April 13, 2020
South Carolina Tornado Outbreak – OPEN FILE REPORT

South Carolina State Climatology Office
Report Date: June 9, 2020
Website: http://www.dnr.sc.gov/climate/sco/

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This report serves as the full detailed report, expanding upon the information of our Preliminary Report of the impacts of the April 13, 2020, Tornado Outbreak in South Carolina. This report will be updated if new data becomes available.

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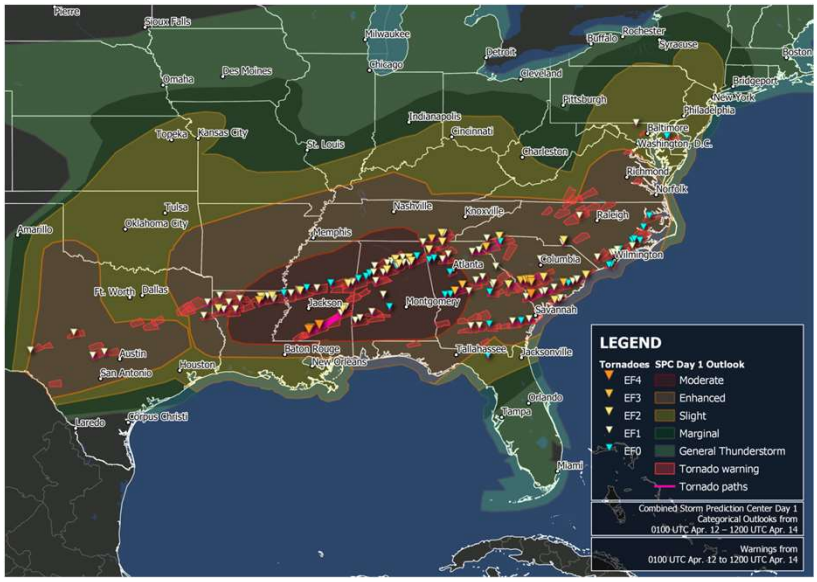
Cover Picture Credit
A demolished red SUV sits among debris and snapped trees, the result of an EF4 tornado that tore through the community of Estill, SC, in Hampton County (courtesy of Christopher Jackson). The pictures of EF3 damage from Livingston (Orangeburg County) and Seneca (Pickens County) are courtesy of the National Weather Service Offices in Columbia and Greer. Additional pictures used throughout this report were retrieved from the NWS Damage Assessment Tool or provided to the office by Mr. Jackson.

OUTBREAK OVERVIEW

The clash of cold, dry air over the Central United States, with warm, moist air over the Southeast United States provided the set-up for a significant tornado outbreak from April 12-13, 2020. The system developed early Saturday (4/11), producing tornadoes and two-to four- inch diameter hail across Texas to Nebraska.

On Easter Sunday (4/12), the storm system spawned tornadoes across six states, including three powerful EF4 ones. Severe weather continued overnight and into early Monday morning, where it impacted the entire state of South Carolina.
As of this report, there have been 139 confirmed tornadoes across ten states, with thirty-five significant tornadoes (EF2+), and a combined length of damage paths over 900 miles.



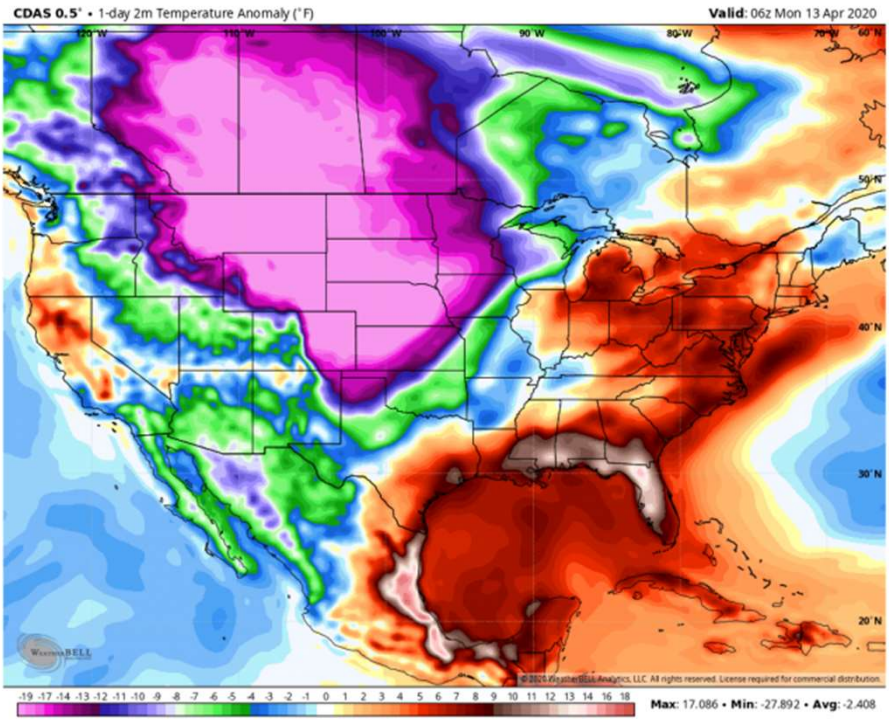
EF0	EF1	EF2	EF3	EF4
29	75	20	12	3

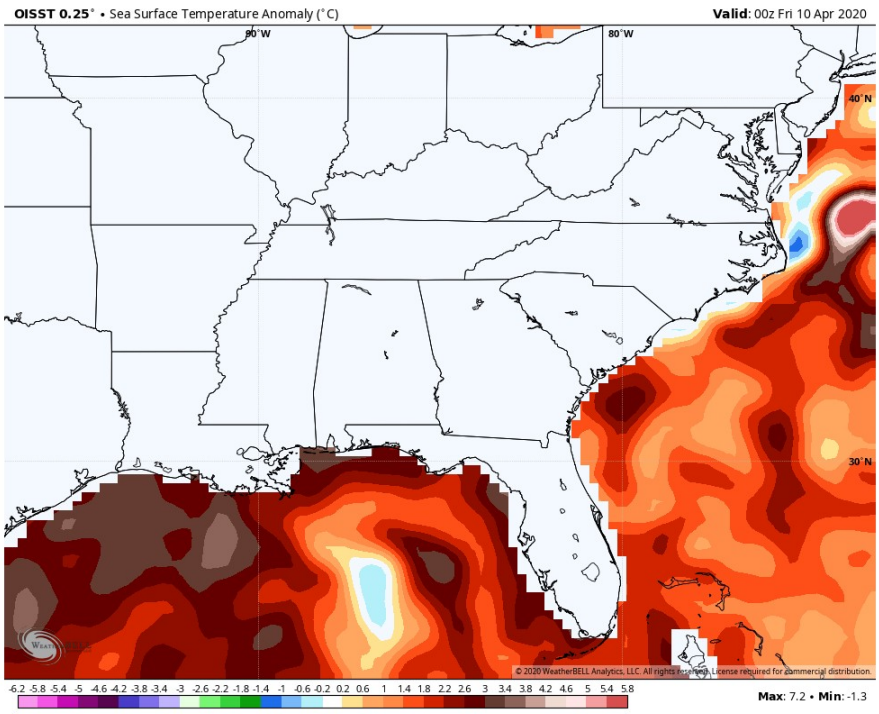
Number of Confirmed Tornadoes	Enhanced Fujita (EF) Rating
4	EF0 (65 – 85 mph)
12	EF1 (86 – 110 mph)
4	EF2 (111 – 135 mph)
7	EF3 (136 – 165 mph)
1	EF4 (166 – 200 mph)

Overview of SC's Outbreak

- Most significant (EF2+) tornadoes reported in a single day: 12
- Most EF3 tornadoes reported in a single day: 7
- All of the EF3 tornadoes occurred between 3 – 7 AM EDT.
- Second deadliest (9 fatalities) outbreak on record since 1950
    - 15 fatalities on March 24, 1984
- First EF4 in the state since November 1995
- First EF4 on record (since 1950) in the Lowcountry
- First EF3 recorded since April 2009
- First EF3 in the Upstate since March 1994

The common denominator for all extensive, severe, tornadic, supercell thunderstorm outbreaks is the baroclinic juxtaposition of diametrically dissimilar air masses: very cold, very dry air aloft and northwest of a very warm, very moist surface layer. The map to the right shows the different air masses responsible for the 12-13 April severe storm outbreak. Temperatures across Montana and North Dakota were in the teens with single-digit dew points.

