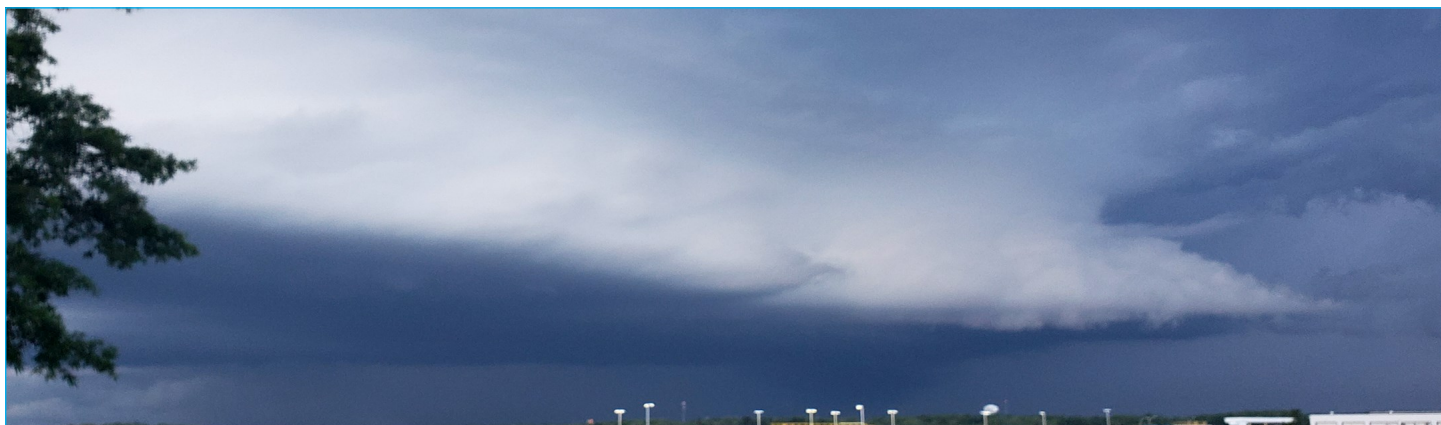


THE WEDGE FRONT

NATIONAL WEATHER SERVICE GREENVILLE-SPARTANBURG SC



Volume 3, Issue 1

Summer 2020

Stay Safe at the Beach

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Headed to the beach this summer? Did you know that a majority of rip current fatalities are linked to those who live inland? Make sure you know the hazards before heading to the beach! Your biggest risks will be the heat and rip currents. National Weather Services along the coast issue a Surf Zone Forecast each day. This forecast provides important information to all beachgoers, including the daily rip current risk (“low”, “moderate”, “high”), as well as expected weather conditions, water temperatures, UVI index, and any additional hazardous information, including waterspout risk. Before heading to the beach, make sure to be go over the expected beach conditions. When at the beach, always swim near lifeguards— never swim alone! NWS Beach Forecast Page: www.weather.gov/beach

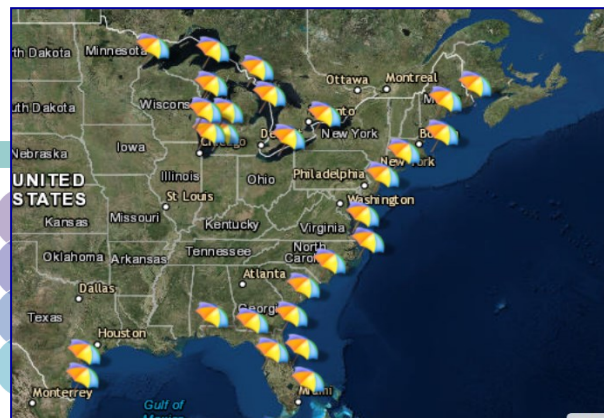
Summer Hazards: Are You Prepared?

Summer means vacation, outdoor activities, and fun in the sun! It’s a time when families hit the road to visit national parks or distant relatives. The warm months and long days mean that there is plenty of time for baseball games and barbecues. The sultry temperatures practically invite you to take a dip in the pool or ocean. But don’t let the sunny days and warm nights fool you. Summer also holds significant weather hazards. Heat waves can be lengthy and deadly. Lightning deaths are at their peak during the summer. Beach hazards such as rip currents can catch the unprepared. And, it’s the start of hurricane season.

To learn more about summer safety, visit <https://www.weather.gov/wrn/summer-safety>



Building a Weather-Ready Nation

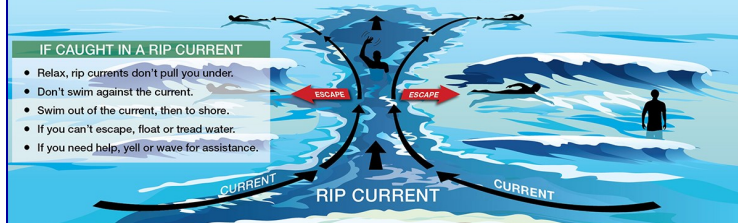


RIP CURRENTS

KNOW YOUR OPTIONS

IF CAUGHT IN A RIP CURRENT

- Relax, rip currents don't pull you under.
- Don't swim against the current.
- Swim out of the current, then to shore.
- If you can't escape, float or tread water.
- If you need help, yell or wave for assistance.



Rip currents are powerful currents of water moving away from shore. They can sweep even the strongest swimmer away from shore. If at all possible, swim near a lifeguard.

Social Science in the National Weather Service

It's no secret that the National Weather Service is filled with scientists. Most of us are meteorologists, so we've dedicated years of our lives to the study of weather - how it works, how to predict it, and how to issue warnings when it becomes dangerous. Getting forecasts and warnings to the public in a timely manner is our stated mission.

In our interconnected society, we have more options to communicate the science of weather than ever before. We also know that no matter how good our forecasts and warnings are, if no one receives or understands them, they won't matter. This means that as meteorologists, we need to study and apply another type of science: social science. This is an area that's now being studied in the National Weather Service, including at the local level. The weather and people of each forecast area are different, so as your local office, we're looking to apply social science research in a way that helps our area!

So what is social science, and how is our office using it? For our purposes at the National Weather Service, social science describes the study of how people understand, process, and take action on certain information - for example, how do people get forecast and warning information, and what actions (if any?) do they take when they receive that information? What drives peoples' decision making? Why do some people take shelter from tornadoes while others don't? Why do some people drive into flood waters while others don't? Our first priority is people's safety— our mission is the protection of life and property. We continually try to improve how we support them taking safe actions during bad weather by how we communicate the weather hazard.

