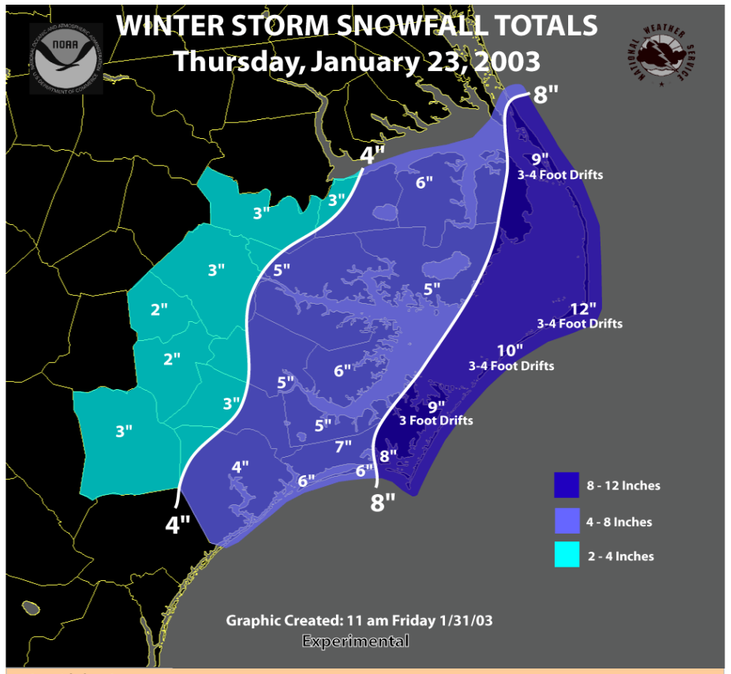
Carolina Sky Watcher

National Weather Service, Newport, NC *Vol. 11, Number 3 (#40) Dec 2004 - Feb 2005*

Winter in Eastern North Carolina



In this Issue...

Winter is a beautiful time of the year in Eastern North Carolina. Carolina Blue Skies are more common, and the air clears itself as the humidity of summer takes a break. Meteorological winter begins on the first day of December and marks the start of the three coldest months of the year. Astronomical winter follows about three weeks later when the Sun reaches its furthermost apparent point south. On that day, the Sun is directly over the Tropic of Capricorn, which is 23.5 degrees south of the equator.

Almost everyone has snow on their Holiday wish-list. But snow is not a surety during the winter, since the moderating influence of the ocean can manifest itself with a mixture of precipitation types: rain, sleet, freezing rain, snow. However, snow is really not that unusual in Eastern North Carolina. The 30 year average annual snowfall runs from 2 inches along the Outer Banks to 3 to 4 inches inland. On average, Eastern North Carolina gets one major snow storm, 6 inches or more of snow, every 10 years. Two storms of note have occurred over the recent years.

