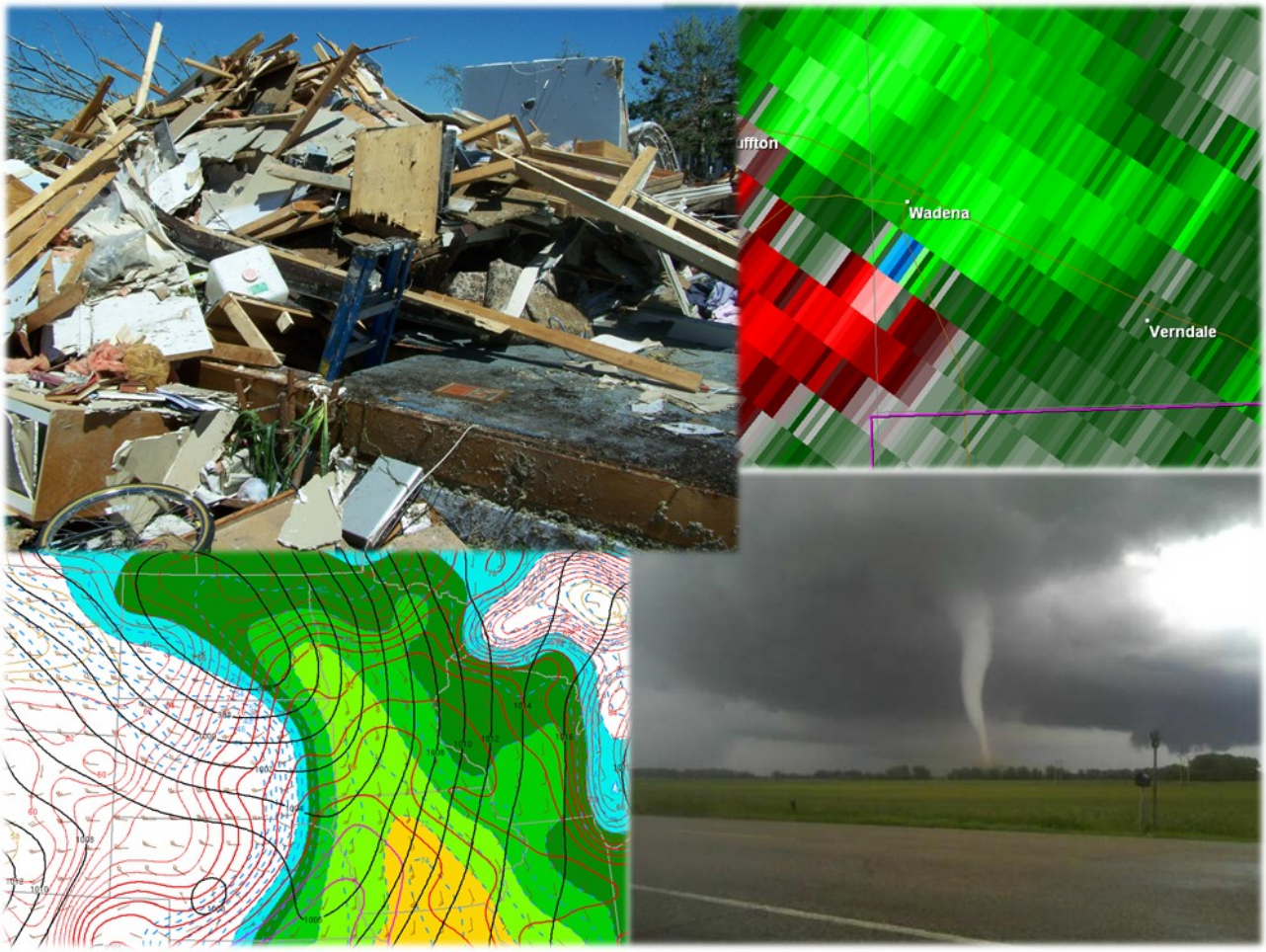
Basic Information Guide

June 17, 2010 Northern Plains Tornado Outbreak



Contributions From

