

National Weather Service
Raleigh, North Carolina

Changing Skies



Volume 1,
Issue 1

Winter
2003

Are you ready for the next North Carolina winter?

By GAIL HARTFIELD and KERMIT KEETER

Before the National Weather Service office in Raleigh composes a single statement, advisory, watch, or warning for winter weather, and before we even mention daunting words like “snow” and “ice” in the forecast, we thoroughly analyze satellite imagery, surface observations, upper air data gathered from weather balloons, computer forecast models, and other data. We also must throw another bundle of information into the mix: the “psychological factor”. Truth is, as soon as people in central North Carolina hear even a casual mention of wintry weather, a frenzy of preparation and chatter ensues. Milk and bread are bought, batteries and generators are cleaned out of the stores, and public officials schedule meetings. Comments such as “They’re saying it may snow over the weekend!” can be heard in workplaces and homes across the area. Certainly, critical users of NWS products have very specific needs that must be met when the possibility of winter weather is in the forecast (see Table 1). This puts the NWS in a

Table 1. (Continued on page 3)

What RAH Users Need (according to a recent informal survey)	
Emergency Managers	12-24 hours of lead time for essential winter weather preparation
School officials	On-time forecast issuances (decision to close schools often done by 5 am)
TV media	Timely winter storm watch / warning products (so the TV graphics can be constructed)
Other NWS forecasters	Early forecast discussions and coordination (to help set the stage)

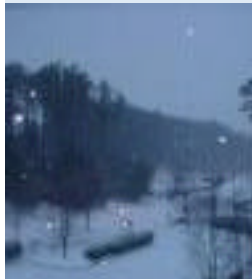
Hurricane Isabel hits North Carolina

By DOUG SCHNEIDER and
JEFF ORROCK

On September 18, Hurricane Isabel made landfall as a Category 2 hurricane along the Outer

Banks of North Carolina near Cedar Island. The storm center then tracked northwest passing near Williamston and Roanoke Rapids. Winds gusts were measured over 100 mph at Ocracoke. In Central North Carolina,

North Carolina to observe Winter Weather Awareness Week



By JEFF ORROCK

The National Weather Service and North Carolina Division of Emergency Management will declare the week of December 1st as Winter

Weather Awareness Week in North Carolina. Each day this week National Weather Service offices serving North Carolina will issue Public Information Statements discussing how winter weather impacts North Carolina. These statements will be broadcast over NOAA Weather Radio and will also be posted on the Internet (weather.noaa.gov/rah).

North Carolina experiences a wide variety of winter weather every year. One of the most dangerous and common winter weather threats we experience is ice. Heavy accumulations of ice, in the form of freezing rain and sleet, can bring down trees, power lines and telephone poles. This can disrupt power and communications for days as many residents experienced last year during the December ice storm when over 126 million residents from the Triangle to the mountains lost electricity. Even small accumulations of ice can cause extreme hazards to motorists and pedestrians. When driving in freezing conditions, the roadway may appear to be wet, however, what appears to

(Continued on page 5)



winds of 35 to 65 mph blew down trees and power lines as far west
(Continued on page 3)

Inside this issue:

Severe Weather Season Review 2

Skywarn: Our eyes and ears 2

NWS Raleigh winter products 4

Cooperative observers 4

Climate watch: a look at this winter 5

Looking back: the Dec. '02 ice storm 6

What do you know about North Carolina winters? Take our quiz!

- ◆ How cold was the coldest day ever in Greensboro, Raleigh, and Charlotte?
- ◆ The December 2002 ice storm did major damage to trees and power lines, but very little ice accumulated on the roads. Why?
- ◆ What was the most snowfall in a day in Greensboro? How about Raleigh?
- ◆ When was the coldest winter (Dec.-Feb) in Raleigh (the average temperature was 34.3°F)?

See inside for answers!

