effects of your service reach much further than our office here in St. Louis. From local climate products, to river forecast centers, and the National Climatic Data Center, information you provide is part of an ever growing collection of data; Data that will help identify climate trends, and will allow forecasters to study impacts of extreme weather events to develop an enhanced understanding that can be applied during future, similar scenarios.

From all of us at the National Weather Service in St. Louis, thank you for another great year of service, and we wish you all and your families a safe and happy Holiday Season!

Dual-Polarization Radar Coming to St. Louis in 2012

Julie Phillipson

Since the early 1990s, weather service offices across the country have relied on data from The Weather Surveillance Radar-1988, Doppler (WSR-88D) for warning issuance and hydrometeorological information. The WSR-88D was groundbreaking and provided information that had never been utilized in an operational environment prior to its deployment, such as Doppler velocity data (most often used to identify locations of possible tornadoes and wind speeds associated with microbursts).

Similar to its predecessor, the introduction of Dual-Pol radar will provide information that the NWS has not previously had access to, such as information about the size and shape of intercepted objects. The WSR-88D only provides information about precipitation intensity and movement. Dual-Pol radar technology will help to better discern exceedingly heavy rainfall, and allow for the detection of hail (including differentiating potential "giant" hail (>2" diameter)). Given field test results, Dual-Pol also can serve to improve classification of precipitation types in the winter (rain vs. snow vs. ice), and during severe weather when tornadoes are possible, Dual-Pol radar will better detect airborne debris, providing the forecaster a greater level of confidence, especially if there are no spotter reports of a tornado.

The St. Louis NWS office will transition to Dual-Pol radar technology beginning on February 27, 2012. The transition is expected to be completed by March 11, 2012. Stay tuned!

Summer 2011—One for the Record Books!

Julie Phillipson, Jayson Gosselin, Ben Miller, Jim Sieveking

If you thought this summer seemed to stretch on forever, and seemed unusually hot, you were on to something! It turns out; this summer (climatologically defined as the months of June, July, and August) was one of the hottest summers experienced across the region, ranking in the top 10 warmest in St. Louis, MO and Quincy, IL and in the top 20 for Columbia, MO since records began.

St. Louis (1870 - Present)

Summer in St. Louis started out fairly rainy, with June ranking as the 6th wettest June since record keeping began in 1870. June 2011 also ranked as the 18th warmest June, with 7 maximum or high-minimum temperature records tied or broken. While the records set or broken in June are impressive, July 2011 proved to be even more impressive. July 2011 overall ranked as the 4th warmest July in St. Louis history, with an average temperature of 85.7 degrees. July 2011 ranked behind 1934 (86.3 degrees), 1935 (86.4 degrees), and 1901 (87.4 degrees). Interestingly, no record high temperatures were recorded during the month of July, though there were 6 instances of new record high-minimum temperatures. On July 11th, the minimum temperature only dropped to 85 degrees, which tied August 19, 1963 for the second highest minimum temperature ever for St. Louis. The record high-minimum temperature is 86 degrees, which occurred July 24, 1901. August wasn't as hot as July, but still ranked as the 13th warmest August for St. Louis. August 2011 was also the 22nd driest August on record, with only 1.04 inches of precipitation. Throughout the month of August, St. Louis saw only one record high-minimum temperature and one record high maximum temperature. The record high of 103 which occurred on August 31st beat the old record of 100 degrees from 1953, and started off the last heat-wave of the season which lasted 4 days, ending on September 3rd.

Overall, the average temperature for summer 2011 was 81.9 degrees. This ranks as the 4th warmest summer in St. Louis history. The warmest summer occurred in 1901 (82.7 degrees), followed by 1936 (82.3 degrees), and 1934 (82.1 degrees). Interestingly, summer 2010 is now the 5th warmest summer on record, just behind this year with an average temperature of 81.7 degrees.