An example of social science application is a study that was done on tornado sheltering in the aftermath of the violent Moore, OK tornado in 2013 - do people take shelter from tornadoes, where do they shelter, and why do they choose the locations they do? (A. Graettinger et al., 2014. *Tornado Damage Assessment in the aftermath of the May 20th 2013 Moore Oklahoma Tornado. The University of Alabama, United States of America.* The social science portion of the report was headed by Dr. Laura Myers. Link to full study: <https://eprints.qut.edu.au/81311/1/MooreTornadoFinalReport.pdf>)

According to this study, many folks chose to stay in their mobile homes when a tornado warning was issued, either because they didn't know mobile homes are unsafe in tornadoes or because they believed they had no better option. In reality, everyone has options for a "shelter of last resort," even if caught in a vehicle or mobile home when a tornado warning is issued. This research has helped the staff of NWS GSP better tailor our weather safety talks and social media tornado safety messaging to account for the perceptions about mobile homes in tornadoes - that they are NOT safe shelters, but better sheltering options do exist! As another result of this research, this graphic was created in order to give better practical, decision-making information to the public on tornado sheltering options:

Tornado Sheltering Guidelines

Seek the best available refuge area **immediately** when a Tornado Warning is issued.
Your chance of surviving a tornado is excellent if you follow these guidelines.

WORST OPTIONS	BAD OPTIONS	GOOD OPTIONS	BEST OPTIONS
<ul style="list-style-type: none"> Mobile homes Vehicles Underneath a highway overpass 	<ul style="list-style-type: none"> Large open rooms like gymnasiums Manufactured housing 	<ul style="list-style-type: none"> Interior room of a well-constructed home or building Basement 	<ul style="list-style-type: none"> Above or below ground Tornado Storm Shelter (NNSA/ICC 500 compliant)* Specifically-designed FEMA Safe Room*

Find another option → Stay in place until all clear

PHOTO: U.S. Air Force - Tech. Sgt. Bradley C. Church *Recommended by FEMA

This is just one example - we're going to continue applying social science research to how we can get better at communicating and sharing forecasts and warnings, and we're looking forward to doing more local research as well.

Want to learn more!? Check out this article on social science and the National Weather Service:

https://www.weather.gov/git/PeakToValleyWin15V2_SocialScience

COOP Corner: Aviation Weather Observations

Just 10 short years after the Wright Brothers' famous flight, the U.S. Weather Bureau, the predecessor agency to the National Weather Service (NWS), established an aerological section to provide weather forecasts specifically to meet the growing needs of aviation.

Recognizing the important connection between weather forecasting and aviation, on May 20, 1926, Congress passed the Air Commerce Act. This Act included legislation directing the Weather Bureau to "furnish weather reports, forecasts, warnings ... to promote the safety and efficiency of air navigation in the United States."

Back then, forecasters knew little about weather phenomena that affect aviation, such as thunderstorms, fog, low clouds, icing, and turbulence. The taking of weather observations was mostly surface-based using instruments read by a human, along with the most-important observational tool of all, what the human physically observed.

Through the 1930s and 40s, technology evolved to include aircraft observations, radiosondes and radar. The recording of surface weather observations, which include readings of temperature, humidity, wind, visibility, precipitation, sky condition, and pressure, would remain a human-based task for decades to come.

During the 1980s, and especially the 1990s, human-based, manually reported, surface aviation weather observations were supplemented and eventually replaced by automated weather stations. In the United States, there are several varieties of automated weather stations, which include the automated weather observing system (AWOS) and the automated surface observing system (ASOS).

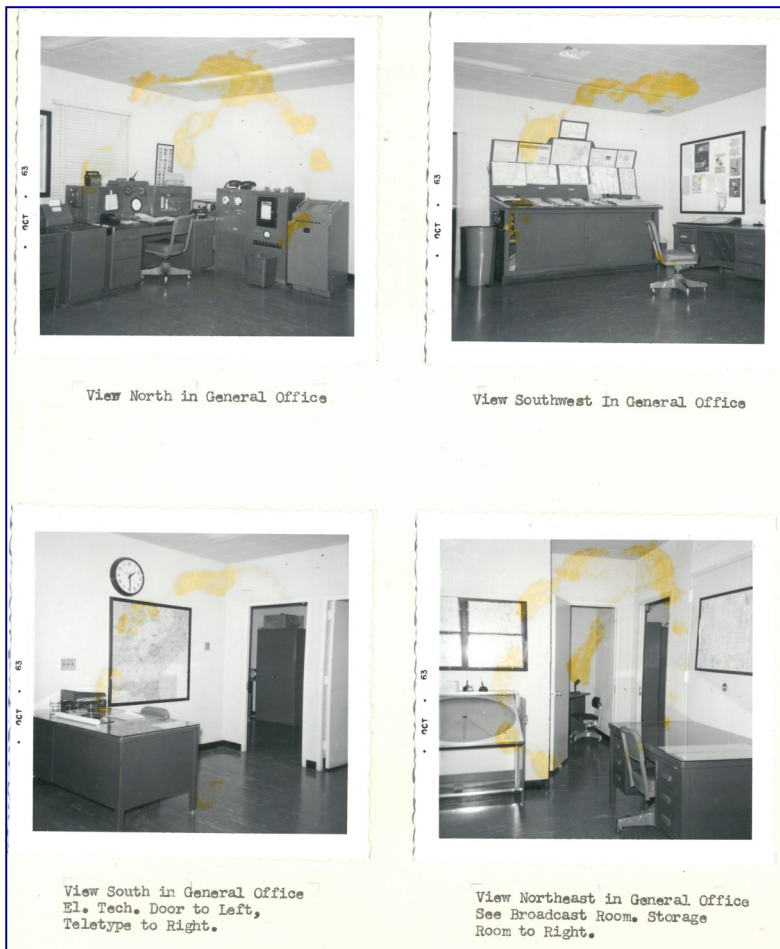
The aforementioned AWOS and ASOS are the most common type of automated observation system in use today across the United States. There are over 900 ASOS units currently in use at airports across the country, constantly monitoring the weather 24/7 and maintained by NWS personnel.



Observers desk in the early 1990s which includes an altimeter, laser beam ceilometer, barograph, and more!



NWS technicians inspect the ASOS at the GSP Int'l Airport.