SKYWARN: Our eyes and ears across central North Carolina

By JEFF ORROCK

The Raleigh NWS office would like to sincerely thank all of you who helped further the mission of protection of life and property by providing timely and important weather information. The Raleigh NWS office trained over 1000 spotters this past year, placing the total SKYWARN network at over 3000 persons strong. Your ground truth storm reports aided forecasters in their warning decision making processes and played a key role helping us to issue warnings faster with more accurate information. Your storm reports have also been used in warning verification, important for us to measure the accuracy and timeliness of severe thunder-



storm, tornado, and flash flood warnings. For the 2003 season the Raleigh NWS office provided an average warning lead-time of 18 minutes, with a probability of detection of nearly 92 percent. Our false alarm rate was around 31 percent. Storm reports live on beyond verification and are entered into a national severe weather database, which can be accessed online by visiting www.spc.noaa.gov.

For this winter season we hope to again call on SKYWARN. Last winter many HAMS in both the Triad and Central Carolina SKYWARN spotter groups provided one to 3 hourly reports of temperature, type of precipitation and accumulation during winter storms. These winter weather reports allow forecasters to accurately track the

progression of cold air and precipitation type across the area. Everyone at the Raleigh NWS office commented on how useful this type of information is in real time, and area media meteorologists have found the data immensely helpful. As everyone knows, winter weather creates an array of problems and conditions can change rapidly. We look to again utilize SKYWARN as our eyes in the field this winter.

The Raleigh HAM station, WX4NC, is also undergoing a face-lift. An additional dual band radio is being installed and will be hooked up to a new 17-foot, 200-watt antenna. This will provide the station with the capability of monitoring Central Carolina SKYWARN, Triad SKYWARN, IRLP, the Sandhills net, and the Rocky Mount-Wilson net. We will be meeting this winter to discuss staffing of WX4NC with the expanded coverage capability.

2003 Severe Weather Season: One of the Most Active On Record

By DOUG SCHNEIDER

The 2003 severe weather season will be remembered as one of the busiest in recent memory in the Raleigh warning area. There were 266 reported occurrences of severe thunderstorms, tornadoes, and flash flooding from March through August. In the past 18 years, only the 1998 season was more active. Thanks to timely reports from our Skywarn spotters and county emergency management officials, warnings were issued for 92% of this season's events with excellent lead time. The average warning lead time was 19 minutes for severe thunderstorms and tornadoes, and 31 minutes for flash floods.

Flash flooding was especially dangerous in Central North Carolina this season. There were 98 flash flooding events, causing in five deaths and at least \$3.65 million in damage. The worst event was on the evening of June 16th, when

thunderstorms produced copious amounts of rain in Stanly County, flooding many creeks and roads. Radar estimated that between 4 and 6 inches of rain fell within two hours. All five of the deaths that occurred this year happened during this

In the past 18 years, only the 1998 season was more active.

event, when people tried to cross bridges that were flooded. Several other people had to be rescued when their cars were stranded in flooded roads near Norwood and Locust. Heavy rain in Hoke and Cumberland counties on May 25th and 26th resulted in several dam breaks near Rockfish and Hope Mills, and some homes and businesses were damaged. On July 13th, extensive flooding in Mebane in Alamance County forced evacuations, and resulted in over 30 homes and businesses being damaged.

There were several large hail events this season, and a few tornadoes. Severe thunderstorms on May 3rd produced golfball and baseball sized hail in parts of Davidson, Scotland, Richmond, Montgomery, and Stanly counties. Over \$7 million in crop and structural damage was reported from these storms. On May 9th and 10th, severe thunderstorms produced penny to golfball sized hail from Granville to Edgecombe counties. Also on May 9th, a tornado damaged a marina on the southern end of Kerr Lake in

Vance County. A tornado in Moore County on July 2nd blew down trees and damaged some homes and vehicles between Aberdeen and Vass. Brief tornado touchdowns also occurred in Warren, Nash, Anson, and Chatham counties, resulting in some trees and power lines being blown down. None of the tornadoes that occurred this year were stronger than F0 on the Fujita Scale.