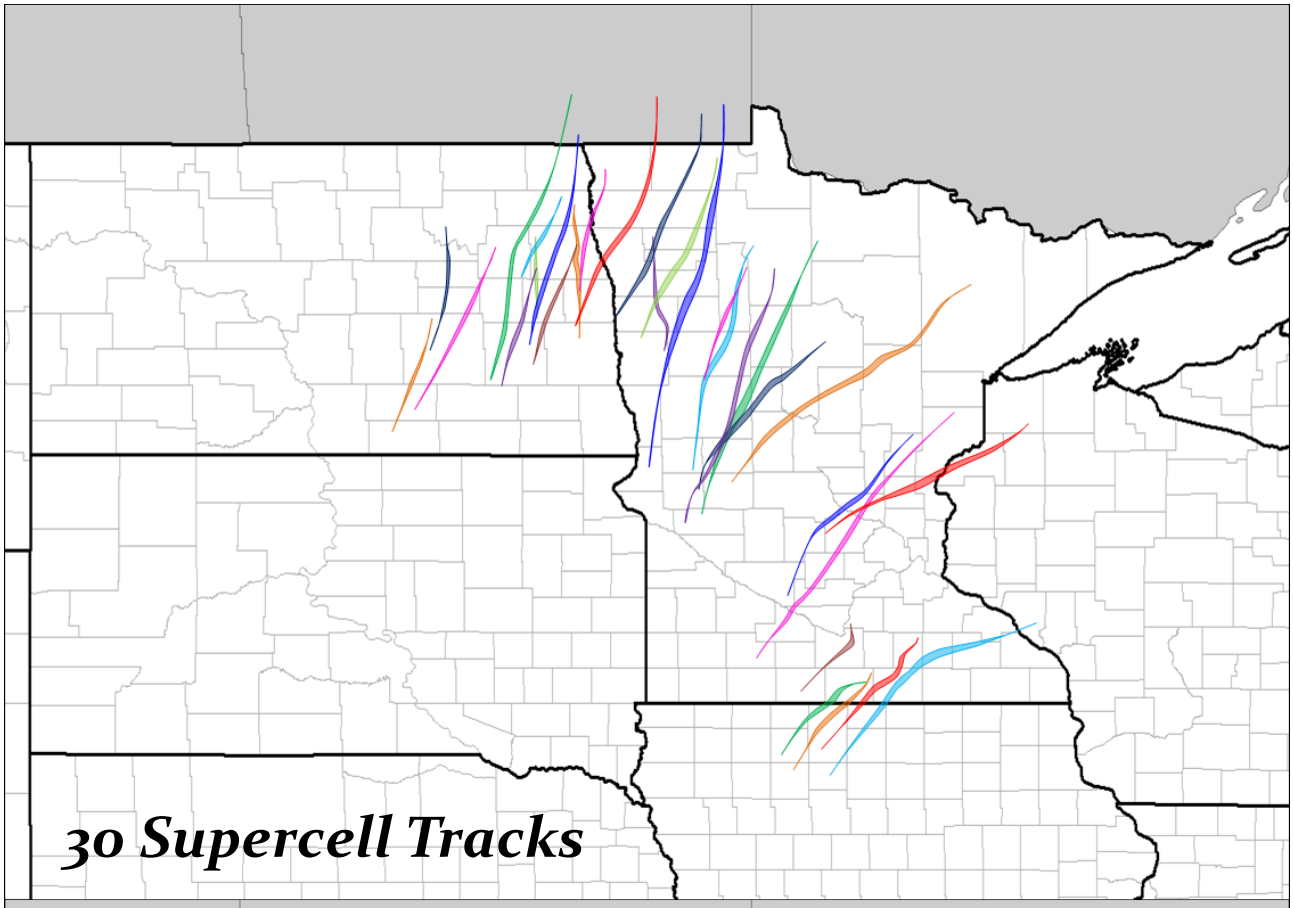
NWS Grand Forks, ND
NWS Chanhassen, MN
NWS Duluth, MN
NWS La Crosse, WI
NWS Des Moines, IA
NWS Bismarck, ND

