

Downbursts: As Dangerous as Tornadoes?



National Weather Service
Greenville-Spartanburg, SC



What is a Downburst?

“It had to be a tornado!” This is a common statement made by citizens of the Carolinas and North Georgia who experience damaging winds associated with severe thunderstorms, especially if those winds cause damage to their homes. However, the combination of atmospheric ingredients that are necessary for tornadoes occurs only rarely across our area. In fact the 46 counties that represent the Greenville-Spartanburg Weather Forecast Offices’s County Warning Area only experience a total of 12 to 15 tornadoes during an average year.

However, thunderstorms and even severe thunderstorms are a relatively common occurrence across our area, especially from late spring through mid-summer. This is because a warm and humid (i.e., unstable) atmosphere is required for thunderstorm development. If some atmospheric process forces the unstable air upward, the air will rise and cool until it saturates, causing a cloud to form. This rising air is called an

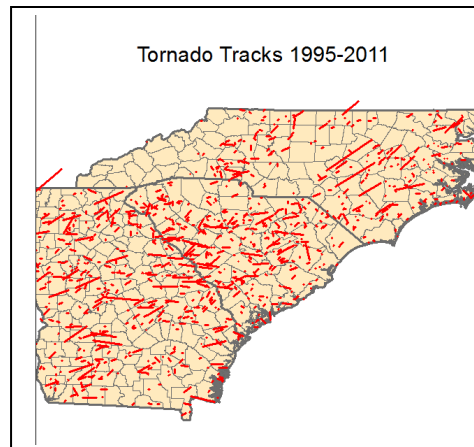


Fig. 1. Tracks of tornadoes across the Carolinas and Georgia from 1995 through 2011. Compare this with the downburst reports during this time (Figure 3).

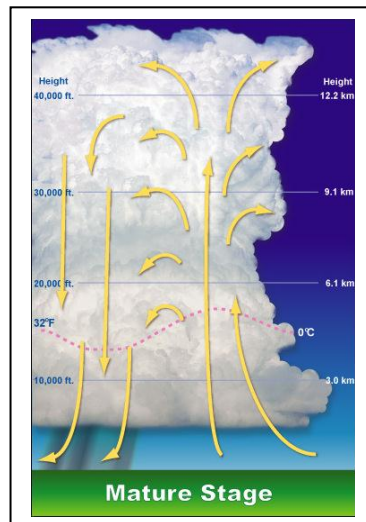


Fig. 2. Schematic of a mature thunderstorm, depicting the updraft (yellow arrows pointing toward top of the page) and the downdraft.

draft.”

a typical day in the warm season, a cloud grows to 20,000 to 30,000 feet, it will begin to produce heavy rain and lightning. The falling rain causes a “downdraft,” or sinking column of air to form. A thunderstorm eventually grows to a height of 40,000 feet or more before it stops developing. Generally speaking, the “taller” the storm, the more likely it is to produce a strong downdraft. Once the air within the downdraft reaches the surface, it spreads out parallel to the ground. Very strong to damaging

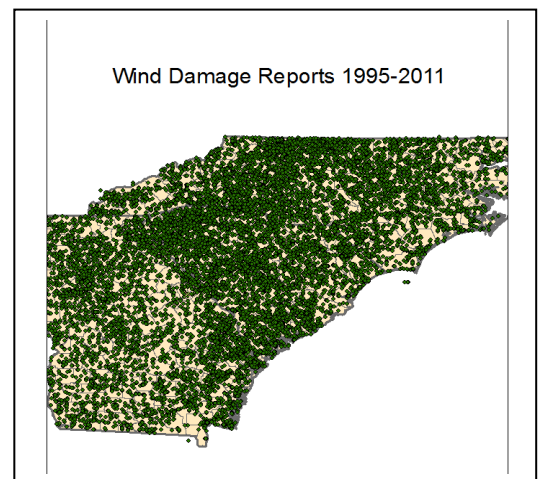


Fig. 3. Reports of downburst wind damage across the Carolinas and Georgia from 1995 through 2011.