The increase in severe weather and flash flooding this year can partly be attributed to a persistent upper level trough over the eastern United States for much of the summer, which provided a flow of moist air from the south. This pattern differs from the previous four years, which were characterized by a high pressure ridge over the region that caused drought conditions through most of the summers.



Baseball-sized hail in Greensboro in May.



Severe flooding in Davidson county in September.

Are you ready for the next North Carolina winter?

(Continued from page 1)

unique position of having to issue a forecast that is as quality, timely, and specific as the science allows, while striving to avoid both alarming the public unnecessarily and wasting the time and money of local and state officials.

NWS Raleigh, aiming to operate with a good balance of lead time and accuracy, has developed a set of target lead times for our issuances of winter weather outlooks, watches, and warnings (Table 2). These guidelines were based on known user needs, as well as statistics of NWS forecasts from the last decade, which show a notably decreased success rate when winter weather warnings are issued too far in advance.

Table 3 summarizes the minimum probabilities for winter weather product issuances. If any of these products have been issued, our forecasts will contain at least the chance of precipitation indicated.

Forecaster confidence plays a large role in the decisions of what winter weather products to issue and when to issue them. Typically, when a forecaster's confidence of a winter weather event is low, the wording within our products is generally more conservative and less specific in terms of timing, areas affected, and precipitation amounts. Conversely, a highly confident forecaster will be less conservative and provide more specific information.

We hope this gives you a better understanding of the reasoning behind the issuances of our special

Lead Times (time between product issuance and event onset)			
Products	Recommended (our target lead time)	If confidence is very high...	NOT recommended
Winter Weather Outlooks	48 hours	60 hours	beyond 60 hours
Winter Storm Watches	24 hours	36 hours	beyond 36 hours
Winter Storm Warnings/Advisories	12-18 hours	24 hours	beyond 24 hours

winter weather products.

Table 2 .

Product	Forecast must have a probability of wintry weather of....
Winter Weather Outlooks	40% or better chance of winter storm conditions
Winter Storm Watches	50% or better chance of winter storm conditions
Winter Storm Warnings/Advisories	60% or better chance of winter storm or winter weather advisory conditions

Table 3 .

Hurricane Isabel hits North Carolina

(Continued from page 1)

as Greensboro. Within the Raleigh warning area, Halifax County sustained the greatest damage as numerous trees and power lines fell across roads making travel difficult countywide. The strongest winds measured at Roanoke Rapids were sustained at 44 mph with gusts to 62 mph. Rocky Mount and Goldsboro also measured gusts near 60 mph. Flooding also caused problems across the Coastal Plain. Several creeks and roads, including Fishing Creek near Enfield, flooded in Halifax and Edgecombe counties. The maximum measured rainfall of 6.65 inches was recorded at Roanoke Rapids in a 24 hour period.

The National Hurricane Center (NHC) forecast track of Isabel remained on target throughout the storm's life. The new 4 and 5 day forecast provided by NHC proved highly useful for State Emergency Management and the US Navy. State Emergency Management officials began conference calls with the National Weather Service and other state agencies the Friday prior to landfall. As the storm edged closer, coordination and preparations were stepped up, and by Tuesday morning the National Weather Service in Raleigh was heavily involved providing briefings to local and state officials ensuring that decision makers in each county were well aware of impending dangers.

Although Hurricane Isabel will not be

remembered in central North Carolina as well as Hurricanes Fran and Floyd, for many residents along the coast and in northeastern North Carolina this was their worst disaster in decades. Over 1 million people in North Carolina lost power during Hurricane Isabel. In order to find a past storm causing this much destruction along the Outer Banks you have to go back to the September Hurricane of 1933 which made landfall just south of Cape Hatteras as a Category 3 storm. The 1933 Hurricane devastated the Outer Banks as well as many Pamlico Sound communities such as Oriental, Swanquarter, New Bern, and Washington. To learn more about past hurricanes visit the NHC archives at www.nhc.noaa.gov/pastall.shtml.

