THE WEDGE FRONT

NATIONAL WEATHER SERVICE GREENVILLE-SPARTANBURG SC

Volume 4, Issue 2 Winter 2021-2022

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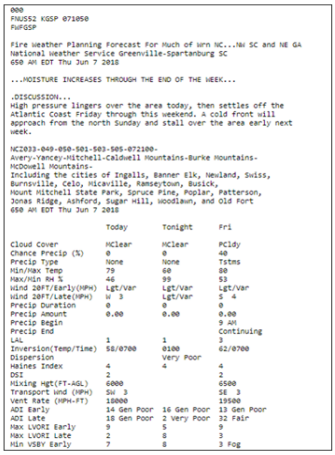
GSP Fire Weather Program

You are probably familiar with National Weather Service (NWS) public forecasts and watches and warnings for severe weather, but did you know the Greenville/Spartanburg forecast office also issues products for Fire Weather? The NWS is responsible for issuing daily and on-demand products to federal and state forestry officials specifically tailored for planning controlled burns and the suppression of real-time wildfires.

The primary fire weather product issued by our office is called the Fire Weather Planning Forecast. This product is used daily by land managers to aide in decision making related to pre-suppression of planned burns and for the allocation and distribution of resources such as personnel and equipment. Some of the weather parameters officials look for are relative humidity and wind speeds at the surface and aloft as well as the stability of the atmosphere. The magnitude and possible overlap of these variables are crucial aides for decision makers. For instance, very dry air combined with strong surface winds within an unstable atmosphere can result in a rapid spread of planned burns or wildfires leading to an increased safety risk to fire-fighting personnel and the public.

Another product issued by the Greenville/Spartanburg forecast office is called the Spot Forecast. These are on-demand localized forecasts which aide fire control agencies in the protection of life and property when a fire has already started or when planned burning is conducted. Along with fire suppression and the safety of fire-fighting crews, Spot Forecasts are used for smoke management, which means preventing dense smoke from affecting public places and buildings such as hospitals. For example, officials would not plan a



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FNUS52 KGSP 071050
FWFGSP

Fire Weather Planning Forecast For Much of Wrn NC...Nw SC and NE GA
National Weather Service Greenville-Spartanburg SC
650 AM EDT Thu Jun 7 2018

...MOISTURE INCREASES THROUGH THE END OF THE WEEK...

.DISCUSSION...
High pressure lingers over the area today, then settles off the
Atlantic Coast Friday through this weekend. A cold front will
approach from the north Sunday and stall over the area early next
week.

NC2033-049-050-501-503-505-072100-
Avery-Yancey-Mitchell-Caldwell Mountains-Burke Mountains-
McDowell Mountains-
Including the cities of Ingalls, Banner Elk, Newland, Swiss,
Burnsville, Celo, Micaville, Ramseytown, Busick,
Mount Mitchell State Park, Spruce Pine, Poplar, Patterson,
Jonas Ridge, Ashford, Sugar Hill, Woodlawn, and Old Fort
650 AM EDT Thu Jun 7 2018

                    Today       Tonight     Fri

Cloud Cover         MClear      MClear      PCldy
Chance Precip (%)   0           0           40
Precip Type         None        None        Tstms
Min/Max Temp        79          60          88
Max/Min RH %        46          99          53
Wind 20FT/Early(MPH) Lgt/Var    Lgt/Var     Lgt/Var
Wind 20FT/Late(MPH) W 3         Lgt/Var     S 4
Precip Duration     0           0           0
Precip Amount       0.00        0.00        0.00
Precip Begin                                9 AM
Precip End                                  Continuing
LAL                 1           1           3
Inversion(Temp/Time) 58/0700    0100        62/0700
Dispersion                      Very Poor
Haines Index        4           4           4
DSI                 2                       2
Mixing Hgt(FT-AGL)  6000                    6500
Transport Wnd (MPH) SW 3                    SE 3
Vent Rate (MPH-FT)  18000                   19500
ADI Early           14 Gen Poor 16 Gen Poor 13 Gen Poor
ADI Late            16 Gen Poor 2 Very Poor 32 Fair
Max LVORI Early     9           5           9
Max LVORI Late      2           8           3
Min VSBY Early      7           8           3 Fog
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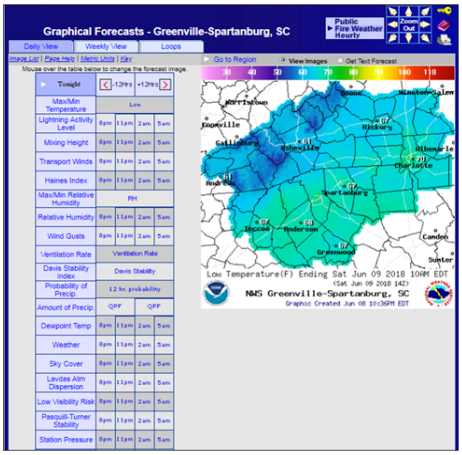

This an example of the Fire Weather Planning Forecast in text format and in graphical web format. This graphic can viewed here: https://graphical.weather.gov/sectors/midatlanticFireDay.php#tabs

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specific location when the winds and stability of atmosphere are forecasted to hold smoke close to the ground and aimed toward a housing area.

An IMET on station at a wildfire briefing potential weather hazards to fire-fighting personnel.

The NWS also has specially trained meteorologists (Incident Meteorologists or IMETs) who work on the front lines to support agencies fighting large wildfires. IMETs keep firefighters safe by interpreting weather information, assessing its effect on the fire, and communicating potential risks to fire crews. Once on-site, IMETs become key members of the incident command teams and provide continuous meteorological support for the duration of the incident. IMETs are located in numerous NWS offices across the country. Once a large wildfire has started, an IMET at any office may be contacted and given orders to travel to the site of the fire as quickly as possible. Usually an IMET is on scene within 24 hours to 48 hours of the initial call.

