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The Plainfield Tornado of August 28, 1990

by Alecia Osbourne, Student Volunteer and Jim Allsopp, Warning Coordination Meteorologist

On August 28th 1990, between 3:15 p.m. and 3:45 p.m. a devastating tornado ripped a 16.4 mile-long path through portions of Kendall and Will counties in northern Illinois. At its strongest, the tornado was rated F5, the highest rating a tornado can be given. A total of 29 people were killed and 350 more were injured. An estimated $160 million in damages occurred. The tornado's path width ranged from 200 yards to half a mile. A total of 470 homes were destroyed and another 1000 homes were damaged. Sixty-five thousand customers lost power.

Looking northwest across Lily Cache subdivision

The tornado was unusual for several reasons:

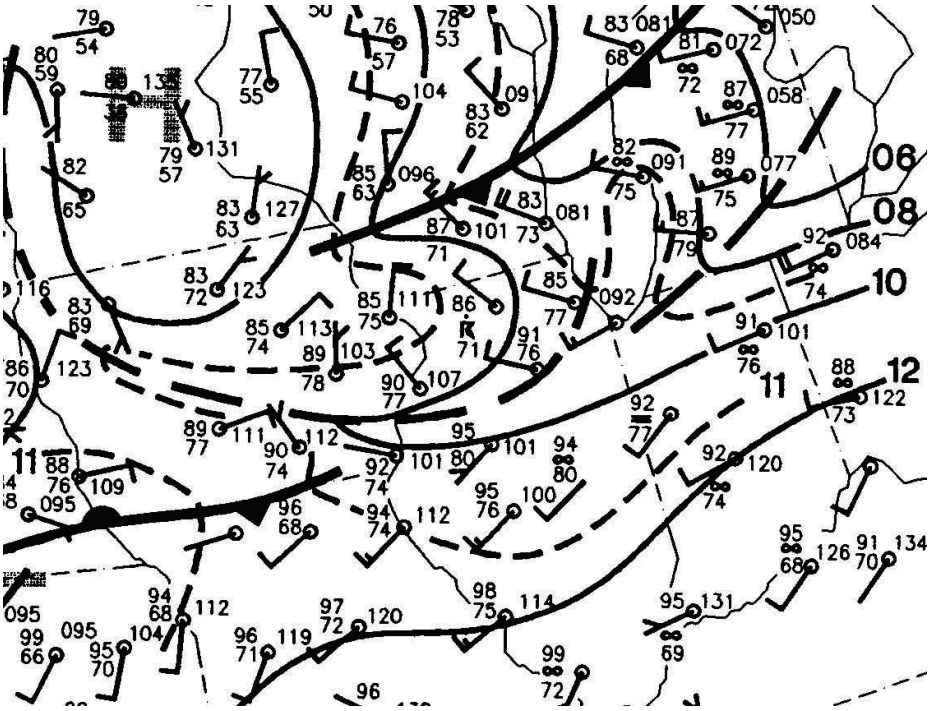
- It was the first ever rated greater than F3 in August in the state of Illinois.
- It was only the second killer tornado to occur in Illinois during the month of August.
- Twenty years later it remains the only F5/EF5 tornado ever documented in the U.S. during the month of August. In fact, only 0.2% of all tornadoes in August have been rated F4/EF4 or greater.
- The tornado moved from the northwest to the southeast. Most tornadoes occur in spring when typical storm motion is from southwest to northeast. It's not unusual for storms to move from the west or northwest in late summer, but tornadoes are not as common that time of year.
- The tornado was shrouded by low clouds and rain, making it difficult to see. As a result, no known photographs or videos of the tornado exist.

Meteorological Conditions

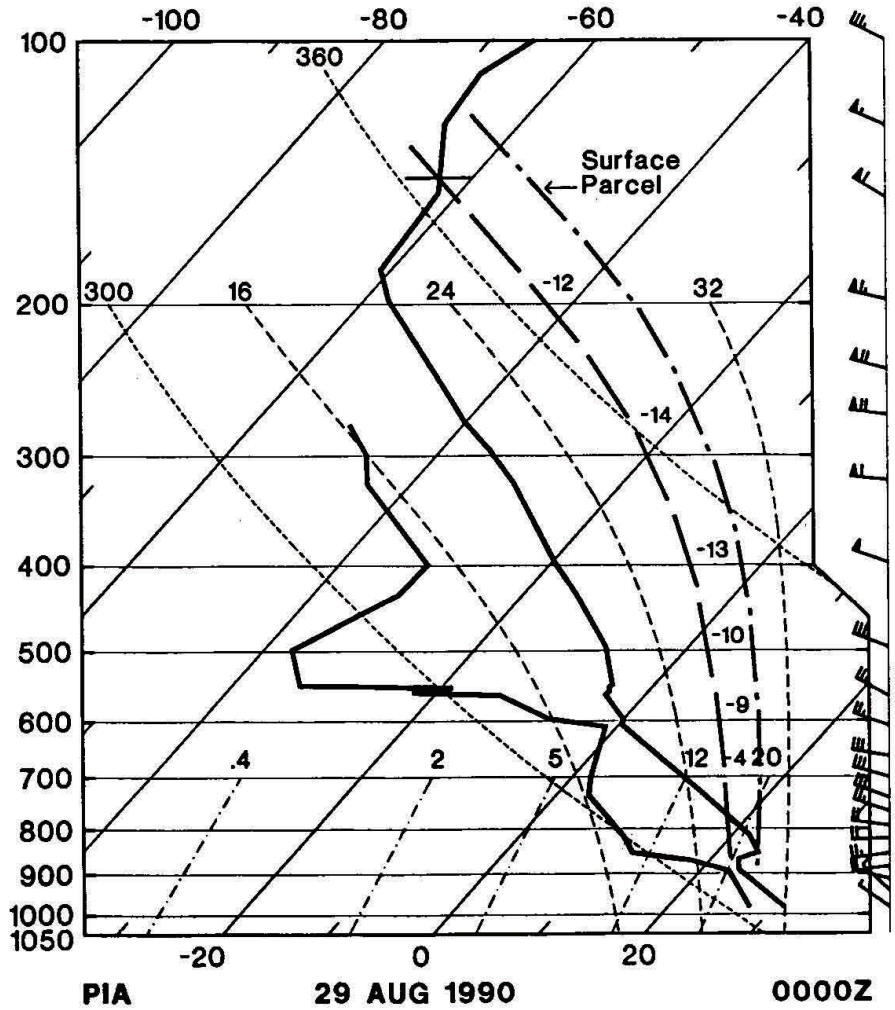
At 10:00 a.m. on August 28, the National Severe Storms Forecast Center (NSSFC) in Kansas City, Missouri (which since has been moved to Oklahoma and renamed the Storm Prediction Center, or SPC) upgraded their severe storm outlook for northern Illinois from a Slight Risk, issued earlier that morning, to a Moderate Risk. At 1:28 p.m., NSSFC issued a Severe Thunderstorm Watch for portions of northern Illinois.