In North Carolina six fatalities resulted from Hurricane Isabel, however, none of these fatalities occurred as a direct result of the storm. Despite the storm's incredible storm surge and wind damage miraculously no one in North Carolina died during landfall when the winds were the strongest and storm surge the highest. Fatalities in North Carolina resulted from secondary indirect effects including electrocution while restoring electric power, structural collapse while repairing buildings, driving into downed trees on the road, and house fires resulting from the burn-

ing of oil lamps and improperly wired generators.

Hurricane Isabel's name will be retired and go down in history as one of the mid Atlantic's most costly and deadly hurricanes. Twenty six counties in North Carolina were declared federal disaster areas by President Bush. Individual property loss across North Carolina exceeded 55 million dollars with agricultural losses over 152 million dollars. These losses do not include damage to highways and bridges or the cost of debris removal and money lost by utilities and businesses.



NWS Raleigh's products help keep you safe & ready

By GAIL HARTFIELD

With winter fast approaching, you should familiarize yourself with some of the key products issued by the National Weather Service in Raleigh.

Special Weather Statement–Winter Storm

Outlook: Issued well in advance of a winter storm, the outlook will provide a general overview of the expected weather pattern, areas expected to be impacted, and early indications of the expected precipitation type(s). This is intended to be a “stay tuned” product and will not provide a lot of detail or specific information.

Winter Storm Watch: A watch means that severe winter conditions, such as heavy snow and/or ice, may affect your area, but its occurrence, location and timing are still uncertain. It is issued to provide 24 to 36 hours notice of the possibility of severe winter weather, to allow enough lead time for those who need to set plans in motion. Media meteorologists use the winter storm watch product to help create their TV graphics and maps.

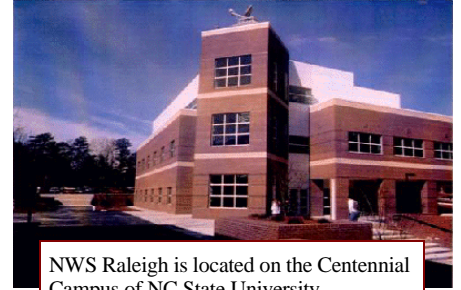
Winter Storm Warning: A watch is upgraded to a warning when winter storm conditions are likely within 24 hours. It is issued under the same product header as the Winter Storm Watch.

Winter Weather Advisory: The advisory, issued under the same header as the Watch and Warning, is for wintry weather that will present an inconvenience and, if caution is not exercised, could lead to life-threatening situations. Like a warning, it also is issued for conditions expected within 24 hours.

Wind Chill Advisory and Wind Chill Warning: An advisory is issued when wind chill temperatures are expected to drop to zero to 14 degrees below zero. A warning is issued when the wind chills are expected to drop to 15 degrees below zero or lower (this is a rare occurrence, however).

Public Information Statements: NWS Raleigh will use this product to provide the public and other users with frequent updates of snow amounts, ice accumulation, a summary of road conditions, and current weather conditions across central North Carolina, using information given to us by Skywarn observers, emergency personnel, and 911 operators.

Nowcasts: Issued every few hours during winter weather, the nowcast enhances the zone forecast by providing details on timing of precipitation, specific areas affected, and precipitation type changeovers (from snow to sleet, for example).



NWS Raleigh is located on the Centennial Campus of NC State University.

NWS participates in local career fair

By RUTH AIKEN

The National Weather Service recently participated in the sixth annual PAMS Career Fair at North Carolina State University. Students in the College of Physical and Mathematical Sciences seeking full time jobs, internships, and part time jobs had the opportunity to meet a wide range of professionals. Along with the National Weather Service, AccuWeather, Census Bureau, IBM, Health and Statistics, and the EPA participated in the career fair, which was held at Dabney Hall on the campus of North Carolina State University.

