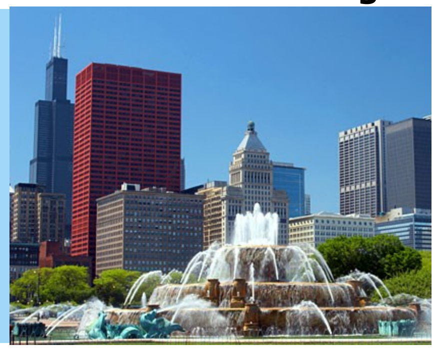
CHICAGO

National Weather Service Forecast Office Chicago

Weather Currents



Summer 2015

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Website: weather.gov/Chicago

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Why is My Flight Delayed?

by Robb Kaczmarek, NWSU Aurora

Skies are clear; winds are light, a seemingly good weather day here in Chicago? But many arriving and departing flights are delayed in and out of O'Hare and Midway. And yours may be one of them.

On any given day, more than 85,000 flights are in the skies over the United States. The NAS (National Airspace System) is what the FAA (Federal Aviation Administration) calls its' vast infrastructure needed to move aircraft across the nation. It includes the airspace, navigation facilities, airports, personnel in the towers, tracons and centers, which include air traffic controllers and air traffic managers, along with all the rules and procedures that must be followed. Not to mention the infrastructure that the airlines have in place such as dispatchers and baggage handlers.

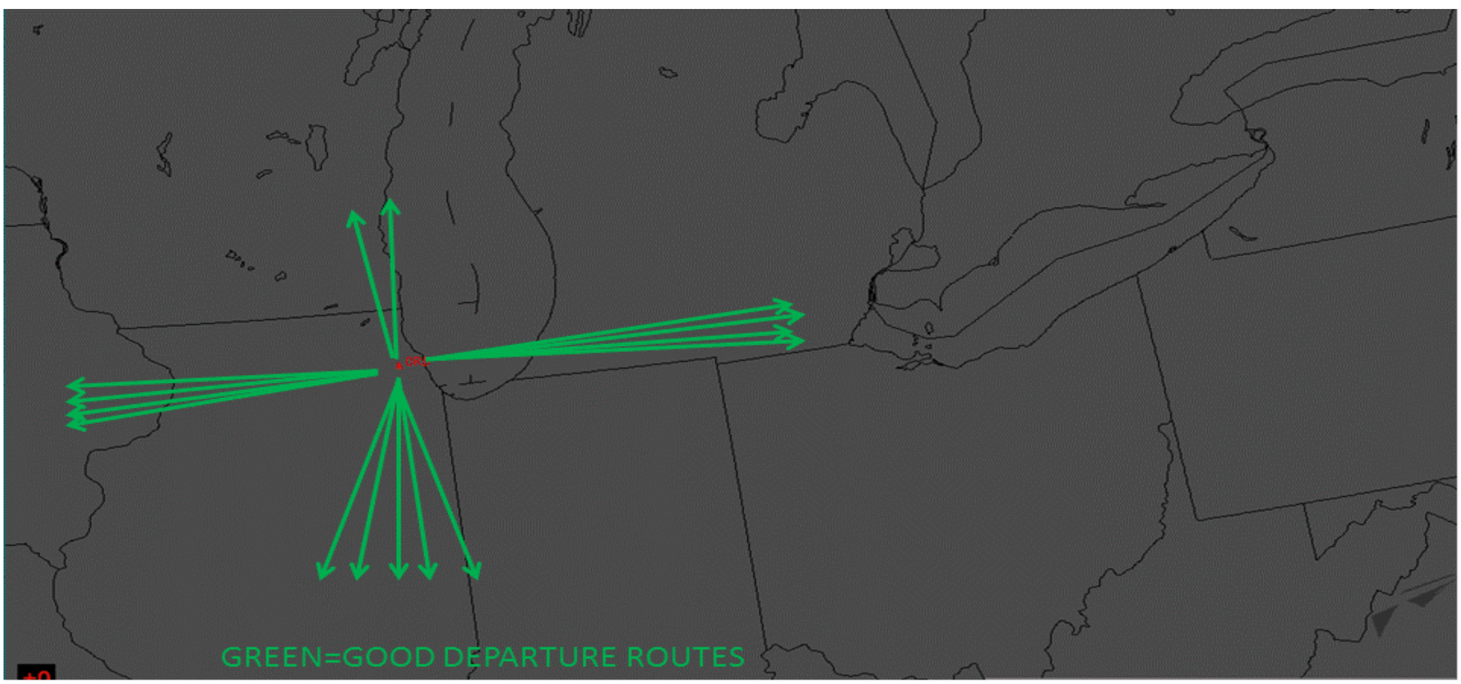
The FAA's mission is to use this system to provide the safest, most efficient airspace in the world to make your travel more convenient and dependable.