Conditions were favorable for severe thunderstorms, as an upper level short wave trough was moving through the Great Lakes and an associated surface cold front was forecast to move southeast across northern Illinois during the afternoon. Ahead of the cold front, the atmosphere was unstable with CAPE (Convective Available Potential Energy) values over 4000 J/Kg when thunderstorms initiated near the Wisconsin/Illinois border around noon. However, weak wind shear in the lower atmosphere suggested more of a threat of multicell severe storms with wind and hail, rather than tornado-producing supercells. Even so, one or two brief tornadoes caused minor damage near Pecatonica and Seward, west of Rockford, around 142 pm.

The atmosphere became even more unstable during the course of the afternoon as temperatures across northern Illinois climbed to the lower and middle 90's and dew point temperatures reached the upper 70's. Furthermore, the wind shear also was becoming more favorable for supercells, as indicated by an upper air sounding taken at Peoria a couple hours after the tornado occurred.



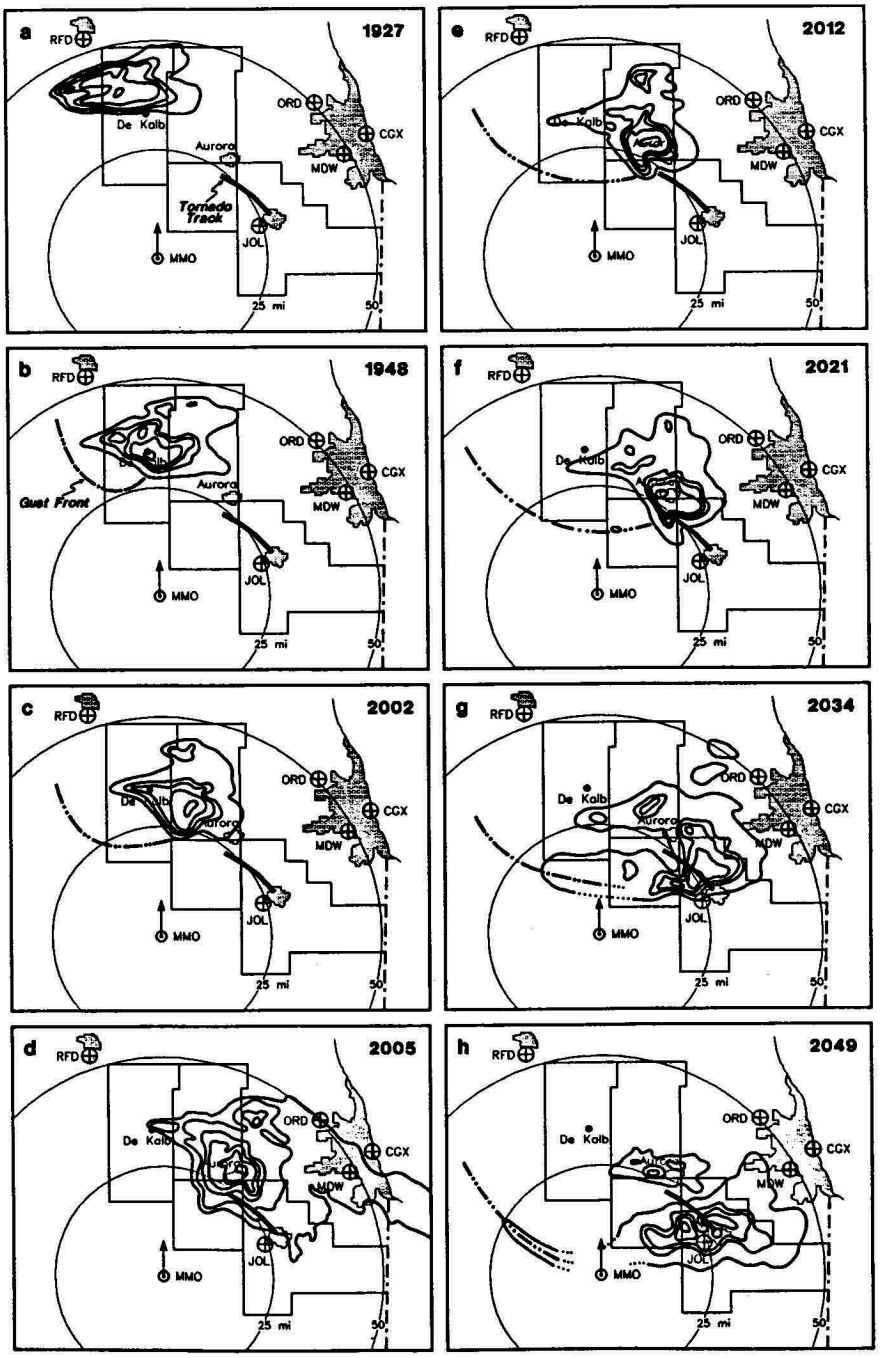
Surface map at 200 PM CDT August 28 showing the cold front moving toward northern Illinois and the warm, moist air ahead of the front.



The sounding taken at Peoria at 700 PM shows large instability and 50kt winds at mid-levels of the atmosphere, which contributed to the favorable conditions for supercells.

Thunderstorms grew to a height of 65,000 feet in this favorable shear and explosive instability and began to exhibit supercell characteristics, including a motion to the right of the mid level winds, toward the southeast. The primary supercell produced a swath of large hail (golf ball up to tennis ball sized) and damaging wind as it moved across DeKalb and Kane Counties.

As the storm moved southeast, low level winds ahead of the storm continued to back from northwest to southwest, further increasing the low level wind shear. In addition to the increasing shear, by 3:00 p.m. CAPE values had exceeded an astonishing 7000 J/kg. A series of downbursts and four small tornadoes occurred in rural southern Kane County before the increasing wind shear combined with the incredibly intense updraft eventually led to the development of the main tornado near Oswego in Kendall County.



Series of radar images from 227 PM through 349 PM CDT showing a pronounced hook echo as the storm moved into northwestern Will County.