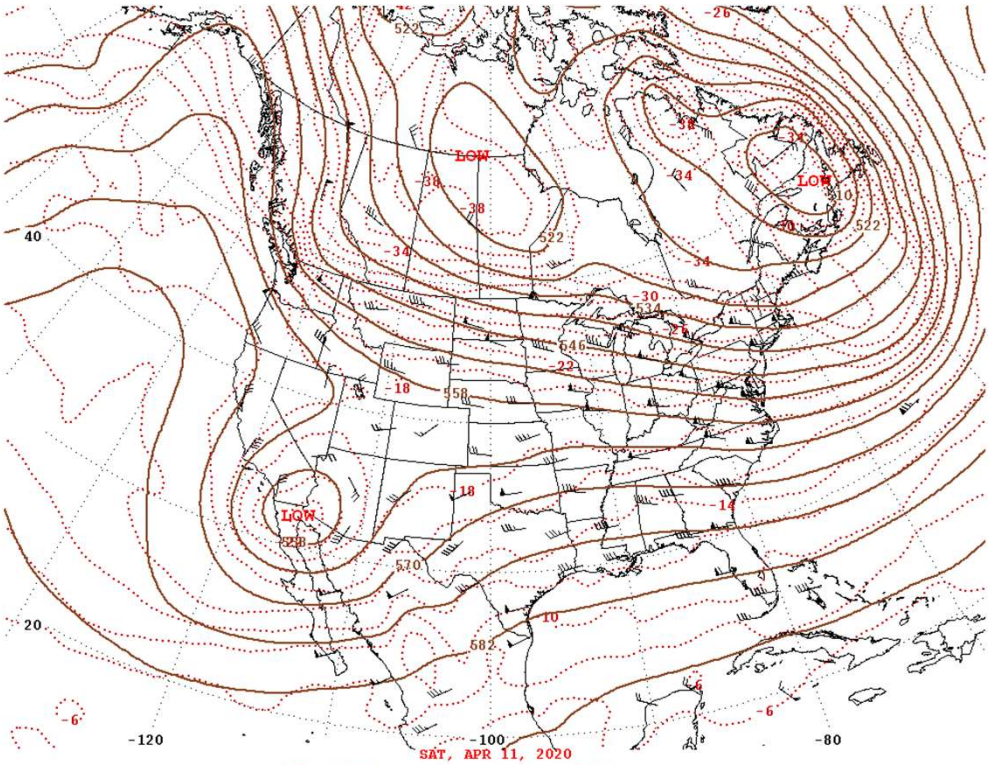




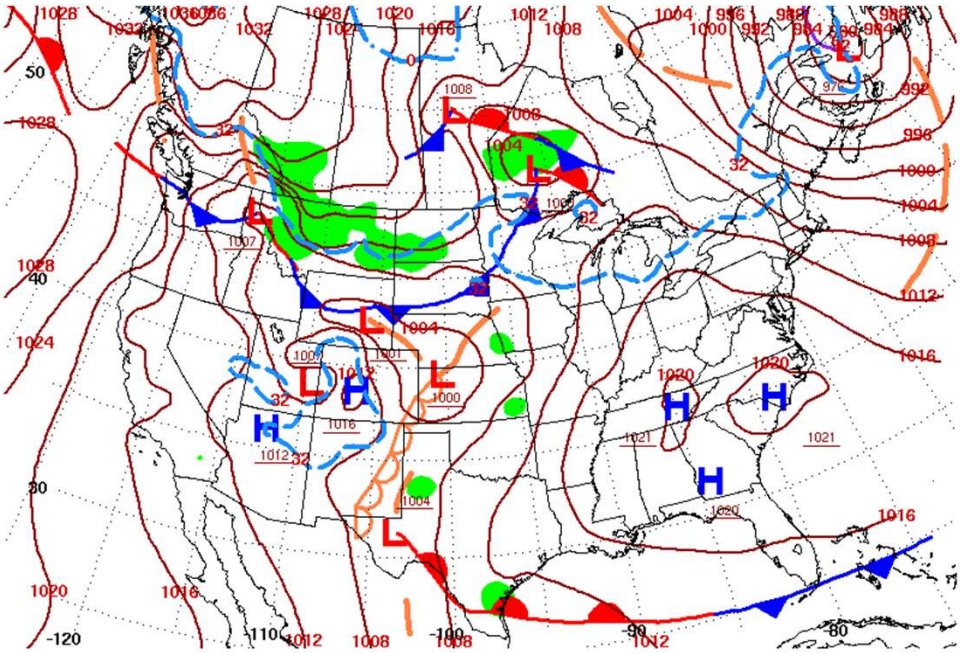
Anomalously warm Gulf of Mexico waters (left) reinforced a broad surface air mass of warm, high dew point air over the southeast US. Dew points across South Carolina were in the upper-60s to low 70s before the tornado outbreak.

SYNOPTIC ANALYSIS

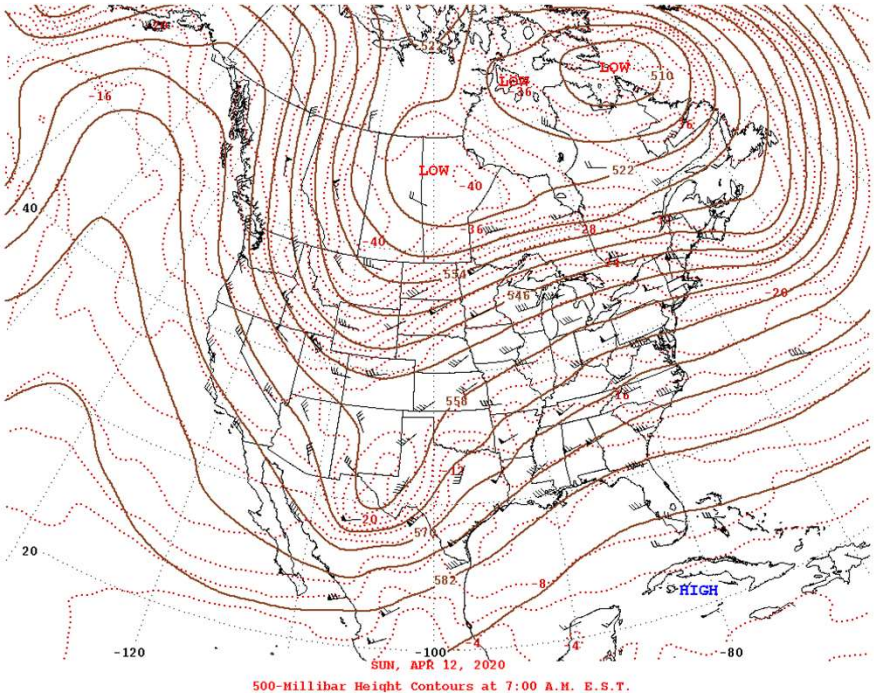
The synoptic pattern and mesoscale features responsible for South Carolina's tornado outbreak began at 500 millibars, as a deep trough of very cold, dry air rotated into the western United States on 11 April with an attendant cut-off low over southern California (top map).