Quincy (1948 - Present)

Like St. Louis, Quincy also began summer with plenty of precipitation. During the month of June, Quincy received 10.71 inches of rainfall, which was a whopping 7.10 inches above normal, and ranks as the wettest June since record keeping began in 1948. June 2011 was also the 22nd warmest June for Quincy, with an average temperature of 81.9 degrees. After a wet start to summer in Quincy, things quickly dried up in July, which was the 5th driest July on record with only 0.98 inches of precipitation received. In addition to the lack of rainfall, temperatures in July skyrocketed, and with an average temperature of 81.7 degrees, July 2011 was the 2nd hottest on record for Quincy. August, with an average temperature of 77.3 degrees was not as warm as July, but still came in as the 9th hottest August. More importantly, only 0.25 inches of rainfall was received in Quincy during the month of August, which was 3.38 inches below normal, and made August 2011 the driest August ever for Quincy.

Overall, the average temperature for summer 2011 was 77.4 degrees. This ranks as the 3rd warmest summer in Quincy since records were kept in 1948. Also, summer 2011 ranks not in the driest summers, but as the 26th wettest, thanks to all of the precipitation received in June. Interestingly, summer 2011 had a driest month and wettest month (August and June, respectively) in the same season – a definite rarity!

Columbia (1948 - Present)

Summer 2011 in Columbia wasn't nearly the season of extremes as observed in St. Louis and Quincy. June 2011 was very close to normal, with an average temperature of 75.1 degrees (2.2 degrees above normal), and 4.75 inches of precipitation (0.28 inch above normal). July 2011 for Columbia was both warmer, and drier. With an average temperature of 82.2 degrees, July 2011 was 4.9 degrees above normal, and ranked as the 6th warmest July on record. Only one temperature record was tied during July, with a record high-minimum of 78 degrees on the 11th. This tied the previous record which was originally set in 1936. Precipitation for July was also 1.15 inches below normal, at only 3.22 inches, though this was not low enough to make the top driest lists. August 2011 had an…

Continued on next page...

Columbia summer (continued…)

...average temperature of 77.5 degrees, which was only 1.3 degrees above normal, and 3.19 inches of precipitation, which was 1.17 inches below normal. Despite the average temperature being close to normal for August, there was one temperature record that was shattered. On August 2nd, a record high temperature of 108 degrees was observed in Columbia, which bested the previous record of 104 degrees, set in 1991.

Overall, the average temperature for summer 2011 was 78.3 degrees. This ranks as the 13th warmest summer in Columbia since record-keeping began in 1889. Despite precipitation falling below normal in July and August, and being near normal in June, summer 2011 does not rank as either a wettest or driest summer. However, the record high temperature of 108 degrees on August 2nd was the hottest temperature observed this summer at any of the official climatological sites in the NWS St. Louis county warning area.

St. Louis set the most records, but Columbia had the highest temperature of the Summer—108 degrees on August 2nd!

The Drought of 2011

Mark Britt

After an active winter and spring of 2011, the summer months quickly turned hot and dry over much of Missouri and Illinois. Rainfall reports from most locations across the area were above normal from January 1st to June 30th including St. Louis which was almost 10” (9.93”) above normal, Quincy which had 6.26” above normal and Columbia, MO which had a surplus of 0.76”. Missouri and Illinois were in a very active weather pattern during the winter and spring months which brought the most snowfall to much of the region since the late 1970’s and multiple rounds of severe spring thunderstorms (Figure 1).

The flow in upper atmosphere which had been mainly west to east during the first half of 2011 quickly changed during the summer as a large area of high pressure developed over the Southern Plains (Figure 2). This limited thunderstorm development over the area which resulted in below normal rainfall during the summer. The first column in Table 1 shows the amount of precipitation that fell at selected sites in the first nine months of the year, and the second column shows the amount that was recorded just during the months of July, August, and September. In the first column, the stations varied between a surplus and deficit compared to normal. All of these stations were below normal in the second column owing to the dry summer.