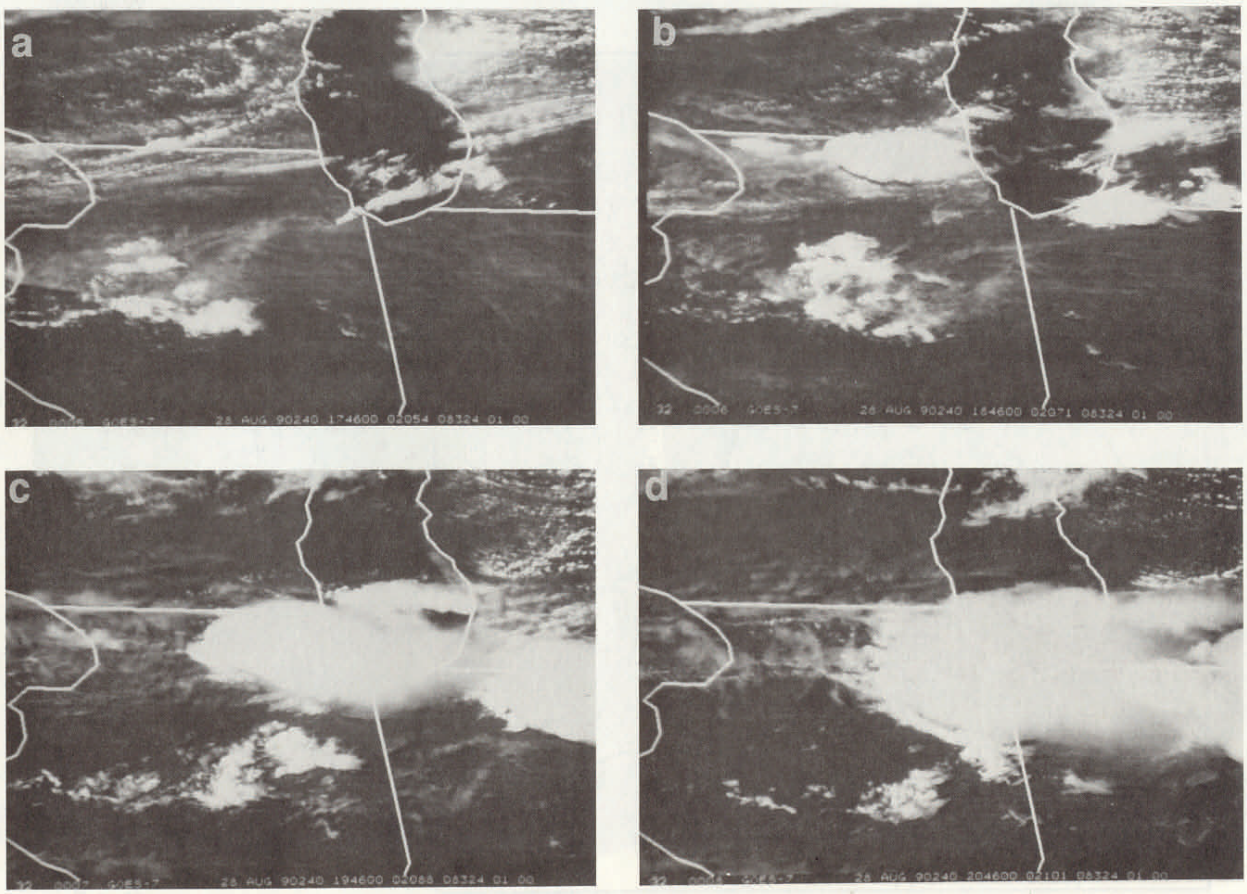


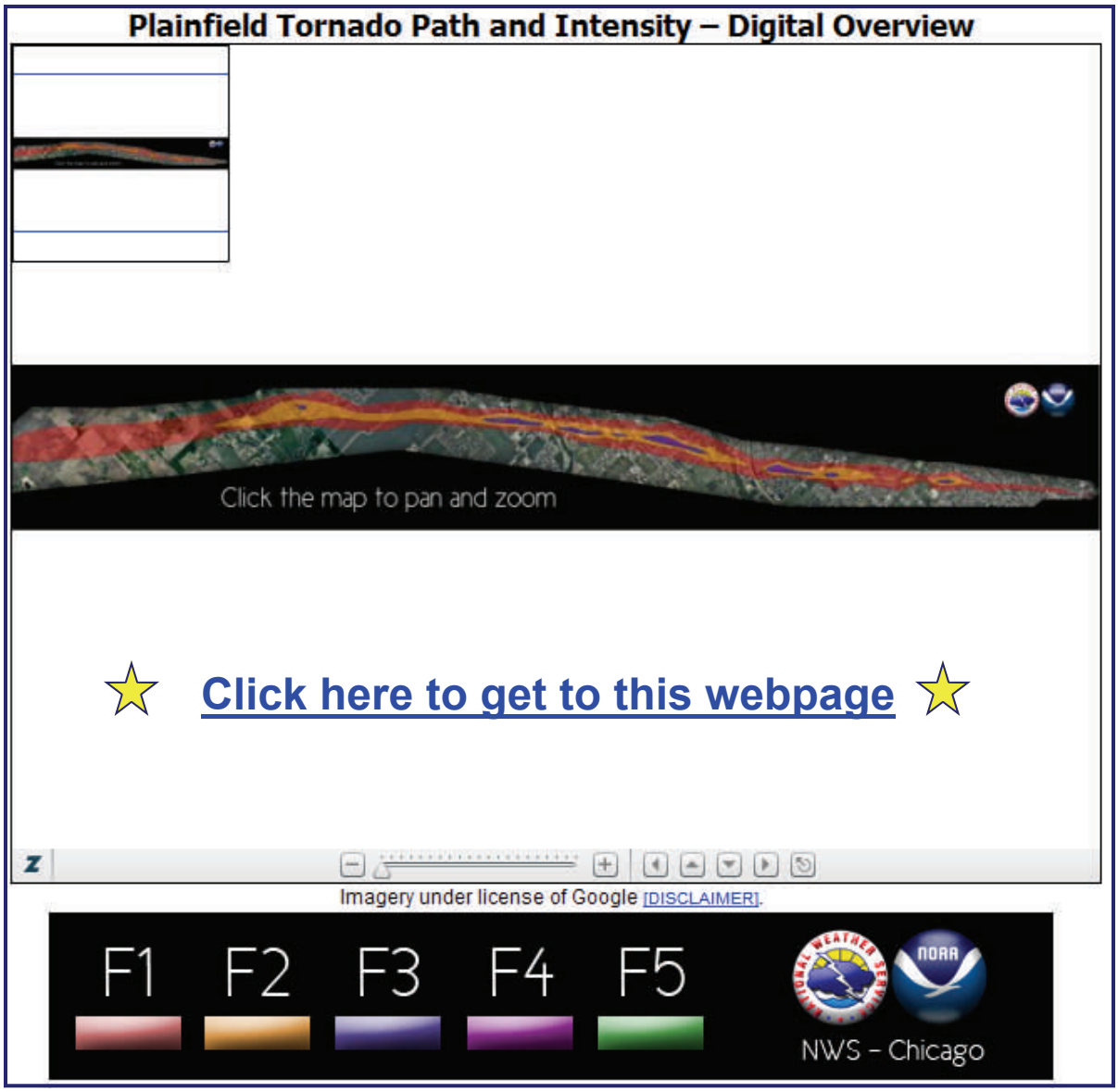
Figure 2.5 Visible GOES images showing the development and progression of the tornadic thunderstorm across northern Illinois at: (a) 1746 UTC (12:46 p.m., CDT); (b) 1846 UTC (1:46 p.m., CDT); (c) 1946 UTC (2:46 p.m., CDT); and (d) 2046 UTC (3:46 p.m., CDT) on the afternoon of August 28.

The tornado reached its peak intensity between 3:15 p.m. and 3:45 p.m. as it moved from Kendall County into northwestern Will County and through the communities of Plainfield and Crest Hill. After the main tornado dissipated in Joliet, the parent thunderstorm continued producing damage as it moved through Kankakee County and on into Indiana. The storm produced nearly continuous damage over northern Illinois for 4 1/2 hours.