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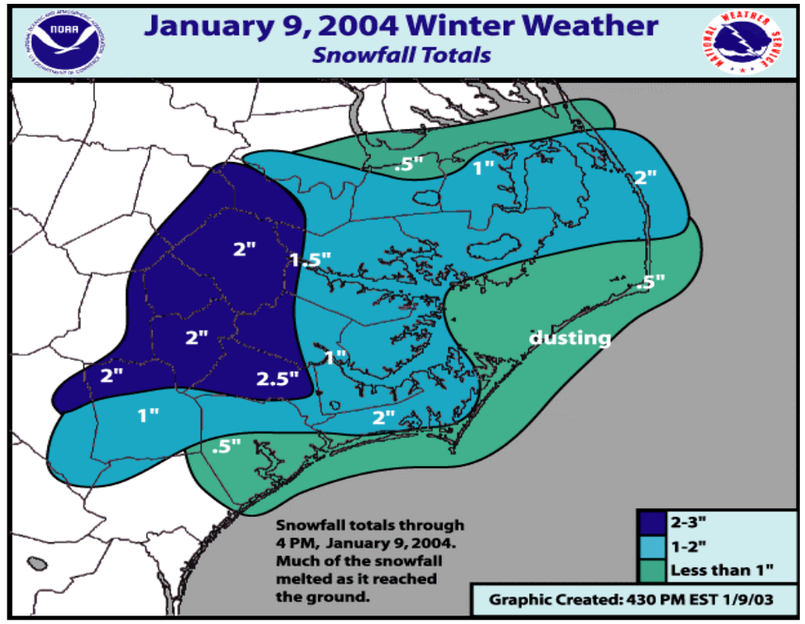
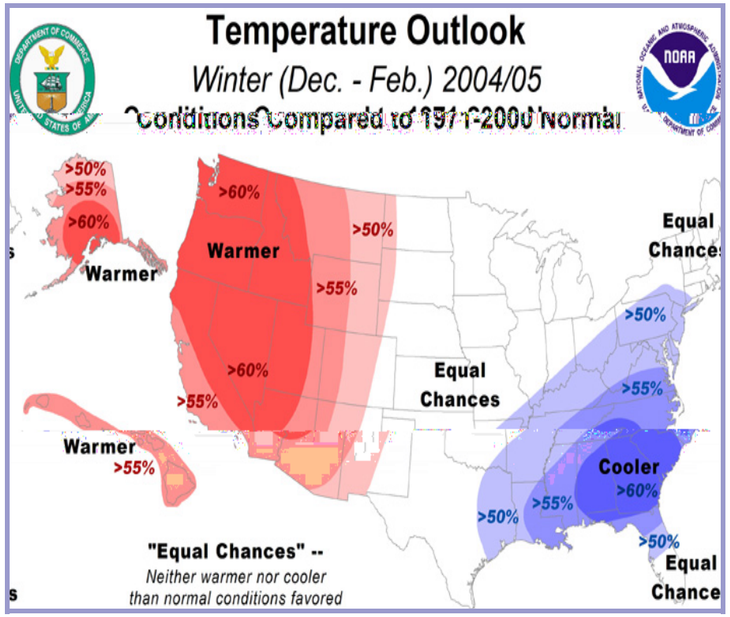
A major winter storm affected eastern North Carolina on January 23, 2003. The storm dumped the highest amounts of snow east of highway 17, including the Outer Banks, where 8 to 12 inches of snow fell with isolated amounts up to 14 inches. This was the largest one day snowfall on the Outer Banks in over a decade. Snowfall amounts from 4 to 8 inches fell across central sections of the county warning area including Craven, Pamlico, Beaufort, and Tyrrell counties. Other western counties received 2 to 4 inch snowfall amounts.



On January 9, 2004, a low pressure system moved up the coast of the eastern United States. In this event, the snowfall was more over the inland areas than during the 2003 snow storm. Two to three inches were reported in the Coastal Plains and a half inch along the Outer Banks. Both of these storms were lows that moved north along the east coast, pumping moisture into eastern North Carolina…the famed "Cape Hatteras Storms", otherwise known as the "Nor'easter".

By Carin Goodall



Winter Outlook

In November, the NOAA Climate Prediction center issued its final U.S. winter outlook for December 2004 through February 2005, and the forecast was a mixed bag for eastern North Carolina. There is a 55 to 60 % chance of cooler than average temperatures during the period (Fig. 1), while the precipitation outlook (Fig. 2) indicates equal chances of above or below normal conditions. The main factor of the seasonal outlook is the expected continuation of a weak El Niño event in the tropical Pacific. El Niño is an extreme phase of a naturally occurring climate cycle referred to as the El Niño/ Southern Oscillation. It refers to