One of the FAA's jobs is to balance the number of arriving and departing aircraft at particular airports. For example, when looking at O'Hare airport, between 92-114 aircraft can land each hour while departing aircraft can range from 75 to as many as 150 per hour.

But this summer with thunderstorms abundant, a very efficient airspace becomes hampered by deviations, reroutes and delays as these cumulonimbus clouds block flight routes. Thunderstorms are one of the most significant hazards to aviation safety. There are just too many hazards for aircraft to fly in or near them and they must be avoided. The updrafts, downdrafts, hail cores and other thunderstorm elements must be avoided which means that closing jet routes becomes a common procedure. But with the same number of planes scheduled by the airlines each day the NAS can become restricted.

Unlike when you are driving your car and a thunderstorm rolls through as you may need to slow down, if there is a thunderstorm on a jet route that route is essentially closed to air traffic. Now, if there is just a single pop-up thunderstorm an aircraft has the ability to make slight deviations. However, when thunderstorms become organized into lines or multi-cell clusters as aircraft do not have anywhere to deviate and the FAA Traffic Managers have to close jet routes.

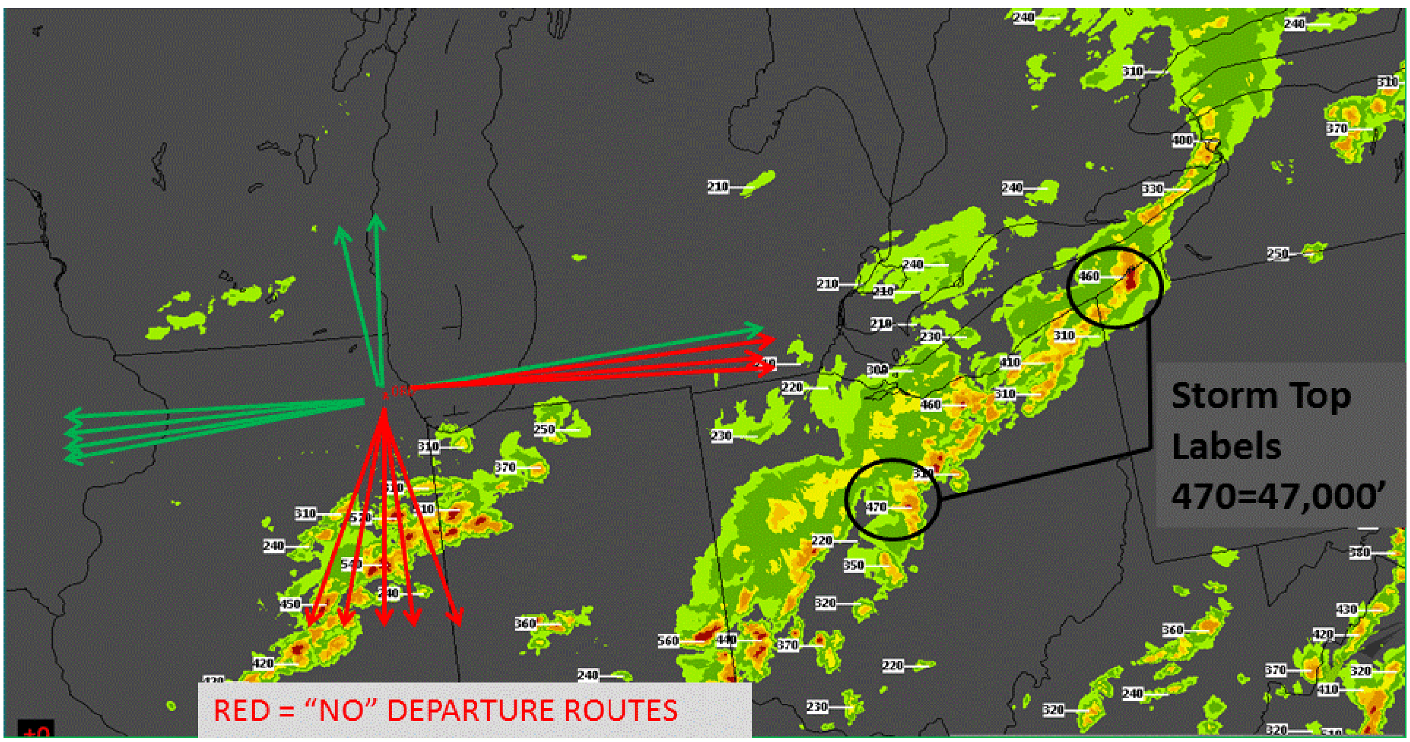
While the weather might be nice and sunny here in Chicago, thunderstorms in the other parts of Illinois and the Midwest can have a significant impact on air traffic flow at O'Hare and Midway. The green arrows below highlight the normal departure route here in Chicago.



These green arrows are typical Chicago departure routes.