In addition to the dryness, the high pressure also brought extreme heat to the region. St. Louis recorded the fourth warmest summer since records began in 1874. There were 15 days this year that Lambert International Airport reach 100° or higher, the most since 1980. While Columbia only had three days in the triple digits, it did reach 108° on August 2nd which was warmest temperature recorded at the airport in 27 years. The temperature at the Jefferson City airport on that same day reached 109°.

The combination of the heat and lack of rainfall caused drought conditions to develop quickly, especially over northeast Missouri and west central Illinois. The U.S. Drought Monitor first indicated that abnormally dry conditions developed over parts of the area by early August (Fig. 3) which then deteriorated quickly into moderate to severe drought conditions by late August (Fig. 4). *(continued…)*

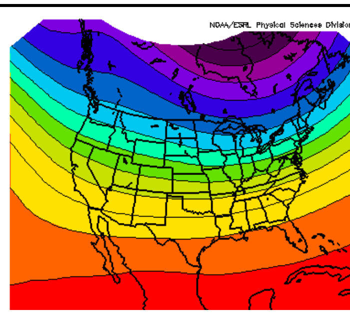

Fig. 1: Upper wind flow around 20,000 feet above the ground from January to June 2011. Note how the flow is almost straight west to east which allowed multiple storm systems moves across the region. (Image provided by the NOAA/ESRL Physical Sciences Division, Boulder Colorado from their Web site at http://www.esrl.noaa.gov/psd/)

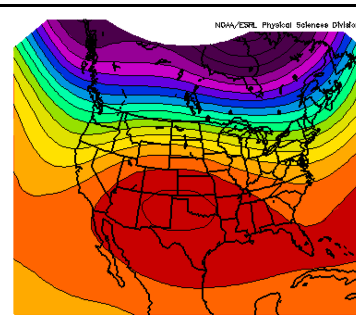

Fig. 2: Upper wind flow around 20,000 feet above the ground during July and August 2011. A large area of high pressure had developed over the Southern Plains which limited thunderstorm development and pushed temperatures well above normal over much of Missouri and Illinois.

The Drought of 2011 (continued…)

By early October, farmers reported yields from the soybean and corn harvests were generally worse than expected, though conditions varied widely depending on soil type and when the crop was planted. Crops that were planted later tended to do poorly as they pollinated at the same time that heat was at its worst.

There were no water restrictions reported during this drought. Most of the rivers and local streams that were running high during the first half of the year had flows between 25 and 75% of normal by early October. A handful of river gages in Missouri and Illinois were running significantly below normal early in October. The Missouri River remained above flood stage through July and August because of record releases from the Gavins Point dam in South Dakota.

Since October, the region has benefitted from multiple storm systems that have provided several inches of rainfall across the area. However, despite any prolonged rainfall events, local river and stream gauges are slow to respond, indicative of increased moisture absorption and the ongoing recovery from this drought. Runoff has been minimal during these events, and though topsoils have gained some much needed moisture, deeper soils have yet to recover. In October, the US Department of Agriculture declared 101 Missouri counties as natural disaster areas because of the effects of drought and excessive heat felt earlier this year. Though the summer is over, it will take a lot of precipitation to recover fully from the drought in time for the spring planting and growing season.