Answers to Front Page Quiz:

- The coldest day ever for those 3 cities was Jan. 21, 1985. The low was -5° at Charlotte, -8° at Greensboro, and -9° at Raleigh-Durham.
- On that day, the ground was relatively warm, but the trees were at or below freezing. The ice tended to accumulate on the trees and power lines, but melted on the ground.
- The most snow in one day in Greensboro was 14.3 inches on Dec. 17, 1930. The greatest daily snow at

Raleigh was 17.9 inches on Jan. 25, 2000.

- The coldest winter in Raleigh was 1976-77, which ranked as the coldest winter to date east of the Mississippi River. It was the coldest winter to that time in other eastern cities like Baltimore, Boston, and New York. The Northern Hemisphere saw its greatest snow cover ever in '76/'77—nearly 39 million square kilometers — which was surpassed last winter ('02-'03 season). Miami, FL, actually saw its first snow ever on Jan. 19, 1977.

-Gail Hartfield

Cooperative observers help the NWS in its mission

By ROBERT USSERY

The National Weather Service Cooperative Observer (COOP) Program is truly the nation's weather and climate observing network of, by, and for the people. More than 11,000 volunteers take observations on farms, in urban and suburban areas, National Parks, seashores, and mountaintops. The data are truly representative of where people live, work and play.

Volunteer weather observers conscientiously contribute their time so that observations can provide the vital information needed. These data are invaluable in learning more about the floods, droughts, heat, and cold waves which affect us all. The data are also used in agricultural planning and litigation. COOP data plays a critical role in efforts to recognize and evaluate the extent of human impacts on climate from local to global scales.



Hydrometeorological Technician Robert Ussery presents a 25-year service award to the Hamlet Water Treatment Plant, located in Scotland County.

Climate watch: A look at the winter ahead

By BRANDON LOCKLEAR

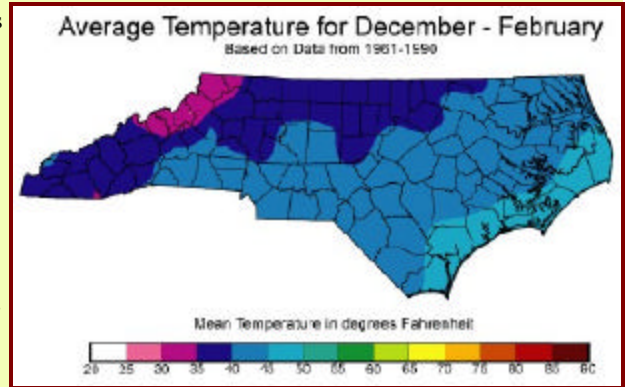
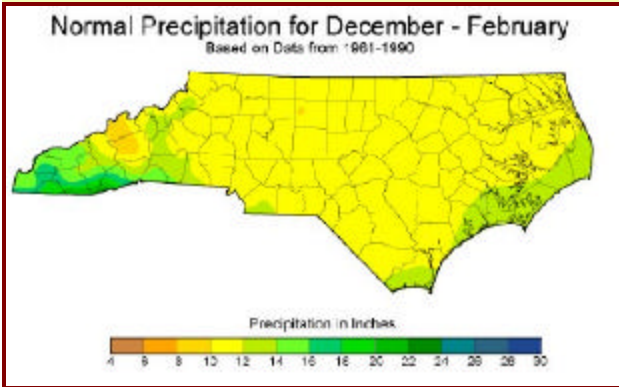
Currently, there are a lack of sufficient atmospheric signals or predictors that allow forecasters to make a skilled long-term temperature forecast. High uncertainty exists

among the forecast tools that are used to derive the December-January-February (DJF) temperature outlook. Because of this uncertainty, there is an equal chance of below, near, or above normal temperatures and precipitation.