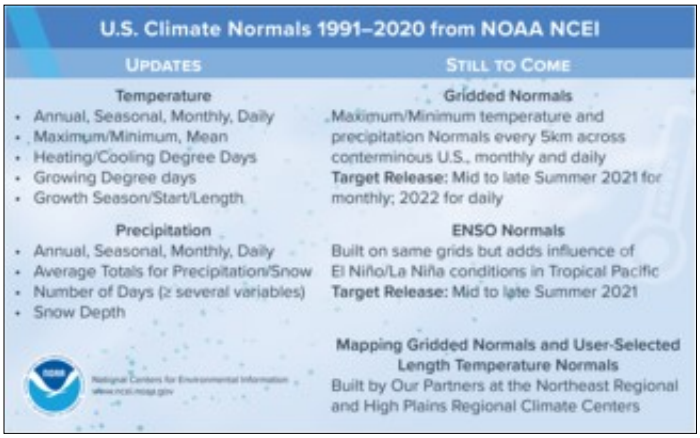
During the late Fall and early Spring, low brush and vegetation across the Carolinas and northeast Georgia can become quite dry. These periods are informally known as "Fire Weather Seasons" and this is when relative humidity values can drop very low, while winds can become strong and gusty in association with the passing of dry cold fronts. When these weather variables are forecasted to come together, our office will coordinate with area land managers and issue either a Fire Weather Watch or a Red Flag Warning. A Fire Weather Watch is generally issued 24 -72 hours in advance of hazardous fire weather conditions and a Red Flag Warning will be issued 12-24 hours before a probable dangerous event. These products alert all affected forestry, state, and media officials to impending adverse fire weather conditions and recommend no burning by the public as fires could get out of hand and spread easily. For more information on what you can do to prevent wildfires, please visit the links below for important information concerning outdoor fire safety.

- Scott Krentz, Meteorologist

North Carolina Forestry Service - https://ncforestservice.gov/fire_control/fire_control.htm
South Carolina Forestry Commission - https://www.state.sc.us/forest/fire.htm
Georgia Forestry Commission - https://gatrees.org/fire-prevention-suppression/wildfire-prevention/

NOAA Releases New 30-year Climate Normals for Years 1991 through 2020

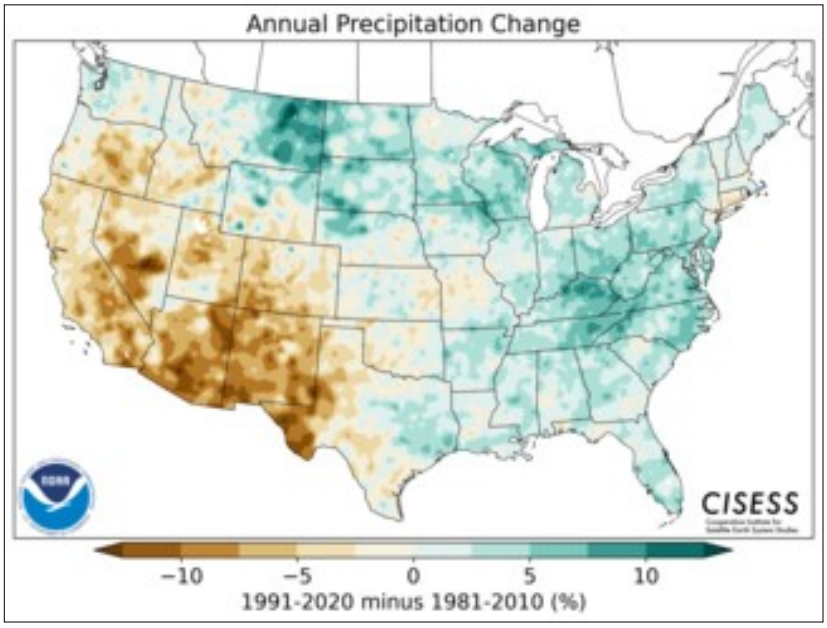
NOAA's new U.S. climate normals give the public, weather forecasters, and businesses a standard way to compare today's conditions to 30-year averages. Temperature and precipitation averages and statistics are calculated every decade so we can put today's weather into proper context and make better climate-related decisions. Normals may be familiar to most Americans by their inclusion in local daily weather information from television, radio, print, and digital media. Not only do normals indicate how conditions measure up for the nation as a whole, but also for specific locations—from Bangor, Maine to San Diego, California. And from Nome, Alaska to San Juan, Puerto Rico.



Climate normals are designed (and best-suited) for better understanding what is happening today. Rather than assess long-term climate trends, normals reflect the impacts of the changing climate on our day-to-day weather experience. Normals are not merely averages of raw data. Thirty years of U.S. weather station observations are compiled, checked for quality, compared to surrounding stations, filled in for missing periods, and used to calculate not only averages, but many other measures. These then provide a basis for comparisons of temperature, precipitation, and other variables to today's observations.

Why Update U.S. Climate Normals?

Member states of the World Meteorological Organization (WMO) are required to calculate their country's normals at ten-year intervals. Countries follow recommendations by the WMO, which provides a framework for international cooperation among meteorologists, climatologists, and hydrologists. The decadal update is the equivalent of the Census for those who use the data. It replaces the previous set of normals, which cover all 50 states and U.S. territories such as Puerto Rico and Guam. NCEI and its predecessors have been the official source for U.S. climate normals since the 1950s. New data come from approximately 8,700 National Weather Service stations operated by NOAA, which include Automated System Observing Stations (ASOS) and Cooperative Observer Program (COOP) stations.



Annual U.S. precipitation changes by percentage from the 1981–2010 U.S. Climate Normals to the newest data in the 1991–2020 Normals, released by NOAA in May, 2021. Decreases indicate a drier Southwest, and increases indicate wetter sections of the Northern Plains, Great Lakes region, and Southeast. Courtesy of CISESS.

Normals provide information about national and localized average temperature and precipitation as well as other parameters such as snowfall, heating and cooling degree days, frost and freeze dates, and growing degree days. Several new normals will be introduced for the first time, including seasonal normals representative of different states of the El Niño/Southern Oscillation (ENSO) and high-resolution gridded normals, which are data that represent climate normals at 5 km intervals north and south across the contiguous U.S. to allow for easier calculations and mapping of climate averages and departures from normal.

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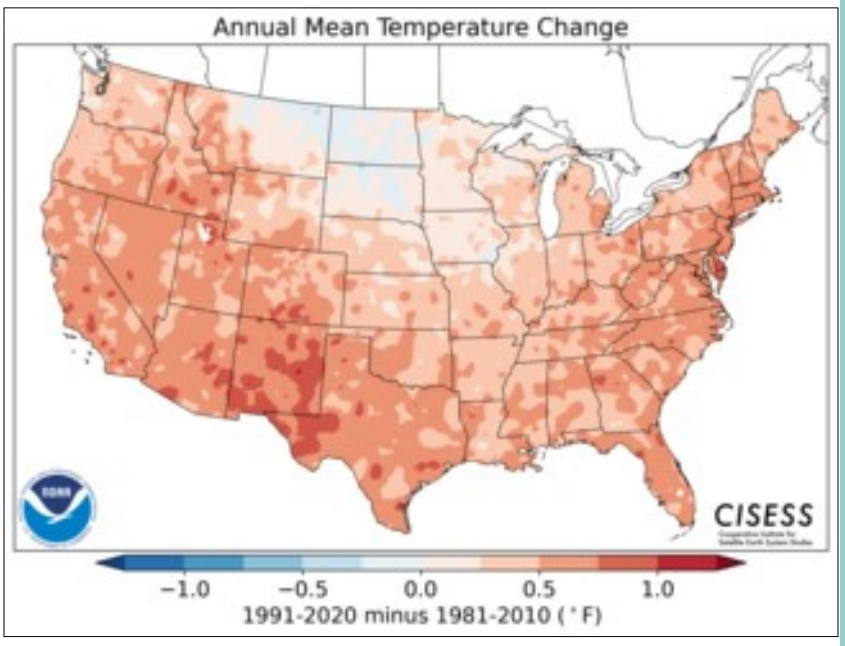
By comparing averages to weather observations, anyone interested in the conditions at specific locations can learn whether a variable is above, below, or near average. For instance, the average temperature during the February 2021 arctic-air cold outbreak in the Dallas–Fort Worth area was 42°F below normal on February 16, according to the 1991–2010 normals.