Location	Jan 1-Sep 30 Precipitation (Departure From Normal)	July 1-Sep 30 Precipitation (Departure From Normal)
Airport Observations		
St. Louis (KSTL)	37.71" (+6.83")	7.13" (-2.79")
Columbia (KCOU)	30.71" (-2.91")	8.93" (-3.55")
Quincy (KUIN)	25.44" (-3.73")	2.39" (-8.28")
Cooperative Observers		
Canton L/D 20 (CANM7)	31.86" (+0.69")	3.32" (-8.92")
Farmington (FARM7)	40.71" (+7.51)	8.29" (-3.06")
Hannibal (HNNM7)	25.61" (-6.64")	3.99" (-8.52")
Highland (HGHI2)	32.25" (-0.18")	5.72" (-5.02")
Monroe City (MNCM7)	21.05" (-10.96")	3.48" (-9.12")
STL Science Center (SSCM7)	31.86" (-0.56")	7.14" (-3.84")
St. Peters (SPEM7)	36.12" (+4.72")	6.27" (-4.44")
Salem (SLOI2)	41.43" (+8.72")	10.26" (-0.32")
Saverton L/D 22 (SVRM7)	25.67" (-4.06")	4.01" (-7.87")
White Hall (WHLI2)	30.55" (+1.52")	4.03" (-6.21")

Table 1. Precipitation amounts and departures from normal.

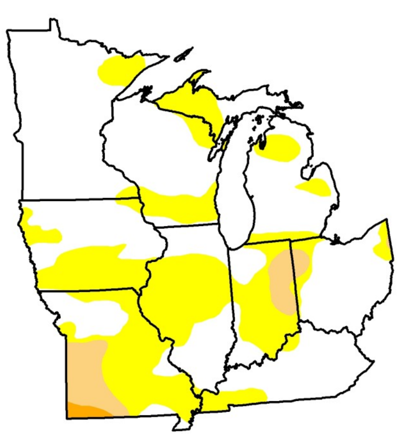

Fig. 3. Midwest Drought Monitor showing abnormally dry conditions (shaded in yellow) had developed by August 2nd.

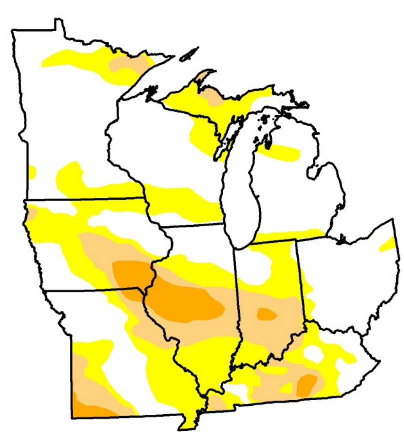

Fig 4. Moderate (tan) to severe (orange) had developed over the region by August 30th.

Tornadoes in the St. Louis Area…A Historical Perspective

Wes Browning

The EF-4 tornado which tore through the St. Louis metropolitan area on April 22 was a rare event, however violent tornadoes have occurred on several occasions in the past. In the early morning hours of February 10th, 1959, an F4 tornado roared through portions of Saint Louis. Within minutes, 21 people were killed and 345 were injured. Numerous homes and businesses were destroyed. While this was a historic tragedy for the city, it was by no means unprecedented. Violent tornadoes also struck the city in 1896 and 1927, leaving a total of 209 people dead. Less than 10 years after the 1959 tornado, an F4 tornado tore across portions of St. Louis County on January 24th, 1967, killing 3 and injuring 216.

During the 44 year period from 1967 until 2011, the St. Louis area has been largely spared the devastation seen in these earlier tornadoes, however the night of April 22 proved that the city is indeed vulnerable. This article is designed to provide a guide to historical tornado data and climatology and to be a resource for raising public awareness of the risk of tornadoes.

Data taken from the publication *Significant Tornadoes* by Grazulis (1993) shows that the county warning area which the St. Louis National Weather Service Forecast Office serves has seen its share of tornadoes (Fig. 1). While reporting data for weak tornadoes (F0 to F1) was unreliable through about 1949, an increase in population and observing capability led to a reasonably reliable database of all tornado tracks (F0 through F5) from 1950 through 2004 (Fig 2).