Again, O'Hare can depart between 75-150 aircraft per hour if they utilize all four departure directions: North , East , South and West. But if these departure routes become blocked by thunderstorms an imbalance of arriving and departing aircraft develops.

Example of departing aircraft starting to develop congestion.



During this day, June 12th of this summer. O’Hare airport was landing 92 aircraft per hour. Storms initially developed over Ohio, northwest Pennsylvania and Lake Erie, and significantly impacted eastern departures.

A second area of storms developed over east-central Illinois into Indiana which ultimately closed all of the south departure routes.

During the above scenario, O'Hare was unable to utilize its normal departures routes. This resulted in an increasing number of aircraft unable to depart at their normal times and there began to develop departure delays. But the number of aircraft arriving into O'Hare initially remained the same at 92 per hour. So more and more airplans were landing and fewer were departing. At this time the airport was becoming unbalanced. More taxiways were filling up with aircraft waiting to depart. Some aircraft were not leaving their gates on time which means arriving aircraft do not have open gates.

This is where the FAA needs to step in. Otherwise a situation could develop in which the airport develops "gridlock". Taxiways and holding pads can fill up while gate congestion builds and airport personnel become unable to find areas to effectively move aircraft. The solution for this weather situation was to lower the number of aircraft arriving from 92 to 64 per hour. And this 64 arrival rate as the FAA calls means that O'Hare now is unable to utilize its' full capacity in which the airlines have built their schedules around.

Not only were aircraft departing Chicago getting delayed but also aircraft departing say New York, Tampa, Dallas or San Francisco where also getting delayed. And if you checked your NOAA weather source it would have indicated a good weather day here in Chicago. So when traveling, zoom out a bit and remember to always check the bigger weather picture. Weather conditions in one location can have a significant impact on other parts of the country.

Beat the Heat: Heat Statistics & Facts

by Nicole Batzek, Student Volunteer

Chicago has had quite a few notable heat waves, especially over the past two decades. A heat wave is in place when at least 3 consecutive days hit high temperatures of at least 90^{0}F. The most well-known and fatal heat wave in Chicago history occurred between the 12th and 15th of July in 1995, with a more recent and comparable event in July of 2012. The previously mentioned heat waves were all unfortunately fatal events, which is why it is important to know the statistics and facts on everything heat.

When people think of heat, the first thing that pops into a lot of minds is primarily very high, unbearable temperatures. However, even though temperature is a big influence, it is not the only parameter factored into heat wave events. Temperature along with relative humidity are put together to determine what is known as the heat index. The heat index is defined as a measure of how hot the air really feels to the human body when the relative humidity is factored in with the actual temperature. The chart below shows what the heat index would be with the given temperature (^{0}F) across the top and the relative humidity (%) down the side.

NOAA's National Weather Service

Heat Index

Temperature (°F)

Relative Humidity (%)	80	82	84	86	88	90	92	94	96	98	100	102	104	106	108	110
40	80	81	83	85	88	91	94	97	101	105	109	114	119	124	130	136
45	80	82	84	87	89	93	96	100	104	109	114	119	124	130	137	
50	81	83	85	88	91	95	99	103	108	113	118	124	131	137		
55	81	84	86	89	93	97	101	106	112	117	124	130	137			
60	82	84	88	91	95	100	105	110	116	123	129	137				
65	82	85	89	93	98	103	108	114	121	128	136					
70	83	86	90	95	100	105	112	119	126	134						
75	84	88	92	97	103	109	116	124	132							
80	84	89	94	100	106	113	121	129								
85	85	90	96	102	110	117	126	135								
90	86	91	98	105	113	122	131									
95	86	93	100	108	117	127										
100	87	95	103	112	121	132										

Likelihood of Heat Disorders with Prolonged Exposure or Strenuous Activity

Caution Extreme Caution Danger Extreme Danger

Relative humidity percentages indicate how much water vapor, or moisture, each air molecule is holding. So, for example, a 100% relative humidity value indicates that air molecules are saturated, or completely full of water vapor. With high relative humidity values, it makes it hard for humans to find comfort. This is because humans use evaporative cooling, or better known as sweating, to keep our bodies from overheating. If the relative humidity is high, the evaporative cooling is limited because the air molecules already have a lot of water in them. As a result, limited evaporative cooling makes a person feel too warm, which can cause discomfort, or even more severely, heat related illnesses such as heat exhaustion or heat stroke.

When National Weather Service employees forecast high temperatures and moisture values, the heat index chart above is an essential tool when it comes to determining if a heat advisory, excessive heat watch, or potentially an excessive heat warning needs to be issued. A **heat advisory** is issued when the maximum daytime heat index values are forecast to reach or exceed 105^0F. **Excessive heat** is when the maximum heat index values are forecast to reach or exceed 110^0F and a minimum heat index value of less than or equal to 75^0F for at least 48 hours. The criteria for an excessive heat watch (conditions are likely for this to occur) and an excessive heat warning (conditions are occurring) in the Chicagoland area is listed below:

- 3 consecutive days with a peak heat index between 100^0F and 105^0F
- 2 consecutive days with a peak heat index between 105^0F and 110^0F
- 1 day with a peak heat index of 110^0F or greater

When forecasters feel that there is a good potential that the above criteria will be met within the next couple of days (36-48 hours) an **excessive heat watch** will be issued by the National Weather Service. When the criteria above is met or is highly likely to be met within the next day (up to 24 hours in advance) an **excessive heat warning** is issued.