Along with the National Weather Service (NWS) and meteorologists and forecasters in the private sector, the new normals impact the work of numerous public and private stakeholders. These include the energy and agricultural sectors of the American economy, building design, infrastructure, construction, and several governmental organizations such as the USDA.

- Jeff Taylor, Meteorologist



Average annual temperature change in degrees Fahrenheit for the contiguous U.S. from the 1981–2010 U.S. Climate Normals to the newest data in the 1991–2020 Normals, released by NOAA in May, 2021. Averages indicate a warming pattern occurred in all but portions of the Upper Midwest and Northern Plains. Courtesy of CISESS.

Be Prepared for Winter Weather

Exposure to extreme cold, fires and poisoning due to the improper use of heaters, and vehicle accidents are just a few reasons as to why dozens of fatalities are reported each year due to winter weather, an overlooked significant threat. Now you may be thinking that the winter season across the Coastal Carolinas is nothing compared to, for example, the New England region. Well, we have our share of winter weather across the Carolinas, thus you should always be prepared.

In preparation for a winter weather event, keep in mind that the primary concern will be the loss of heat, power outages, and shortage of supplies if storm or proceeding conditions persist for more than one day.

Before winter weather strikes, be sure to take necessary precautions such as maintaining, cleaning, and annually inspecting chimneys and other heating equipment, and making sure your vehicle is prepared by having a full gas tank and inspecting the antifreeze levels, brakes, battery, and more!

For additional information, visit www.ready.gov

Safety Kit Checklist: Home & Work

- ❑ Flashlight and extra batteries
- ❑ Battery-powered NOAA Weather Radio
- ❑ Extra food and water (1 gallon of water per person, per day)
- ❑ Prescription medicines
- ❑ Special items for infant, elderly or disabled family members
- ❑ Cash
- ❑ Emergency phone numbers
- ❑ Important documents
- ❑ Blankets and extra clothing
- ❑ First aid supplies
- ❑ Fire extinguisher/smoke alarm/carbon monoxide detector
- ❑ Emergency heat source (fireplace, space heater, etc)

Safety Tips: Outdoor Animals & Pets

- Move animals to sheltered locations
- Have extra feed on hand or near feeding areas
- Have water available (animals may die from dehydration)

Source: NOAA NWS Weather-Ready Nation Winter Safety Campaign

Tropical Storm Fred Remnants Bring Catastrophic Flooding and Weak Tornadoes to Portions of the Western Carolinas and Northeast Georgia

Tropical Storm Fred made landfall in the Florida Panhandle during the afternoon of 16 August 2021 and steadily increased in speed as the center of the remnant circulation lifted north through Alabama and Georgia over the subsequent 24 hours before moving into the southern Appalachians on the afternoon of the 17th (Fig. 1). Tropical moisture and strong southeast upslope flow into the Blue Ridge Mountains resulted in widespread showers and some thunderstorms producing extremely heavy rainfall rates. By the time the rain tapered off by the end of the 17th, 24-hour rainfall amounts of 5-12 inches were reported across portions of the mountains and foothills. This was in addition to a small area of 5-10 inch amounts that fell across portions of the southern North Carolina Mountains during the morning of the 16th. The result of this rainfall was significant to catastrophic flash flooding across portions of the French Broad and Pigeon River basins, including some of the worst flooding to impact these areas in almost 20 years. The most severe flooding occurred in portions of southern and central Haywood County, where a number of fatalities and hundreds of millions of dollars in damage occurred. In addition, several brief, weak tornadoes touched down across the area.

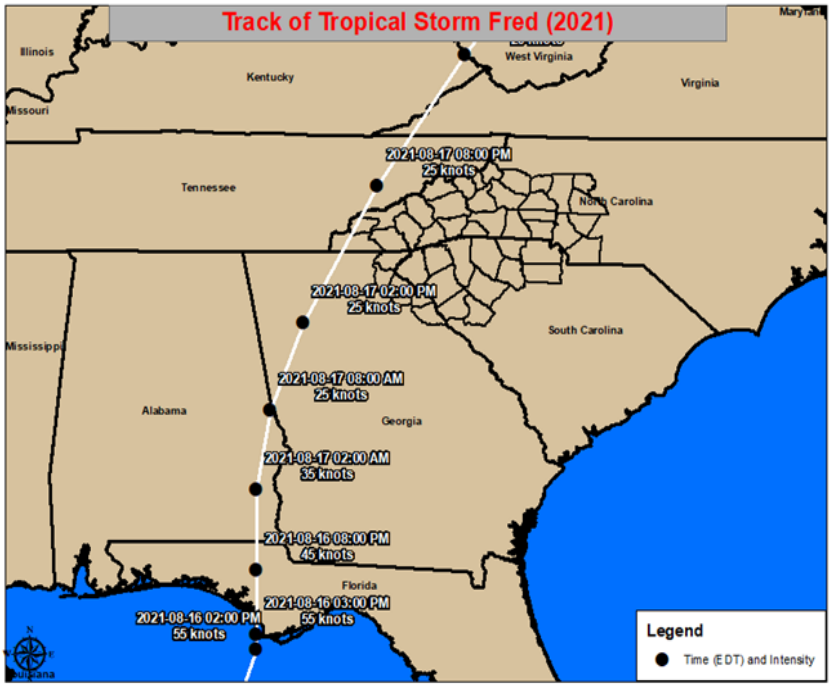


Figure 1. Track of the center of Tropical Storm Fred and its remnants 16-18 August 2021. Labels are the time and peak sustained wind speed at the dotted locations.