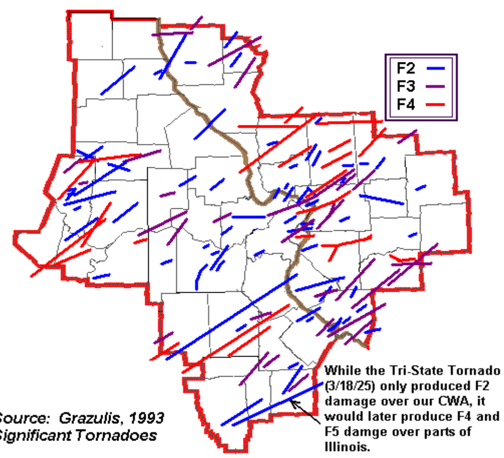

Figure 1. Tornado tracks (F2 to F5) from 1880 to 1949.

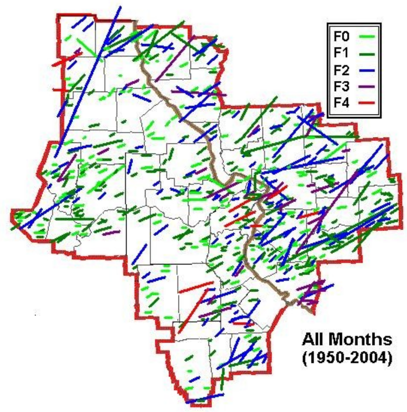

Figure 2. Tornado tracks (F0 to F5) from 1950 to 12004

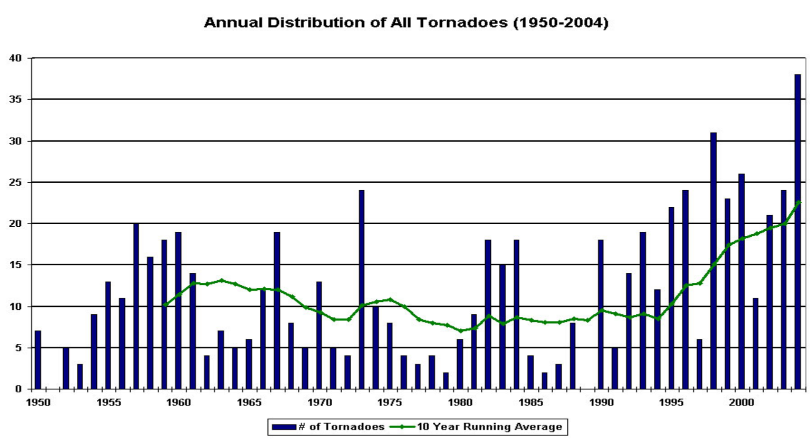

Figure 3. Annual distribution of all tornadoes (F0 – F5) from the period 1950 through 2004.

…There is no evidence for a long-term increase or decrease in the threat from significant tornadoes nationwide.

The graph in Figure 3 shows all tornadoes across the St. Louis metropolitan area from the years 1950 through 2004, where the record is fairly reliable. So has the number of tornadoes actually increased? Note that the number of tornadoes has increased steadily since the mid 1990s, especially the 10 year running average (the green line, which is the average of the preceding 10 years). This is at least partially due to improvements in detection of tornadic storms via the National Weather Service WSR-88D Doppler radar, an increase in the number of trained weather spotters, and frequent and thorough storm surveys. Even though only about 10% of tornadoes are F2 or stronger, these tornadoes are responsible for the majority of deaths caused by tornadoes in the country, with violent tornadoes (F4-F5) claiming 67% of the total. There was a decrease of strong to violent tornadoes in the National Weather Service St. Louis county warning area since the middle 1970s, even though increases in population and urban sprawl have created far more potential targets. Recent research (Concannon et al., 2000: Climatological Risk of Strong and Violent Tornadoes in the United States, Second Conference on Environmental Applications, American Meteorological Society, Long Beach, California) found no evidence for a long-term increase or decrease in the threat from significant tornadoes (F2 or stronger) nationwide. It is certainly possible that the area will see a return to more frequent occurrences of strong to violent tornadoes. *(continued on next page…)*