Another aspect to keep in mind when dealing with heat events in large urban areas, like Chicago, is the urban heat island effect. Urban areas have the potential of getting warmer than rural areas. This is primarily caused by the lack of vegetation and soil moisture in urban areas with an excess of manmade structures such as paved surfaces and buildings. The absence of moisture in these manmade surfaces causes the sun's energy to go directly into them, which as a result raises the temperature of these objects. This poses a problem during the nighttime hours when these surfaces radiate the heat that has been collected all day back into the atmosphere. This unfortunately keeps nighttime lows relatively high, which is not helpful during excessive heat events.

Some ways to stay safe and beat the heat during heat wave events include staying hydrated, remaining in air conditioned buildings either at home or at a local cooling center, and limiting outdoor activities. Keeping people updated and aware of the many dangers during excessive heat periods will keep people safe and potentially help save lives during future events.

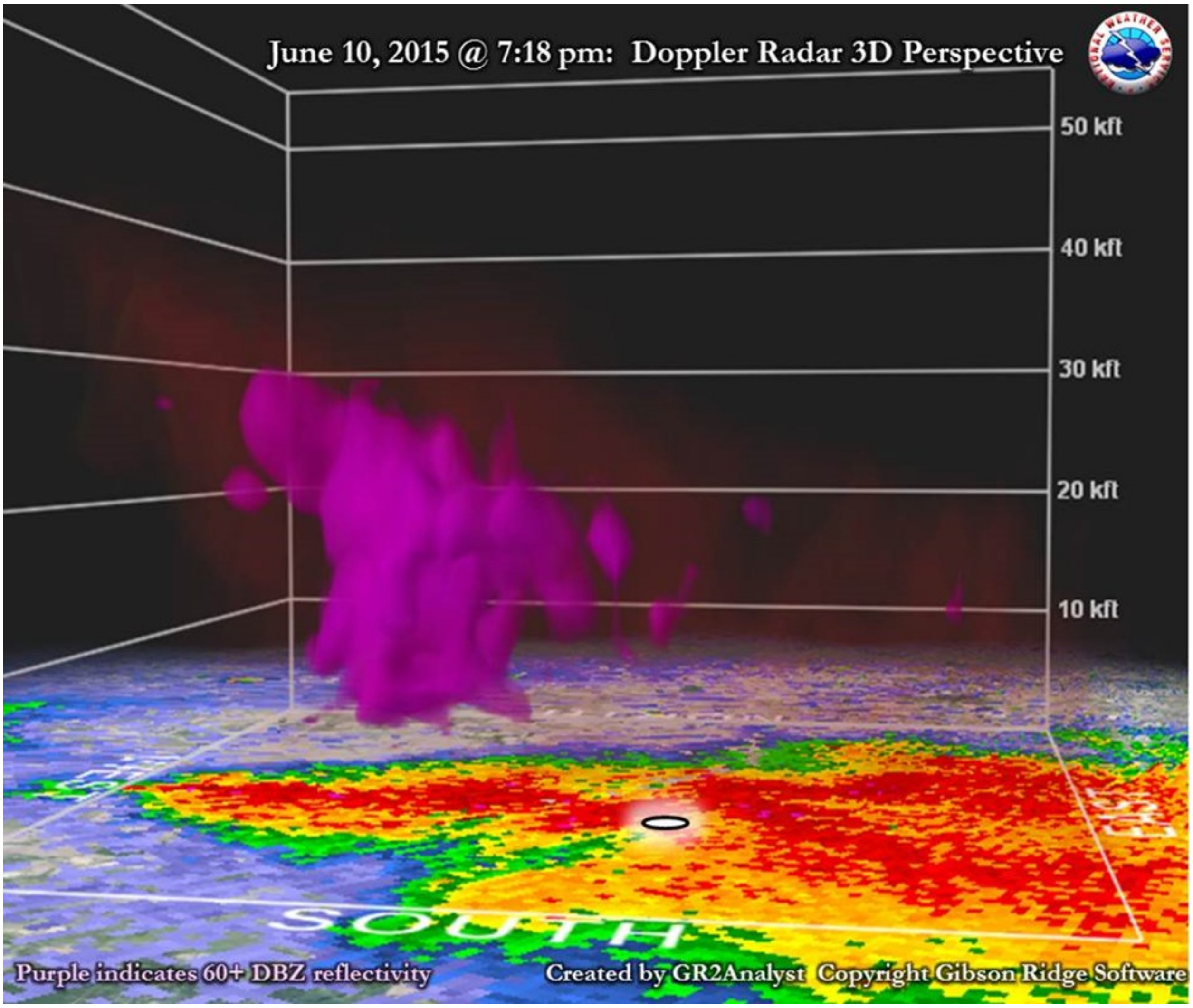
Giant Hail: June 10, 2015

by Cameron Nixon, Student Volunteer

On June 10th, a giant hailstone was found near Minooka, IL. How giant? At 4.75 inches, this solid ball of ice was larger than a softball, and the largest hailstone reported in Illinois since a 6-inch stone fell on April 23rd, 1961 in Kankakee county.