winds can be experienced along the leading edge of this “spreading out” air. When the wind reaches damaging levels (i.e., around 60 mph or higher), we refer to the damaging winds as “downbursts.” Much like tornadoes, downbursts can vary widely in strength and size. Most downbursts across the Carolinas and North Georgia are small and of short duration, covering an area the size of a couple of city blocks and lasting a matter of seconds. Because of their small size, these are called “microbursts.” However, some downbursts cover hundreds to thousands of square miles and can last for many hours. These events are sometimes referred to as “derechos.” Most downbursts produce wind speeds of around 60 mph. The main impacts from wind of this strength are downing of a few trees and power lines. In some instances, downbursts can produce hurricane force wind gusts of 70 to 90 mph. These winds can blow down numerous



Fig. 4. Although the damage in these photos may appear to be the result of a tornado, it was actually caused by downbursts. Downbursts can produce damage similar to a tornado, and are quite common across the western Carolinas and northeast Georgia. This is why severe thunderstorm warnings should be heeded.

trees and power lines, cause minor structural damage to frame homes, and flip mobile homes that are not tied down. In rare instances, downbursts can produce tornado force wind gusts in excess of 90 mph. These winds produce damage similar to a tornado: causing moderate damage to frame homes, completely destroying mobile homes, and blowing down large swaths of trees. Although Severe Thunderstorm Warnings are typically issued for these types of events well ahead of time, they often catch people off guard because the warnings were not taken seriously.

Fig. 5 (Right). A “shelf cloud” (sloped down away from the area of rainfall) is often an indicator of a long-lived downburst. Wind speeds just ahead of and underneath the leading edge of this cloud can exceed 90 mph



Fig. 6 (Right). From several miles away, a microburst can be seen as a “rain foot.” The “foot” develops as rapidly sinking air within the downdraft “spreads out” parallel to the ground.

Even severe thunderstorms that produce marginally severe wind gusts (i.e., around 60 mph) represent a threat due to the potential for falling trees. Falling trees result in millions of dollars in property damage and even occasional injuries and fatalities across the western Carolinas and northeast Georgia each year.

Downbursts are the most common form of severe



Downburst Climatology

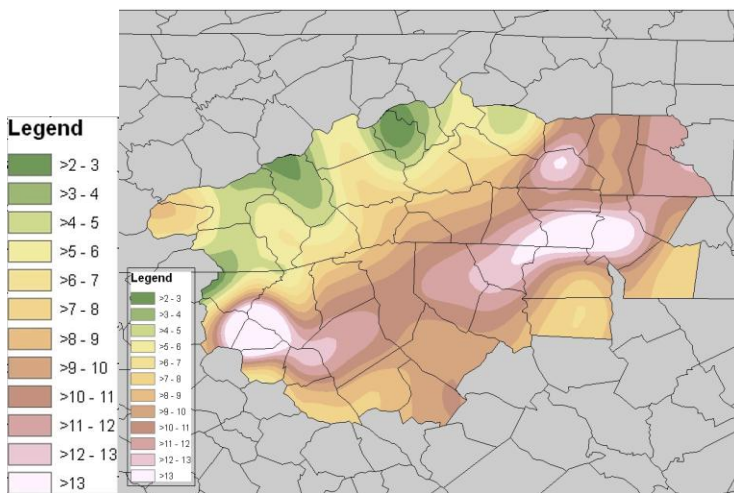


Fig. 7. A map depicting the average number of days during a 5-year period with a severe thunderstorm wind gust within 200 square miles of any point.

weather across the western Carolinas and northeast Georgia. They are especially common in the Piedmont. A typical Piedmont county experiences at least one downburst on four to seven days per year. Contrast this with tornadoes, which occur only once every 3 to 5 years.