View North in General Office

View Southwest In General Office

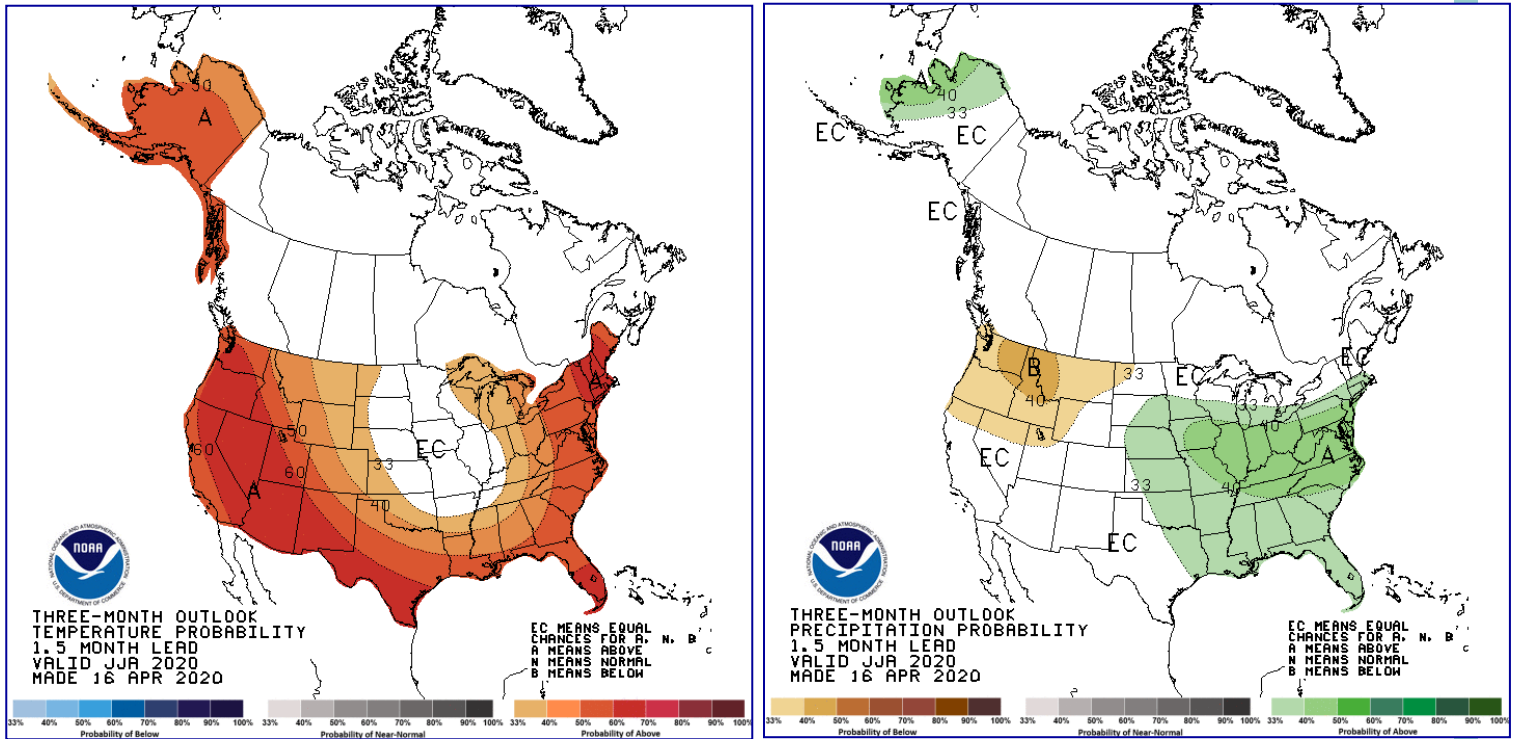
View South in General Office
El. Tech. Door to Left,
Teletype to Right.

View Northeast in General Office
See Broadcast Room, Storage
Room to Right.

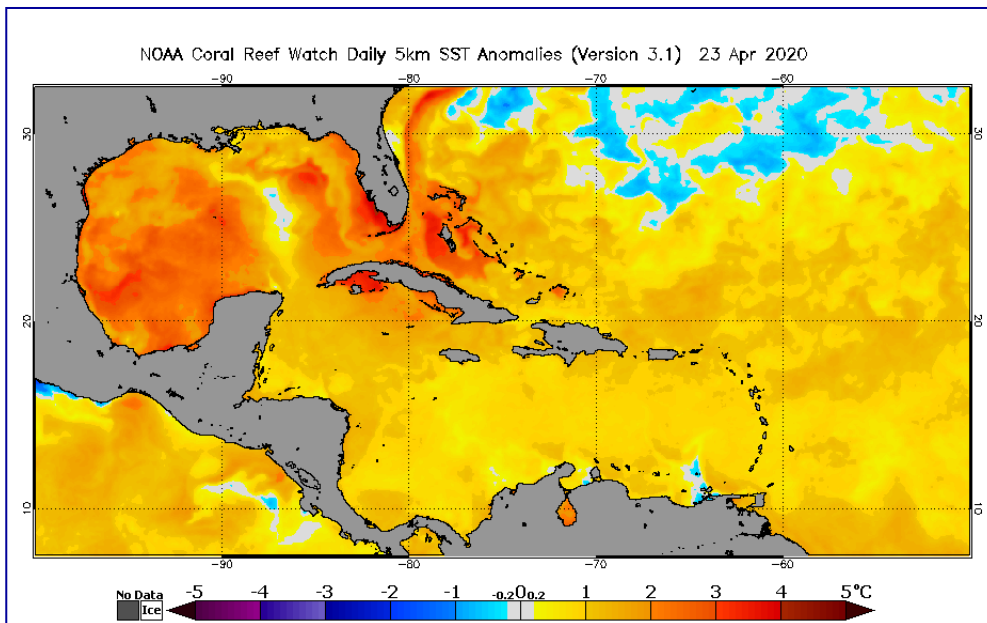
Office setup 1963.

The Climate Corner

Many people may be wondering how this summer is shaping up to be, weather-wise. The short answer is that the deck is stacked towards continued warm and wet weather as shown in the Climate Prediction Center's outlook for June, July, and August.



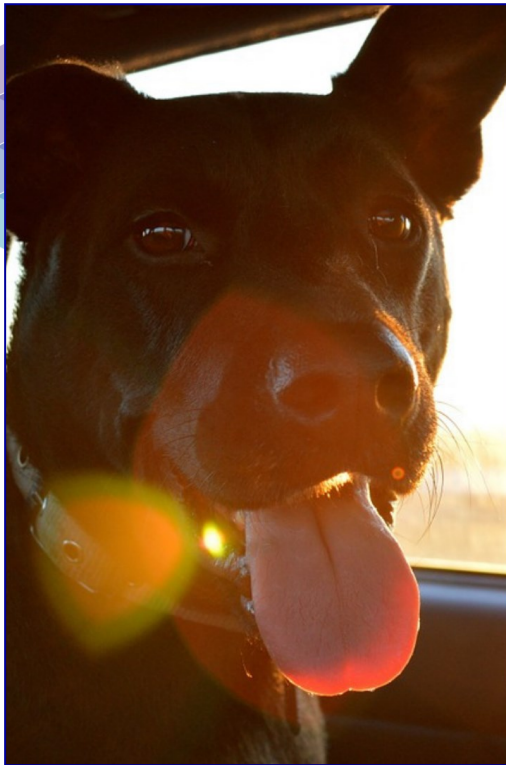
Climate signals, namely the El Niño Southern Oscillation (ENSO), do not provide much to go off of heading into this summer. Neutral ENSO conditions are likely to persist, which is another way of saying business as usual. Some of the more aggressive models do suggest the potential of a La Niña (cooler than normal temperatures across the central Equatorial Pacific Ocean) by the end of the summer or early Fall which could have an impact on the Hurricane season (La Niña tends to favor a more active Hurricane season).



Due to the lack of a strong signal from climate oscillations, this forecast is based strongly on the antecedent conditions (what has happened recently) and long range weather/climate models. Wet soils and elevated streams from a wet winter (antecedent conditions) across our region slightly favor continued wet conditions (known as a positive feedback) as weather systems that pass through the region have effectively more fuel to work with (more near surface water = greater evapotranspiration = greater rain chances). Well above normal sea surface temperatures (oranges and reds = 2 to 5 degrees C or about 5 degrees F above normal) across the Gulf of Mexico into the Gulf Stream in the western Atlantic Basin, further support the potential for energetic and moisture bound storms. Periods of heavy rain and isolated flooding may continue well into the summer as a result of the predicted pattern. While more difficult to predict, the active pattern could also support an active severe weather season as well with plenty of energy to tap into from the nearby Gulf of Mexico and Gulf Stream.