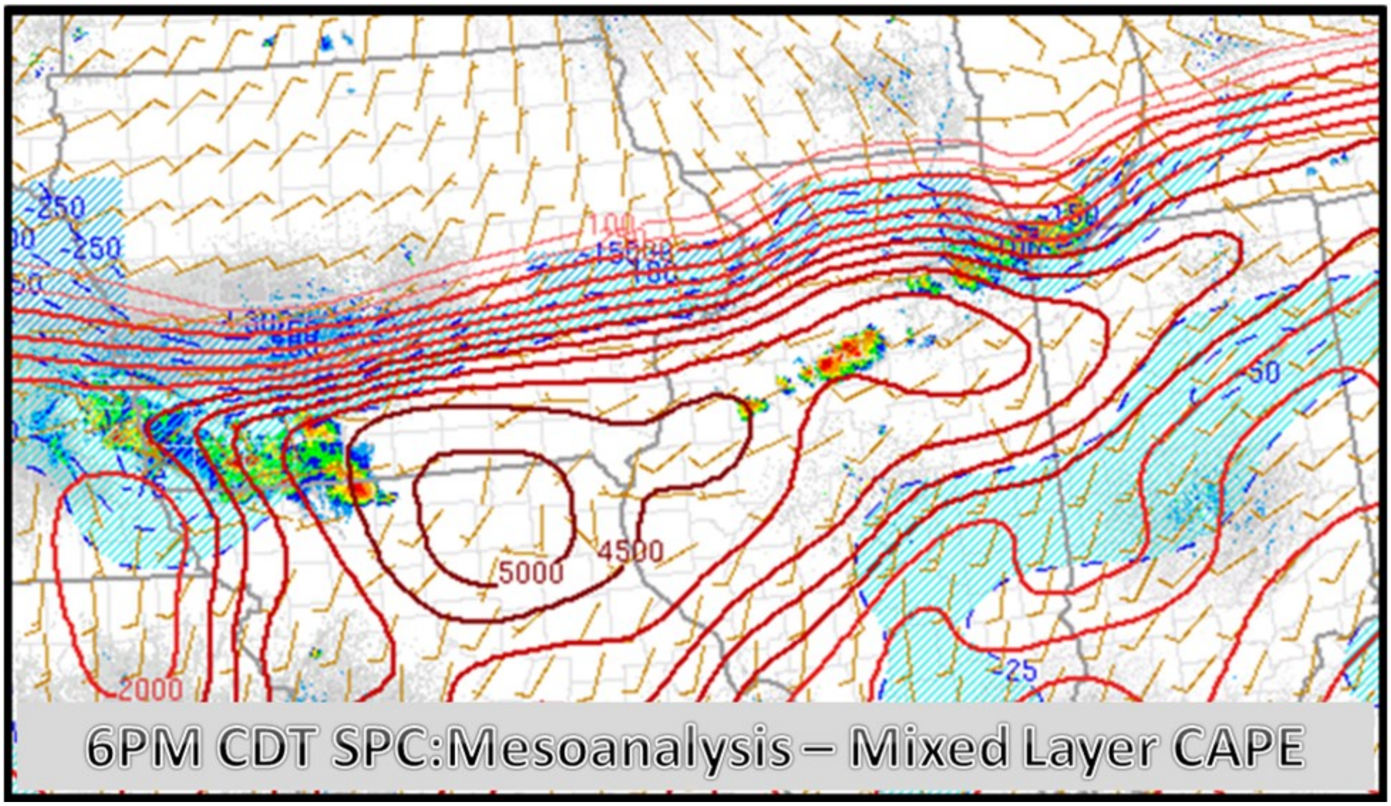
Photo by Lauren Geiselman

What makes such massive hail? Hail is formed when supercooled water droplets collide and freeze together, forming a stone. The longer the stones are suspended in the updraft of a thunderstorm, the larger they become, as they have more chances to collide with the supercooled water droplets. The length of time a hail stone can still "float" in the updraft, given its ever-growing size, depends on many factors. This three-dimensional radar analysis shows how the Minooka thunderstorm updraft kept the hail “floating”.