Tornadoes in the St. Louis Area…A Historical Perspective (continued…)

Let's look at several of the most memorable St. Louis tornadoes. A sobering bit of history: When one adjusts damage done by tornadoes in the United States according to wealth (not only how much things cost, but how many things the average person owns), the ten most damaging tornadoes in the United States (1890-1999) are shown below:

Rank	Date	Location	Damage ($M)
1	May 27, 1896	St. Louis, MO-E. St. Louis, IL	2916
2	Sept. 29, 1927	St. Louis, MO	1797
3	March 18, 1925	Tri-State (MO-IL-IN)	1392
4	April 10, 1979	Wichita Falls, TX	1141
5	June 9, 1953	Worcester, MA	1140
6	May 6, 1975	Omaha, NE	1127
7	June 8, 1966	Topeka, KS	1126
8	April 6, 1936	Gainesville, GA	1111
9	May 11, 1970	Lubbock, TX	1081
10	June 28, 1924	Lorain-Sandusky, OH	1023

Up until the night of April 22, 2011, the last violent tornado to strike the St. Louis area occurred January 24, 1967 impacting western and northern St. Louis county.

Yes, that's right…the two most damaging tornadoes in United States history, as normalized by wealth, both occurred in St. Louis! If history is a lesson, then the message is clear. St. Louis is indeed vulnerable to strong and violent tornadoes. Let's look back at 4 memorable ones...

On **May 27, 1896**, a huge, violent tornado devastated part of St. Louis. Normalized by wealth, this is the costliest tornado in United States history. It moved through Tower Grove Park, into Downtown St. Louis, crossed the Mississippi River, and tore through East St. Louis. It killed 255 people and injured at least 1000. Figure 4 shows the track of this killer tornado.

Figure 4. The approximate path of the May 27, 1896 tornado.

September 29, 1927 saw yet another violent tornado in St. Louis. In fact, normalized by wealth, this is the second costliest tornado in United States History. The tornado formed in Webster Groves and moved ENE across a corner of Forest Park into downtown St. Louis. In downtown St. Louis, the path widened from 100 to 600 yards, with microburst damage extending out over a mile wide. A few multi-story dwellings were destroyed and partly swept away (possibly **F4**), and some non-residential buildings were completely blown away. Over 200 city blocks were torn apart. The tornado then moved into Illinois. The total death toll was 72, with 550 injured.

Figure 5. The approximate path of the September 29, 1927 tornado.

Another violent tornado struck the St. Louis metropolitan area on **February 10, 1959**. This tornado formed near Ellisville and moved ENE into the city. Considerable damage occurred south of Forest Park, and a large TV tower was toppled. From that point the tornado strengthened to **F3** and minimal **F4** intensity. The greatest damage from Forest Park to McKinley Bridge was to tenement houses and apartment buildings including near Boyle and Olive as well as near Page and Grand. A few homes were leveled, and some large tenement houses collapsed, burying the occupants in the wreckage. Nearly 2,000 buildings were damaged or destroyed in the city. Forward speed was estimated at 50 to 60 mph with some evidence of more than onefunnel. The tornado then crossed the river in the Venice-Granite City, IL area. The track of this tornado was not far from the tracks of the major tornadoes in 1871, 1896, and 1927. The tornado killed 21 and injured 345 people.

Up until the night of April 22, 2011, the last violent tornado to strike the St. Louis area occurred on **January 24th 1967**, when a violent F4 tornado ripped a 21 mile long path of destruction across St. Louis County. It ranks as the fourth worst tornado in history to hit the St. Louis Metropolitan Area . The tornado initially touched down around 6:55 p.m. in western St. Louis County at Olive Street Road near the Howard Bend Pumping Station where damage was reported to the Chesterfield Manor Nursing Home. The tornado moved northeast at 40 mph striking the small community of Lake, the luxury homes at River Bend Estates and Old Farm Estates valued between $25,000 and $33,000 (1967 dollars), Creve Coeur Meadows and Glenwood Subdivisions, and the heavily populated communities of Maryland Heights, Bridgeton, St. Ann, Edmundson, Woodson Terrace, Berkeley, Ferguson, Dellwood, the Hathaway Manor Subdivision,

Tornadoes in the St. Louis Area…A Historical Perspective (continued…)

and Spanish Lake. The tornado apparently dissipated or weakened as it crossed the Mississippi River, as there is no record of significant damage in Illinois.