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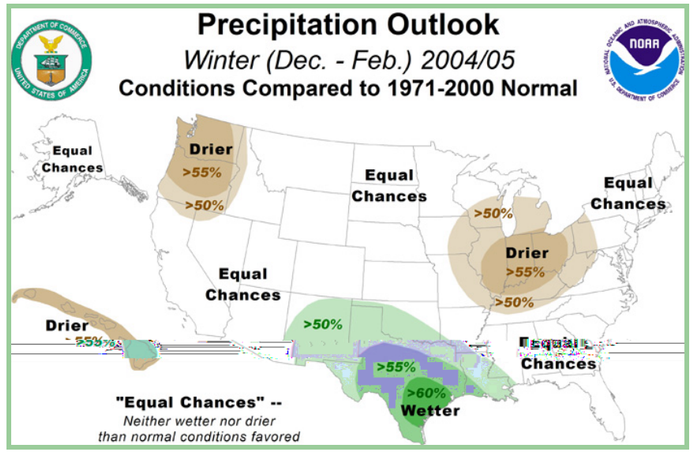
large-scale changes in sea-surface temperature (SST) across the eastern tropical Pacific. During an El Niño, the SST warms over much of the eastern Pacific, which in turn impacts the atmosphere. The primary impact for the United States during the winter is a stronger than normal sub-tropical jet stream, leading to wetter than normal conditions over the southern United States.

By Jim Merrell



Winter Weather Forecasting

Forecasting the various elements associated with winter weather (e.g., placement, amount and timing of snowfall, banded precipitation, and forecasting freezing rain/sleet) is challenging. One of the most important factors determining frozen precipitation is knowing what the temperature profile is like for several miles up in the atmosphere. This is because the temperatures aloft are just as important if not more so in the development and prediction of winter type precipitation than the surface temperature.

Accurate prediction of precipitation types near coastal locations can be a challenge. While inland locations could be seeing heavy snowfall amounts, the slightly more temperate coastal locations could be dealing with sleet or rain. To meet this challenge, forecasters must analyze the vertical temperature and moisture profiles across the region.

The National Weather Service in Newport/Morehead City is one of many NWS offices that launch weather balloons twice daily. The information we receive from the radiosondes attached to the balloons give a clear picture of the low, mid, and upper levels of the atmosphere where cloud formation and subsequent weather is likely to form. Of particular importance for winter weather are the temperatures in the clouds where precipitation forms, and the temperature below the clouds which affect what will happen to the precipitation as it falls to the ground. In order for snow to develop, temperatures in the cloud must be below freezing (typically well below freezing for sublimation to occur). If temperatures are around freezing, then ice crystals are unlikely and only supercooled water droplets will form. This would lead to a more rain or freezing rain scenario.

After deciding what type of precipitation development occurs in the cloud, then the temperatures below the cloud will determine whether or not the precipitation will remain frozen or melt before reaching the ground. Snow will occur when the temperatures remain below freezing all the way to the surface (*Figure 1*). Occasionally, especially in a coastal location such as eastern North Carolina, a shallow warm layer close to the ground will melt the snow

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partially. If the surface temperatures are below freezing, then a freezing rain or sleet event will occur (*Figure 2/3*). As the warm layer becomes warmer or deeper further away from the cold source, then the weather event becomes more of a cold rain event. If the warm layer aloft is deeper and/or warmer, then complete melting of the snow will occur resulting in drops of liquid water.