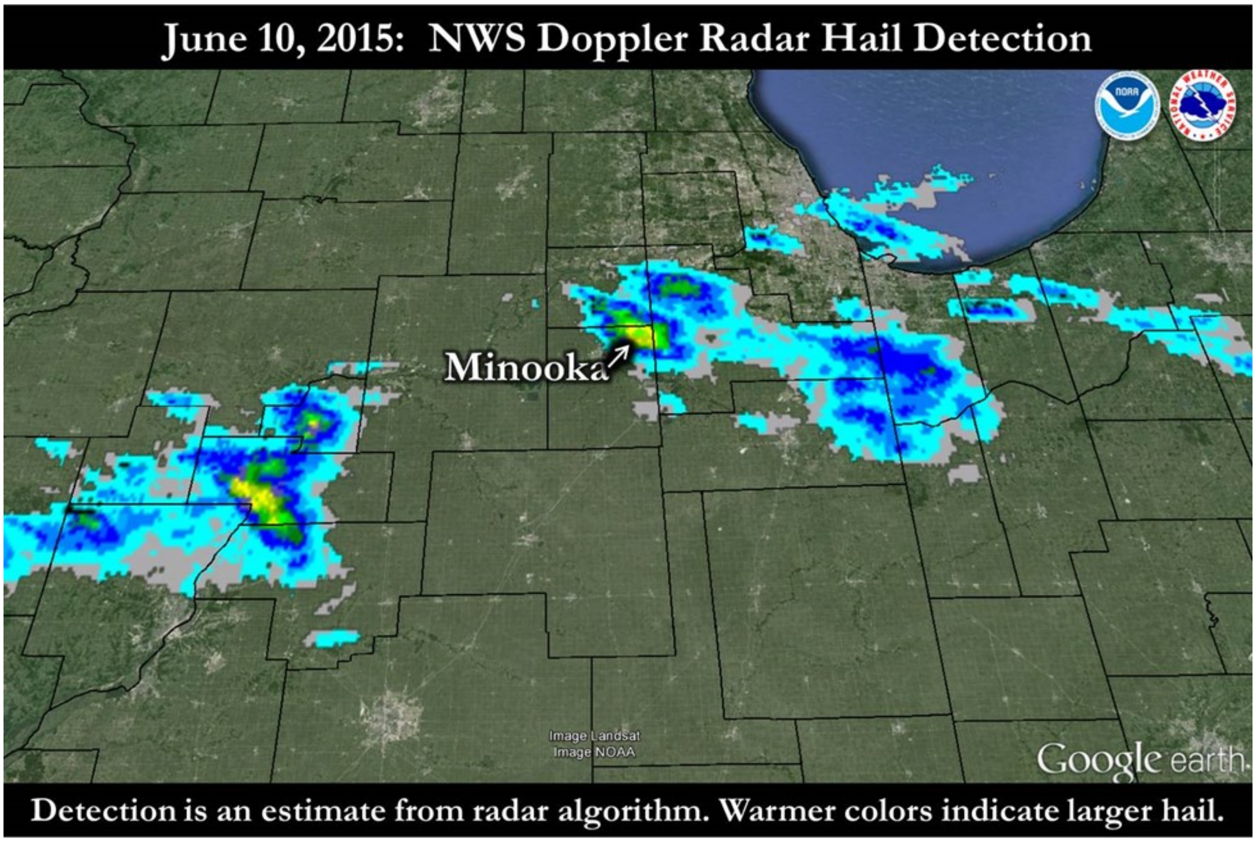
Usually in our region, large hailstorms come earlier in the spring because jet stream winds are stronger and the height of the freezing level is lower. Faster upper-level winds help to cause longer-lived, rotating updrafts which keep hail aloft longer. A lower freezing level means that this hail spends much of its lifetime in below-freezing air and does not have much time to melt on its way down to the ground.

On June 10th, however, we had neither of these. However, this was for many the first 90-degree day of the year, and combined with oppressive dew points approaching the lower 70s, this made the surface air extremely buoyant. We measure this instability in the form of Convective Available Potential Energy, which measures the energy a thunderstorm updraft would potentially have were it to explode in a certain environment. This day, we had eye-catching CAPE values of 3500-4500 J/kg.



6PM CDT SPC:Mesoanalysis – Mixed Layer CAPE

But how strong was the storm? Using a simple formula, we can actually calculate the maximum wind speeds in an updraft by taking the square root of twice the CAPE. Assuming the storm had formed with about 4000 J/kg of CAPE, its maximum upward wind speeds would have been about 90 meters per second, or a whopping 200 miles per hour! Putting this into perspective, many high-end damaging wind storms fail to produce gusts over 90 mph at the ground.