The damage path ranged from 50 to 200 yards wide and the tornado was on the ground for approximately 35 minutes. Remarkably only 3 fatalities were reported while 216 people suffered injuries. Damage included 168 homes destroyed, 258 with major damage, and 1485 with minor damage. At least 600 businesses were damaged or destroyed. The total damage was estimated to be around 15 million dollars.

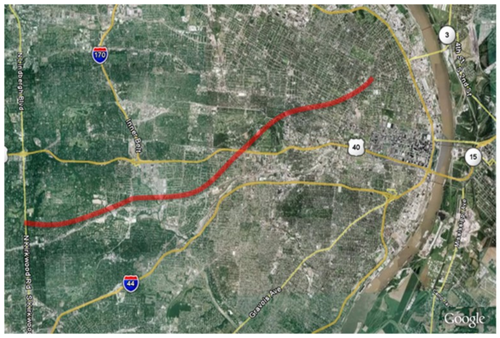

Figure 6. The approximate path of the Feb. 10, 1959 tornado.

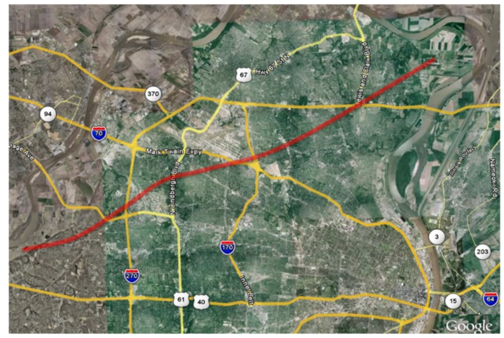

Figure 7. The approximate path of the Jan. 24, 1967 tornado.

So though it had been over 40 years since the last violent tornado, the events of April 22, 2011 showed once again that we are all at risk, and we must be prepared for the next one.

How the NWS Issues a Warning

Laura Kanofsky

When the NOAA weather radio starts to beep and the text is crawling across the bottom of the TV screen, it's usually because a meteorologist at the National Weather Service office has just issued a severe weather warning. Here's an inside look at the decision making process and what forecasters are thinking about when they issue a severe thunderstorm or tornado warning.

Radar data: Doppler radar is a vital tool during severe weather operations. With it, forecasters can look inside storms and determine if hail, severe wind, or tornadoes are likely to be present. It takes a great deal of practice to learn how to accurately interpret the patterns in Doppler radar imagery. Sometimes, a nearby radar has a better view of the storms than the radar at the St. Louis office, so forecasters often monitor more than one radar to get the best information. Nearby radars are located in Springfield, MO; Paducah, KY; Lincoln, IL; Davenport, IA; and Kansas City, MO.

Storm environment: When a thunderstorm develops, the characteristics of the surrounding atmosphere play a role in whether or not severe weather will occur. These characteristics are collectively called the "storm environment". Different storm environments are why two different storms on two different days might look very similar on radar, but one storm produces widespread wind damage and the other does not. Understanding the storm environment is crucial to making good warning decisions.

Spotter reports: We're always grateful when a spotter calls in to report that he/she sees hail (any size), a wall cloud, a funnel cloud, a tornado, or wind damage because only spotters can provide information about what's actually happening at the ground. Spotter training classes are held every year across the area, usually in late winter and early spring. The classes are free and open to everyone. Visit this website for a list of training classes: http://www.crh.noaa.gov/lsx/?n=schedule.