In summary, there is plenty of uncertainty with respect to how the summer will shape up, but signs point towards a continued prevailing warm and wet weather pattern. While very difficult to predict, it could also lend itself towards an active severe weather season.

- Robbie Munroe, Meteorologist



PET HEAT SAFETY

SAVE A PET'S LIFE IN A HOT CAR

Animals can die of heatstroke within 15 minutes.

Cracking the windows does not help, the inside still gets dangerously hot.

During hot weather, keep your pets at home.

If you see a pet in an unattended vehicle, do not leave until the problem has been resolved!



[weather.gov/heat](https://www.weather.gov/heat)

A reported total of 51 children died in 2019 from being left in a hot vehicle! So far in 2020, there have been 6 vehicle heat-related deaths. Heat is one of the leading and underestimated weather-related killers in the United States. During the hot summer months, it's extremely important to **NEVER** leave children, the elderly or disabled, or pets in the car. Unfortunately, children like to play in cars as well and can accidentally lock themselves in the car, as well. Be sure to know where they are at all times!

For more information on Heat Safety, visit www.weather.gov/safety/heat



What Does WEATHER-READY look like?

During HEAT

Responsible caregivers and parents never leaving the vulnerable alone in vehicles, and always looking before they lock.

[weather.gov](https://www.weather.gov)



How Do We “Rate” Tornadoes?

Have you ever heard reporters or meteorologists on your favorite TV station say, “The National Weather Service rated this tornado as an EF1” or something like that? Have you ever wondered what that means, or how we can tell the difference between straight-line winds and a tornado?

We want to maintain an accurate meteorological record of events, and so if we suspect that a tornado may have occurred, we want to go out and look at the damage to determine if it was indeed a tornado (vs. straight-line winds or a downburst) and, if so, how strong. We have several meteorologists on staff at GSP who are qualified to survey damage in order to make those determinations.

Step #1 is to determine what “type” of wind caused the damage. To put it bluntly, was the wind straight (straight-line winds or downburst) or in circles (tornado)? There are certain clues we look for to help us.

- Radar data. What radar signature were we looking at? Was it a rotating storm that prompted a Tornado Warning? Were we looking at a downburst signature from a summer thunderstorm, or maybe straight-line winds from a squall line pushing through the area? Descriptions of these radar phenomena are beyond the scope of this article, but our meteorologists are trained to see these signatures and issue the appropriate warnings.
- Tree damage. Our forecast area is thickly covered in trees, and MOST of the damage we see is the result of falling trees. The direction of tree fall tells us a lot about the winds. For example, with a downburst, the wind comes out of the storm and “splats” on the ground, spreading out as it does so. This creates a “divergent” or spreading-out pattern of tree damage. A tornado on the other hand, as it moves forward, will snap or uproot trees in all directions, some on top of the other, in a “convergent” pattern. The first image below shows a “divergent” pattern; note the arrows spreading out. The second image below shows a “convergent” pattern; note the arrows pointing in all different directions.

As a note, there are things that we see with tree damage *no matter how the wind is blowing* – specifically “twisted” trees. We hear this a lot from residents across the area: the tree twisted when it fell so it must have been a tornado. Not true, at all! The “twisting” action of a tree has to do with the tree itself. Perhaps the wind caught one portion of the foliage a little more than another, or perhaps there was a weakness in the tree that caused it to twist as it fell. Bottom line, a twisted tree does not a tornado make. You have to look at the bigger picture of how trees fall *relative to one another*.

- Structural damage. There are things we see with tornadoes that do not happen with downbursts or straight line winds. For example, we might see insulation strewn on the *opposite* side of a house from the direction of storm movement, that is, *backwards*. In this case, it’s because the rotation of the tornado blew the insulation back on the other side of the house as the tornado passed by (whereas straight-line winds and downbursts will only spread debris *out* from the point of impact, not backwards). Additionally, there is generally a max limit to the damage that will result from straight-line winds or downbursts; typically around 100-110 mph is about the max, but most of these events are between 60-80 mph. However, tornado wind speeds can be much, much greater. (In the end, if a tree falls on your house and destroys it, it doesn’t matter if the wind was straight or in circles – your house is still destroyed and the tree could cause serious injury if not death. It is critically important to heed *ALL* warnings, and take shelter when one is issued!)

Once we determine that yes, it was a tornado, we give it a rating based on the Enhanced Fujita* (EF) scale. (If we determine that it was *not* a tornado, we can still use the same tools that we would for a tornado to estimate the wind speeds associated with the straight-line winds or downburst.) The EF scale became operational in 2007 and is used to assign the tornado a “rating” based on estimated wind speeds and related damage. When we go out to survey damage, we compare what we see to a list of “Damage Indicators” to help estimate the range of wind speeds the tornado produced, and then assign the EF rating (on a scale from 0 to 5) based on that.

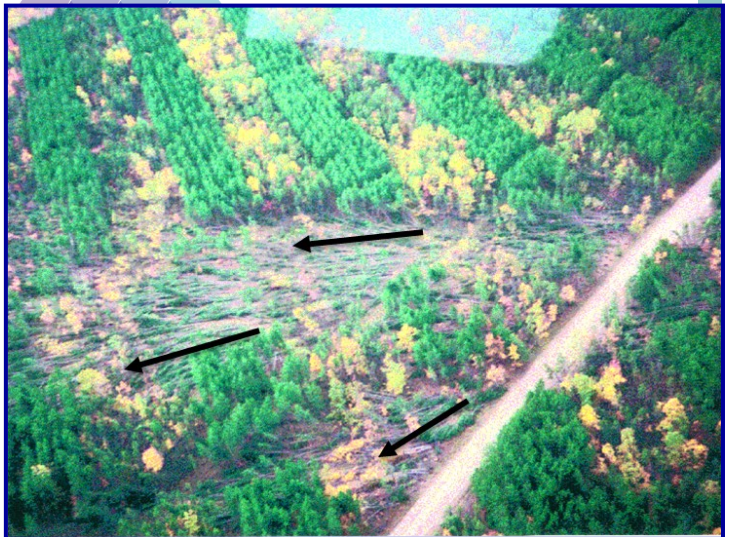


Image: Straight-line winds.



Image: “Twisting” winds.