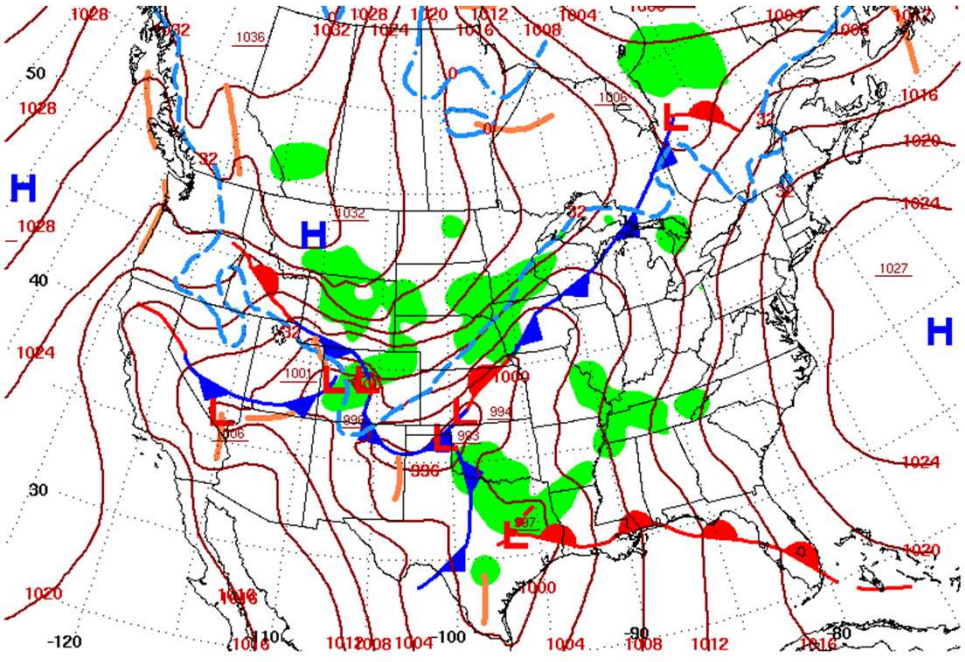
At the surface (bottom map), related to upper-level trough complex, cyclogenesis began over the four corners of UT-CO-NM-AZ with a distinct dryline extending from Nebraska through New Mexico.



After 24 hours, at 500 millibars (right map), the longwave trough broadened and ushered in cold air farther south over the Rockies. In response to the deepening pattern, the short wave trough, now an open wave, pushed rapidly to the east with strong positive vorticity advection, an 80 mph jet streak, and a highly divergent pattern ahead of the wave. Figure 7 shows the rapid 24-hour cyclogenesis of the surface low over Texas in response to the 500 millibar forcing.



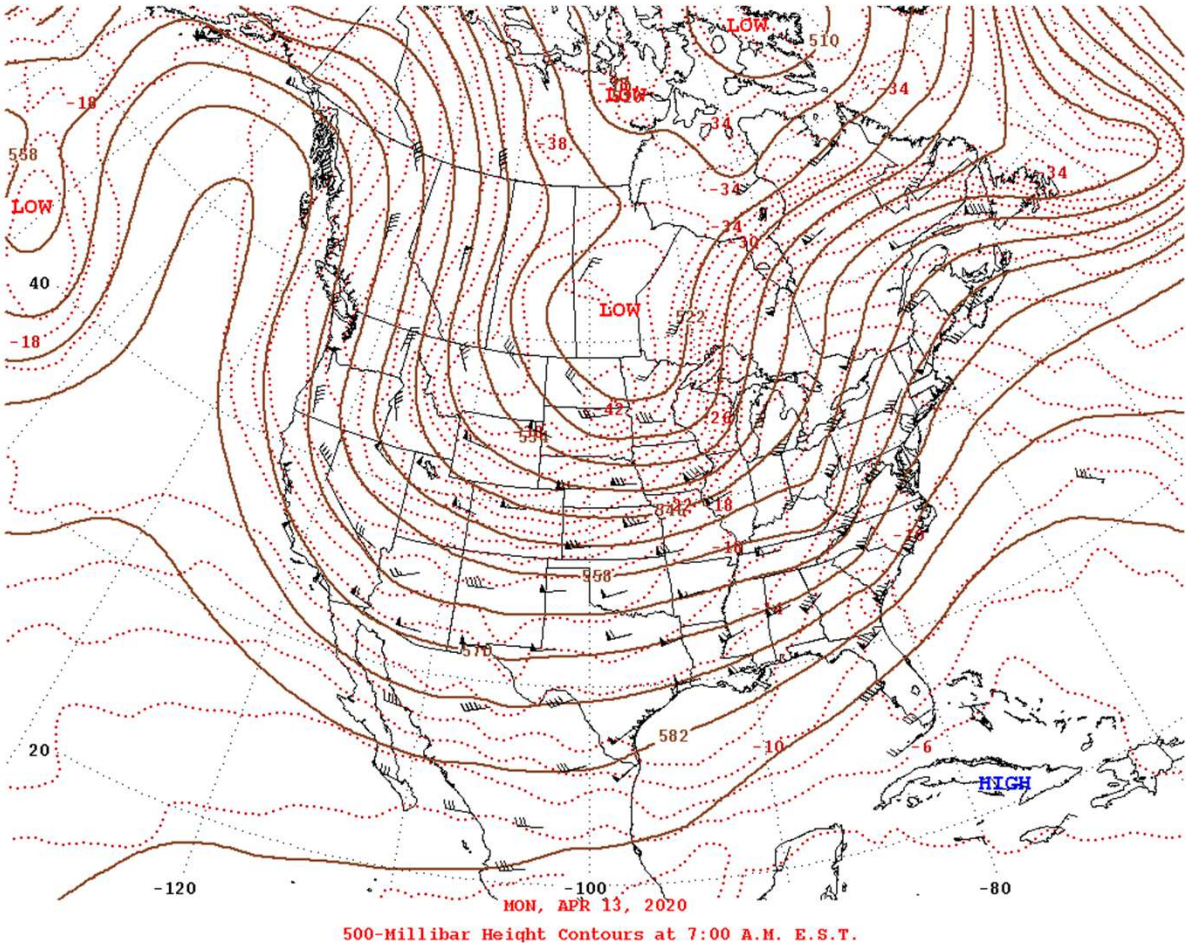
500-Millibar Height Contours at 7:00 A.M. E.S.T.



Surface Weather Map at 7:00 A.M. E.S.T.

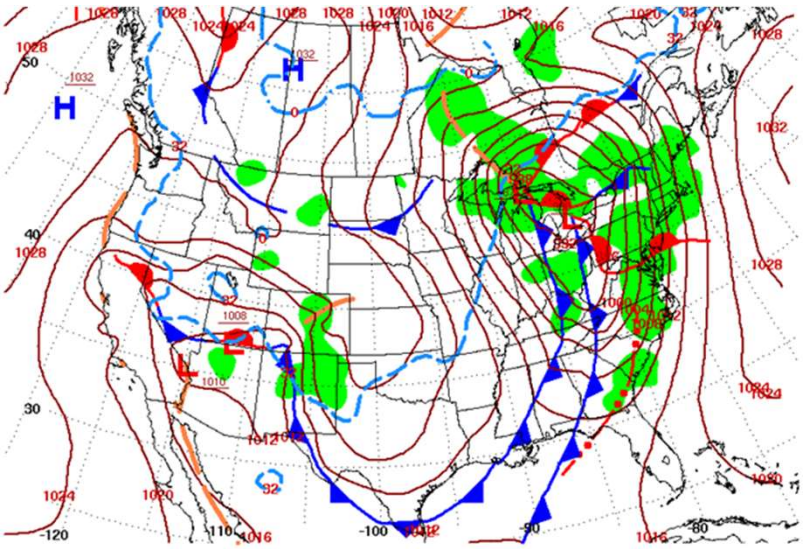
The low deepened over the Texas panhandle complete with a strong cold front over Texas and a warm front draped across the Gulf Coast. Ahead of the deepening surface low, stubborn high pressure over the western Atlantic helped build the gradient of convergent southerly winds that created an extensive warm sector surface layer of 65°-72° dew point air across the southeast United States.