Training and experience: NWS meteorologists complete over 100 hours of radar training before they can issue real warnings. During a severe weather event, we often discuss difficult warning decisions with each other to benefit from collective experience. Forecasters also work through weather simulations of past severe weather events from around the country (at least 2 simulations per year). This practice is similar to how pharmacists, lawyers, and other professionals keep current in their fields by earning CE (continuing education) credits.

Warning criteria: A severe storm is a storm that produces any of the following: hail 1" in diameter or larger, winds of 58 mph or greater, or tornadoes. A severe thunderstorm warning is issued when forecasters believe a storm is producing hail of at least 1" or winds of at least 58 mph. A tornado warning is issued when forecasters believe a storm is capable of producing a tornado or is already producing a tornado. Although all thunderstorms produce lightning and all lightning can be deadly, lightning alone does not make a storm "severe". The NWS does not issue severe thunderstorm warnings solely for lightning.

Computer algorithms: Computer algorithms are automated routines that process large amounts of radar data. The algorithms look for certain features that can indicate severe weather in a storm. The results require human interpretation. Computer algorithm results are never the basis for severe weather warnings. When a warning states, "Doppler radar indicated a severe thunderstorm", it refers to a forecaster's analysis of the radar data.

It's a lot of information to process at once. The forecaster is constantly analyzing the latest radar data (sometimes from multiple radars), thinking about recent spotter reports, considering the results from computer algorithms, checking the storm environment to see how it has changed over time, and relying on his/her training and experience to pick out the severe storms (those that meet warning criteria) and the sub-severe storms that are likely to intensify. The forecaster then issues a warning to let people know that there is a dangerous storm, and to tell people that it's time to take shelter. The answer to "Why did they issue that warning?" is always "To protect life and property!"

Winter Observing Guide

OBSERVERS WITH NON-RECORDING GAGES RECORD THREE MEASUREMENTS WHEN IT SNOWS

① WATER IN SNOW

Record in this column to inches and hundredths.

Melt contents of gage and measure like rain. If high winds have blown snow out of the gage, the outer container is used to obtain a substitute sample from the snow on the ground where the depth represents the amount that fell since yesterday's observation.

24 HOUR AMOUNTS		at obsn
Rain Melted Snow etc. (ins & hundrths)	Snow Sleet Hail (ins & tenths)	Snow Sleet Hail ice on gnd (inches)
.22	2.0	2
.35	3.0	5
T	T	4
0	0	2
T	T	T
0	0	0
.11	0.9	1
0	0	0

③ DEPTH OF SNOW ON THE GROUND AT OBSERVATION TIME

Record in this column to nearest inch—if less than 1/2 inch, record "T".

Any time there is snow on the ground at observation time record average depth on ground at observation time. Include old snow as well as newly fallen snow.

*note that the amounts are entered as 2 and not 2.0

Please fill in blanks with zeroes. Do **NOT** use fractions.

② SNOWFALL SINCE YESTERDAY'S OBSERVATIONS

Record in this column to the nearest 0.1 inch.

Find some place where the freshly fallen snow is least drifted and is about average depth for the locality. Measure the depth of the snow which fell since yesterday's observation. Report an estimate if the snow melted before observation time.

A few pointers…

- If you cannot take the observation or will be out of town, please get someone—a friend, relative, or neighbor—to take the temperatures or measure the rain and snow. Some data is better than no data at all!
- If no one can be found and you are only going to be gone for a weekend, for rainfall, go ahead and measure what is in the gage and record it on Monday, with a comment in the remark section stating that it is a weekend total. For temperatures, enter "M" for missing, and explain in the remarks section.
- Use the letter "T" for traces of rain and snow, not "Tr" or "Trace".
- When flurries occur with no accumulation, the proper measurements are: Snow Melt (or Water Equivalent) = T, Snow-fall = T.