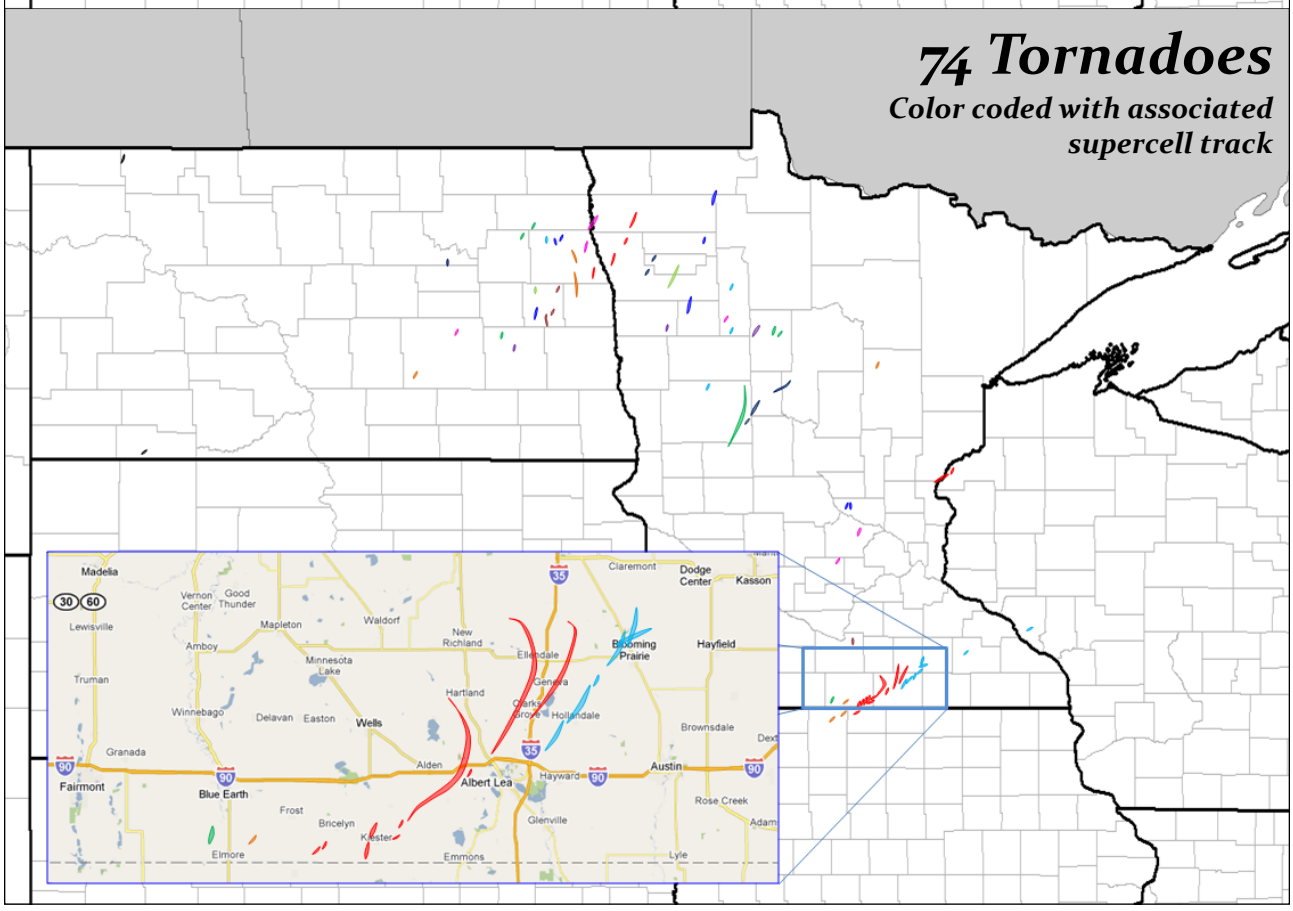
Last update: 8 September 2010

Foreword

On June 17, 2010, a significant tornado outbreak occurred across the Northern Plains. Beginning around 2 PM, thunderstorms moved across the region, producing 74 tornadoes. Of those tornadoes, 48 were in Minnesota, eclipsing the single-day tornado record. At the time that it occurred, it went down as the 17th largest tornado outbreak on record in the United States, and the 2nd largest in the summer months of June-August.