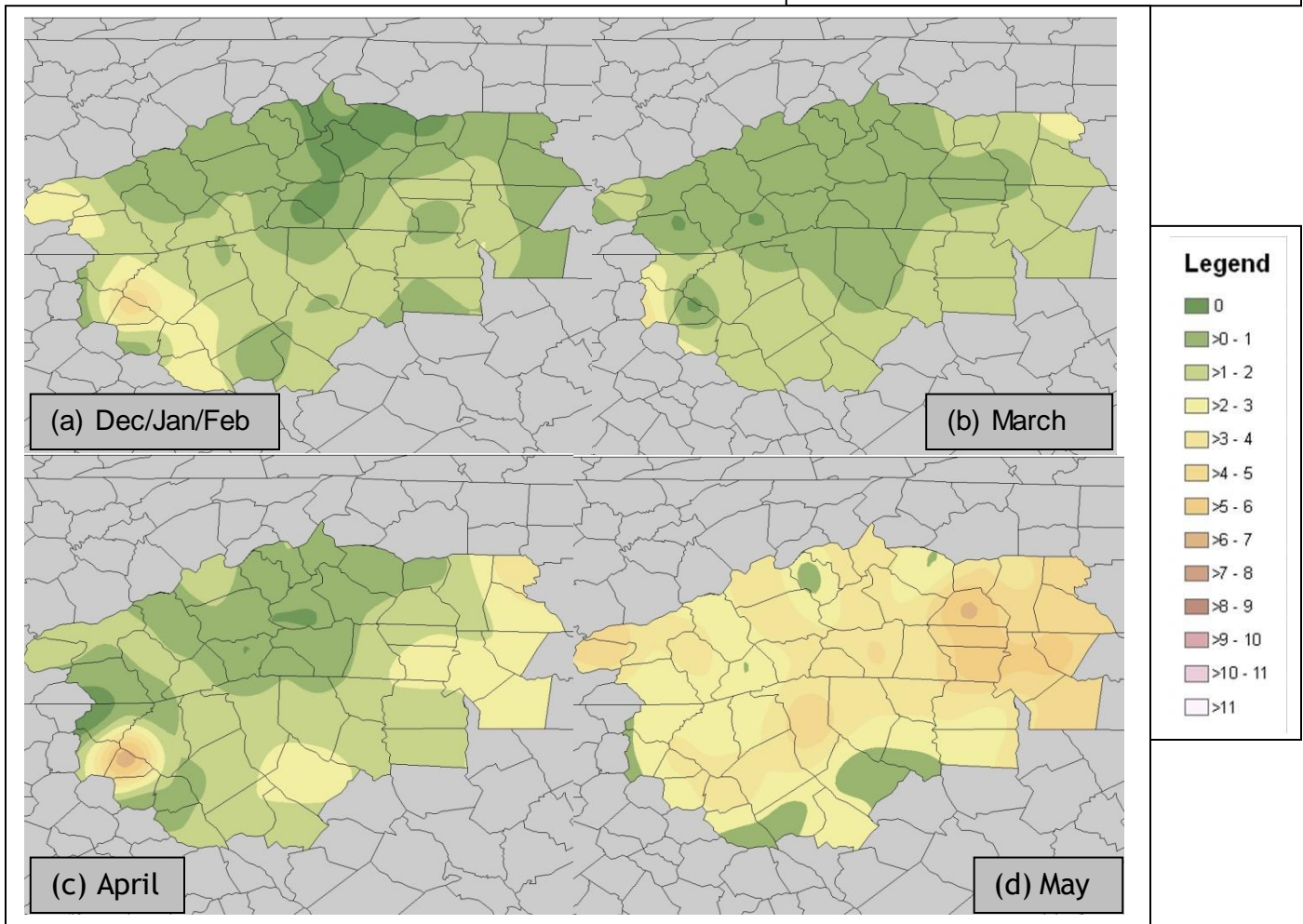
The peak time of year for downbursts across the region is June and July, although they can occur at any time of year. June and July coincides with peak thunderstorm activity across the region. Meanwhile, tornadoes are most common in March and April and quite rare in June and July, despite frequent thunderstorms. This is because