1) 16 August 2021 Flash Flooding

Hours before Fred made landfall, conditions were becoming increasingly favorable for heavy rainfall across the southern Appalachians as moisture increased and a weak southeast upslope flow developed. Areas of precipitation with scattered heavy rain showers and thunderstorms developed over the southern mountains of North Carolina during the early morning hours (Fig. 2) and persisted through much of the morning. The persistent upslope flow enabled heavy rain showers to repeatedly develop and move over the higher elevations along the border of Jackson and Transylvania Counties. By the time the showers tapered off late on the morning of the 16th, rainfall amounts of six to twelve inches, with locally higher amounts were reported in the headwaters of the French Broad and Davidson Rivers in Transylvania County.

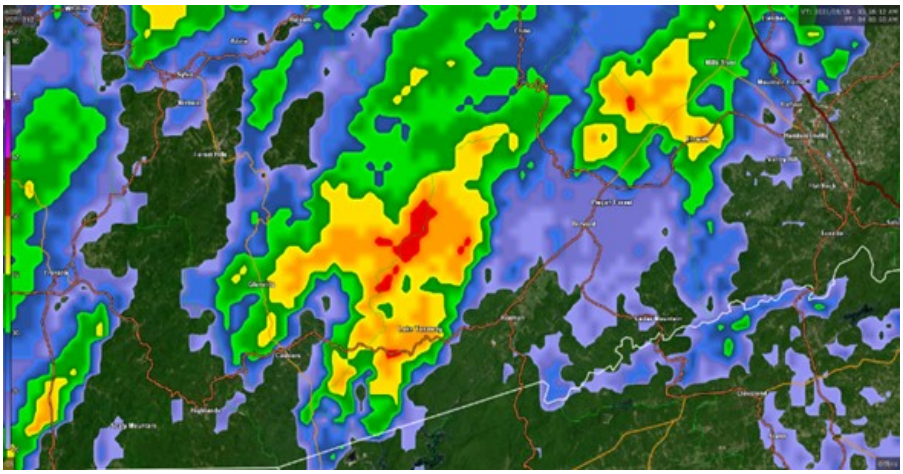


Figure 2. Composite reflectivity from the Greer, SC (KGSP) Weather Service Radar 1988 Doppler at 3:56 AM EDT on 16 August 2021.

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Flash flooding developed throughout the upper reaches of the French Broad River, including in the Balsam Grove area beginning in the early morning. The flood wave quickly moved down-stream to the Rosman community, where a stream gauge (Fig. 3) indicated the highest level on that part of the river in almost 30 years (17 August 1994 during Tropical Storm Beryl) and the fourth highest level on record (Continuous obser-vations at that site date back to 1935). Multiple structures along the river were inundated in the town of Rosman, including on Depot St, Highway 178, Main St, and Chestnut St.

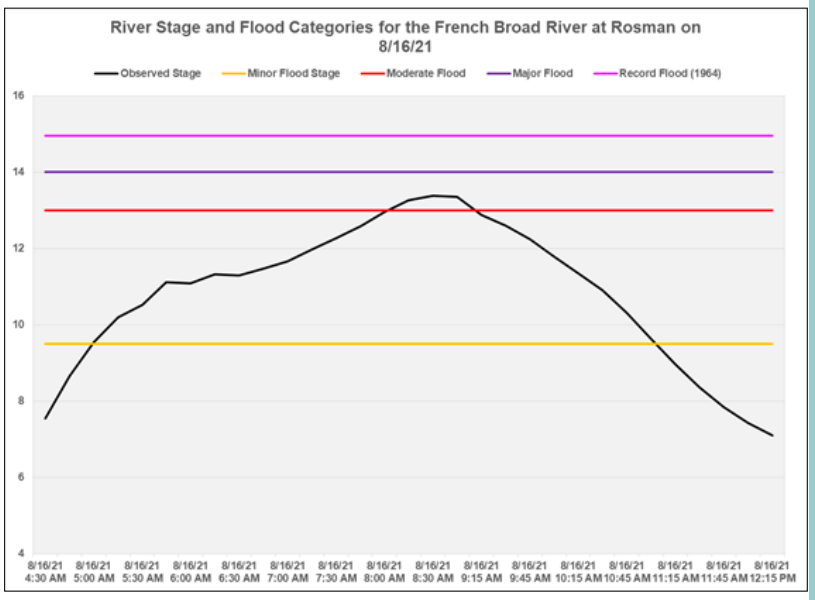

Figure 3. Stream level observations from a gauge on the French Broad River at Rosman, NC on 16 August 2021. The black line traces the observations. Minor (orange line), moderate (red), major (purple), and record (pink) flood levels are also plotted.

2) 17 August 2021 Flash Flooding

By late morning on 17 August, the center of Fred's remnants had moved to west central Georgia. Northeast of the cyclone's center, widespread moderate to heavy rainfall, with embedded tropical rain showers and a few thunder-storms overspread northeast Georgia, upstate South Carolina, and the North Carolina mountains throughout the morning. Meanwhile, southeast low level upslope flow continued to intensify as the system drew nearer. This result-ed in enhancement of heavy rainfall rates along southeast-facing slopes of the Georgia and Carolina Mountains. This area of rain steadily lifted north throughout the morning into the afternoon as drier air filtered into the area in the mid-levels of the atmosphere. However, this drying resulted in areas of clearing afternoon skies across portions of north Georgia and upstate South Carolina. Resultant surface heating combined with the drying and slight cooling of the mid-levels allowed for relatively strong destabilization of the atmosphere in these areas. The unstable air feeding into the back edge of the precipitation shield resulted in intensification of embedded heavy rain showers, while also allowing for now bands of showers and thunderstorms to develop. As these areas of heavy precipitation moved north/northeast and pivoted across the North Carolina Mountains, very heavy rain falling over locations that were already near saturation from the heavy rain on the 16th caused major flash flooding to develop in the watersheds north and south of the Balsam range along the border of Transylvania and Haywood Counties.

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For the second day in a row, significant flash flooding developed near the upper reaches of the French Broad River after 3 to 6 inches of rain fell in the headwaters in just a few hours. This was on top of the 6-12 inches that fell during the morning of the 16th. Flooding was slightly worse in the Rosman and Balsam Grove area than what was observed on the 16th, with the stream gauge at Rosman reaching its second highest level on record (4 October 1964). Multiple structures along the river were once again inundated, including on Depot St, Highway 178, Main St, and Chestnut St in Rosman. Flash flooding also developed along the Davidson River in the Pisgah Forest area, overflowing portions of Davidson River Rd and Deavor Rd and inundating several businesses near the intersection of Highways 64 and 276.