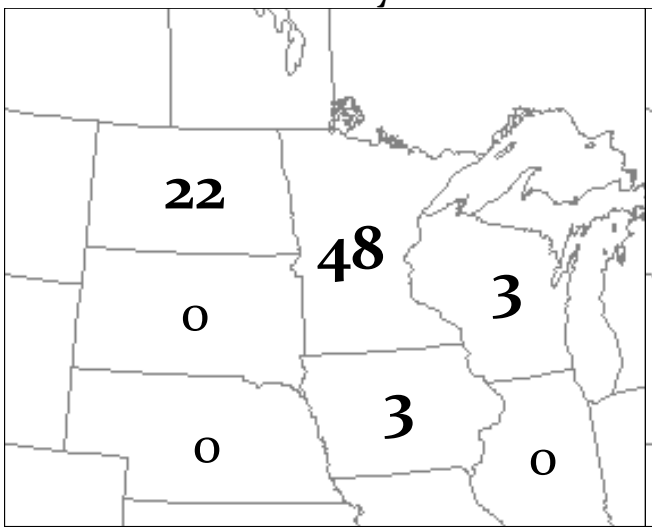
Supercell and Tornado Track Maps



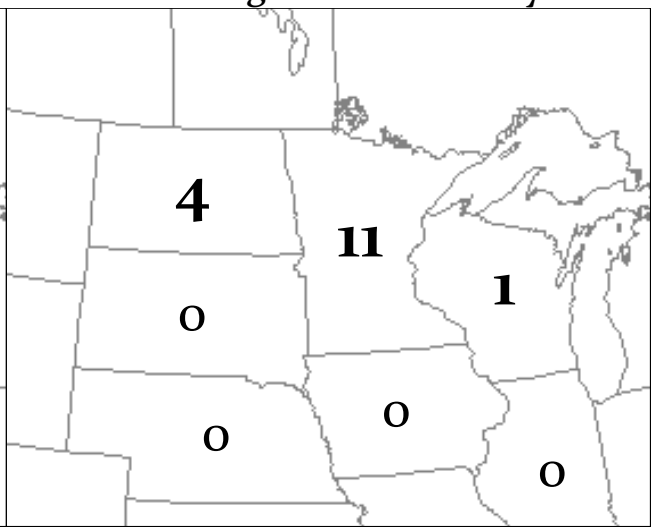


Outbreak Statistics

Tornadoes by State



EF-2 or Stronger Tornadoes by State



74 total tornadoes: note that adding the tornadoes in individual states may not sum to the same number as the official tornado counts. This is because some tornadoes crossed state borders.

Tornadoes by EF-Scale Rating	
EF-0	33
EF-1	26
EF-2	7
EF-3	4
EF-4	4

Tornadoes by Path Length	
Less than 1 mi.	14
1 to 4.99 mi.	37
5 to 9.99 mi.	14
10 to 19.99 mi.	7
20 mi. or more	2

Tornadoes by County Warning Area	
Bismarck	4
Grand Forks	39
Duluth	4
Minneapolis	25
La Crosse	4
Des Moines	3

Violent tornadoes are ones that are rated EF-4 or EF-5 on the Enhanced Fujita Scale, Strong tornadoes are rated EF-2 or EF-3. From 1990 to 2009, only 10.6% of US tornadoes were rated strong, and 0.6% were rated violent. In the same span, strong and violent tornadoes accounted for 92.4% of all tornado-related fatalities.