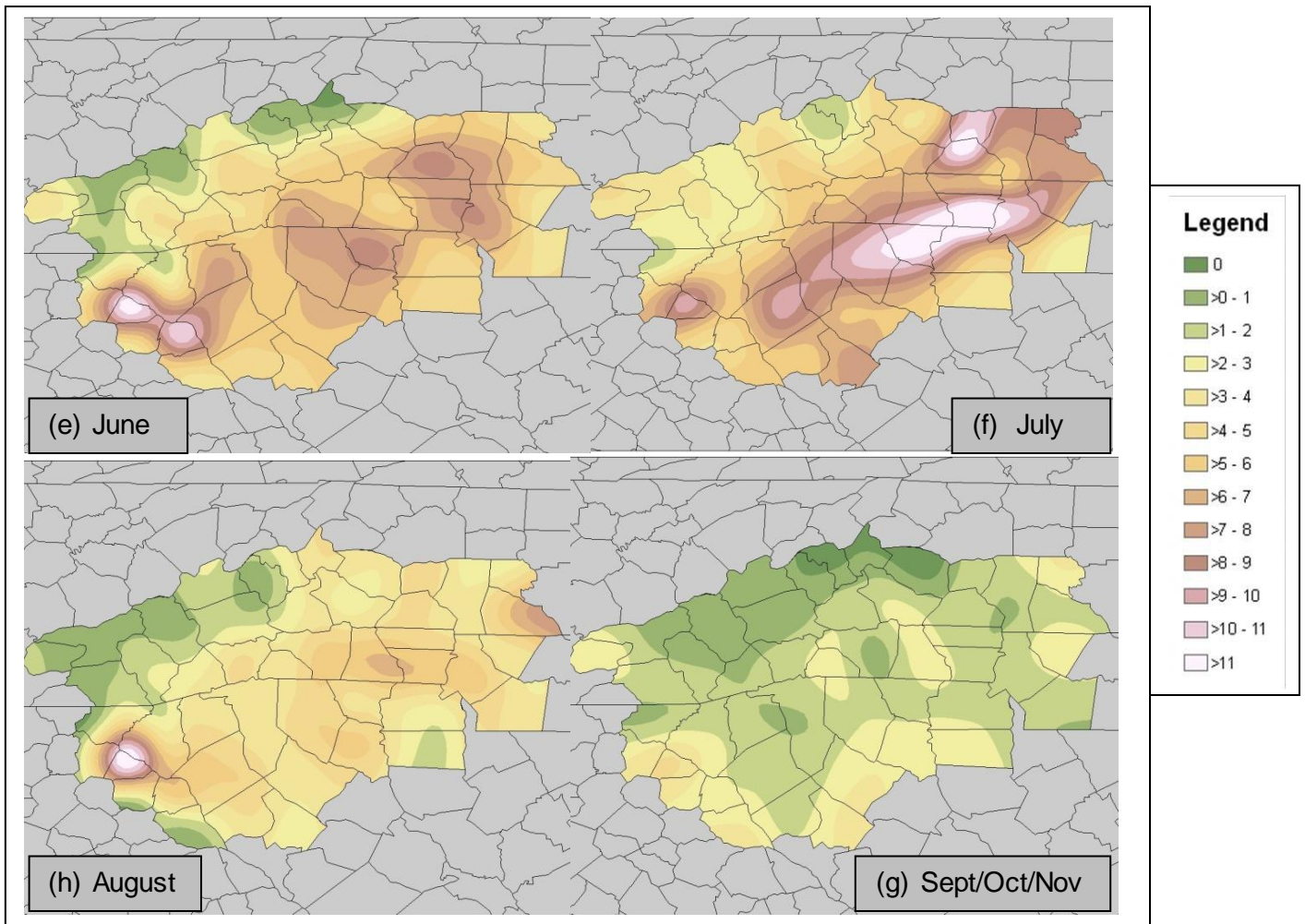
a key atmospheric ingredient for tornado development is usually missing across the Southeast during the summer: wind shear. Meteorologists define wind shear as winds increasing and changing direction with height. All things being equal, the stronger the winds in the upper levels of the atmosphere (i.e., jet stream winds), the stronger the wind shear. However, the jet stream migrates north and south with the seasons. During the winter, it can often be found dipping well into the Southeast. During the transitional spring season, the jet stream tends to oscillate between northern and southern latitudes. By summer, it is usually found across the northern U.S. and Canada. Thus, wind shear is typically weak across the Carolinas and Georgia from late spring through summer and tornadoes are very rare during our peak thunderstorm season. However, downbursts do not necessarily require strong wind shear. In fact, microbursts may be more likely when wind shear is weak.