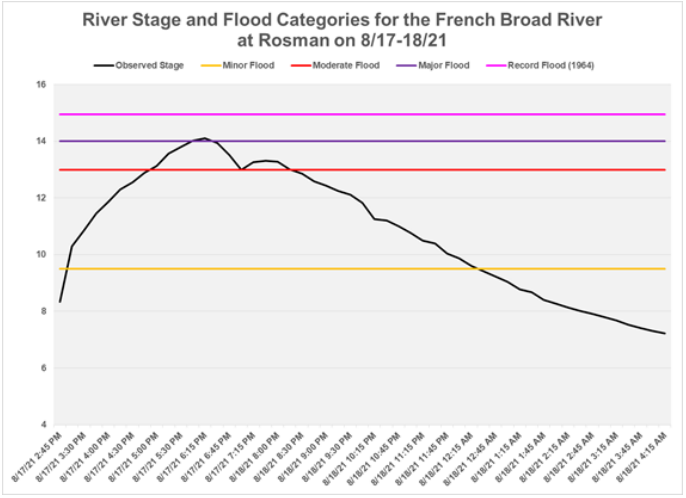

Figure 4. Same as in Fig. 3 except for 17-18 August 2021.

Meanwhile, catastrophic flash flooding developed in the Pigeon River basin in Haywood County, specifically along the East Fork of the Pigeon in the Cruso community after four to seven inches of rain fell in just a few hours. Water from the stream combined with a large landslide swept downstream through the community causing widespread damage. Six people were killed in Cruso, four of them in a campground along the East Fork, where numerous recreational vehicles and automobiles were swept away. A stream gauge on the East Fork a few miles downstream from Cruso indicated the river rose around 2.5 feet in just 30 minutes at the peak of the flooding and exceeded its record stage by more than three feet (Fig. 5, 17 September 2004, during Tropical Cyclone Ivan). Water from the two forks of the river rushed downstream to the main channel of the Pigeon, causing major flooding along the stream in Canton and Clyde for the first time since Ivan. Numerous buildings in downtown Canton were inundated. In total, around 700 homes were impacted by flooding, with a couple of hundred of those destroyed. Numerous vehicles were also swept away or otherwise damaged and hundreds of people were rescued. Dozens of roads were flooded, with many roads and bridges damaged or destroyed.

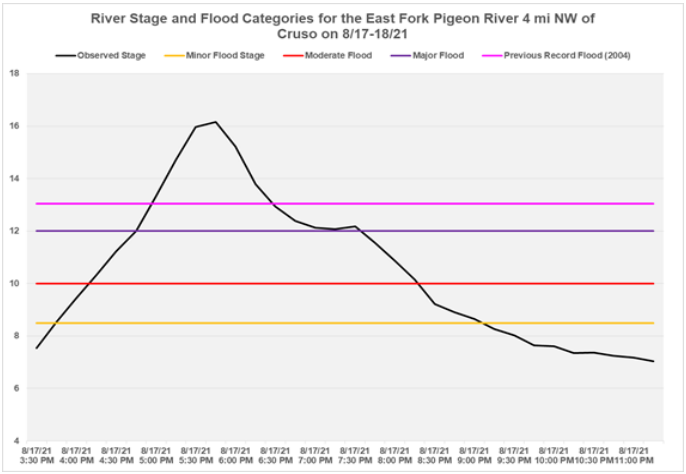

Figure 5. Stream level observations from a gauge on the East Fork of the Pigeon

By the time the rain tapered off during the late afternoon and evening, 36-hour rainfall totals generally ranged in the three to six inch range across the mountains and foothills (Fig. 7), with a small area of one to two feet in northern and western Transylvania County and adjacent areas of Jackson and Haywood Counties (Fig. 8). The rainfall resulted in additional areas of flash flooding across northeast Georgia and the mountains and northern foothills of North Carolina, but this flooding was much less significant that what occurred near the headwaters of the French Broad and Pigeon Rivers.

Figure 6. FLash flood and debris flow damage at a campground along the East Fork

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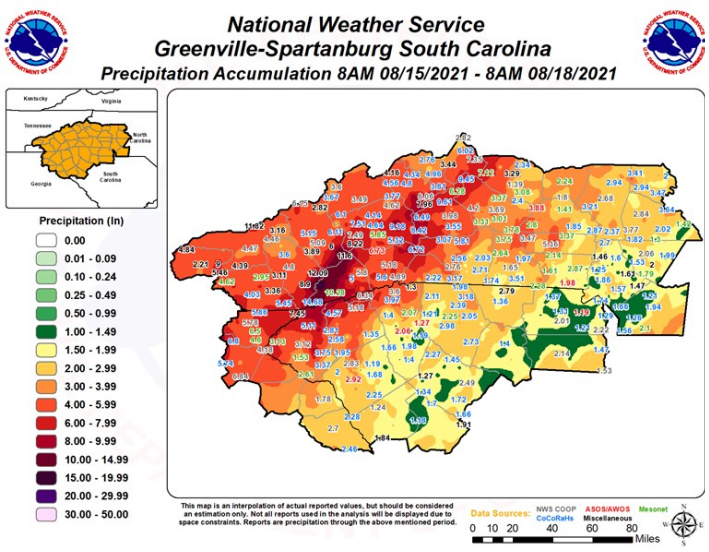

Figure 7. Analysis of observed rainfall amounts in the NWS Greenville-Spartanburg (GSP) County Warning Area (CWA) for the 60-hour period ending at 8:00 AM on 18 August 2021.

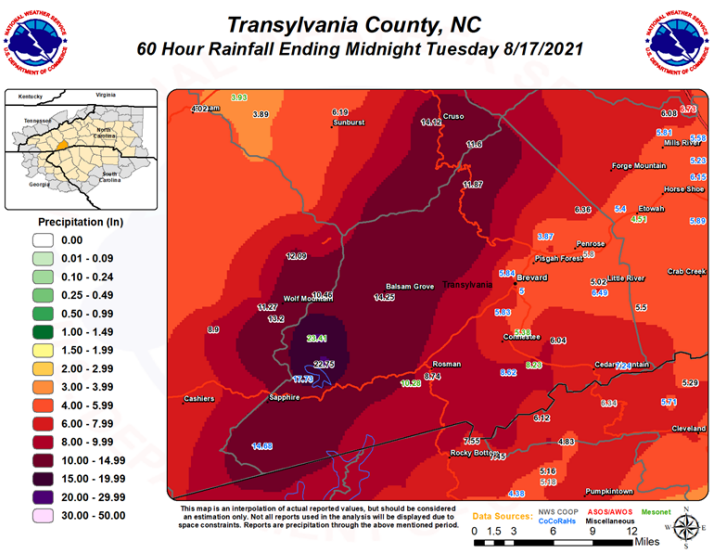

Figure 8. Analysis of observed rainfall amounts centered on Transylvania County, NC for the 60-hour period ending at midnight EDT on 18 August 2021.