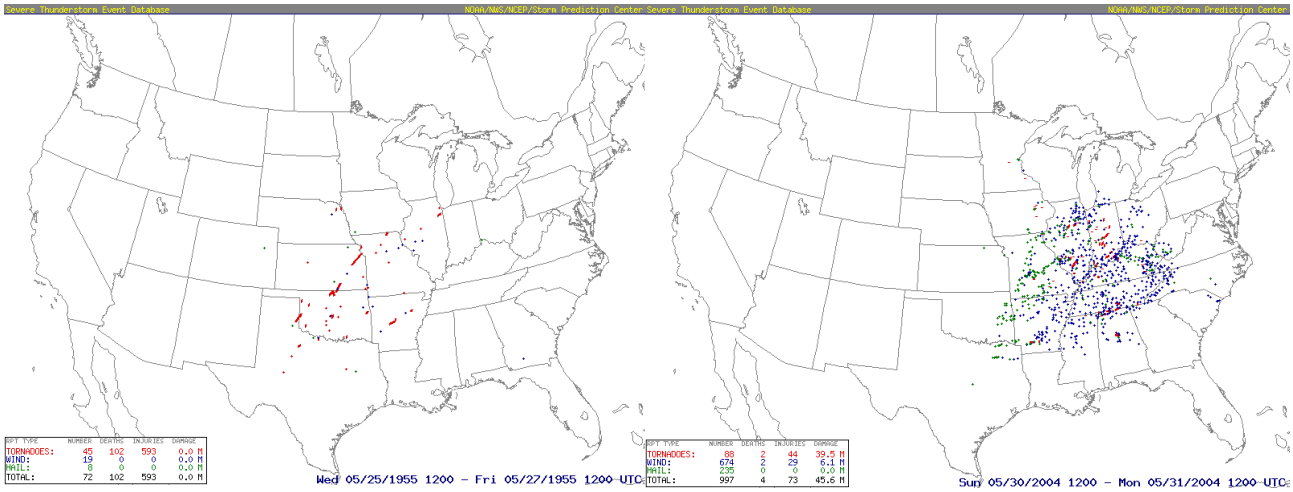
Historical Rankings

*****See notes on historical comparisons on next page*****

- 17th largest US tornado outbreak*
- 2nd largest US tornado outbreak in meteorological summer* (June through August)
- Most tornadoes in the state of Minnesota on a single day.
- First violent tornado in Minnesota since the Granite Falls F4 of July 25, 2000.
- First violent tornado in North Dakota since August 26, 2007.

Historical Comparisons

Comparing tornado outbreaks from different decades.



Left: severe weather reports from May 25-26, 1955 severe weather outbreak that included the Udall, KS and Blackwell, OK F5 tornadoes. Right: severe weather reports from May 30, 2004 severe weather outbreak.

Comparing the significance of tornado outbreaks across time is a difficult thing to do. Many improvements in technology, weather education, and severe weather reporting over the past half century have contributed to an increased ability to document extreme weather events. Beyond population increases, things like cell phone technology, the internet, and increased vehicle use have made witnessing, recording, and reporting severe weather much easier in recent decades. The National Weather Service Doppler radar network allows meteorologists to track and document thunderstorms more easily, and national field campaigns like VORTEX and VORTEX2 have increased our knowledge of the processes surrounding tornado formation.

As a result of all those advancements, the number of tornado, large hail, and damaging wind reports have been increasing with time. In fact, the average number of tornado reports logged in recent years by the National Weather Service offices across the country are about double what was reported back in the late 1950s and 1960s.

Of course, this makes comparisons of tornado outbreaks across time very difficult. Take the comparison of severe weather reports maps above for two severe weather outbreaks similar in areal extent. The one on the left is from 1955, and the one on the right is from 2004. This is merely one example, but the overall trend is similar.