The 500 millibar cut-off low tracked rapidly along the southern periphery of the long wave trough while transitioning to a negatively-tilted trough north-northwest of South Carolina after midnight 12 April (map below).



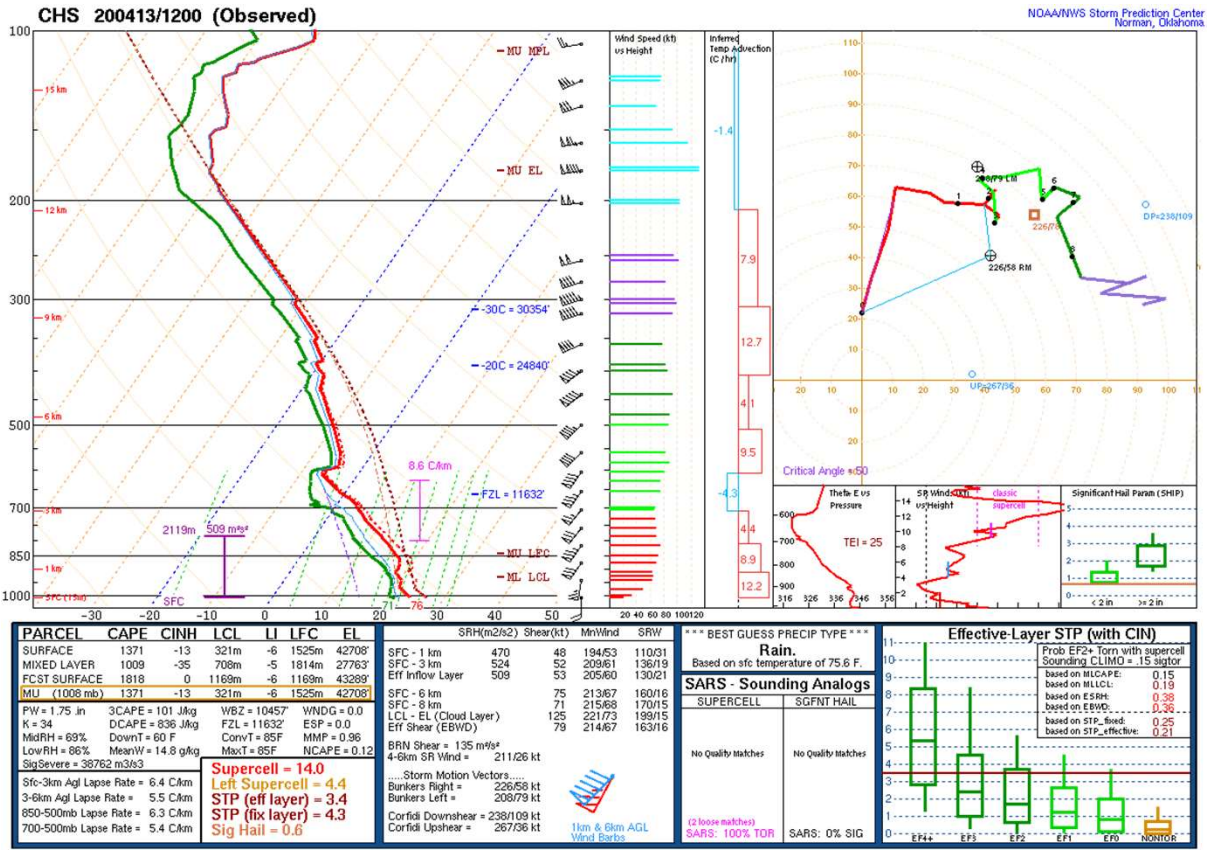
This negatively-tilted trough indicated strong differential temperature advection, strong vertical wind shear and the existence of a strong jet streak near the base of the trough. By becoming negatively tilted, this shortwave trough tapped into a frigid pool air centered over southeastern North Dakota with an extraordinarily rare minimum temperature of -43 degrees Celsius (-45.4° F). This intensified the thermodynamic instability during the early morning hours of 13 April.

SYNOPTIC ANALYSIS



Surface Weather Map at 7:00 A.M. E.S.T.

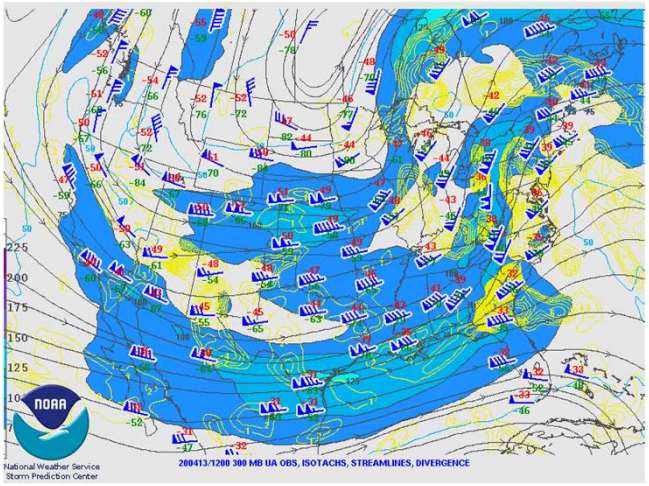
The surface analysis at 8 AM on 13 April (left map) shows the explosive cyclogenesis, rapid east to northeast cross CONUS movement of the surface low and a potent squall line that developed in the warm sector ahead of the main cold front. It was this strong squall line supported by surface convergence, strong wind shear, upper level divergence and strong instability that was responsible for the multiple tornadoes on 13 April. Charleston NWSFO's 8 AM 13 April atmospheric sounding (graphic below) captured the strong surface-based instability and the 75-125 mph wind shear aloft.



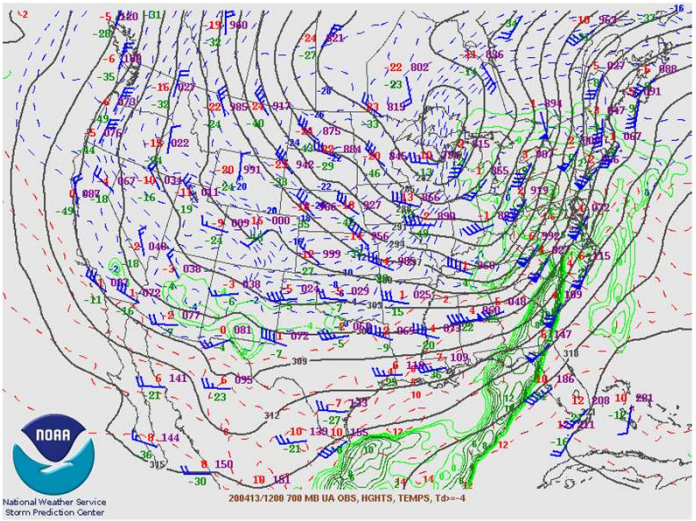
The Storm Prediction Center's analysis of the Charleston upper air sounding along with soundings from surrounding NWS stations show the patterns at various levels above the state that were responsible for 13 April tornado outbreak.