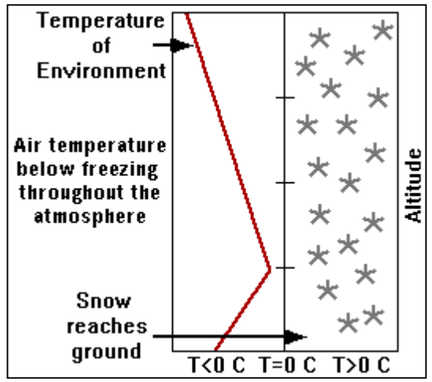

Figure 1

Snow

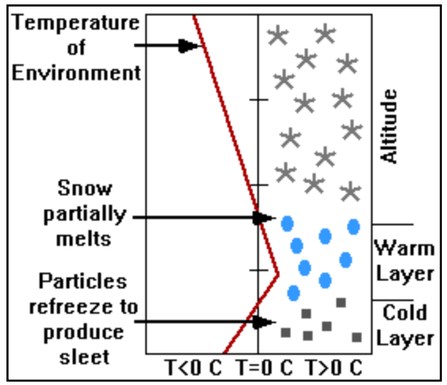

Figure 2

Sleet

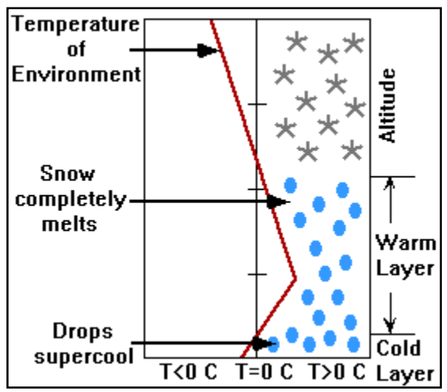

Figure 3

Freezing Rain

One of the biggest "busts" in a winter weather forecast can occur when forecasters try and pin-point the exact location of the snow/sleet/rain line. One portion of a county could receive several inches of snow, while another portion of that same county could see nothing but harmless rain. Numerical models have added significantly to forecasting over the last several years, but even they are unable to calculate all the complex physical aspects in the atmosphere to the point where freezing lines can be depicted perfectly. Knowing this, forecasters typically reference historical cases where a similar pattern had developed and compare it to what is currently occurring. Overall, precipitation type forecasting in eastern North Carolina will continue to present a significant challenge.

By Sarah Jamison

Winter Climatology

Average high temperatures for December across our County Warning Area (CWA) range from 56 at Williamston to 60 at Hofmann Forest and Morehead City. Average low temperatures for December range from 34 at Williamston and Greenville to 43 at Cape Hatteras. Average high temperatures for January range from 52 at Greenville, Manteo, and Williamston, to 57 at Hofmann Forest and Morehead City. Average low temperatures in January range from 31 at Aurora and Greenville to 39 at Cape Hatteras. February average high temperatures range from 54 at Manteo to 61 at Hofmann Forecast and the average low temperatures range from 33 at Aurora to 39 at Cape Hatteras. Average annual snowfall across eastern North Carolina ranges from around one inch at Aurora to 3.9 inches at Belhaven. However, it is not

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out of the question for amounts from 6 to 12 inches to occur. The most snowfall that eastern North Carolina has received was in March 1980 when Williamston got 24.4 inches, 24 inches at Jacksonville, 22 inches at Morehead City while Cape Hatteras only got 7.3 inches. Ice storms are rare but do occur in eastern North Carolina, but it is rare that accumulations reach more than one-quarter inch.

The favored synoptic pattern that generates the biggest snow events across eastern North Carolina in large cold high pressure centered to our north (usually between Pennsylvania and southern Quebec in Canada) and low pressure that moves northeast out of the Gulf of Mexico along the gulf stream waters off the Carolinas.

The average dates for the first freeze across eastern North Carolina are October 29 at Kinston, November 9 at Plymouth, November 19 at New Bern, and December 11 at Cape Hatteras.

By Wayne Shaffer

Coastal Impacts from Winter Storms

Winter Storms, often called Nor'easters, can produce damage to the coastline of North Carolina that rivals that from a Hurricane. Winter Storms are often huge, covering hundreds of miles with strong winds and battering waves. Typically these strong low pressure centers develop or move just offshore, and produce north to northeast winds along the coast, hence the name Nor'easter. Since these storms

are often very large, long durations of winds at or above gale force are sometimes observed. These long lasting strong winds will produce very large seas that lead to beach erosion, ocean over-wash and coastal flooding. Areas from Cape Hatteras north typically receive the most significant damage from Nor'easters. The southern coast can be impacted as well, especially if the storm track is along or inland from the coast resulting in strong southeast to southwest winds. Coastal flooding can also impact areas adjacent to the sounds. Severe coastal flooding will impact the southern portion of the Pamlico Sound when persistent gale force winds from the north or northeast develop. When the strong winds shift to the southwest, west or northwest, sound-side flooding will develop along the Outer Banks.