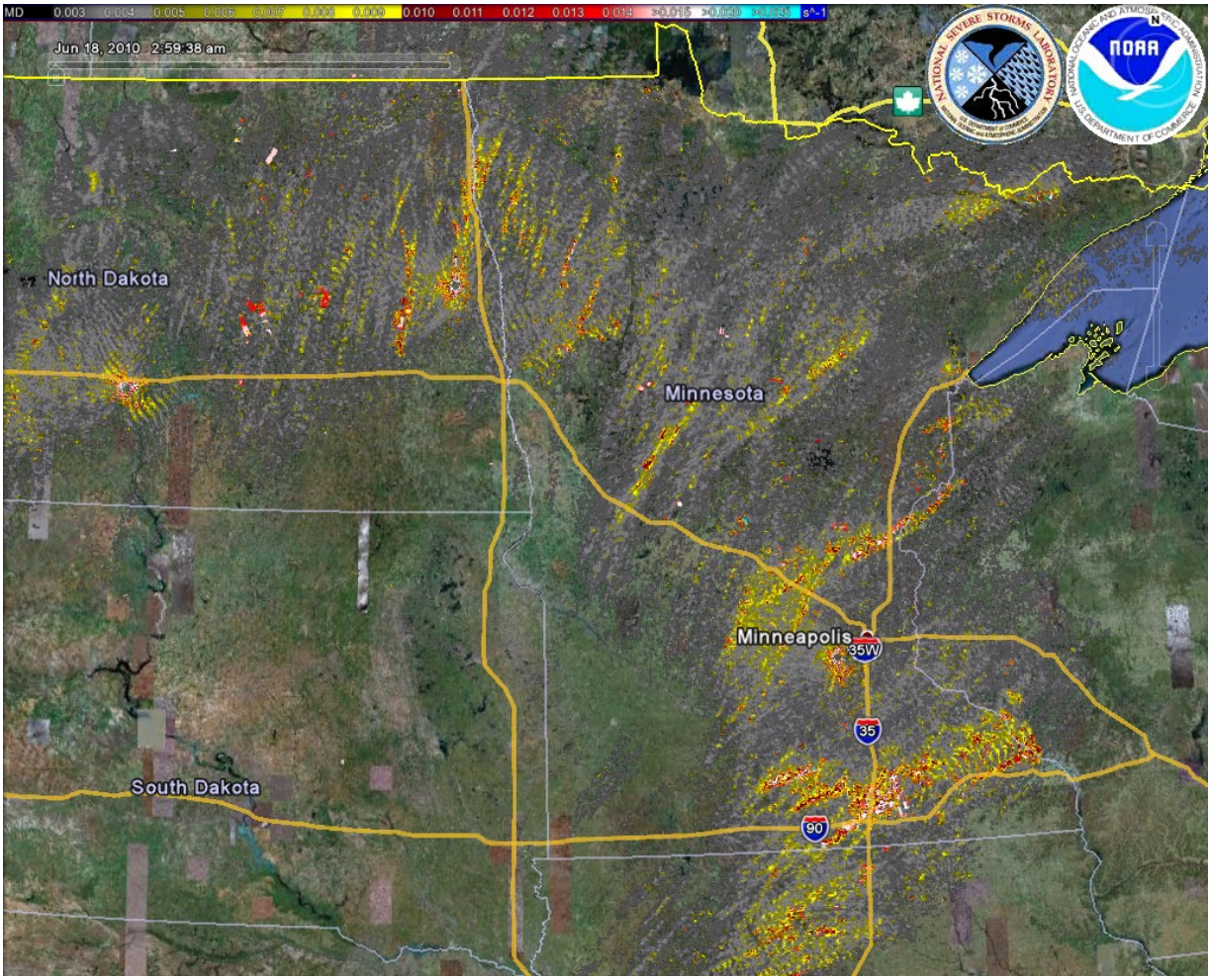
Because of the fact that tornadoes tend to be more thoroughly documented now than they were in the mid 20th century, many of the largest tornado outbreaks on record have happened in the last several decades. The largest US tornado outbreak is still the “Super Outbreak” during which 147 tornadoes struck 13 states on April 3-4, 1974.

Therefore, while the tornado outbreak on June 17th was technically the 17th largest in US history, keep in mind the limitations of the tornado record discussed above.

Rotation Track Maps

The National Severe Storms Laboratory produces several experimental products that prove useful when analyzing severe weather outbreaks. One of those is something called a "rotation track map". This map is produced by running radar velocity data through a filter, and determining the shear at given instants in time across the entire United States radar network. These instantaneous values are then integrated across an entire time period. The resulting maps can reveal both tracks of rotating supercells, and fluctuations in intensity in those supercells.