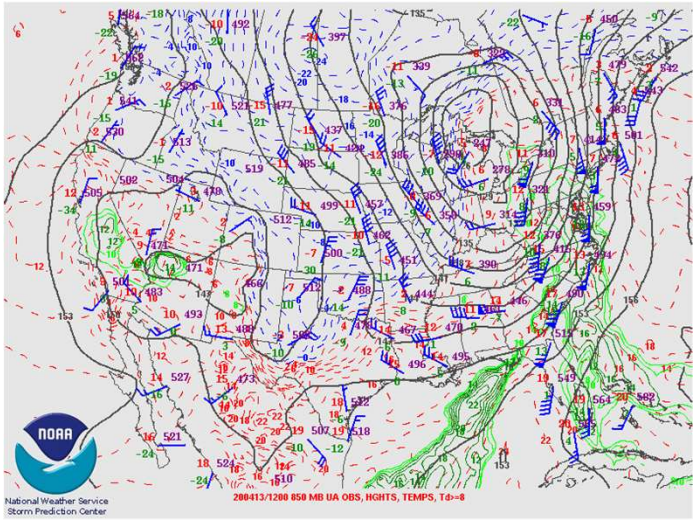
SYNOPTIC ANALYSIS

The map to the right shows the state directly under the right entrance region of a 120 knot (138 mph) jet streak. Strong divergence within this region provided the dynamic lift required to sustain tornadic supercell thunderstorms. The negative tilt of the 300 millibar trough indicates differential temperature advection at that level contributing thermodynamic instability adding to the upward forcing.



Below the 300 millibar level (bottom left) the 700 millibar analysis strong south-southwesterly inflow of high dew point air over the state that provided air with high latent heat content to sustain the severe thunderstorms. A negative tilt in the 700 millibar trough also provided additional forcing. The map (bottom right) shows the same moist air inflow at the lower 850 millibar level albeit with a more southerly component indicating veering winds from 850 millibars through 300 millibars. This clockwise rotation with height is indicative of the strong directional shear associated with tornadoes. At 850 millibars, a convergent wind pattern coupled with a 70-75 knot (80-86 mph) low-level jet provides the requisite surface-based dynamic and thermodynamic forcing for tornadic thunderstorms.





CONFIRMED TORNADOES - UPSTATE

Southeast Tornado Outbreak: April 13, 2020
Upstate

Seneca EF3 Tornado

Maximum Wind Speed: 160mph
Track Length: 16.66 miles
Track Width: 900 yards

Summary

A large, significant tornado passed through parts of Oconee and Pickens counties. The tornado touched down near Westminster and caused damage to houses and structures until it dissipated near Central.

Pumpkintown EF2 Tornado

Maximum Wind Speed: 120 mph
Track Length: 8.01 miles
Track Width: 200 yards

Summary
The tornado destroyed two mobile homes along its path from Pumpkintown in Pickens County, to just outside out of Cleveland in Greenville County. There was a large number of trees down near Marietta.

Jocassee EF1 Tornado

Maximum Wind Speed: 105 mph
Track Length: 4.03 miles
Track Width: 400 yards

Summary
The tornado touched down in extreme northern Oconee County, snapping and uprooting hundreds of trees in the vicinity of the Crystal Geyser plant and near the Bad Creek area. The path could have extended further into the Jocassee Gorges area.

No Pictures Available

Easley EF0 Tornado

Maximum Wind Speed: 80 mph
Track Length: 7.70 miles
Track Width: 30 yards

Summary
The tornado downed, snapped and uprooted trees as it tracked across the Easley area around 3:30 AM EDT. Many of the damaged trees were softwoods, consisting of mainly pine.

Greenville EF0 Tornado

Maximum Wind Speed: 85 mph
Track Length: 0.63 miles
Track Width: 10 yards

Summary

The weak tornado touched down in J Verne Smith Park, downing limbs and uprooting some trees, including a tree that landed on a house near Scruggs Circle.

Southeast Tornado Outbreak: April 13, 2020
Midlands

Savannah River Site EF3 Tornado

Maximum Wind Speed: 140mph
Track Length: 38.28 miles
Track Width: 800 yards

Summary

A strong, long-track tornado started at the Savannah River Site and continued across Barnwell and Orangeburg counties. The tornado destroyed a cinder block store, snapped large swaths of trees, and caused extensive damage to homes along the path.

Barnwell EF3 Tornado

Maximum Wind Speed: 138 mph
Track Length: 8.55 miles
Track Width: 50 yards

Summary
A clear damage scar seen from the Sentinel Satellite prompted the NWS Columbia office to investigate the area. Survey revealed the tornado started in the Savannah River Site and dissipated southwest of Williston.

Livingston EF3 Tornado

Maximum Wind Speed: 140 mph
Track Length: 36.9 miles
Track Width: 770 yards

Summary
A strong, long-track tornado began near Elko and moved northeast before dissipating near St. Matthews. The tornado destroyed mobile and well constructed homes, snapped trees, and caused two fatalities and seven injuries.

Blackville EF3 Tornado

Maximum Wind Speed: 140 mph
Track Length: 1.38 miles
Track Width: 40 yards

Summary
The tornado collapsed portion of a large warehouse, twisting some steel support beams, and also damaged several chicken houses just south of Blackville.

Hilda EF3 Tornado

Maximum Wind Speed: 145 mph
Track Length: 5.45 miles
Track Width: 800 yards

Summary
The tornado touched down southeast of Barnwell and moved into Bamberg County. A two story wood framed house was shifted off its foundation and a metal structure and tin tractor were destroyed. Oak and pine trees were uprooted and snapped.

Rowesville EF2 Tornado

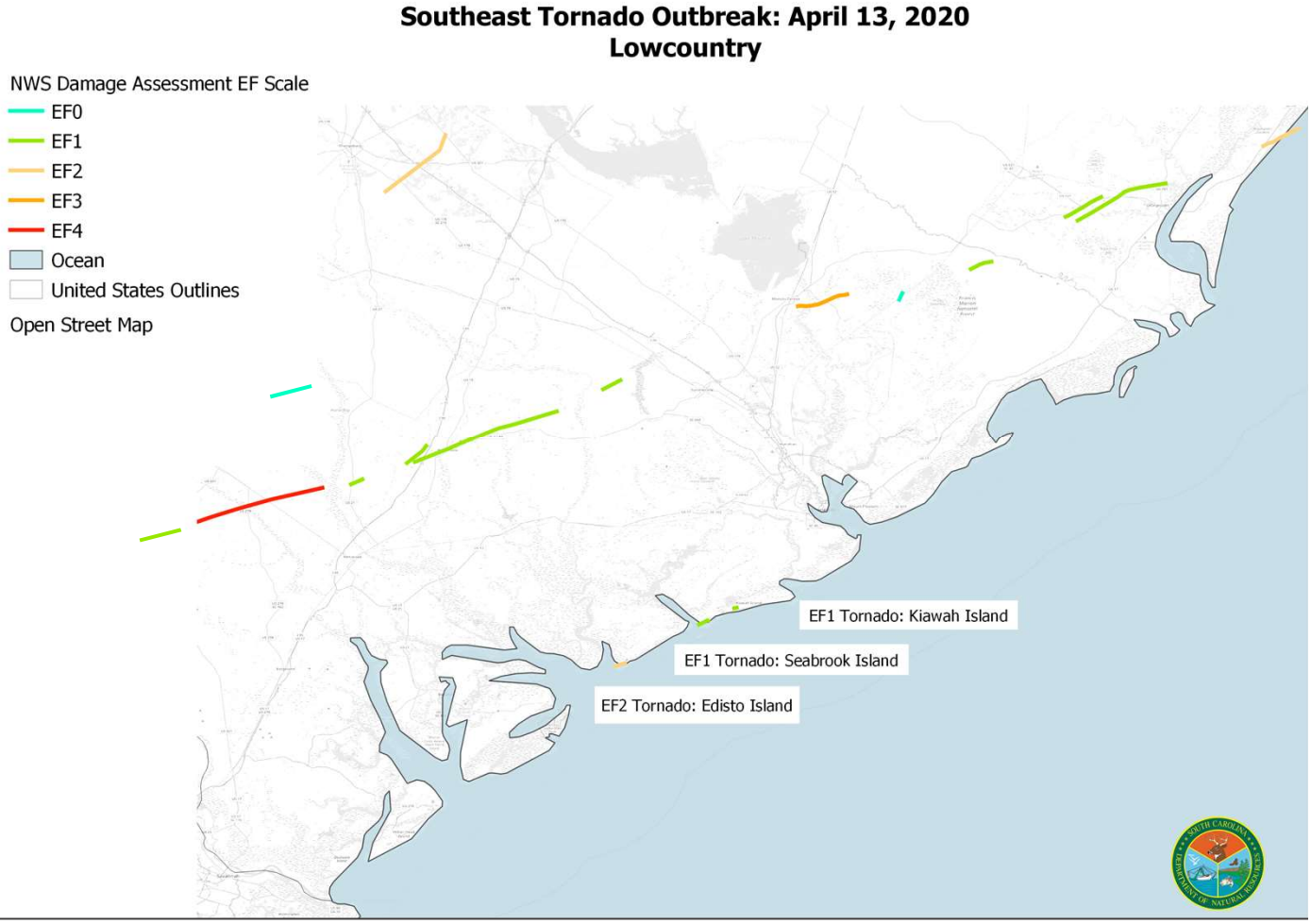
Maximum Wind Speed: 119 mph
Track Length: 10.29 miles
Track Width: 700 yards