Aerial view of damage path looking east from Illinois 126 west of Plainfield.

Plainfield Tornado Path and Intensity – Digital Overview

By Sam Shea, Meteorologist



This map depicts the Plainfield tornado damage path. The map begins to the southeast of the initial touchdown point, which is southeast of Oswego. The path continues to the southeast through Plainfield and into Joliet where the tornado eventually lifted. For viewing purposes – the map has been rotated 45° to fit in the viewer and top of the image is northeast. The path of the tornado goes from left to right (on this viewer) over time…I.E. northwest to southeast. The map was ***not*** updated to reflect the current Enhanced Fujita (EF) scale. Tornado intensities are signified by the colorization in the legend with F1 estimation being the outermost layer. For information on the difference between the older Fujita (F) scale versus the new Enhanced Fujita (EF) scale, please click this link. Note: Care was taken to make sure this map is as accurate as possible...although there may be small errors in location. A map detailing F1 estimation and urban development can be found here.

The map was digitized with the available data given from Fujita, T.T., 1993: Plainfield Tornado of August 28, 1990. The Tornado: Its Structure, Dynamics, Prediction, and Hazards. Geophysical Monograph 79, 1993. American Geophysical Union.

Imagery under license of Google™ Map.

Plainfield Tornado Path and Intensity – Digital Overview

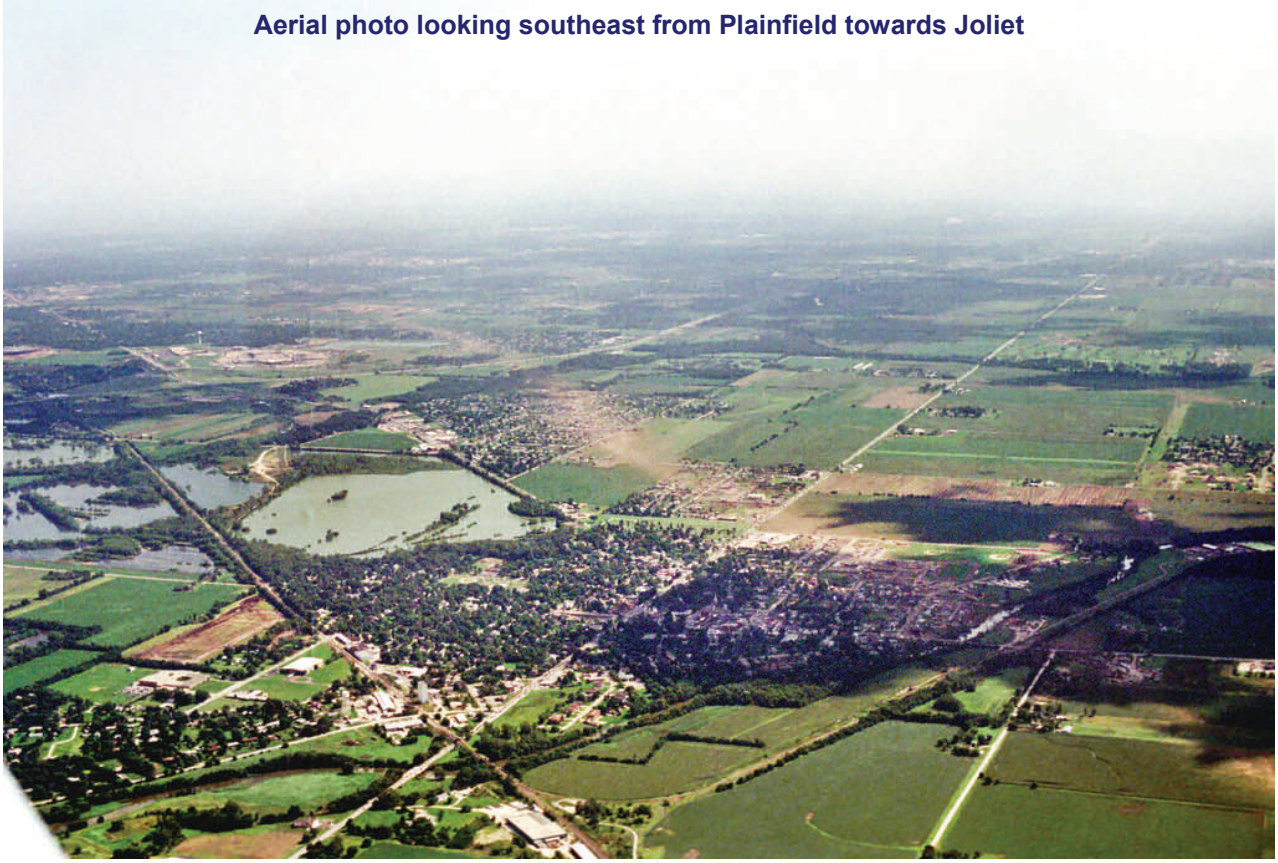
Imagery under license of Google [DISCLAIMER].

This image shows the path of the tornado when it was at its greatest intensity. You can see the whole path and then zoom in by going to http://www.crh.noaa.gov/lot/?n=plainfieldTor-1.

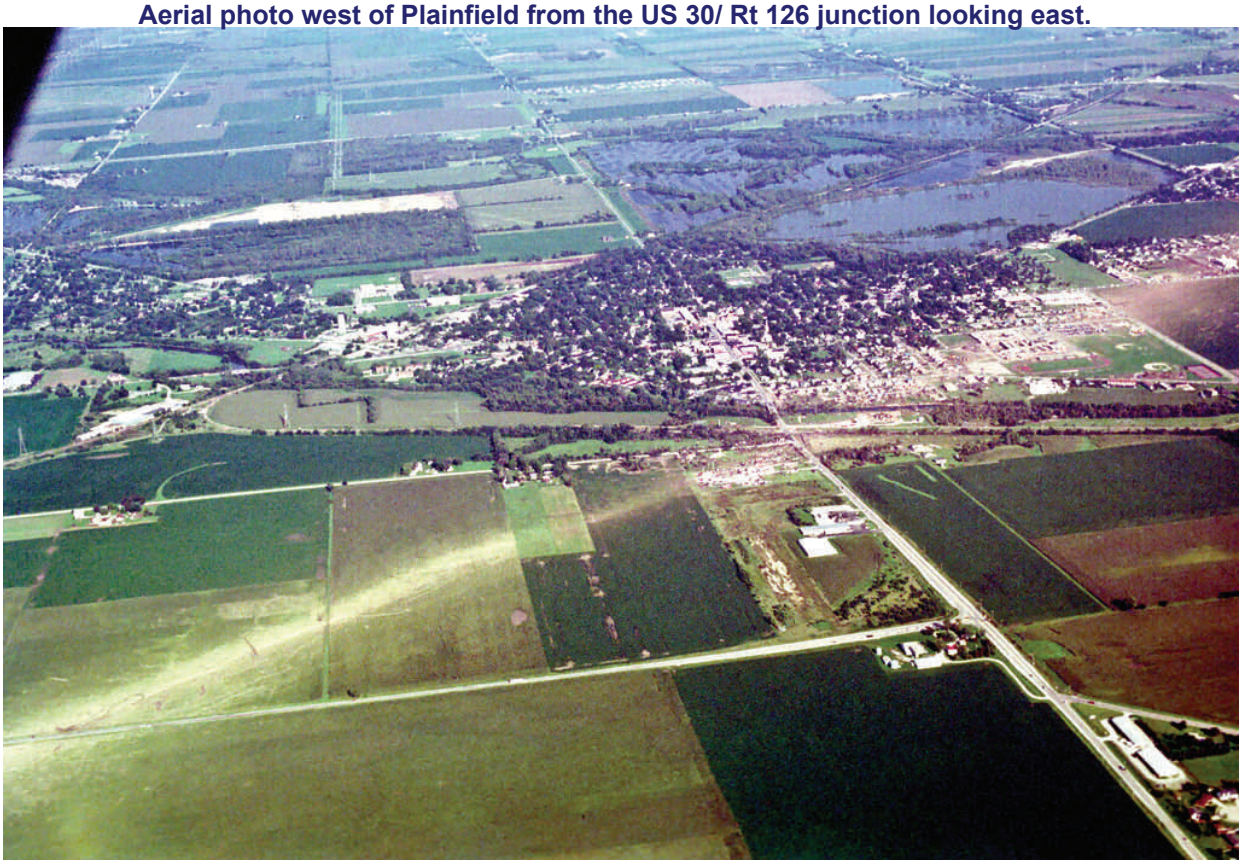
The map was digitized with the available data given from Fujita, T.T., 1993: Plainfield Tornado of August 28, 1990. The Tornado: Its Structure, Dynamics, Prediction, and Hazards. Geophysical Monograph 79, 1993. American Geophysical Union.