An example of one of those maps is shown below, for June 17, 2010.

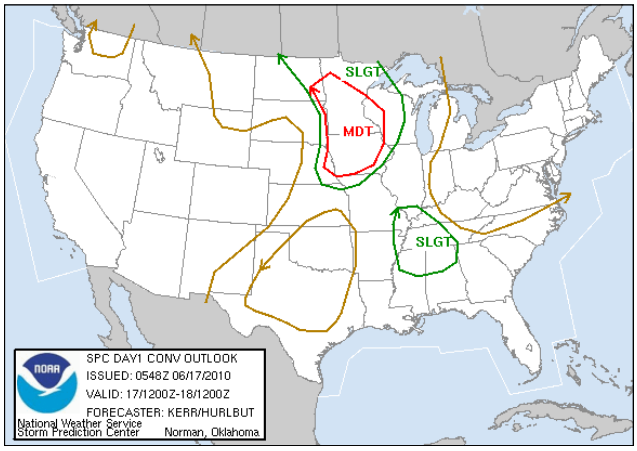


Because the June 17, 2010 tornado outbreak was so large in scope, many damage surveys had to be conducted over a large area of the Northern Plains. Some of the National Weather Service offices used maps such as the one pictured above, combined with reports received from spotters and law enforcement, to plan damage surveys and validate the survey results.

Spotter reports received in real-time during the outbreak were enormously helpful. Hundreds of spotter reports were logged by the National Weather Service offices in the region, and provided critical information that aided in the warning process.

Advance Notice

Examples of how the National Weather Service provides advance notice about severe weather from June 17th

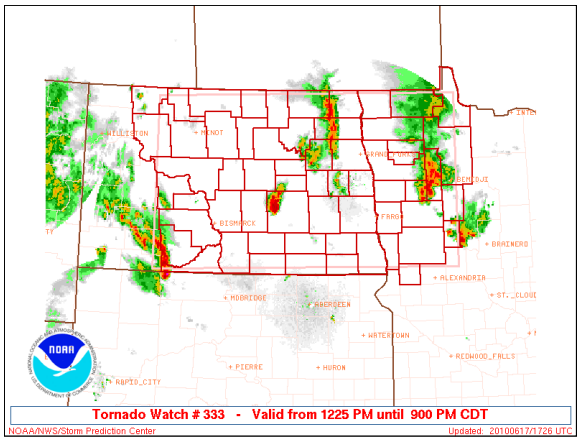


Days in advance of potentially significant severe weather episodes, the National Weather Service will use several methods to highlight the threat. The national Storm Prediction Center in Norman, Oklahoma is responsible for issuing severe weather outlooks up to 3 days in advance. These outlooks outline areas of the United States in slight, moderate, or high risks of severe weather. To generalize, slight risks mean that some severe weather is possible, but limiting factors may keep it more isolated, or less intense. Moderate risks indicate the potential for a fairly potent severe weather outbreak with some significant severe weather (*hail over 2 inches in diameter, wind gusts over 74 mph, or strong to violent tornadoes*). A high risk suggests that a widespread severe weather outbreak is likely. The image above and to the left shows that the Storm Prediction Center issued a moderate risk for the region on June 17th.

> “ In this case, on June 13th NWS offices in the Northern Plains began discussing the potential for strong and severe thunderstorms in their HWO products, 5 days in advance of the tornado outbreak.

In addition to these national outlooks, local National Weather Service offices will issue a daily Hazardous Weather Outlook (HWO) text product, that will describe the potential for severe weather within the next seven days. The HWO is played regularly on the NOAA Weather Radio broadcast cycle, and is also available on NWS websites. In this case, National Weather Service offices in the Northern Plains began discussing the potential for strong and severe thunderstorms on June 13th in their HWO products, 5 days in advance of the tornado outbreak.