EF-Scale	
EF Rating	Estimated Wind Speed (3 Second Gust) (mph)
0	65-85
1	86-110
2	111-135
3	136-165
4	166-200
5	Over 200

For example, if we are looking at a *site-built* one- or two-family residence, here are some examples of damage associated with different wind speeds:

One- and Two-Family Residences

Damage Description	Range of Wind Speeds (mph)
Threshold of visible damage	53-80
Loss of roof covering material (<20%), gutters and/or awning; loss of vinyl or metal siding	63-97
Broken glass in doors and windows	79-114
Uplift of roof deck and loss of significant roof covering (>20%); collapse of chimney; garage doors collapse inward; failure of porch or carport	81-116
Entire house shifts off foundation	103-141
Large sections of roof structure removed; most walls remain standing	104-142
Exterior walls collapsed	113-153
Most walls collapsed, except small interior rooms	127-178
All walls	142-198
Destruction of engineered and/or well-constructed residence; slab swept clean	165-220

You might be asking, why the “range” of wind speeds? Well, take the “All walls: 142-198 mph” category. What we have to do is look at the home and determine, to the extent possible, *how* the walls were connected to the foundation. In some (rare) cases, the walls aren’t connected at all, but rather the only thing “attaching” the house to the foundation is the weight of the house itself. On the opposite end of the spectrum, some houses are built with hurricane clips, straps, and bolts connecting the walls to the foundation. You can imagine that in the first example, it would certainly not take wind speeds on the upper end of the range to completely destroy the house, whereas in the second example, the wind speeds needed to completely destroy the house *would* necessarily be on the upper end of the range. Our meteorologist(s) on the ground doing the survey will inspect what is left of the structure and make adjustments within the range based on what he or she sees.

Contrast the wind speeds needed to destroy a site-built home versus that of a manufactured or mobile home:

Manufactured Homes – Single-Wide

Damage Description	Range of Wind Speeds (mph)
Threshold of visible damage	51-76
Loss of shingles or partial uplift of one-piece metal roof covering	61-92
Unit slides off block piers but remains upright	72-103
Complete uplift of roof; most walls remain standing	73-112
Unit rolls on its side or upside down; remains essentially intact	84-114
Destruction of roof and walls leaving floor and undercarriage in place	87-123
Unit rolls or vaults; roof and walls separate from floor and undercarriage	96-128
Undercarriage separates from unit; rolls, tumbles and is badly bent	101-136
Complete destruction of unit; debris blown away	110-148

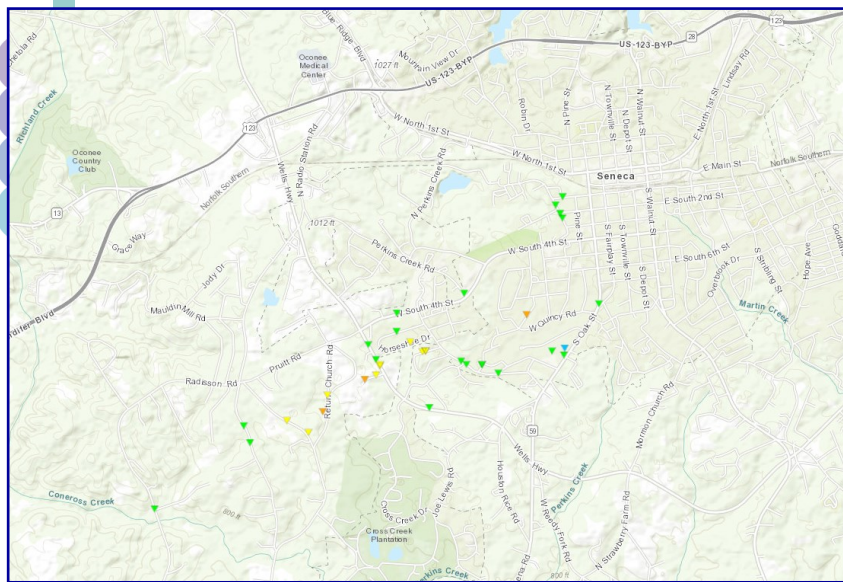
Continued from Page 11



So it might take wind speeds of only 110 mph (high-end EF1) to completely destroy a single-wide manufactured/mobile home! This underscores the point that **if you live in a manufactured or mobile home, you must find safe shelter somewhere else during a tornado!** (The range of wind speeds listed here depend on how well the house is secured to the ground; e.g., is it just sitting on block piers [lower end of range] or is it actually anchored to the ground by multiple straps with bolts driven into the ground [upper end of range]?)

Continuing on the survey, we then travel the length of the path, using information gathered from radar and from county Emergency Management – we want to find the beginning, the end, and the most intense damage, as the tornado’s overall rating is determined by the *worst* damage. We have to do a lot of walking (the picture below is of our former Warning Coordination Meteorologist, Tony Sturey), and sometimes some serious hiking and even climbing over fallen trees (though safety is a paramount concern). Sometimes we need an escort from county Emergency Management to get to the hardest-hit areas. Storm surveys usually result in very long days with hundreds of miles driven.

The more we can see, the more accurate the survey will be. We then compare these points to radar data or eyewitness accounts to determine what time the tornado began and ended. Out in the field, we use an iPad or tablet with special software called the Damage Assessment Toolkit to input points. The image below is a screen capture of points surveyed from the Seneca, SC, tornado from Monday, April 13. The triangles indicate tornado damage: blue corresponds to EF0 damage, green to EF1, yellow to EF2, and orange to EF3. There was of course quite a bit more damage than these points; it would be impossible to log every bit of damage.



PUBLIC INFORMATION STATEMENT
 NATIONAL WEATHER SERVICE GREENVILLE-SPARTANBURG SC
 522 PM EDT MON APR 13 2020

...NWS DAMAGE SURVEY FOR EF3 TORNADO EVENT...

START LOCATION...3 SSE WESTMINSTER IN OCONEE COUNTY SC
 END LOCATION...2 W CENTRAL IN PICKENS COUNTY SC
 DATE...04/13/2020
 ESTIMATED TIME...03:20 AM EDT
 MAXIMUM EF-SCALE RATING...EF3
 ESTIMATED MAXIMUM WIND SPEED...160 MPH
 MAXIMUM PATH WIDTH...900.0 YARDS
 PATH LENGTH...16.66 MILES
 BEGINNING LAT/LON...34.6175 / -83.0834
 ENDING LAT/LON...34.7329 / -82.8263
 * FATALITIES...1
 * INJURIES...?

...SUMMARY...
 A LARGE AND SIGNIFICANT TORNADO PASSED THROUGH PARTS OF OCONEE AND PICKENS COUNTIES EARLY MONDAY MORNING, BEGINNING SOUTH OF WESTMINSTER, AND ENDING NORTH OF CLEMSON. MAXIMUM STRUCTURAL DAMAGE TO HOUSES AND A LARGE WAREHOUSE IN THE AREA INDICATE PEAK WINDS NEAR 160 MPH, FOR A STRONG EF3 RATING. DAMAGE EXISTS OVER A WIDE SWATH, AND THE WIDTH OF THE TORNADO WAS AT LEAST A HALF MILE. THERE IS ONE KNOWN FATALITY, NUMEROUS INJURIES, AND 2 PEOPLE STILL MISSING AT THE TIME OF THIS STATEMENT.

EF SCALE: THE ENHANCED FUJITA SCALE CLASSIFIES TORNADOES INTO THE FOLLOWING CATEGORIES:

EF0...WEAK.....65 TO 85 MPH
 EF1...WEAK.....86 TO 110 MPH
 EF2...STRONG....111 TO 135 MPH
 EF3...STRONG....136 TO 165 MPH
 EF4...VIOLENT...166 TO 200 MPH
 EF5...VIOLENT...>200 MPH

* THE INFORMATION IN THIS STATEMENT IS PRELIMINARY AND SUBJECT TO CHANGE PENDING FINAL REVIEW OF THE EVENT AND PUBLICATION IN NWS STORM DATA.