It is now easy to see how the storms of June 10th could have birthed such a heavy hailstone, as nothing but the strongest winds could possibly have kept it afloat. In contrast, run-of-the-mill dime sized hail needs updraft speeds of about 37 mph, while 56 mph can suspend golf balls. While golf balls can be damaging, softball-sized hail can be dangerous and even deadly. Treat large hail like a large tornado by moving indoors to a central location away from windows, putting as many walls between you and the hail as possible. Documentation of large hail can help us know when to warn others; however, safety must always be priority with hail this size. Photos can wait until after the storm; after all, hail of that size will not melt any time soon!

April 9th, 2015 Severe Weather Recap: From the Perspective of Undergraduate Meteorology Students

by Nicole Batzek and Alex Krull, Student Volunteers

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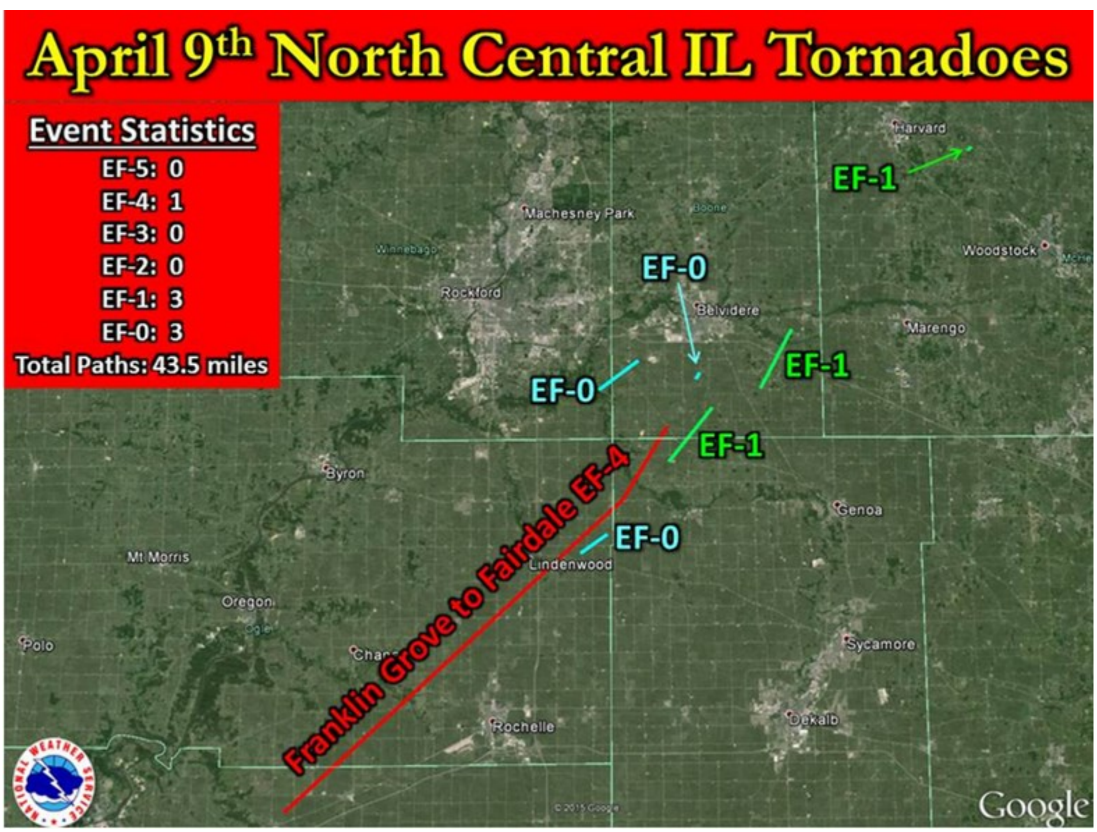
Near I-39 Looking North of Rochelle. Courtesy of Jodi Mair.

It was an unseasonably warm, moist day in Northern Illinois on April 9th, 2015 with surface temperatures in the 80s and dewpoints above 60°F. A strong low pressure system moved across the Great Lakes Region into the unstable atmosphere, which was also accompanied by strong wind shear. This low pressure system brought a strong frontal boundary providing substantial lift. In Northern Illinois, the 4 basic ingredients for severe weather came together: instability, moisture, lift, and wind shear. The Valparaiso University Storm Intercept Team (V.U.S.I.T.) observed these favorable parameters and checked for updates from the Chicago National Weather Service's Area Forecast Discussions (AFDs), Hazardous Weather Outlooks, as well as the Storm Prediction Center's convective outlooks. The final decision based on the parameters and products prompted an issuance of a "Code Red," which is the term used when the team decides conditions are favorable to intercept storms. The team hit the road late that morning on the 9th to observe and relay reports to the National Weather Service and also to students back at the Valparaiso University weather center. Around 1:30 p.m. CDT a severe thunderstorm produced a tornado near Peoria, IL, but the team did not have enough time to move south from the LaSalle-Peru area to see it.