Imagery under license of Google™ Map.

Aerial photo looking southeast from Plainfield towards Joliet



Aerial photo west of Plainfield from the US 30/ Rt 126 junction looking east.



Twenty Years Later — What Has Changed

by Jim Allsopp, Warning Coordination Meteorologist

On August 28, 1990 an F5 tornado struck the southwest suburbs of Chicago, killing 29 people and injuring more than 300. There was no tornado watch in effect. There was no tornado warning in effect. Could a storm of this magnitude strike without warning again?

Radar Technology

In 1990 the National Weather Service (NWS) was using 1974 radar technology, which was a solid state version of the 1957 radar design. The forecast office was located in Rosemont but the radar was located remotely in Marseilles, IL. Warning forecasters could only view the base radar display on a TV monitor. Details of what the radar operators were seeing had to be relayed in radar summary products, or by phone. Without Doppler technology, radar operators could determine that the storm was an intense supercell. But it was not possible to determine the presence of strong rotation indicative of a tornado in 1990.

Today the NWS uses state of the art Doppler radar technology. The radar, which is co-located at the forecast office in Romeoville, has higher resolution, more power, and Doppler capability, which was not available in 1990. The Doppler radar not only produces dozens of products for analysis of precipitation, it can also detect wind motion in the storm, pointing out the intense circulation in a tornadic storm. In addition to the Romeoville radar, NWS forecasters have access to the FAA's terminal Doppler radars which serve O'Hare and Midway Airports, and other nearby radars in the NWS radar network. Next year, the NWS Doppler radar will be upgraded to Dual-Polarity giving forecasters greater capability to detect hail and flood producing rain.

Spotters and Emergency Communications

In 1990, the NWS conducted 21 spotter training classes, with total attendance of 1055 people. But there were no organized spotter networks activated on August 28. No spotter reports of wind damage, hail, or tornadoes were received at the Chicago NWS office. Storm chasers observed a wall cloud, hail and high winds as they followed the storm through rural areas of DeKalb and Kane Counties. But they couldn't get ahead of the storm to see the tornado form, and without cell phones, their observations were not relayed to the NWS. The NWS had little or no communications with emergency management or law enforcement officials in Kane, Kendall, or Will Counties prior to or during the storm. The first report of the tornado was received by the NWS as the tornado was dissipating in Joliet.

In 1990, watches and warnings were disseminated to emergency management, law enforcement and the media by radio and wire services. Warnings were broadcast to the public through two NOAA Weather Radio stations – one in Rockford and one in Chicago. Much of northern Illinois and northwest Indiana did not have adequate weather radio coverage.

Today, the NWS conducts about 50 spotter training classes per year, mostly between February and April, before severe weather season. On average, more than 3000 people attend the classes every year. In addition, an all-day "advanced" spotter training program has been provided every year by DuPage County Office of Homeland Security and Emergency Management, College of DuPage, and NWS, for a core group of dedicated spotters and emergency management officials.

The NWS now works more closely with county and community emergency management agencies to establish communications, training opportunities, and a close working relationship. Warnings are disseminated nearly instant aneously via satellite communications. NWS receives reports from spotters, storm chasers, law enforcement agencies, fire departments, and other community, county, state and federal agencies via phone, amateur radio, internet, and chatroom software. The NWS also has close ties to the TV weather broadcasters to provide a unified message about severe weather threats. Communications with the media and emergency management are established through conference calls, email, chatrooms and web pages.

There are now eleven NOAA Weather Radio transmitters across northern Illinois and northwest Indiana serving nearly 100% of the population. The radio broadcasts now provide coded information that can trigger the radios for specific types of alerts, and for specific counties. Department of Homeland Security, Department of Education, and NOAA teamed up to provide weather radios to every school in the country. In addition to weather radio, commercial radio, and television, weather information and warnings are now available through the internet and cell phones.

Science

Today, NWS meteorologists go through extensive training on Doppler radar, storm structure, and meteorological conditions that are likely to produce severe thunderstorms and tornadoes. Forecasters go through exercises on warning simulators, review severe weather cases, and issue practice warnings. Research meteorologists have learned a lot more about severe storms and tornado development over the last 20 years. Using Doppler radar and state of the art work stations, meteorologists can now graphically depict the greatest threat based on the storm's position and motion, issuing more efficient and accurate "storm-based" warnings, rather than the old larger "county-based" warnings.

As a result of these advancements, warning accuracy has greatly improved over the years. Nationwide, for the four year period from 1987-1990, NWS tornado warnings had an accuracy of 36% and an average lead time of 5.4 minutes. For the four year period of 2007-2010, warning accuracy has improved to 70% and lead time has increased to 13.1 minutes. Those numbers include all tornadoes, including weaker, more short-lived EF0 and EF1 tornadoes. The small, short-lived, weak tornadoes are more challenging to warn for because many times they don't produce strong signatures on radar. But very few people are killed or injured by the weaker tornadoes. Looking at statistics for just the strong and violent tornadoes of EF2 or greater intensity, the Chicago NWS office has an accuracy of 99% and an average lead time of 19 minutes over the last few years!

Is the Chicago Area Ready for a Major Tornado?