Back at the office, a meteorologist can then quality-control the points, collect all the information, and issue a Public Information Statement with the preliminary rating. The Public Information Statement that was issued for the Seneca tornado is included to the right.

With each tornado, and each storm survey, we learn something new that we can use in later events to improve the warning process. At times, it can be meteorologically fascinating to do a survey, to compare what we saw on radar to what actually happened on the ground. However, storm surveys can also be very difficult for our meteorologists, as we go out and talk to residents who have had their lives and livelihoods torn apart. We know that our presence can sometimes be an intrusion of their privacy and grieving, and we are sincerely appreciative of everyone’s understanding of our need to survey the damage. While fatalities are rare, they do occur, as with the Seneca tornado on April 13. Fatalities are especially difficult for our meteorologists to deal with, as we have dedicated our lives to providing the best forecasts and warnings possible, but sometimes especially with the bigger tornadoes it’s just not enough. Our prayers are, and will remain, with those who are impacted by severe weather.

*The original Fujita scale was developed by Dr. T Theodore Fujita in 1971, and was just based on damage intensity rather than wind speed. Dozens of meteorological and engineering experts worked for over four years to re-design the Fujita scale to more closely align the estimated wind speeds based on actual damage.

SAFE BOATING TIPS



HIGH WINDS/WAVES
Know Your Action
 Reduce speed
 Head to shore

KNOW BEFORE YOU GO
 Check the forecast at weather.gov
 Always wear a life jacket!



COLD WATER
Know Your Action
 Remain calm and control your breathing
 Minimize time in the water
 Get dry and warm ASAP



LIGHTNING
Know Your Action
 Remain weather-ready
 If you hear thunder, it's time to stay in the cabin or head to shore



CAMPING SAFETY TIPS



FLASH FLOODING
Know Your Action
 Avoid hiking in canyons
 Don't camp near streams or rivers

KNOW BEFORE YOU GO
 Check the forecast at weather.gov
 Always pack for inclement weather, regardless of the forecast!



HEAT
Know Your Action
 Remain hydrated/bring extra water
 Wear light, loose fitting clothing
 Use sunscreen
 Take breaks in shade



LIGHTNING
Know Your Action
 Remain weather-ready
 If you hear thunder or see lightning... go immediately to an enclosed building or hard-topped vehicle.
 Avoid isolated tall trees or ridge tops.



BEACH SAFETY TIPS



RIP CURRENTS/DANGEROUS WAVES
Know Your Action
 Swim at a beach with lifeguards
 Never swim alone
 If caught in rip...relax and call for help and swim along the shoreline

KNOW BEFORE YOU GO
 Get beach-specific forecasts at weather.gov/beach



HEAT
Know Your Action
 Remain hydrated
 Use sunscreen
 Find shade - beach umbrella
 Cool off in water



LIGHTNING
Know Your Action
 Remain weather-ready
 If you hear thunder or see lightning...go immediately to an enclosed building or hard-topped vehicle.



Our Tornado “Drought” is Definitely Over!

Droughts are usually considered to be negative phenomena, but the western Carolinas and northeast Georgia experienced a “good” drought that began in the spring of 2012, when the area saw five years of well-below normal tornado activity. Between 4 March 2012 and 1 April 2017, only 11 tornadoes were confirmed in the Greenville-Spartanburg (GSP) County Warning Area (CWA). This is actually a little less than the average number of tornadoes that touch down in our area each year. The drought began to “break” with a somewhat typical spring season in 2017, when 12 tornadoes were confirmed in April and May. This was followed later that year by something quite unusual: October, typically dry and pleasant in our area, yielded two significant severe weather outbreaks (on the 8th and 23rd) with a total of 19 tornadoes. This tied September 2004 as the most active month for tornadoes in the GSP CWA’s recorded history, and also resulted in 2017 setting the yearly record for the most confirmed tornadoes with 31.

After another quiet year in 2018 and a somewhat typical 2019, 2020 has unfortunately been very busy. As of 14 May, 22 tornadoes have already been confirmed in the forecast area this year. This is the most that have ever occurred for the year-to-date in the western Carolinas and northeast Georgia (Table 3). The total tornadoes for the least three years has increased to 62, or more than five times the number that occurred during the preceding five years! Behind this dramatic turn has been an increase in the number of tornado outbreaks across our area (Tables 1 and 2). During the “drought years,” there was only one day in which more than two tornadoes occurred in our area (14 October 2014). Since April 2017, there were eight such days. Additionally, the increase in significant tornadoes, defined as those rated EF2 or stronger, has also been dramatic. None of the 11 tornadoes confirmed between 4 March 2012 and 1 April 2017 were rated as significant. Meanwhile, there have been 12 significant tornadoes documented since April 2017. This includes the Oconee County tornado of 13 April 2020, which was rated as a strong EF3. This was the strongest tornado that has occurred in the forecast area since 27 April 2011, and only the second E/F3 or stronger tornado in our area since 1998.

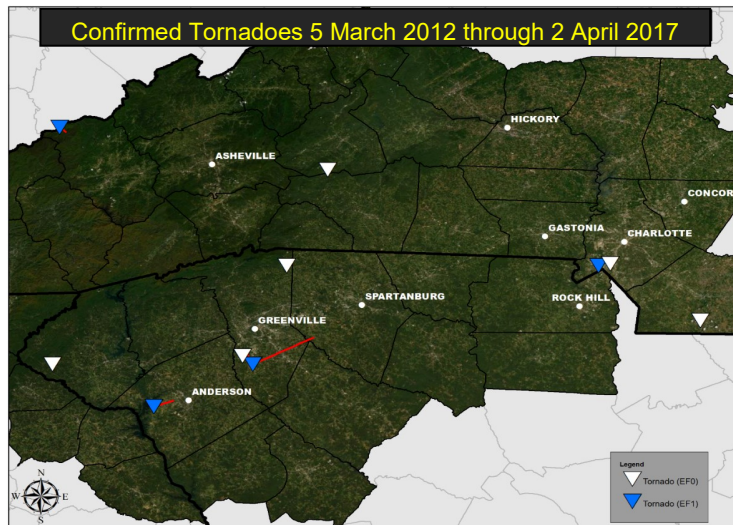


Fig 1. Confirmed tornadoes in the GSP CWA Between 4 March 2012 and 2 April 2017.

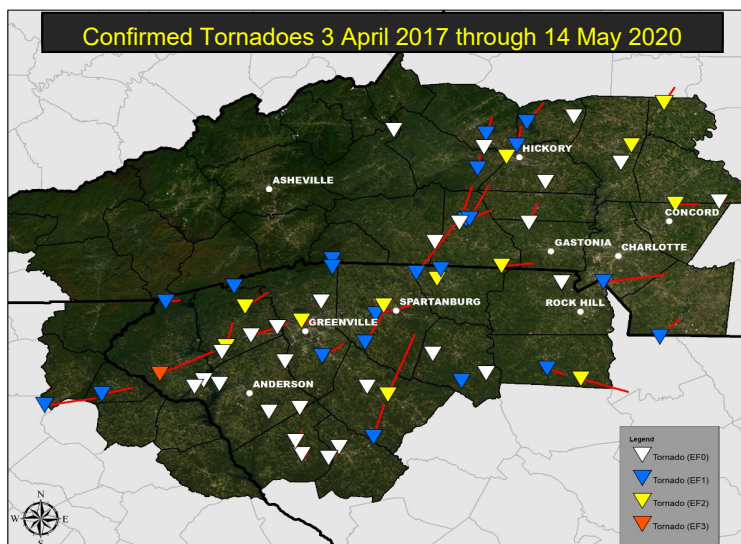


Fig 2. Confirmed tornadoes in the GSP CWA Between 3 April 2017 and 14 May 2020.