3) 17 August 2021 Tornadoes

Another consequence of the intensifying low level southeast flow accompanying the approach of Fred's remnants was increasing wind shear. This wind shear combined with the destabilizing atmosphere to produce favorable atmospheric conditions for tornado development. Several weak (i.e., EF0 and EF1) tornadoes indeed developed from late morning through the afternoon (Fig. 10). The first tornado, rated EF1 developed with a scattered thunderstorm that developed over the northwest North Carolina Piedmont during the late morning. Damage was primarily limited to uprooted and snapped trees near the border between Iredell and Davie County. Several EF0 tornadoes followed within the rain band that moved across northeast Georgia and western Upstate South Carolina during the afternoon.

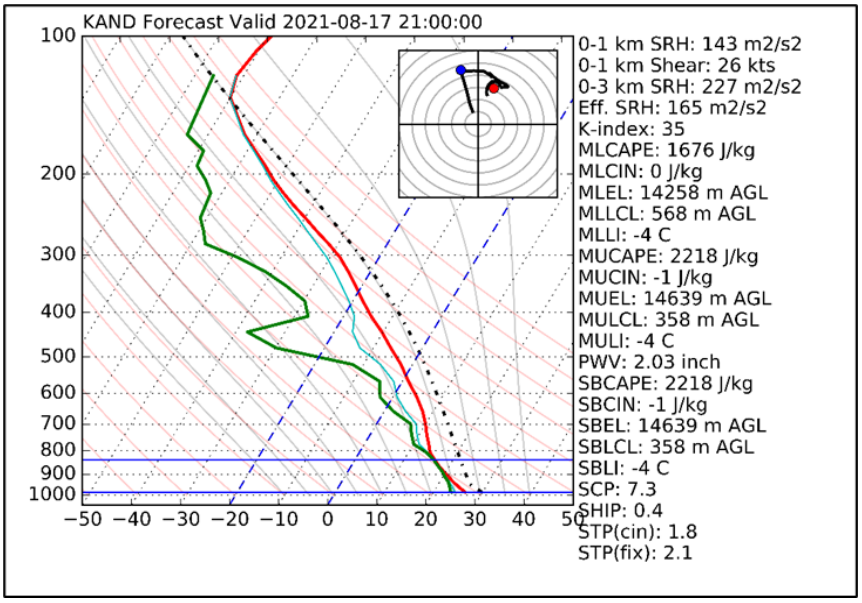

Figure 9. Skew T/log p plot of the vertical profile of air temperature (red line) and dewpoint temperature (green line) at Anderson, SC from the 2:00 PM EDT 17 August 2017 run of the Rapid Refresh (RAP) model valid at 5:00 PM EDT on 17 August 2021. Temperature (degrees C) is skewed along the horizontal scale. The logarithmic vertical scale is atmospheric pressure in mb. Values of various parameters are listed along the right side of the image. Mixed layer Convective Available Potential Energy (MLCAPE) of 1676 J/kg represents moderate levels of atmospheric instability. Effective Storm Relative Helicity of 165 m2/s2 indicates good potential for storm updrafts to rotate and possibly produce tornadoes.

The most notable tornado of the event occurred during mid-afternoon in the city of Mauldin in Greenville County, SC (Fig. 11). This EF1 tornado moved through the center of the city, downing numerous trees and power lines and causing mostly minor damage to several apartment complexes just east of U.S. Highway 76. A couple of additional weak tornadoes developed across extreme northern Laurens County within a trailing rain band that moved through the Upstate during the evening.

- Justin Lane, Lead Meteorologist

See Page 10 For Additional Figures

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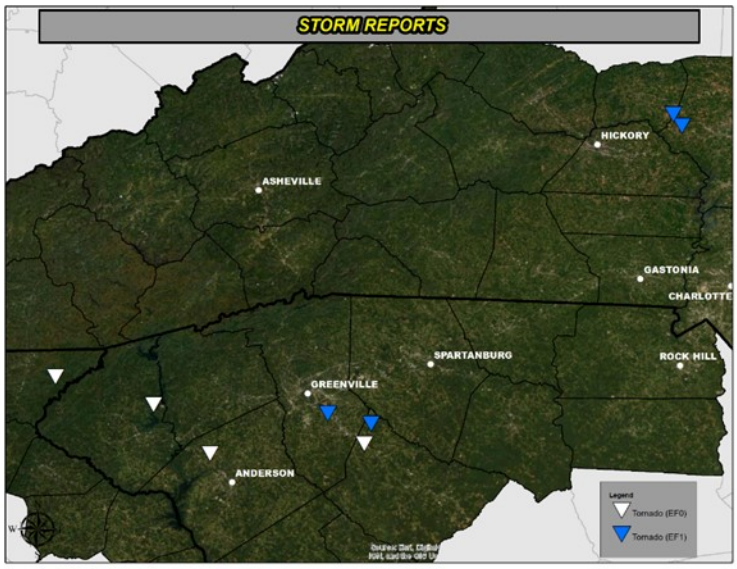


Figure 10. Map of confirmed tornandoes in the GSP CWA on 17 August 2021.