Overall, North Carolinians should

experience large temperature swings throughout the winter. Cold air surges will follow cold frontal passages, followed by several days of modifying temperatures before the next cold front moves through the state. Average winter snowfall over the State ranges from about inch

per year on the outer banks and along the lower coast to about 10 inches in the Northern Piedmont and 16 inches in the Southern Mountains. Some of the higher mountain peaks and upper slopes receive an average of nearly 50 inches a year.



North Carolina to observe Winter Weather Awareness Week

(Continued from page 1)

be water can actually be ice. This phenomenon is known as “black ice” and is most common on bridges and overpasses. Black ice occurs when water on the road freezes into a sheet of ice posing a threat to automobiles and pedestrians. For the latest road conditions and access to web cameras statewide visit the Department of Transportation online at www.ncsmartlink.org.

Snow is also no stranger to the area. Most residents in the Triangle still remember the snow storm of January 2002 when 18 to 24 inches of snow fell in less than 24 hours resulting in one of the snowiest winters on record. Some of North Carolina’s most dangerous and costly winter storms such as these come as a result of nor’easters. Nor’easters are areas of low pressure that form just off the North Carolina coast during the winter and spring. These low-pressure systems tend to intensify rapidly within a period of a few hours and can produce winds up to hurricane force. Nor’easters can blanket nearly the entire state with snow. Nor’easters are very hazardous to marine interests as well. Winds and seas typically intensify rapidly as the storm strengthens and the low pressure deepens. The Outer Banks of North Carolina can receive substantial property loss, flooding, and beach erosion from nor’easters similar to the nor’easter of March 1993 which earned the title “Superstorm”. Peak wind gust along the Outer Banks during this March storm

reached speeds of near 100 mph; winds of 70 mph were recorded in Goldsboro, while over 2 feet of snow fell over the North Carolina mountains stranding dozens of hikers. The 1993 storm closed all interstates from Georgia north.

Winter storms can be deceptive killers because most deaths are indirectly related to the storm. Winter storm-related deaths often result from traffic accidents, heart attacks while shoveling snow, falling trees, or succumbing to carbon monoxide poisoning while using improper heat sources indoors. Some safety rules to follow this winter include preparing for winter weather before it strikes. If snow and ice are forecast, make sure you have enough food and necessary medicine at home to last several days. This will prepare you in case you become snowed in and will keep you from venturing out into hazardous conditions. Also make sure there is enough fuel for alternative heat sources such as fireplaces, wood stoves, and space heaters. Always make sure that the proper fuel is used in space heaters. Using improper fuel in heaters creates very dangerous fire conditions. Many people fall victim to fires in their homes during the winter. This fact means that everyone should test fire detectors in their home and replace any broken detectors and dead batteries. House fires also result from improperly wired generators, so make sure your generator is wired by a professional. Also, you should never use charcoal or gas grills indoors as a source

of heat as carbon monoxide build-ups can become deadly.

In order to protect life and property the National Weather Service issues Winter Storm Advisories, Watches, and Warnings. Winter Weather Advisories are issued when a light accumulations of freezing rain or sleet is forecast. Advisories are also issued if snow accumulations of 1 to 3 inches or are expected. If a quarter of an inch of freezing rain, a half-inch of sleet and/or 4 or more inches of snow is expected, Winter Storm Watches and Warnings are issued. In order to provide the public with as much planning time as possible Winter Storm Watches can be issued as much as 48 hours in advance.

You can keep up with winter forecasts, warnings and advisories by visiting the Raleigh NWS online at www.nws.noaa.gov/er/rah. To learn about snowfall history and climatology for the entire state, visit the National Climatic Data Center at www.ncdc.noaa.gov/oa/climate/monitoring/snowclim/mainpage.html.