The Ash Wednesday Storm of 1962 was one of the worst Nor'easters to impact North Carolina. Storm tides were 6 to 9 feet above normal along the Outer Banks, and a new inlet was cut north of Buxton. Thousands of coastal homes were damaged or destroyed by this slow moving storm.

The National Weather Service continues to improve its ability to forecast these major storms, and will issue Coastal Flood Watches and Warnings to alert coastal residents when these systems threaten.

By Bob Frederick

Winter Weather Hazards

As we enter the upcoming winter season, now is the time for everyone to reacquaint themselves with winter weather terminology. For county executives, emergency managers, and others, it especially is important to fully understand the message we are trying to convey. The following is a brief review of the winter weather products issued by the National Weather Service.

Winter Storm Watch: A winter storm watch is issued for the potential occurrence of heavy snow, blizzards, or significant accumulations of freezing rain or sleet. A winter storm watch usually will be issued 24 to 36 hours in advance of an event, as soon as the meteorologist has reasonable confidence that the event will occur. A winter storm watch normally is not issued 48 hours or longer in advance of an event, unless there is strong confidence in the forecast.

Winter Storm Warning: A winter storm warning is issued 12 to 24 hours in advance of an event to inform the public of the high probability of occurrence of severe winter weather. A winter storm warning is issued for heavy snow, or significant accumulations of freezing rain or

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Wind Chill Chart

Wind (mph) \ Temperature (°F)	Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5		36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10		34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15		32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20		30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25		29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30		28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35		28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40		27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45		26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50		26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55		25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60		25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes | 10 minutes | 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph) *Effective 11/01/01*

As discussed in our previous newsletter, a new Wind Chill Temperature index was implemented on November 1, 2001. Whereas the existing index had been in use for over half of a century, the new index uses a more understandable and useful formula that more accurately documents the combined effects of air temperature and wind speed.

Above, you'll find the new Wind Chill Temperature Index chart. To use, simply find the actual air temperature in the row column, and then scan downward until you reach the designated wind speed. For example, if it were 5° F with a wind speed of 15 mph, the Wind Chill Index would be -13° F.

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sleet. The forecasters have the option of issuing a "Heavy Snow" or "Ice Storm" warning if that is the sole weather factor driving the warning process.

For blizzard conditions, a Blizzard Warning would be issued. Blizzard conditions are roughly defined by sustained wind speeds or frequent gusts of 35 mph or greater, and considerable falling and/or blowing snow which frequently reduces visibility to less than 1/4 mile. These conditions must persist for three hours or more. Blizzard conditions are rare in our area.

Heavy Snow Criteria for issuing a Winter Storm Watch/ Warning:

4 inches or more in 12 hours, or 6 inches or more in 24 hours

Freezing Rain Criteria for issuing a Winter Storm Watch/ Warning:

Ice accumulation of 0.25 inches or greater.

Winter Weather Advisories: These are issued when hazardous winter weather may cause inconvenience or difficulty to travelers, or for people who must be outdoors. Advisories normally are issued only for the first 12 hours of the forecast, but can extend out to 24 hours if necessary.

The most common type of winter advisory is a Snow Advisory, which would be issued for average snowfall totals from 1 to 4 inches. Other advisories include a Freezing Rain or Freezing Drizzle Advisory for average ice accumulations less than 1/4 inch, and a generic Winter Weather Advisory would be issued for a combination of phenomena.

The key to surviving winter storms is to plan ahead.

• Check battery powered equipment before the storm arrives. A portable radio or television set may be your only contact with the world outside.