Despite the advances in science, technology, communications, and education, the Chicago metro area is still very vulnerable. The Plainfield Tornado was 20 years ago. There has not been a violent F4 or F5 tornado in the Chicago metro area since 1990. That means an entire generation of citizens has never experienced a major tornado disaster in this area. Many people have moved to northeast Illinois and northwest Indiana from other parts of the country, or other parts of the world, and may not be familiar with Chicago's history of violent tornadoes. Many people still believe the myths that tornadoes can't hit urban areas or will be stopped by the cool water of Lake Michigan. The truth is tornadoes have occurred in the heart of other major cities in recent years, including Atlanta, Fort Worth, Salt Lake City, Nashville, and Miami. Tornadoes have struck within the city limits of Chicago in the past. And tornadoes have occurred at the lakefront as recently as 2006, when a tornado occurred briefly at the Loyola University campus and moved out over Lake Michigan as a waterspout. Despite the high speed communications available, many people still rely on tornado sirens – which are designated as outdoor warning systems. Also, as the population of the metro area grows and spreads further out, more people are in harm's way.

The truth is that large violent tornadoes have struck the Chicago metro area in the past, and they will again. It is only a matter of time. We now have the tools, the communications, and the partnerships with emergency management and the media to effectively warn people when the big one strikes. But people still need to take personal responsibility to monitor forecasts, have a method to receive the warning, have an emergency plan at home, work, and school, and then to take action when the warning comes.

Crest Hill Lake Apartments on Ingalls Avenue just east of Cedarville Drive.

Examining the Forecastability of the Deadly Plainfield EF-5 Tornado Using the WRF Model

by Gino Izzi, Senior Meteorologist

The tornado that devastated portions of the southwestern suburbs of Chicago on August 28, 1990 came as a surprise to forecasters and the general public alike. During the past 20 years there have been so many incredibly important advances in the science of meteorology, and in particular in forecasting severe weather and tornadoes. Some of the data that is available today would likely not have been even dreamt of by many forecasters 20 years ago. In addition to a greater understanding of how and why tornadoes form, meteorologists today also have a wealth of observational data that was not available back in 1990 as well as far more accurate and higher resolution numerical models.

Numerical computer models provide forecasters with a computer generated forecasts of future states of the atmosphere using a series of complex mathematical equations performing millions of calculations in relatively short periods of time. One of the newer computer models that is getting a lot of use by both operational forecasters and researchers is the "WRF model" or the Weather Research & Forecasting model. The WRF model is currently being run operationally by many National Weather Service local offices and national centers, as well as by many universities, and can provide very high resolution forecasts, while being run using computers with relatively modest computing capabilities (by today's standard).

One of the nice features of the WRF model is that it can be easily used for research, allowing meteorologists to run the model for past events. With the 20 year anniversary of the Chicago area's strongest tornado approaching later this summer, a version of the WRF was installed locally at the National Weather Service Chicago office so that the Plainfield tornado event could be modeled to see if the WRF model (which was not available to forecasters in 1990) would do a better job at identifying a greater tornado potential.

The WRF model forecast generated using data 3 days prior to the tornado really did not suggest any appreciable tornado threat in Illinois. In fact, the forecast showed a cold front down to the I-70 corridor by afternoon and no thunderstorms developing within 300 miles of northern Illinois (Figure 1). While the atmosphere was forecast to be hot and very unstable, the model was maintaining a strong cap, or layer of warm air aloft preventing thunderstorms from forming over the Midwest.

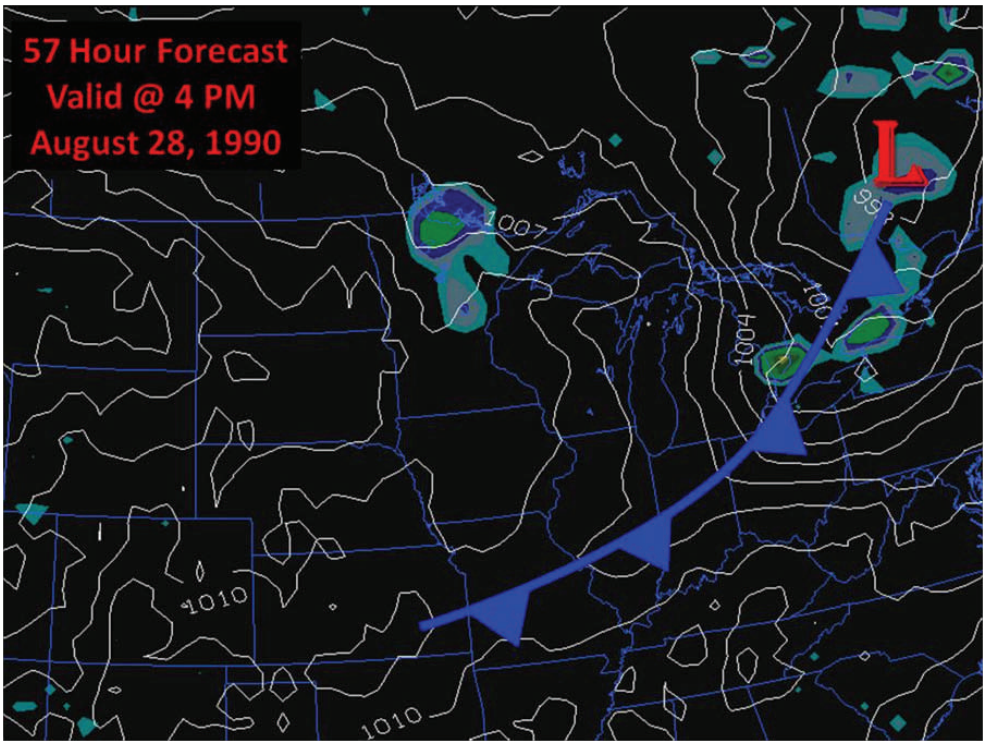


Figure 1.

Forecast map for roughly the time of the Plainfield tornado from the WRF model generated about 2 and a half days prior to the tornado.

The WRF model's forecast for the event using data the day before the tornado was an improvement over the previous forecast. The front was forecast to move slower and still be over northern Illinois during the late afternoon of August 28th, 1990 (Figure 2). In addition, the WRF was also showing a much weaker cap and depicted thunderstorms developing over extreme northeast Illinois and particularly across Indiana, Ohio, and southern lower Michigan (Figure 3). Even though the model did suggest that some thunderstorm activity could occur in northern Illinois, the parameters generally did not suggest there would be much of a tornado threat, let alone a threat for an F5 tornado to occur.