**National Weather Service
Raleigh, North Carolina**

1005 Capability Drive
Suite 300
Raleigh, NC 27606

Phone: 919-515-8209
Fax: 919-515-8213



"Changing Skies" is a triannual publication of the National Weather Service, Raleigh NC. For information or questions, contact Warning Coordination Meteorologist Jeff Orrock (jeff.orrock@noaa.gov) Issue Editor: Gail Hartfield (gail.hartfield@noaa.gov)

Mailing Address Line 1
Mailing Address Line 2
Mailing Address Line 3
Mailing Address Line 4
Mailing Address Line 5

Looking Back: The December 4-5, 2002 Ice Storm

By PHILLIP BADGETT

A very cold arctic air mass sank southward into North Carolina late on December 3, 2002. Strong high pressure over the upper Great Lakes region built south into the state, driving the cold air down the eastern seaboard into South Carolina and Georgia. Low temperatures on Wednesday morning (12/4) fell into the teens across the northern mountains, the 20s across much of the Piedmont, and 30s to the coast. This set the stage for a major early season Winter Storm for North Carolina on December 4-5, 2002, as low pressure developed to our southwest. The winter storm that ensued was unusually strong

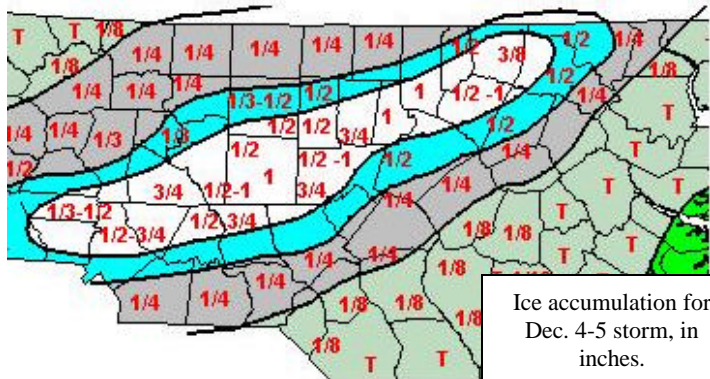
and damaging for so early in the season, occurring only a week after Thanksgiving. Typically, strong winter storms that affect North Carolina occur in late December through March. These storms rarely occur before Christmas.

The surface map on the evening of December 4th, 2002, revealed a so-called Miller "B" pattern of cyclogenesis, or low pressure development. This pattern is characterized by a strong "wedge" of cold high pressure east of the Blue Ridge Mountains separating dual surface low pressure areas. An old decaying low pressure system was approaching the mountains from the southwest, combined with a develop-

ing secondary coastal low (becoming the primary low pressure storm) along a commonly shared frontal boundary. This Miller "B" pattern is often associated with mixed wintry precipitation, where corridors of predominant precipitation types are distributed across

North Carolina. As the low pressure moved from the lower Mississippi valley region toward the mountains early on the 4th, moisture quickly flowed up and over the cold arctic air mass over North Carolina. Snow and sleet began falling over western North Carolina by afternoon, then spread quickly east across the state as a variety of precipitation types through Wednesday evening. A corridor of snow fell with this system over the northwest corner of the state – topped off by a layer of freezing rain at the end of the storm. A corridor of sleet then freezing rain fell over much of the Piedmont, and a corridor of freezing rain then rain fell over the Sandhills and Coastal Plain – with rain along the immediate coast. The precipitation continued to fall into the morning hours on the 5th, but finally tapered off as the dual low configuration evolved into a single coastal low which then moved north of Cape Hatteras.

The vast majority of the precipitation fell as freezing rain over the Piedmont, causing very damaging ice accumulations of 1 to 2 inches, felling trees and power lines. Some areas were without power for 1 to 2 weeks.



ing secondary coastal low (becoming the primary low pressure storm) along a commonly shared frontal boundary. This Miller "B" pattern is often associated with mixed wintry precipitation, where corridors of predominant precipitation types are distributed across