• Check your food stock and extra supplies. Your supply should include food that requires no cooking or refrigeration in case of power failure.

• Always fill your gasoline tank before entering open country, even for a short distance.

• Stay indoors during storms unless you are in peak physical condition. If you must go out, avoid overexertion.

• Do not kill yourself shoveling snow. It is extremely hard work for anyone in less than prime physical condition, and can bring on a heart attack, a major cause of death during and after winter storms.

• If the storm exceeds or even tests your limitation, seek available refuge immediately.

• If traveling, plan your travel carefully and select primary and alternate routes. Check the latest weather information on your radio. Inform others of your expected arrival time.

• Try not to travel alone; two or three persons are preferable.

Wind Chill Advisory: Issued when wind chill temperatures are expected to be between -10° F and -24° F inclusive with wind speeds around 10 mph or higher.

Wind Chill Warning: Issued when wind chill temperatures are expected to be at or below -25° F with wind speeds around 10 mph or higher

By Sarah Jamison

Cooperative Observers

Official Procedures for Measuring and Reporting Frozen Precipitation

One of the more challenging tasks of weather observing in eastern North Carolina is the measurement of frozen precipitation. Snow and ice do not occur very often in this area, allowing observers little opportunity to gain experience measuring and reporting it. In addition, the snow is usually accompanied by wind, resulting in a variable snow cover on the ground. Due to these difficulties, the following guide-

lines have been developed to assist observers with frozen precipitation measurement and reporting.

Prior to snow and ice events, the funnel and measuring tube must be removed from the outer can and taken inside until the end of the event. If this is not done, the measuring tube may crack, resulting in leaks.

The daily snowfall is the amount of snow that has fallen in the 24 hours since the last measurement, while the snow depth is the total depth of snow on the ground at the observation time. If there have been several consecutive days of snow, these two amounts may not be the same.

The snowfall and snow depth are measured with the metal snow sticks. Take several measurements around the property in areas where the snow cover is fairly uniform. Make sure to avoid snowdrifts, as they are never representative of the true amount. Also, try not to include the depth of grass below the snow in the measurement. Determine an average measurement to the nearest tenth (0. 1) of an inch, and enter the average on your B-91 form in the column to the immediate right of the rainfall column. In the column to the right of the snowfall, enter the total snow depth to the nearest whole inch (ex. 1.5=2)

In addition to the amount of snowfall and snow depth, the amount of liquid equivalent precipitation must also be measured and reported. The liquid equivalent is essentially the amount of rainfall that would have been measured had the precipitation fallen as a liquid rather than in a frozen state. The snow that accumulates in the overflow can is melted down and poured through the funnel into the measuring tube. The liquid is measured with the rainfall measurement stick, to the nearest hundredth (0. 01) of an inch, and entered in the rainfall column of the B-91 form.

By Sarah Jamison

Winter Weather Safety Tips

It's that time of year again, when the temperatures begin to fall and the threat of winter storms becomes all too real. Although this area is not as well known for winter weather as the northeast, eastern North Carolina has had their share of winter storms. As a result, it pays to be prepared in the event another winter storm affects the area. Here are a few safety and preparedness tips to help families accomplish this.

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If a Winter Storm WATCH is in effect for your area, hazardous winter weather conditions are expected in the next 12 to 36 hours.

In preparation, you should have the following at home or work:

- Flashlight
- Battery-Powered Weather Radio
- Extra Food and Water
- Extra Baby Items

- First Aid Kit
- Heating Fuel
- Emergency Heat Source
- Fire Extinguisher

When it comes to your vehicles, they should be fully checked and winterized. In addition, the gas tank should be kept near full. It is best to not travel alone, and always let someone know your travel timetable and route. If you own a cellular phone, always keep it with you. In addition, the following should be kept in your vehicle in the event you become stranded:

- Blankets or Sleeping Bags
- Flashlight and Extra Batteries
- Knife
- High Calorie, Non-Perishable Food
- Sand or Cat Litter
- Shovel
- Windshield Scraper
- Tool Kit
- Tow Rope
- Jumper Cables
- Water Container
- Compass
- Road Maps

For those living on farms, animals should be moved to sheltered areas so that they will be less affected by inclement weather. Extra feed should be hauled to feeding areas. A ready water supply should also be available.