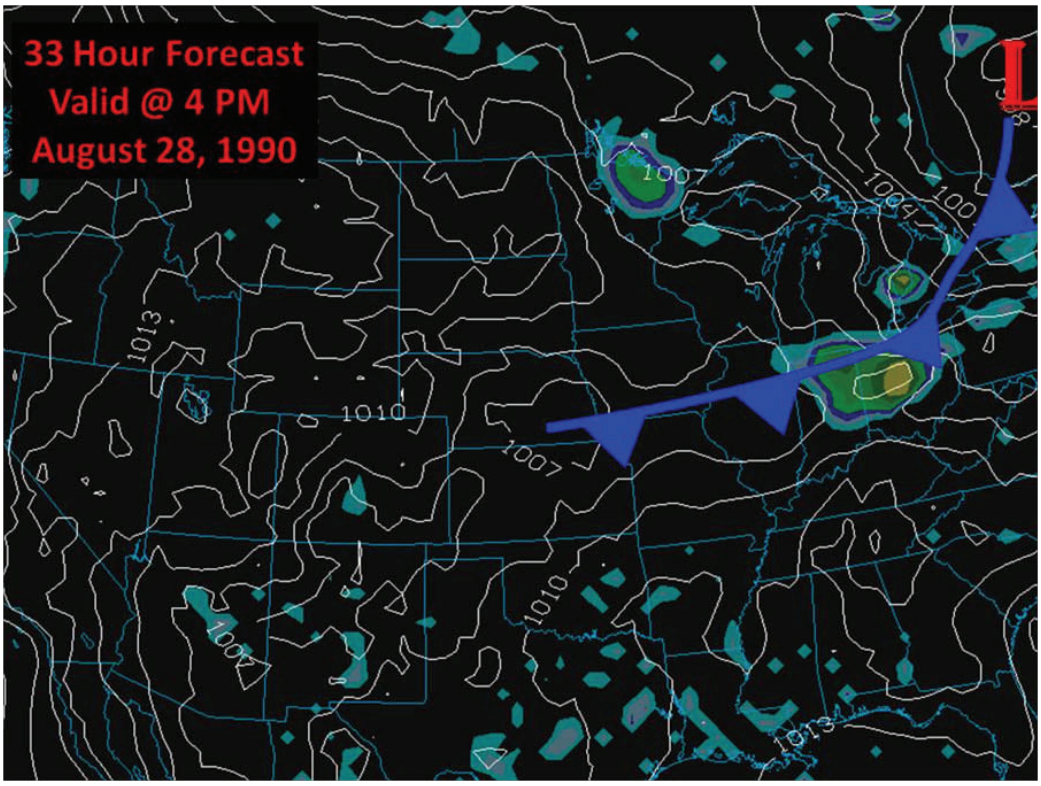


Figure 2.

Forecast map for the time of the Plainfield tornado from the WRF model generated about a day and a half prior to the tornado.

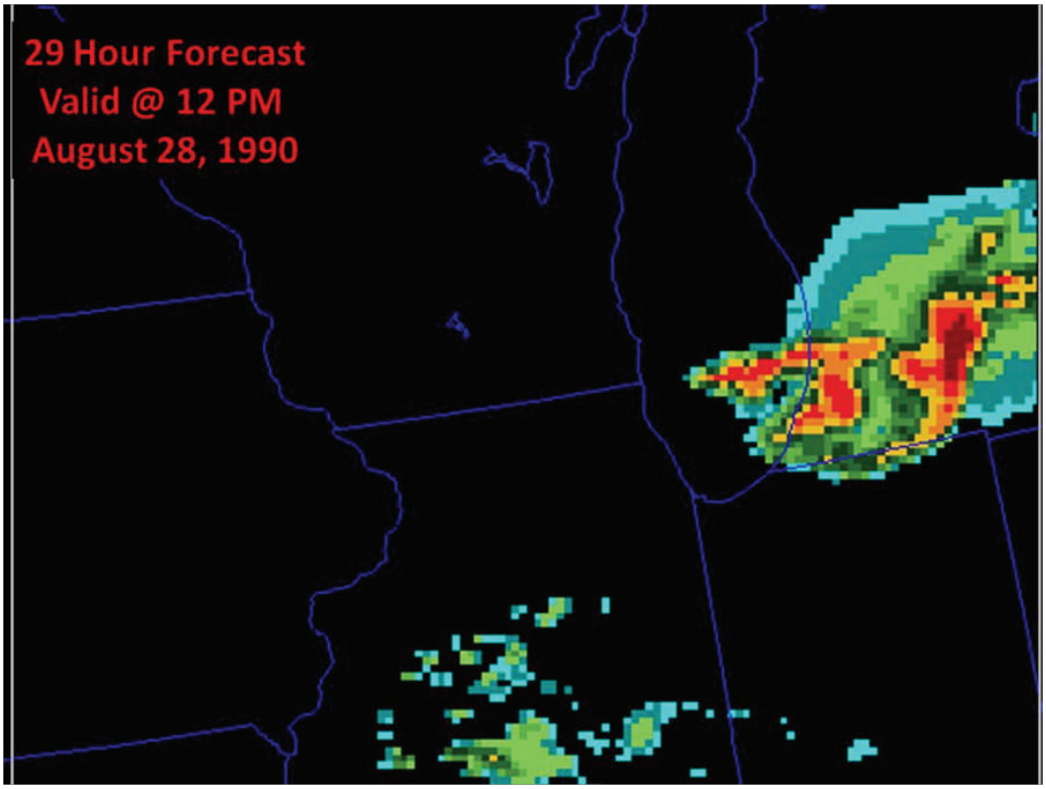


Figure 3.

Forecast radar reflectivity produced by the WRF model for 12 PM CDT Aug 28, 1990.

A subsequent run of the model using data from the morning of August 28, 1990 really did not show any appreciable change in the forecast from the forecast run using data 24 hours earlier. The WRF model output still showed a cold front located just south of I-80 by late in the afternoon with thunderstorms most numerous over Indiana, Ohio, and southern lower Michigan (Figure 4). Even this forecast model run did not indicate any appreciable tornado threat for northern Illinois or even anywhere nearby northern Illinois.

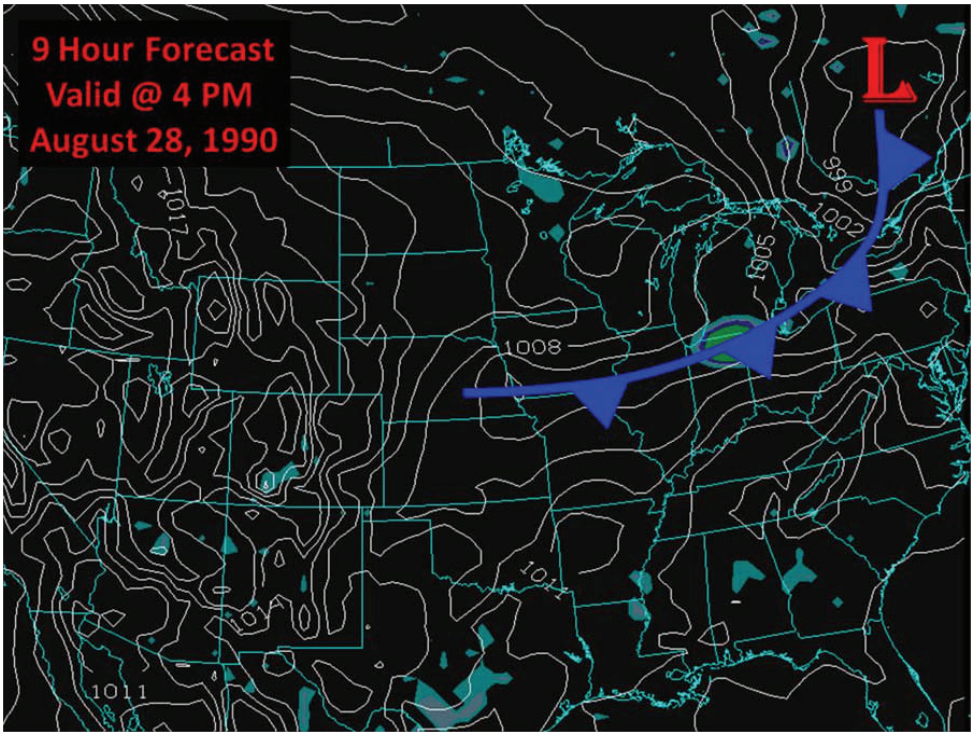


Figure 4.