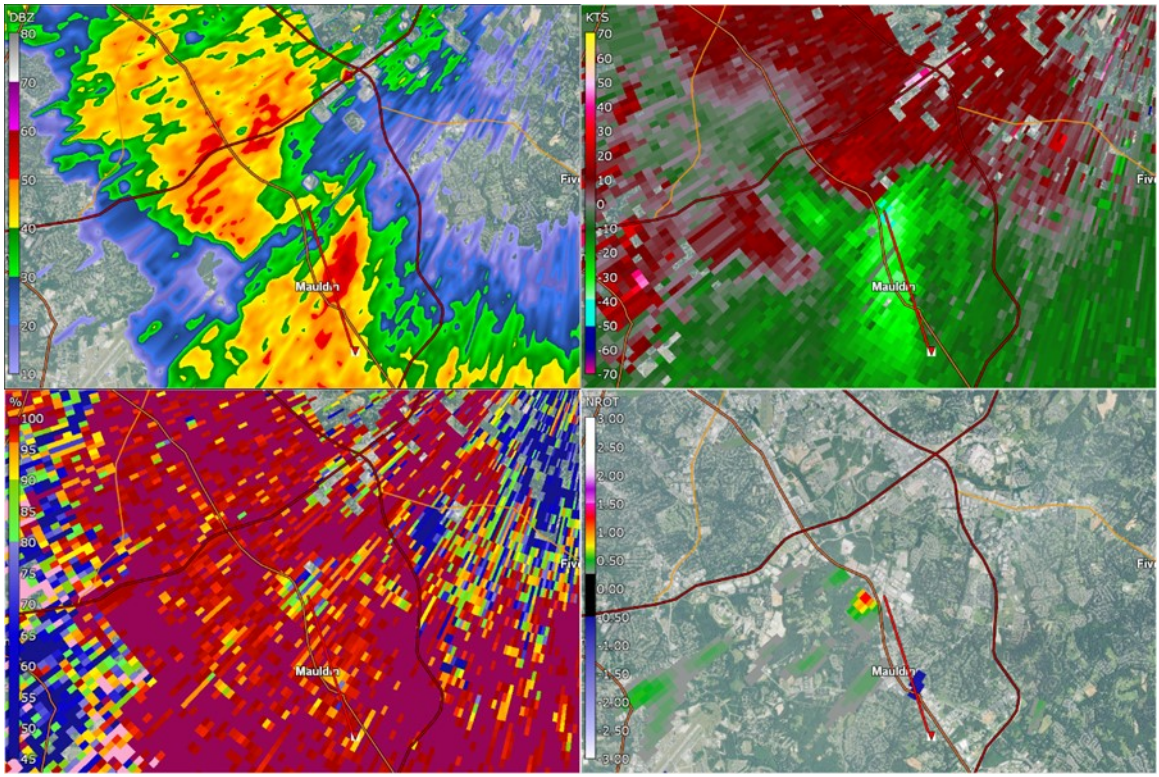


Figure 11. Reflectivity (upper left), storm relative velocity (SRV, upper right), correlation coefficient (CC, lower left), "normalized rotation" (lower right) at 0.2 degree elevation from the KGSP WSR-88D at 2:57 PM EDT on 17 August 2021. The time is near the time of dissipation of a tornado over Mauldin, SC. Rotation is visible in the SRV product north of Mauldin where velocity changes direction from toward the radar (green) to away from the radar (red). Tornado debris signature is visible as the small area of blue and green colors in the CC product collocated with the center of rotation. Image was created with Gibson Ridge Analyst2 software.

Did You Know?

Carbon monoxide can accumulate from:

- Furnaces
- Water heaters
- Boilers
- Wood stoves
- Fireplaces
- Charcoal grills
- Gas cooking stoves
- Clothes dryers
- Gas or kerosene space heaters
- Automobile exhaust

Carbon Monoxide: The Invisible Killer

Carbon monoxide (CO) is a deadly odorless, colorless, and poisonous gas that is the cause of fatalities each year, especially during the winter weather season. It is a result of the incomplete burning of various fuels (ie coal, wood, kerosene, propane) from equipment such as generators and cars.

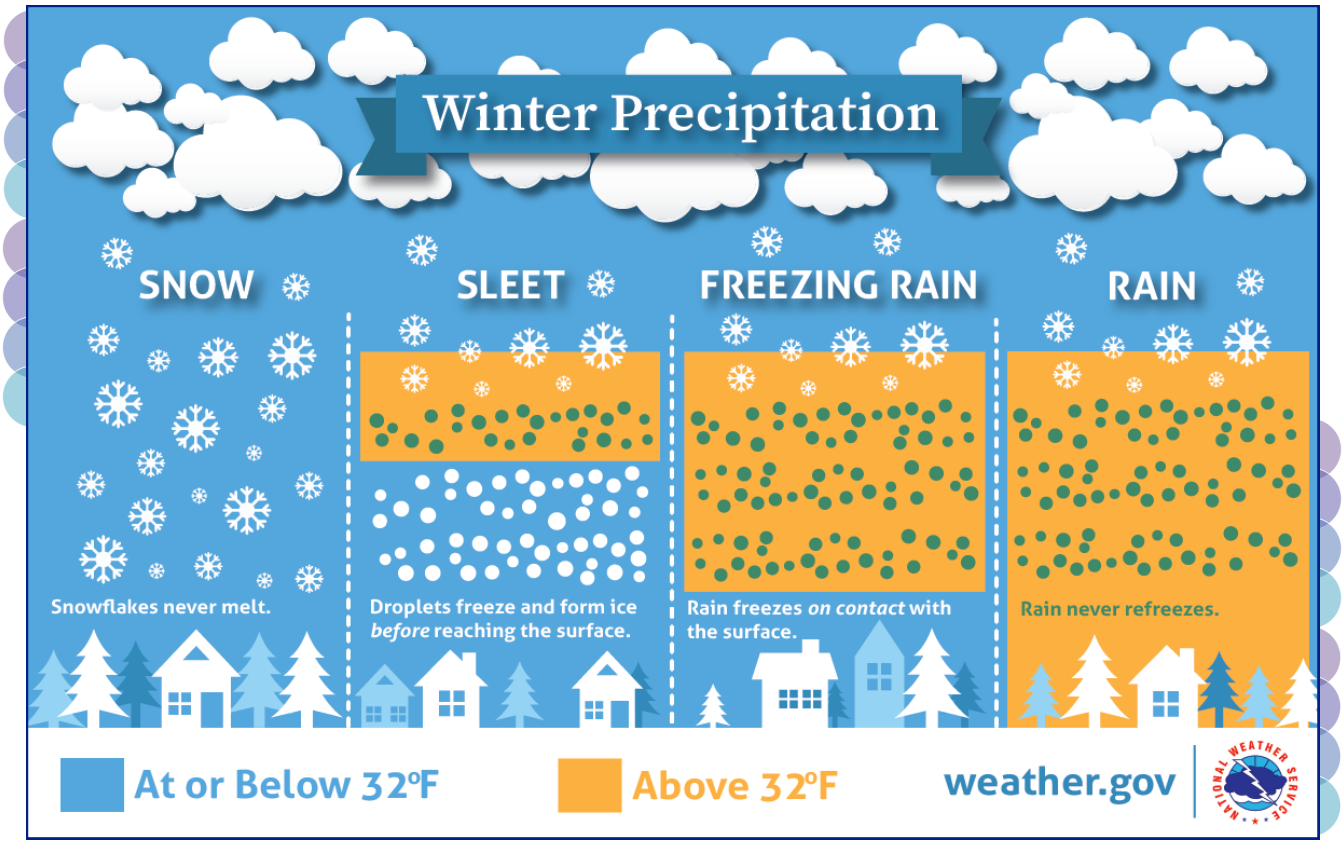
Ways to Prevent CO Poisoning

- Never operate equipment in enclosed spaces (garage or locations in a home)
- Never leave car running in an attached garage (even with garage door open)
- Never burn charcoal inside home, vehicle, garage
- Never use gas appliances to heat your home (ovens, clothes dryers, etc.)
- Never operate equipment where people are sleeping
- Install carbon monoxide alarms in central locations on every level of your home
- If carbon monoxide alarm sounds, move quickly to fresh air