Time Range	EF0	EF1	EF2	EF3	Total
4 Mar '12 – 2 Apr '17	7	4	-	-	11
3 Apr '17 – 8 May '20	27	23	11	1	62

Table 1. Tornadoes in the GSP CWA from 4 March 2012 through 2 April 2017.

Outbreak Date	EF0	EF1	EF2	EF3	Total
3 Apr 2017	4	1	-	-	5
24 May 2017	1	1	2	-	4
8 Oct 2017	3	6	2	-	11
23 Oct 2017	-	5	3	-	8
19 April 2019	3	-	-	-	3
12 Jan 2020	5	-	-	-	5
6 Feb 2020	1	3	2	-	6
13 Apr 2020	2	3	1	1	7

Table 2. Tornadoes in the GSP CWA from 2017 through the present day.

Year	E/F0	E/F1	E/F2	E/F3	E/F4	Total
2020	9	7	5	1	-	22
1998	12	5	3	-	1	21
2008	8	2	3	-	-	13
1989	1	3	6	-	3	13

Table 3. Ranking of the most year-to-date confirmed tornadoes

3 April 2017

Five weak tornadoes developed over Upstate South Carolina on this day. These were the most tornadoes in the GSP CWA in a single day since the “Superoutbreak” of 27-28 April 2011. The strongest was an EF1 in rural Union County, SC that flipped a mobile home, resulting in a fatality. Other weak tornadoes impacted Pickens and Greenville Counties.



Fig 3. Weak tornadoes flipped mobile homes in Union County, SC on 3 April 2017.

24 May 2017

Multiple “mini” supercell thunderstorms moved over the North Carolina Piedmont on this day. One of these storms produced two EF2 tornadoes in the northern Piedmont (Iredell and Davie Counties) which blew the roof off homes and downed numerous trees.



Fig 4. An EF2 tornado moved across rural Davie County, NC on 24 May 2017.

8 October 2017

The most active tornado day in the GSP CWA since 16 September 2004 saw 11 confirmed events. This is almost the average number of tornadoes that our area sees in a single year.

An EF2 tornado tracked north/northeast for over 20 miles from the eastern city limits of Laurens, SC, passing between Woodruff and Cross Anchor before dissipating in the Glen Springs community in Spartanburg County. Multiple manufactured homes were severely damaged or destroyed in Laurens and one house had its roof torn off and multiple exterior walls destroyed along Highway 49 between I-385 and the Spartanburg County line.

Another EF2 developed near Norris in Pickens, SC and tracked to a location just west of the city of Pickens before dissipating. Otherwise, weak tornadoes developed over other areas in the Upstate as well as the North Carolina foothills.



Fig 5. An EF2 tornado blew roofs from homes near Norris, SC on 8 October 2017

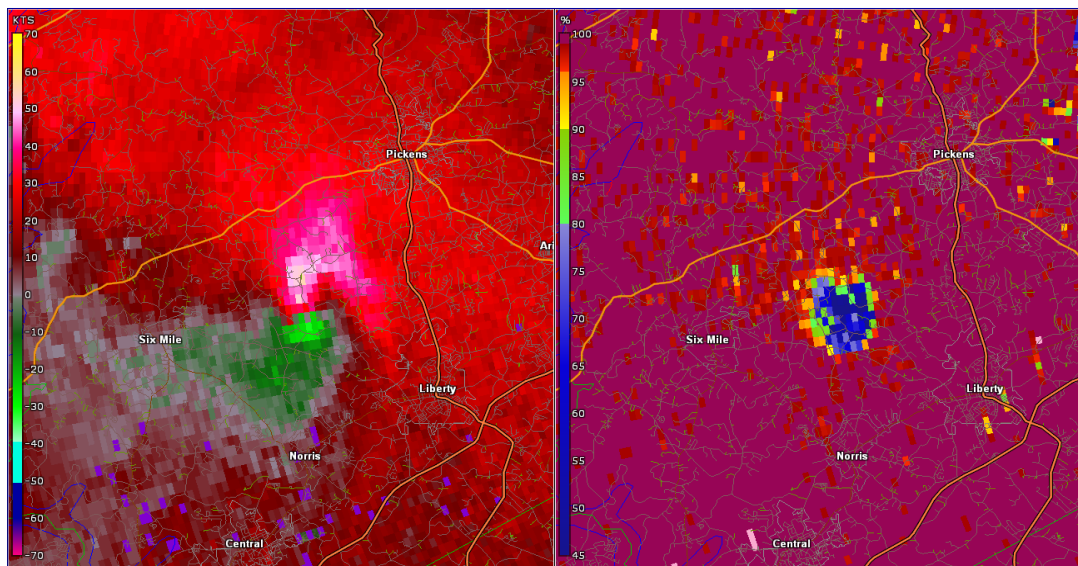


Fig 6. Storm relative velocity (SRM; left) and correlation coefficient (CC; right) imagery from the Greenville-Spartanburg, SC (KGSP) radar at the time that a tornado was in progress near Norris, SC on 8 October 2017. SRM revealed strong rotation while the CC product revealed an area of very low values coincident with the rotation: a Tornado Debris Signature (TDS).

Image created using GRLevel2 software.

Fig 7. A tornado developed near Hudson, NC on 8 October 2017.

Image courtesy of Caldwell County Sherriff's Dept.



GARMIN 10/08/2017 06:00:36 PM N035.86991 W081.49813 014MPH

Continued from Page 12



Fig 8. A high voltage tower was toppled by an EF2 tornado along Business 85 on the north side of Spartanburg, SC on 17 October 2017. Part of the warehouse building in the background was also destroyed.

23 October 2017

For the second time in just over two weeks, an outbreak of tornadoes impacted the upstate of South Carolina and the North Carolina foothills, with many of the same counties being affected during both outbreaks. In fact, a tornado in northwest Cherokee County, SC on the 23rd crossed the path of a tornado from the 8th! The 8 tornadoes that occurred on this day brought the total for October 2017 to 19. This almost doubled the total number of October tornadoes that have occurred in the GSP CWA since 1950.

An EF1 tornado tracked for over 12 miles, from north of Woodruff, SC to the Westgate area of the city of Spartanburg. As this tornado dissipated, a more intense EF2 tornado developed just to the north along Business 85, causing extensive damage to warehouse buildings and injuring one person.

Five tornadoes touched down across the North Carolina foothills on this day, with the strongest being an EF2 that significantly damaged a hangar and aircraft at the Hickory and Regional Airport.