Forecast from the WRF model for the time of the tornado using data from the morning of August 28, 1990.

The forecast data produced by re-running of the WRF did improve somewhat as the event drew nearer, but there was never any indication using the WRF model that there would be an enhanced tornado threat for northern Illinois. While this is not the result that was hoped for when undertaking this project, all hope is not lost. The forecasting of tornado potential does not rely solely on forecast model data, as an event nears the forecast hinges much more on observational data such as satellite, radar, upper air soundings, and surface observations. The other thing to consider is that the WRF model was run using data that was available in 1990 and that 20 years later much, much more observational data is fed into the WRF model, which would likely result in different and possibly a more accurate forecast.

While it is much more likely that forecasts leading up to a Plainfield-like tornado event today would key in on a tornado threat, meteorology is still a young science and occasionally “surprises” will occur. So even though it is still possible that a major tornado may not be anticipated 6, 12 or more hours in advance, once a tornado develops the dense National Weather Service Doppler Radar network would make it extremely difficult for a tornado as major as the one that struck Plainfield to strike without a warning.

More information on the WRF model can be found at:

http://www.wrf-model.org/index.php

NOAA Weather Radio

by Stephen Rodriguez, Meteorologist

Despite the end of the summer quickly approaching, there are still plenty reasons to get out and about and enjoy the weather across the area. With hopes for fair and pleasant weather in mind, there always remains the possibility that the weather could change in a moment's notice. With that in mind, it's always good to be prepared for any adverse weather which could possibly affect your location. One of the best, and easiest, ways to be prepared is to have a NOAA Weather Radio on hand. The NOAA Weather Radio is a simple tool to have, and also one which has been proven to save lives over and over again.

What is the NOAA Weather Radio?
NOAA Weather Radio (NWR) is comprised of a network of radio stations broadcasting continuous weather information directly from the nearest National Weather Service (NWS) Office. Locally in the Chicago area, that would entail broadcasting out of the NWS office in Romeoville, IL for portions of northern Illinois and northwest Indiana. The NWR broadcasts official NWS warnings, watches, forecasts, and other hazard information 24 hours a day, 7 days a week. The NWR is also an "All Hazards" network making it a one stop shop for all emergency information. The NWR is provided as a public service by the National Oceanic and Atmospheric Administration (NOAA).

How Does NWR Work?
Individuals can first obtain a NWR, which can be purchased at many retail stores or online. Next, the radio can be programmed for a particular county or counties, as well as for which products to be received. When an NWS office broadcasts a warning, watch, or non-weather emergency, special tones will precede these announcements. These tones will turn on the NWR alerting the individual of the potentially dangerous conditions in their local area. These special tones are called Specific Area Message Encoding, or SAME, codes. SAME codes allow only information pertinent to one's location to be broadcast. Through the use of the SAME codes and a 1050 Hertz warning alarm tone, individuals are capable of receiving local information within seconds of when the product was issued. These SAME codes are also used in the Emergency Alert System (EAS). The NWR is an essential item for every home, business, and public area.

Routine Weather Information on the NOAA Weather Radio: Hourly Weather Roundup, Hazardous Weather Outlook, Regional Weather Summary, Local Area Forecast, Nearshore and Open Waters Marine Forecast.

Watches, Warnings, Advisories: Severe Weather, Marine Weather, Winter Weather.

All Hazards: Amber Alerts, HazMat, Earthquakes, and more.

Other: Public Information Statements, Climate Data, NowCasts, Special Weather Statements, Marine Weather Statements.

Chicago's NOAA Weather Radio
Broadcasting out of the NWS office in Romeoville, IL, the network is comprised of 11 transmitters which span northern Illinois and northwest Indiana. The Chicago and Crystal Lake transmitters also provide marine forecasts boaters on Lake Michigan.

Figure 1.

Map of transmitters across northern Illinois and northwest Indiana.

A Spotters View on August 28, 1990

by Paul Sirvatka, Professor of Meteorology, Storm Chaser

I started the day like I had started the day so many other times that summer - in hopes of seeing a good storm. August 28, 1990 started out warm and very humid. A very unstable air mass promised big storms but the lack of vertical shear led everyone to believe that storms would be big and rainy but not tornadic.

After departing soon after the noon weather report by WGN's Tom Skilling, I took off from my home in Glen Ellyn to an area just northwest of DeKalb. I observed a storm very similar to storms I had seen often during the summer of 1990. There were reports of golf ball hail to my north, but nothing in my immediate area indicated what was soon going to become of this tremendous storm. I worked my way down through DeKalb where rain and hail started to fall. I struggled through worsening conditions onto eastbound I-88 where I decided to head south on Route 47. As I pulled out of the rain near the Sugar Grove airport, I was amazed to see the storm change its characteristic of being a big rain producer to being something a bit more scary! It was a little after 3:00 when I started video-taping a very intense-looking storm about to cross the road to my south. Torn between what I now know to be a rear flank shelf cloud (Dr. Fujita misidentified this as a wall cloud) and an area almost directly on top of me just to my northwest, I decided to try to head south to Route 126 and head to Plainfield. Unfortunately it was not to be that day. The rear flank of this now 65,000 foot tall storm surged across the road, knocking down power lines right behind me and doing a significant amount of damage at the airport. As the driving conditions became impassable I took shelter in a BP station on the corner of Rt. 47 and Rt. 30. People were all commenting about the storm. I had no cell phone at the time, and the phone in the station was being used. I remember thinking to myself "This storm might produce a tornado! I'll bet that someone is reporting this!"

I was right with the first prediction but terribly wrong with the second. The storm soon put down the tornado just to the southeast of my location. It was not until a few hours later that I became aware of how significant of an event this was. The fact that no one reported this tornado to the authorities until 3:45 shocked me, but it also inspired me to set a goal that this would never happen again in the Chicago area without a report. I have helped train several thousand spotters and worked with various city and county governments, as well as amateur and public groups to help see to it that Chicagoland is a greatly prepared region during a significant tornado event. I hope never to have to test that conclusion.

Click here to see a video from Paul Sirvatka on August 28.

This is a big file, so be patient while it downloads.