However, Mother Nature was not done for the day. After a team discussion and looking at satellite, radar, and surface observations, the storm intercept team found the most favorable parameters for severe thunderstorms north of their location. The team decided to head north on Interstate 39 to move into the favorable area, where radar was indicating thunderstorm initialization. Out of this cluster of thunderstorms, there was a supercell that would produce 6 confirmed tornadoes in the Chicago National Weather Service's County Warning Area (CWA), including the EF-4 Rochelle-Fairdale tornado. Prior to tornadogenesis, the team drove past the intersection of Illinois Route 251 and 64 to acquire a better position to observe the supercell thunderstorm. While getting into position, the radar indicated rotation of the supercell prompted the NWS to issue a tornado warning. Eventually, the team saw the tornado from a distance while it was impacting northern Rochelle. Their route to continue following the storm took them back to the intersection of Route 251 and 64, where the previously untouched area was found torn apart. Cars and semi-trucks were blown over along the highway, and the Grubsteaker's restaurant at the corner of the intersection that was standing before was now destroyed. Although this area is mostly rural, there were unfortunately several residential properties that suffered extensive damage.

The tornado crossed Interstate 39 approximately 2 miles north of the Route 64 interchange and continued northeast. The town of Fairdale suffered a direct hit, leaving it completely devastated. This tornado tragically is responsible for 2 fatalities and 22 injuries in Fairdale. A total of 11 tornadoes were confirmed in northern Illinois on the 9th of April, with 7 of those tornadoes being in the Chicago CWA (see tornado path map below). Out of the 7 tornadoes, there were 3 EF-0's, 3 EF-1's, and 1 EF-4 tornadoes.



The Franklin Grove to Fairdale EF-4 tornado was the 33rd EF-4 or stronger tornado in Illinois on record dating back to 1950. A chart with the Enhanced Fujita Scale classification and descriptions can be seen below.

EF-Scale	Wind Speed, mph	Damage Description
EF-0	65-85	Chimneys damaged, tree branches down, shallow rooted trees uprooted.
EF-1	86-110	Roof surfaces peeled off, windows broken, unanchored manufactured homes are overturned, attached garages may be destroyed.
EF-2	110-135	Roof structures damaged, unanchored manufactured homes destroyed, debris becomes airborne, large trees snapped or uprooted.
EF-3	136-165	Roofs and some walls are torn from structures, some small buildings destroyed, most trees in forest are uprooted.
EF-4	166-200	Well-constructed houses destroyed, some structures lifted from foundation and blown some distance, large debris airborne.
EF-5	>200	Strong frame houses lifted from foundation, automobile sized debris becomes airborne, trees completely debarked.

From this event, the Valparaiso University Storm Intercept team was left with an experience and imprints that they will never forget. Working as a team to determine the most likely position for severe weather provided great forecasting and nowcasting experience. However, the team was also reminded the impacts of the weather on people in everyday life. Unfortunately, these tragic weather events cannot be stopped, but preparedness for these types of events is completely possible. This is what motivates the National Weather Service and the Valparaiso University Storm Intercept Team to continue to work hard to inform the public on how to prepare for severe weather events. If you are interested and would like to learn more on the April 9th, 2015 Northern Illinois tornadoes, visit www.weather.gov/lot/15apr09. Or, if you would like to learn more and stay updated on the Valparaiso University Storm Intercept Team's trips, visit www.valpo.edu/student/vusit.

Weather Puzzle
By Terrie Sheetz

Summer

I	L	I	F	S	R	E	C	Y	H	S	H	B	N	T
S	S	I	U	G	D	A	T	J	E	I	U	C	O	H
H	U	N	G	A	J	I	I	M	Z	T	R	I	I	U
E	S	N	R	H	D	S	A	N	T	S	R	N	T	N
A	G	A	B	I	T	G	K	E	L	C	I	C	A	D
T	P	J	M	U	D	N	R	R	E	E	C	I	C	E
R	N	U	G	N	R	F	I	N	O	Y	A	P	A	R
Z	H	B	A	U	L	N	N	N	J	W	N	Y	V	T
O	H	N	C	Y	C	N	X	Y	G	E	E	B	O	N
G	U	T	H	U	N	D	E	R	S	T	O	R	M	M
F	S	D	O	O	L	F	N	D	J	I	N	N	I	Q
M	O	S	Q	U	I	T	O	N	R	A	N	E	E	F
L	G	U	G	A	B	W	Z	O	D	A	M	Z	L	G
B	E	A	C	H	P	D	Z	O	Z	C	G	E	N	Q
E	D	I	R	E	K	I	B	W	S	H	J	X	J	O

BEACH
BEE
BIKE RIDE
BUTTERFLY
FIREWORKS
FLOODS
FUN AND GAMES
GARDEN
HEAT

HUMIDITY
HURRICANE
LIGHTNING
MOSQUITO
PARADE
PICNIC
RAIN
SUN
SUNBURN

THUNDER
THUNDERSTORM
TORNADO
VACATION
ZOO