Summary
The tornado touched down just south of Orangeburg and crossed Interstate 26 before dissipating in Calhoun County. Numerous hardwood and softwood trees were snapped along the path. There was damage to some grain silos and outbuildings along with residential homes.

Elgin EF1 Tornado

Maximum Wind Speed: 105 mph
Track Length: 4.91 miles
Track Width: 80 yards

Summary
A strong EF1 tornado caused major tree damage, and minor structural damage in the Hunters Run and Crickentree neighborhoods along its five mile path across a portion of northern Richland County.



Estill/Hampton County EF4 Tornado

Maximum Wind Speed: 175 mph
Track Length: 24.04 miles
Track Width: 1300 yards

Summary

An unusually long-track and wide tornado caused extensive damage to many mobile and single family homes in Hampton County. The most significant damage occurred just south of Estill and near Nixville. Damage pattern suggested the tornado may have had multiple vortices.

Moncks Corner EF3 Tornado

Maximum Wind Speed: 145 mph
Track Length: 5.81 miles
Track Width: 880 yards

Summary
The tornado caused significant damage to several homes in the Fairlawn Subdivision, just east of Moncks Corner. It continued off to the east-northeast, snapping and uprooting both hard and soft wood trees.

Edisto Beach EF2 Tornado

Maximum Wind Speed: 125 mph
Track Length: 1.16 miles
Track Width: 140 yards

Summary
The tornado likely started as a waterspout off the coast and moved inland across Edisto Beach. The tornado damaged large sections off six homes, knocked down power lines, and snapped trees along its path.

Murrells Inlet EF2 Tornado

Maximum Wind Speed: 114 mph
Track Length: 4.60 miles
Track Width: 20 yards

Summary
The tornado primarily remained an EF0/EF1 as it moved across portions of North Litchfield Beach. The tornado picked up strength as it moved toward Huntington State Park. A nearby station recorded a wind gust of 114 mph (EF2 waterspout).

No Pictures Available

Islandton EF1 Tornado

Maximum Wind Speed: 90 mph
Track Length: 1.43 miles
Track Width: 50 yards

Summary
The tornado formed just west of Route 21 in southwest Colleton County and traveled about 1.5 miles northeast before dissipating. The tornado snapped a couple of dozen pine trees and broke off some tree branches along the path.

No Pictures Available

Walterboro EF1 Tornado

Maximum Wind Speed: 105 mph
Track Length: 3.16 miles
Track Width: 100 yards

Summary
The tornado produced extensive tree damage in the vicinity of Beach Road. The tornado overturned a tractor-trailer near mile marker 55 on Interstate 95. Hundreds of trees were snapped off or uprooted along the path.

Walterboro/Round O EF1 Tornado

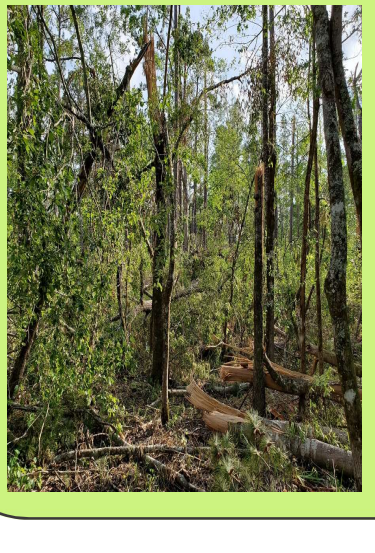
Maximum Wind Speed: 110 mph
Track Length: 17.40 miles
Track Width: 500 yards

Summary
The tornado formed in West Walterboro and tracked to the northeast through the Lowcountry Regional Airport. Extensive tree damage, along with damage to hangers and aircraft was reported. The preliminary track length was extended from 8 miles.

Givhans Ferry EF1 Tornado

Maximum Wind Speed: 102 mph
Track Length: 2.29 miles
Track Width: 150 yards

Summary
The tornado touched down near Givhans Ferry State Park and moved to the northeast. Along the path, the tornado snapped and uprooted trees. There was also straight-line wind damage near the path.



Simmonsville EF1 Tornado

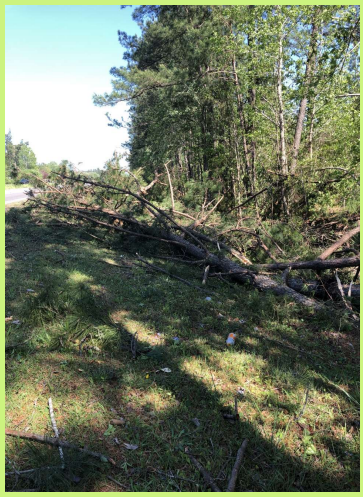
Maximum Wind Speed: 108 mph
Track Length: 2.54 miles
Track Width: 400 yards

Summary
This brief tornado touched down near French Santee Road and tracked to the northeast before dissipating near Forest Road 269. Many trees were snapped and uprooted along the path with minor structural roof damage to a nearby home.

Sampit EF1 Tornado

Maximum Wind Speed: 90 mph
Track Length: 4.80 miles
Track Width: 40 yards

Summary
The tornado formed near Sampit and caused damage to power lines and trees before crossing Hwy 17 and damaging an auto repair shop, two railroad gates and a small double-wide office.



Graves EF1 Tornado

Maximum Wind Speed: 100 mph
Track Length: 11.20 miles
Track Width: 50 yards

Summary
The tornado formed near the Sampit River and moved northeast through the swampy area. It eventually crossed Hwy 17, causing tree damage and minor structural damage before moving into Pawley Swamp.

Seabrook Island EF1 Tornado

Maximum Wind Speed: 105 mph
Track Length: 1.25 miles
Track Width: 120 yards

Summary
The storm that produced a tornado at Edisto spawned another tornado on the southwest portion of Seabrook Island. The tornado cause significant tree damage near the golf course.

Kiawah Island EF1 Tornado

Maximum Wind Speed: 105 mph
Track Length: 0.30 miles
Track Width: 60 yards

Summary
The same storm that produced a tornado at Edisto Beach and Seabrook Island produced a tornado near the 12th hold of the golf course and moved to the east-northeast. Several large trees were snapped along the path.

No Pictures Available

Allendale EF0 Tornado

Maximum Wind Speed: 76 mph
Track Length: 5.87 miles
Track Width: 300 yards

Summary
The weak tornado touched down near the intersection of Route 321 and Mt. Pleasant Church Road and produced sporadic, discontinuous tree damage along the path.