SYMPTOMS OF CO POISONING

- Dizziness
- Nausea
- Fatigue
- Headache
- Shortness of breath
- Vomiting*
- Mental confusion*
- Loss of consciousness*

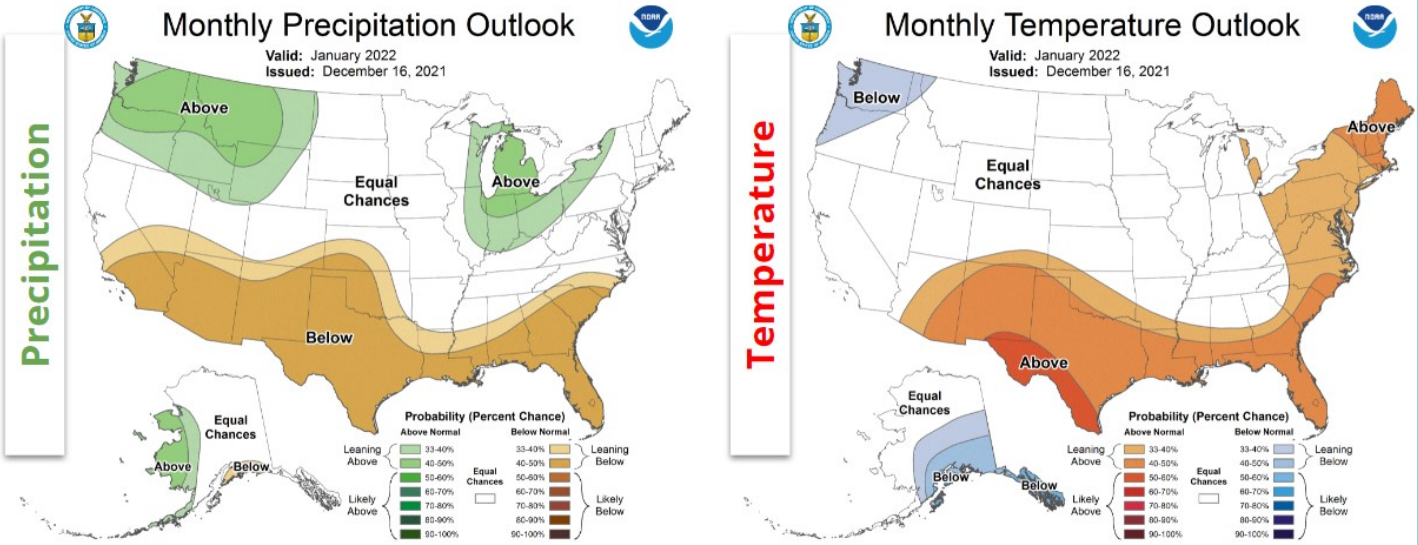
**High level of CO Poisoning*



Will there be rain, ice or snow? This graphic explains how having different layers of warm and cold air between the clouds and the ground determines the type of precipitation that hits the ground. To learn more, visit http://www.nssl.noaa.gov/education/svrwx101/winter/types/

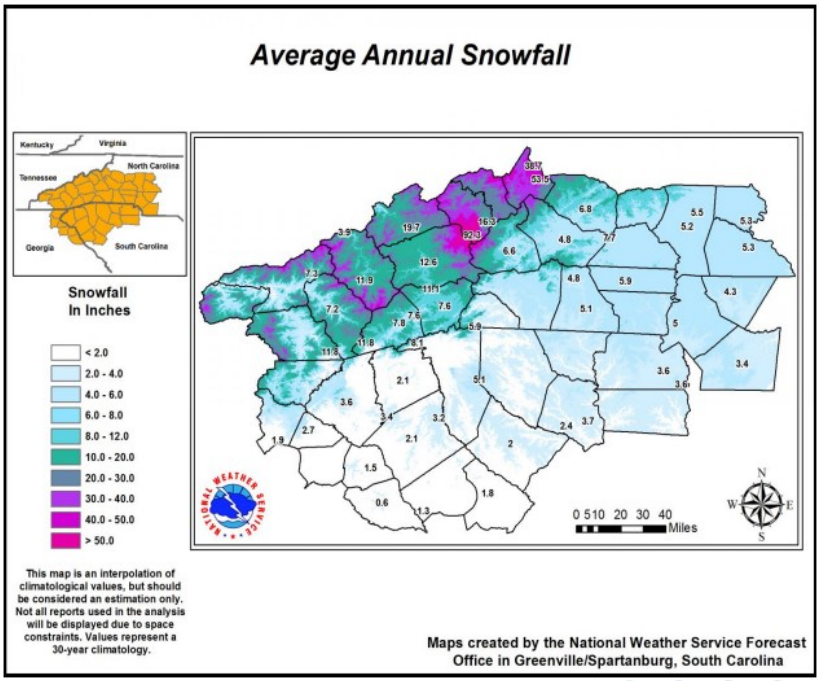
Winter 2021-2022 Outlook for the Western Carolinas and Northeast Georgia

We have now entered meteorological winter, which started on December 1st. So you may be thinking, what might we expect for the rest of the winter? The outlook issued by the Climate Prediction Center (CPC) on December 16th indicated for January that near normal temperatures are favored with near to below normal precipitation for the region. Their prediction is largely reflective on the ongoing La Nina across the central to eastern Equatorial Pacific Ocean. This setup would be somewhat similar to the weather pattern we've experience in the latter half of fall.



Climate Prediction Center January 2022 precipitation (left) and temperature (right) outlooks. Issued December 16th 2021.

However, there is some indication that high latitude blocking may set up by January, which can direct colder and more active weather our direction. This could pave the way for colder and stormy periods, in spite of the ongoing La Nina. Closer to home, above normal sea surface temperatures off of the Southeast Coast may also fuel more frequent or strong winter storms than would typically be expected with the ongoing La Nina. The energy reservoir may also be capable of supporting severe weather somewhere across the south through early January. There is some potential that recent drought and elevated fire danger focused across the Piedmont could see gradual improvement through the remainder of winter should near normal precipitation occur.



For the snow lovers out there, seasonal snow prediction is notoriously difficult, especially outside of the mountains where one snowstorm can make or break a season. Weak to moderate La Nina's (like what we are experiencing) typically lead to below normal snowfall. However, high latitude blocking is at least as important for snowfall across the region and will be something to watch (i.e. North Atlantic Oscillation or Arctic Oscillation) heading into 2022.

- Robbie Munroe, Meteorologist

NATIONAL WEATHER SERVICE
Greenville-Spartanburg SC

1549 GSP DRIVE
GREER, SC 29651
(864) 848-3859

OFFICE WEBSITE
WWW.WEATHER.GOV/GSP

Editor-in-Chief: Robbie Munroe

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