Fig. 7. A map depicting the typical position and strength of the jet stream in the winter (more southern and stronger) and the summer (more northern and weaker).

Fig. 8. (Below and cont next page) Maps depicting the total number of days between 1995 and 2008 with damaging thunderstorm winds within 200 mi² of any point in (a) December/January/February, (b) March (c) April, (d) May, (e) June, (f) July, (g) August, and (h) September/October/November. Downburst activity gradually increases during spring as thunderstorms increase. Downbursts peak during the height of thunderstorm season (June and July), then decrease as thunderstorm activity wanes in late summer and fall.





Downburst Safety

Downbursts are the main severe weather threat in the western Carolinas and northeast Georgia. Perhaps the greatest hazard associated with downbursts in this region is that of trees falling on automobiles and structures. Over the past 10 years, there have been 7 deaths associated with thunderstorm winds across the western Carolinas and northeast Georgia, each fatality being the result of a falling tree. Most of the monetary structural damage associated with downbursts in this area is from falling trees. Dead and diseased trees are especially susceptible to being downed by severe thunderstorm winds. You should strongly consider having these trees removed from your property, especially if they are located on the west side of your home.

Remember that downbursts can produce wind speeds and damage similar to a tornado. National Weather Service Severe Thunderstorm Warnings will include wording such as "Hurricane Force Winds" and "Tornado Force Winds" when forecasters' confidence is high that these types of winds will occur. However, it is ultimately up to individuals to make sure that they are able to receive this information, via local news media outlets, mobile phone applications, or NOAA All-Hazards Weather Radio.

The safest place to be during a severe thunderstorm is on the lowest level of a well-constructed building, in an interior room. Avoid any rooms that may be damaged by falling trees. If you are in an automobile, the safest course of action is to abandon it for sturdy shelter. If shelter is not available, you should attempt to seek out an open area, away from trees and power lines. If strong winds develop, try to turn your vehicle so that your back is to the wind. The strong wind will typically be from the west or northwest.

If you live in a manufactured home, you should strongly consider leaving the home for nearby sturdier shelter if the home is not securely tied down.



Fig. 9. Another major hazard associated with downbursts is from wind-driven large hail, which can cause injury and major property damage, such as with this manufactured home. Photo courtesy of Greenwood County Emergency Management.

Table 1. Some notable recent downbursts in the Western Carolinas.

County	Nearest City	Date	Max Estimated Wind Gust	Impacts
Gaston, NC	Belmont	August 11, 2011	80 mph	Numerous trees blown down, with dozens of homes damaged by falling trees in the Belmont/ Cramerton area.
Graham, NC; Swain, NC; Macon, NC; Jackson, NC; Transylvania, NC; Henderson, NC; Greenville, SC; Spartanburg, SC; Union, SC	From near Robbinsville, NC to near Union, SC	June 15, 2011	85 mph	A derecho developed near the Smoky Mountains and moved across the southern NC mountains and central and eastern portions of the Upstate. Major wind damage occurred across the mountains with widespread trees blown down and multiple homes damaged.
York, SC	Countywide	May 10, 2011	85 mph	Widespread downed trees, with numerous homes damaged or destroyed by falling trees, roof blown off a church.
Alexander, NC	Vashti	April 4, 2011	90 mph	Part of the roof blown off a home, chicken houses severely damaged, outbuildings destroyed
Laurens, SC	Laurens	June 16, 2009	95 mph	Hundreds of trees blown down in the city of Laurens alone, damaging multiple homes. One person was killed when a tree fell on her car.
Greenville/ Spartanburg, SC	Greenville to Spartanburg	June 11, 2009	80 mph	Numerous trees blown down from the north side of Greenville across Taylors, Greer, and to the west side of Spartanburg
Buncombe, NC	Asheville	May 3, 2009	85 mph	Numerous trees down on the east side of Asheville, minor to moderate roof damage.

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Please send any comments or questions to justin.lane@noaa.gov.

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