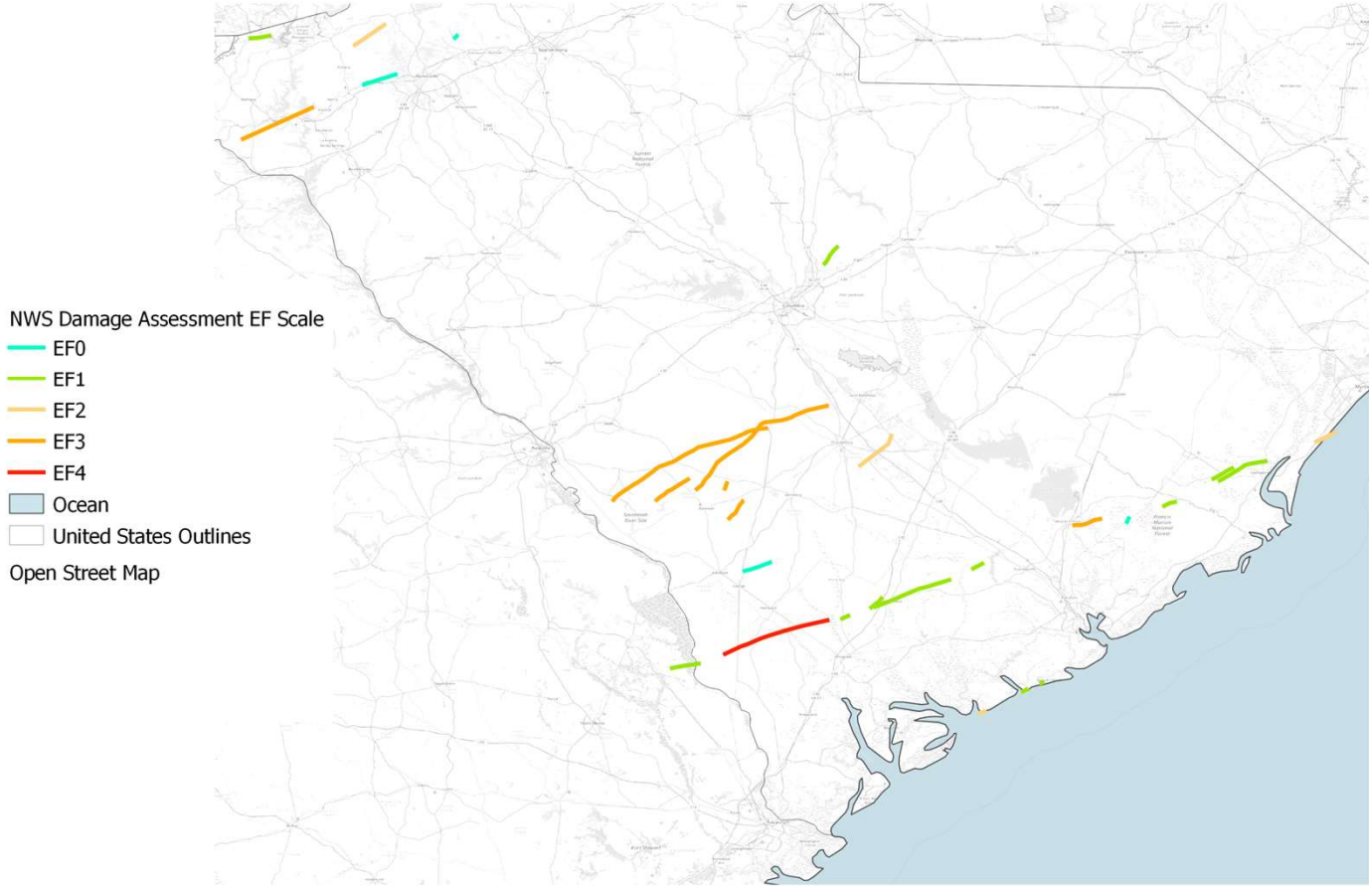
Bethera EF0 Tornado

Maximum Wind Speed: 85 mph
Track Length: 0.93 miles
Track Width: 200 yards

Summary
The weak tornado snapped and uprooted multiple trees along the path, and at least one home along Witherbee Road had a limb blown onto the roof.

CONFIRMED TORNADOES – STATEWIDE

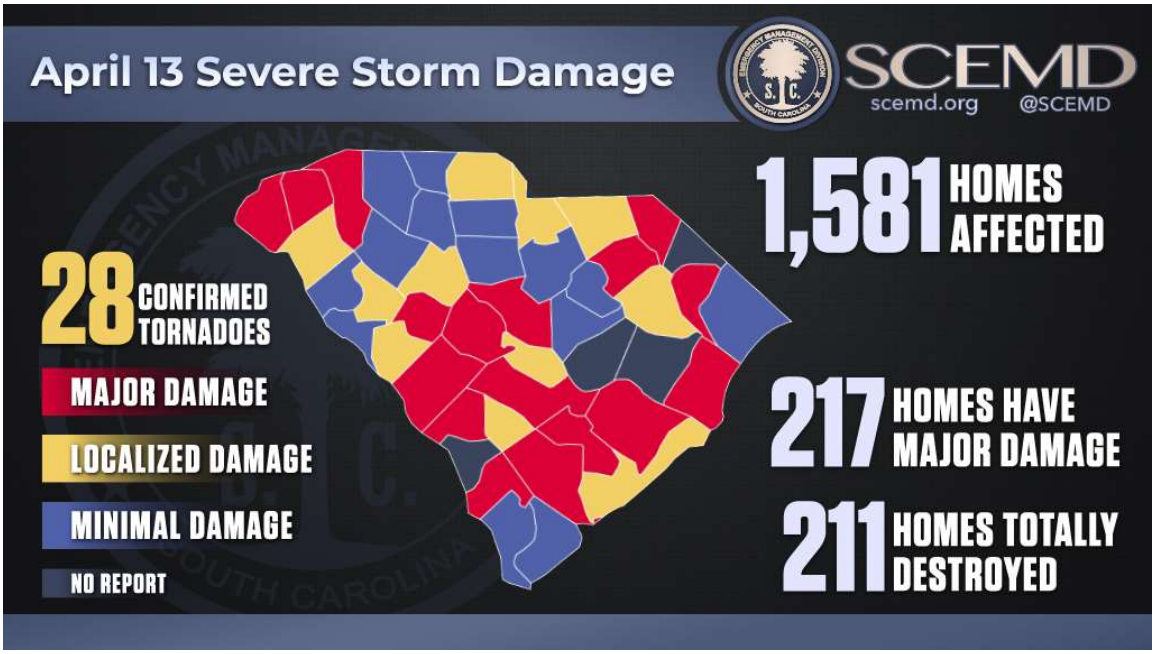
Southeast Tornado Outbreak: April 13, 2020
All South Carolina Tornadoes



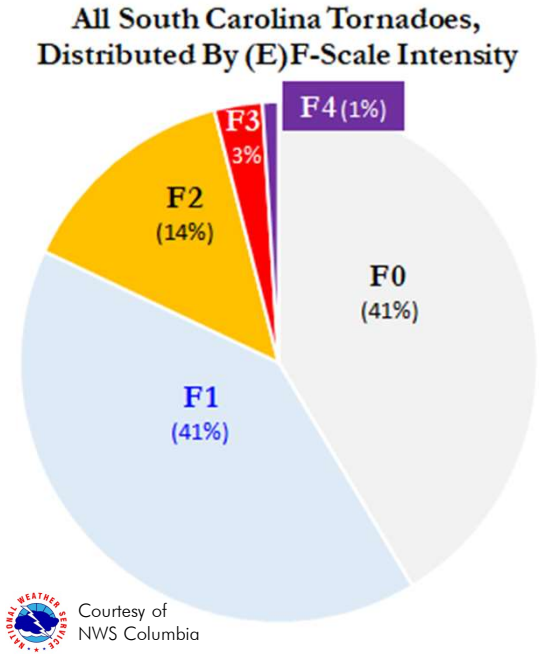
	Enhanced Fujita (EF) Rating				
	EF0	EF1	EF2	EF3	EF4
Wind Speeds	(65 – 85 mph)	(86 – 110 mph)	(111 – 135 mph)	(136 – 165 mph)	(166 – 200 mph)
Confirmed Count in SC	4	12	4	7	1