If a Winter Storm WARNING is in effect for your area, hazardous winter weather conditions are either presently occurring or are expected within the next 12 hours.

If you are caught outside in the storm, you should attempt to find a dry shelter immediately, and cover all exposed areas on your body. This is important in order to avoid hypothermia and frostbite. If

shelter is not readily available, prepare a lean-to, windbreak, or snow cave for protection from the wind. Build a fire for heat, making sure to place rocks around it in order to absorb and reflect the heat. It is important that you do not eat snow, as it will lower your body temperature. Be sure to melt it first.

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If you are stranded in a vehicle, do not leave your vehicle! You should run the vehicle only ten minutes each hour so that you do not use all the fuel quickly. While running the vehicle, open windows slightly to avoid carbon monoxide poisoning. Also, make sure the tail pipe is not blocked. Always try to make yourself visible to rescuers. Some suggestions include turning on the dome light at night when running the engine, tying a cloth to the antenna or door, and raising the hood after snow stops falling. To keep blood circulating and to keep warm, exercise periodically.

If you are at home or another building, stay inside! If there is no heat, close off unneeded rooms to avoid sharing warm air unnecessarily. Stuff towels or rags under doors, and cover windows at night. Make sure to eat and drink plenty of fluids, as food provides your body with heat and fluids prevent dehydration. Wear layers of loose-fitting, lightweight, warm clothing in order to minimize body heat loss.

Always stay tuned to your local National Weather Service Radio station for the latest information!

By Sarah Jamison

NOAA Weather Radio

NOAA Weather Radio (NWR) is a nationwide network of radio stations broadcasting continuous weather information direct from a nearby National Weather Service office. NWR broadcasts National Weather Service warnings, watches, forecasts and other hazard information 24 hours a day.

Working with the Federal Communication Commission's (FCC) Emergency Alert System, NWR is an "all hazards" radio network, making it your single source for comprehensive weather and emergency information. NWR also broadcasts warning and post-event information for all types of hazards--both natural (such as earthquakes and volcano activity) and environmental (such as chemical releases or oil spills).

Known as the "Voice of NOAA's National Weather Service," NWR is provided as a public service by the National Oceanic & Atmospheric Administration (NOAA), part of the Department of Commerce. NWR includes more than 900 transmitters, covering all 50 states, adjacent coastal waters, Puerto Rico, the U.S. Virgin Islands, and the U.S. Pacific Territories. NWR requires a special radio receiver or scanner capable of picking up the signal. Broadcasts are found in the public service band at these seven frequencies (MHz):

162.400
162.425
162.450
162.475
162.500
162.525
162.550

North Carolina Winter Weather Terms

M	U	V	F	E	N	I	Q	A	O	R	K	F	K	H	F	T	R	D	W	W	M	T	M	W	P	N	O	P	G
N	W	I	Y	R	S	Q	U	A	L	L	S	O	Z	B	F	C	E	Y	U	I	O	C	C	L	M	F	I	A	C
H	W	P	O	U	E	S	D	U	Q	T	U	T	O	H	P	C	Q	O	F	N	R	E	E	U	Z	G	D	F	R
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Y	C	T	N	A	Q	U	Z	S	P	S	B	P	Z	W	T	O	U	R	C	E	H	F	O	Z	V	R	R	Z	V
A	Y	C	M	S	K	E	M	I	C	I	I	G	O	I	L	U	A	P	E	R	E	E	F	X	R	H	R	K	C
C	J	J	U	H	R	A	V	G	N	R	V	L	U	I	K	B	O	R	G	I	A	E	R	F	Y	S	E	T	A
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P	U	M	A	D	J	I	T	D	Z	P	X	G	G	N	J	S	L	I	M	X	W	T	C	C	D	H	W	A	C