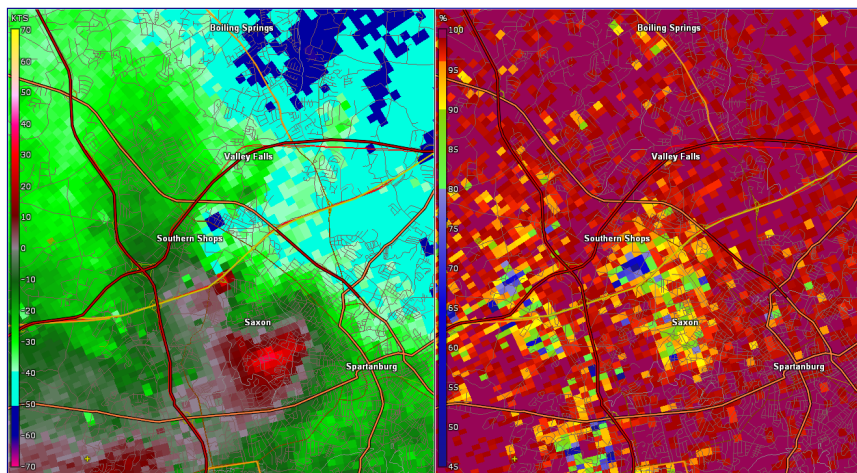


Fig 9. Same as in Fig. 5 except on 17 October 2017 at the time that an EF2 tornado was touching down along Business 85 on the north side of Spartanburg, SC. A very small, but intense rotation signature could be seen in SRM imagery just south of "Southern Shops." This was coincident with a TDS in CC imagery.

6 February 2020

A line of heavy rain showers and embedded thunderstorms moving across the area during the morning and early afternoon was responsible for multiple EF1 and EF2 tornadoes across the North Carolina Piedmont. An EF1 tornado also impacted Spartanburg, SC, causing millions of dollars in damage as it tracked through the heart of the city from the Westgate area through downtown. This was the third tornado to impact Spartanburg since October 2017.

Stronger tornadoes impacted largely rural areas surrounding Crowders Mountain State Park in Cleveland and Gaston Counties in North Carolina, and east of Kannapolis, NC. This outbreak was unusual due to the time of day in which it occurred, with most of the tornadoes occurring in the late morning. Only 17% of the confirmed tornadoes in the GSP CWA since 1950 have occurred in the hours between 0600 and 1200 Local Time.



Fig 10. The third tornado to impact the city of Spartanburg in less than three years flipped vehicles, including these R.V.s, in addition to damaging numerous homes and businesses along Highway 29 through the heart of the city on 6 February 2020.

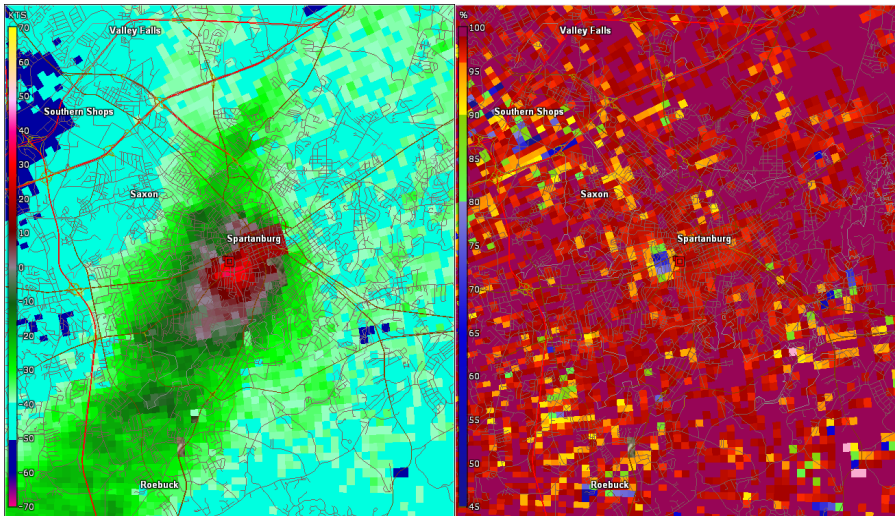


Fig 11. Same as in Fig. 5 except at the time that a tornado was moving across the city of Spartanburg, SC on 6 February 2020. CC data depicted a TDS just west of downtown, coincident with strong rotation.

13 April 2020

A strong cold front brought a line of heavy rain showers and embedded thunderstorms across northeast Georgia and upstate South Carolina during the overnight hours. Multiple tornadoes touched down, including one of the strongest tornadoes in the history of the GSP CWA: a strong EF3 tornado that passed near Seneca, SC, destroying a couple of houses and killing one person at a manufacturing plant. This was the first E/F3 or stronger tornado that occurred between the hours of 0000 and 0600 Local Time in the history of the GSP CWA. In fact, the late night timing of this outbreak was very unusual, as only 7% of all confirmed tornadoes in the GPS CWA since 1950 have occurred during this time of day.



Fig 12. A person was killed at this warehouse facility when a strong EF3 tornado struck near Seneca, SC during the early morning hours of 13 April 2020. This was only the second E/F3 or stronger tornado to impact the GSP CWA since 1998.

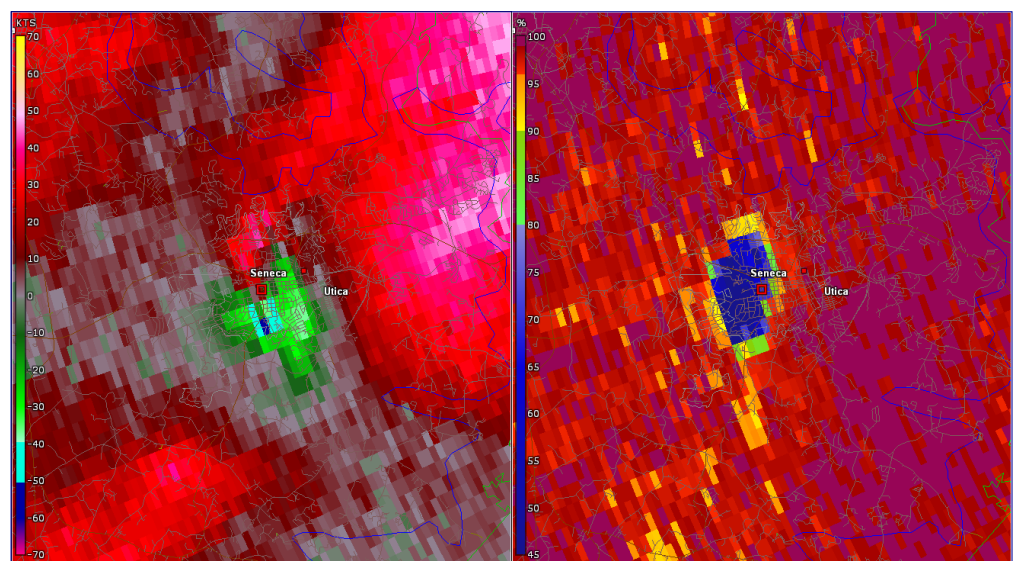


Fig 13. Same as in Fig. 5, except as an EF3 tornado was passing near Seneca, SC on 13 April 2020. CC data revealed a TDS over Seneca.

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