Statewide Initial Damage Estimate

- Maximum power outages 391,000+ (statewide)
- Individual Assistance Registrations: 2,017
- Total disaster estimate for Public Assistance: $15.1 Million



Climatological Perspective 1950-2019



Courtesy of NWS Columbia

Only 4% of tornadoes on record from 1950-2019, were rated at EF3 or higher.
~3% EF3 [28 tornadoes]
~1% EF4 [10 tornadoes]

- Tornado Occurrences by Month:
  - April: 169
  - May: 148
  - September: 137
  - March: 129
- First EF4 tornado on record reported before 12 PM LST
- Only 2 EF3+ Tornadoes have ever occurred between midnight and 8 AM LST
  (8 occurred during April 13 event)

South Carolina Tornado Extremes (since 1950)

Most tornadoes in an outbreak:

46 tornadoes on September 6-7, 2004 (Hurricane Frances)

Longest tornado track*:

62 miles (McCormick-Edgefield-Saluda) on November 22, 1992 (F3)

Widest tornado*:

2600 yards in Marlboro County on March 28, 1984

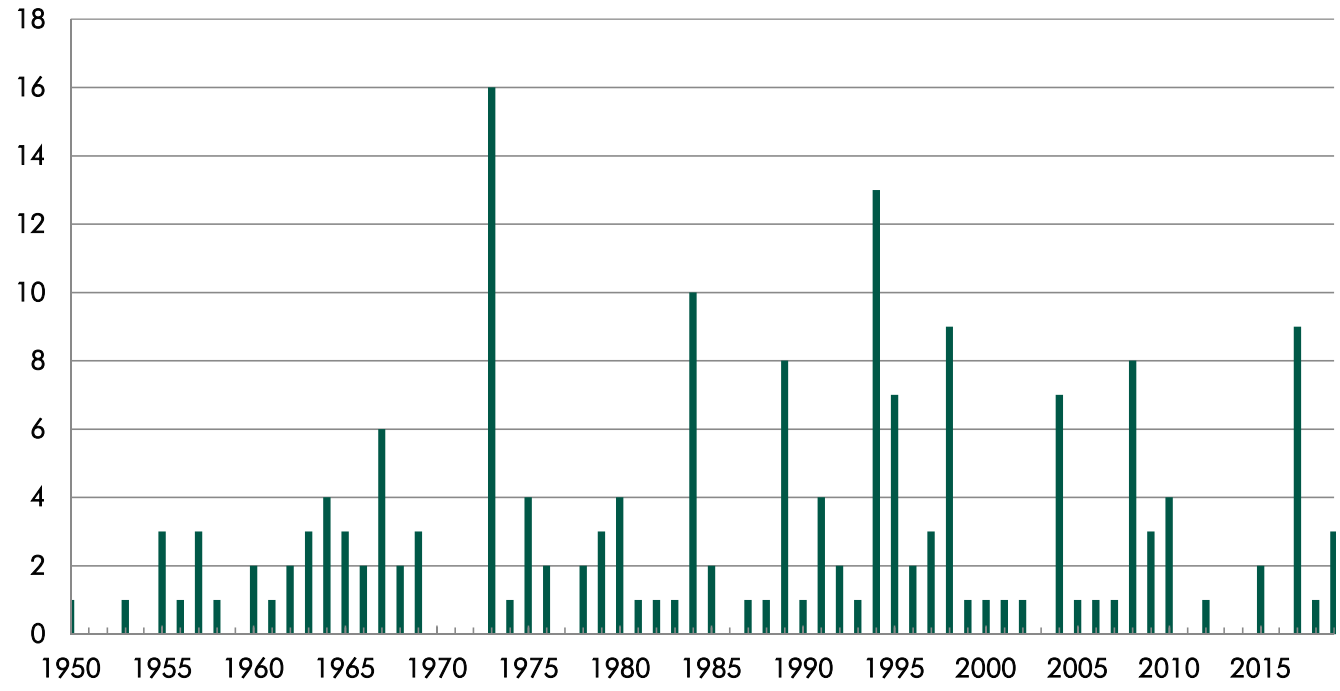
*Average SC tornado tracks are 3.4 miles long and 117 yards wide.

Greatest Number of Tornadoes (by Outbreak Since 1950)

	#	EF0	EF1	EF2	EF3	EF4
9/7/2004	46	24	14	3	1	0
3/15/2008	32	12	15	3	2	0
11/7/1995	28	14	8	4	0	1
4/13/2020	28	4	12	4	7	1
8/16/1994	23	8	7	5	3	0

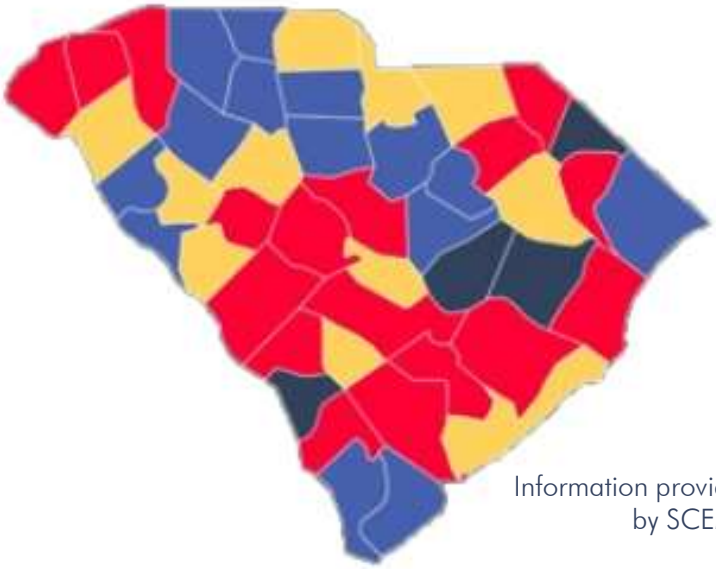
The deadliest tornado in South Carolina history is The Horrell Hill Tornado on April 30, 1924, with 77 fatalities.

Number of EF2, EF3, and EF4 Tornadoes per Year (1950-2019)

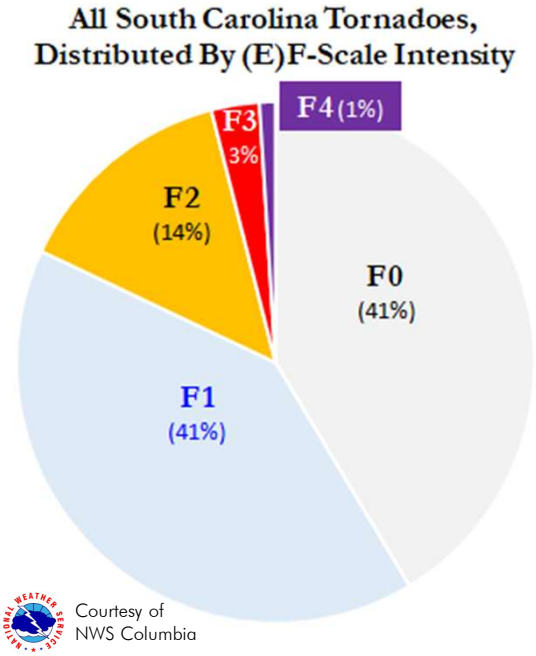


Statewide Initial Damage Estimate

- Maximum power outages 391,000+ (statewide)
- Individual Assistance Registrations: 2,017
  - Oconee: 663
  - Orangeburg: 336
  - Colleton: 319
  - Hampton: 170
  - Pickens: 166
- Total disaster estimate for Public Assistance: $15.1 Million
- 1581 Homes Affected
  - Major Damage: 217
  - Destroyed: 211



Climatological Perspective 1950-2019



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