The Storm Prediction Center is also in charge of issuing Tornado Watches and Severe Thunderstorm Watches for the entire United States. The watch products indicate that conditions are favorable for severe weather in the watch area, and that people in those areas should monitor weather forecasts for the latest information. On June 17th, the Storm Prediction Center issued four Tornado Watches for the outbreak area for a combined average lead time of approximately 4 hours and 24 minutes.



Keeping You Informed

The National Weather Service issued a number of different text products on June 17th that provided advance warning of the severe weather

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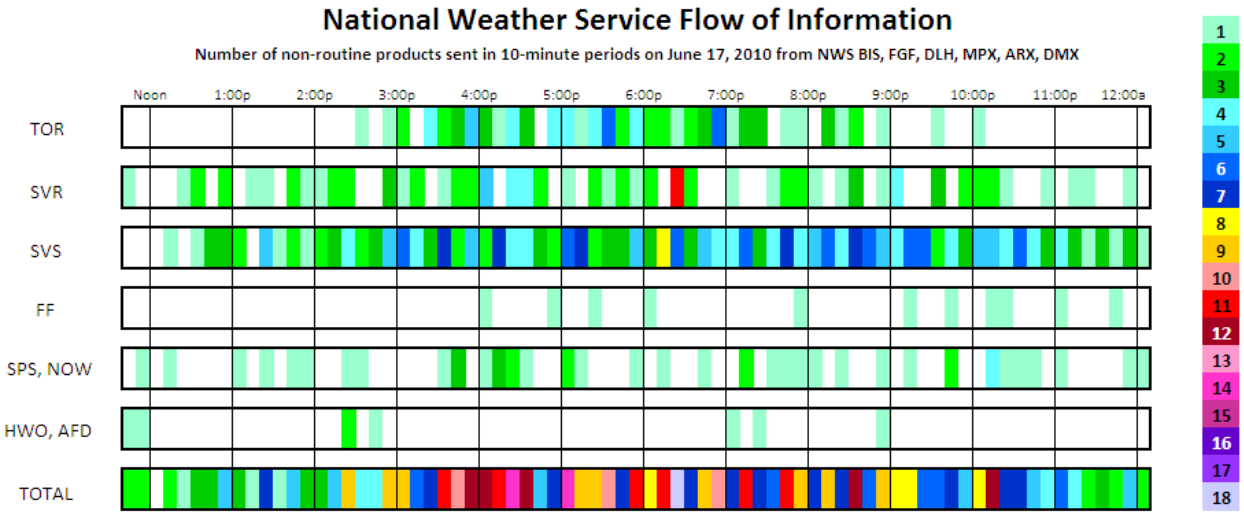
"Non-routine products" that are issued by the National Weather Service are ones that are not issued on a regularly scheduled basis. This includes anything from Tornado Warnings to updates for any routinely issued products.

In the graph below, TOR corresponds with Tornado Warnings, SVR with Severe Thunderstorm Warnings, SVS with Severe Weather Statements, FF with Flash Flood Warnings and Statements, SPS with Special Weather Statements, NOW with Short Term Forecasts, HWO with Hazardous Weather Outlook, and AFD with Area Forecast Discussion.

The time from 11:40 AM CDT on June 17th to Midnight on June 18th was broken down into 10 minute intervals, and then the numbers of various types of products issued were counted for each of those intervals. This graph includes products issued by National Weather Service offices in Bismarck, Grand Forks, Duluth, Minneapolis, La Crosse, and Des Moines.



In total, 519 non-routine products were issued by those 6 National Weather Service offices in approximately a 12 hour period. The busiest timeframe was between 3 PM and 6 PM when 40.4% of the non-routine products in question were issued.

87 Tornado Warnings, 83 Severe Thunderstorm Warnings, and 3 Flash Flood Warnings were issued by the indicated National Weather Service offices in that same 12 hour period. 279 follow-up statements, under the titles "Severe Weather Statement" or "Flash Flood Statement", were issued in the same timeframe.

Initial reports were received in real-time on June 17th in over half (54%) of these warnings, with additional severe weather reports and tornado tracks discovered upon further investigation.