ADVISORY
AIRMASS
ARCTIC
BLIZZARD
BLOWING SNOW
CAPEHATTERAS LOW
COLD
COLD FRONT
FLURRIES
FREEZE
FREEZING RAIN
FROST
FROSTBITE
LAKE EFFECT
MOREHEAD CITY
NEWPORT
NOAA WEATHER RADIO
NOREASTER
SLEET
SNOW
SNOWPELLETS
SQUALLS
THUNDERSNOW
WATCH
WHITEOUT
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WINTERSTORMOUTLOOK

Christmas and Christmas Eve Climatology

		Maximum Temperature					Minimum Temperature					Precipitation			Snowfall		
	Day	AVG	HI	YR	LO	YR	AVG	HI	YR	LO	YR	AVG	HIGH	YR	AVG	HIGH	YR
Morehead City	24	57	72	1990	22	1989	41	60	1956	14	1989	0.15	2.01	2003	0	0	2003
	25	55	74	1974	20	1983	37	58	1987	3	1983	0.112	1.32	1997	0	0	2003
Williamston	24	55	78	1990	19	1989	35	65	1990	14	1989	0.111	0.9	1970	0.12	6.5	1989
	25	54	76	1955	23	1989	33	58	1964	4	1989	0.138	1.53	1986	0	0.1	1966
New Bern	24	58	76	1964	23	1989	36	54	1986	9	1983	0.135	2.87	1978	0.06	2.6	1989
	25	54	78	1955	19	1983	33	63	1964	-4	1989	0.087	1.24	1981	0	0	1993
Manteo	24	55	72	1990	31	1989	39	55	1990	20	1989	0.162	1.38	1978	0	0	2003
	25	51	67	1971	18	1983	37	50	1997	18	1976	0.158	2.39	1989	0.28	0	2003
Hatteras	24	56	72	1957	40	1967	42	58	1956	24	1960	0.107	1.56	2003	0	0	2003
	25	56	72	1979	33	1983	42	58	1986	12	1983	0.11	1.31	1953	0	0	2003
Greenville	24	55	73	1988	24	1989	33	56	1956	6	1983	0.114	0.97	1939	0.08	5	1989
	25	53	77	1964	20	1983	32	59	1964	1	1989	0.133	1.63	1998	0	0	2003
Kinston	24	57	73	1981	25	1989	37	58	2003	16	1989	0.159	1.8	1986	0	0	2003
	25	52	75	1997	24	1983	33	60	1987	-3	1989	0.056	0.58	1981	0	0	2003

New Years Eve Climatology

		Maximum Temperature					Minimum Temperature					Precipitation			Snowfall		
	Day	AVG	HI	YR	LO	YR	AVG	HI	YR	LO	YR	AVG	HIGH	YR	AVG	HIGH	YR
Morehead City	31	57	71	1996	34	1983	39	60	1971	15	1983	0.221	2.26	1975	0	0	2003
Williamston	31	54	77	1973	32	1993	34	59	1990	17	1993	0.128	1.5	1977	0.05	2.4	1955
New Bern	31	58	77	1973	34	1983	36	61	1972	17	1993	0.125	1.56	1952	0	0	1993
Manteo	31	55	75	1973	38	1998	39	54	1969	19	1993	0.142	1.35	1977	0	0	2003
Hatteras	31	55	72	1973	34	1983	42	60	1972	22	1962	0.124	1.27	1982	0	0	2003
Greenville	31	55	75	1971	33	1983	33	54	1971	12	1983	0.075	0.94	1973	0	0	2003
Kinston	31	57	77	1973	31	1983	37	60	1969	15	1993	0.171	1.59	1986	0.01	0.4	1970

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