

# Winter Storms



U.S. DEPARTMENT OF COMMERCE/National Oceanic and Atmospheric Administration/National Weather Service

# Winter Storms

IN SEPTEMBER, the sun leaves the Northern Hemisphere, its perpendicular rays drifting south of the Equator. Until the sun's return in March, polar air rules the northern continental atmosphere, pushing back the tropical warmth of summer. It is autumn, then winter, a season broken by intervals of fine weather, and by the seasonal parade of winter storms—snow-dumping, ice-covering, blood-chilling paralyzers of cities, trappers of travelers, takers of life, destroyers of property.

The storms are generated, as are many of the thunderstorms of summer, from disturbances along the boundary between cold polar and warm tropical air masses, the fronts where air masses of different temperatures and densities wage their perpetual war of instability and equilibrium. The disturbances may become intense low-pressure systems, churning over tens of thousands of square miles in a great counter-clockwise sweep.

In the Pacific, these disturbances form along polar fronts off the east coast of Asia and travel northeastward toward Alaska. But some, particularly those forming along the mid-Pacific polar front, take a more southerly track, striking the United States as far south as southern California. Few Pacific disturbances cross the Rockies, but some do, redeveloping to the east. One region of such redevelopment lies east of the Colorado Rockies; the storms which come out of that region are called Colorado Cyclones. Another region of storm redevelopment is east of the Canadian Rockies, from which come the so-called Alberta Cyclones. Both types take an eastward path, their most frequent ones converging over the Great Lakes. The Lakes themselves are generators of severe local winter storms, and others develop from northward-drifting disturbances originating over the Gulf of Mexico and our southern plains.

On our east coast, winter storms often form along the Atlantic polar front near the coast of

Virginia and the Carolinas and in the general area east of the southern Appalachians. These are the notorious Cape Hatteras storms—nor'easters—which develop to great intensity as they move up the coast, then drift seaward toward Iceland, where they finally decay.

Because they form over water, these storms are difficult to forecast, and occasionally surprise the Atlantic megalopolis with paralyzing snows. In 1969, the U.S. Departments of Commerce, Transportation, and Defense tightened winter storm surveillance by adding reconnaissance aircraft, an ocean buoy, and a new weather ship. With better hour-to-hour information on the storms, weathermen ashore have begun to ease the burden of unexpected heavy snows in eastern cities.

For some parts of the United States—the Northern Rockies, for example—storms with snow followed by cold are a threat from mid-September to mid-May; during one of the colder months from November to March, it is not unusual for eight separate storms to affect some area across the continent. Intense winter storms are frequently accompanied by cold waves, ice or glaze, heavy snow, blizzards, or a combination of these; often, in a single winter storm, precipitation type changes several times as the storm passes. Their common feature is the ability to completely immobilize large areas and to isolate and kill persons and livestock in their path. In our northland, the severity of these storms makes them a seasonal threat. Farther south, the occasional penetration of severe winter storms into more moderate climates causes severe hardship and great loss of warm-weather crops.

Nearly everyone east of the Pacific coastal ranges remembers significant winter storms—days of heavy snow, interminable blizzard, inconvenience, economic loss, and, sometimes, personal tragedy. Winter brings them all. For Wyoming or Kansas or Texas the blizzard of 1888 was one of the worst on record. The period January 11-13, in that year brought the most disastrous blizzard ever known in Montana, the Dakotas and Minnesota, combining gale winds, blowing snow, and extreme cold into a lethal, destructive push from the Rockies eastward. The eastern seaboard got its big storm the same year. March 11-14, 1888, saw the seaboard from Chesapeake Bay to Maine stricken with a blizzard that dumped an average of 40 inches of snow over southeastern New York and southern New England. The storm killed 200 in New York City alone; total deaths were over 400.

But every winter is a bad year for someone. The 1966 season saw the eastern seaboard para-

lyzed by snow from Virginia to New England, with more than 50 deaths, and thousands marooned. A March storm in that year buried the Dakotas, Minnesota, and Nebraska, with 30-foot drifts pushed up by winds gusting to more than 100 miles per hour. The 1967 winter storm season was not much better, and included a May Day blizzard in the Dakotas and a nor'easter which brought snow and hurricane-force winds to northern New England late in May. Snowfall across middle America was as much as four times normal in early 1968, and 1969 was called "the year of the big snows" in the midwest.

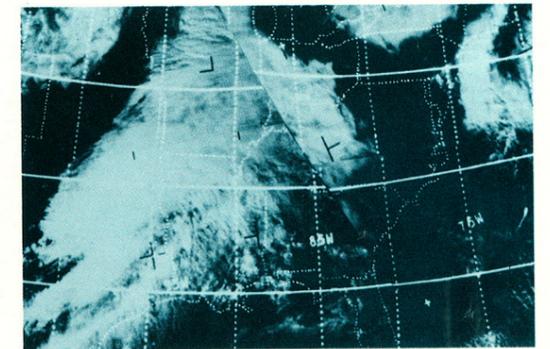
Winter storms can kill without breaking climatological records. Their danger is persistent, year to year. From 1936 through 1969, snowstorms caused more than 3,000 deaths, directly and indirectly. Of those reported deaths, more than a third were attributed to automobile and other accidents; just less than one-third to overexertion, exhaustion, and consequent fatal heart attack; fewer than 400 to exposure and fatal freezing; and the rest to such causes as home fires, carbon monoxide poisoning in stalled cars, falls on slippery walks, electrocution from downed wires, and building collapse. The greatest number of snow-related deaths—354—in this period occurred in 1960; 1958 is second with 345 deaths. About half of those reported occurred in New England, New York, and Pennsylvania.

The National Weather Service, a component of NOAA, the U.S. Commerce Department's National Oceanic and Atmospheric Administration, issues timely warnings against hazards from the air and ocean—hurricanes, tornadoes, severe storms, floods, tsunamis, and pollution-concentrating weather. As winter drops its cold mantle over North America, Weather Service meteorologists work to detect the disturbances which may become severe winter storms, and develop warnings against the storms' approach.

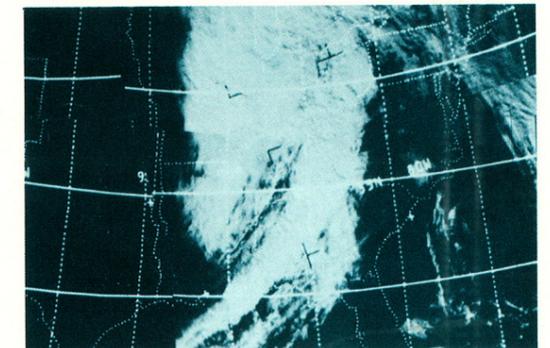
The terms *watch* and *warning* are used for winter storms, as for other natural hazards. The *watch* alerts the public that a storm has formed and is approaching the area. People in the alerted area should keep listening for the latest advisories over radio and television, and begin to take precautionary measures. The *warning* means that a storm is imminent and immediate action should be taken to protect life and property.

This pamphlet is part of the National Weather Service's warning effort. Read it, keep it—and follow its recommendations next time the storms of winter stalk your corner of the land.

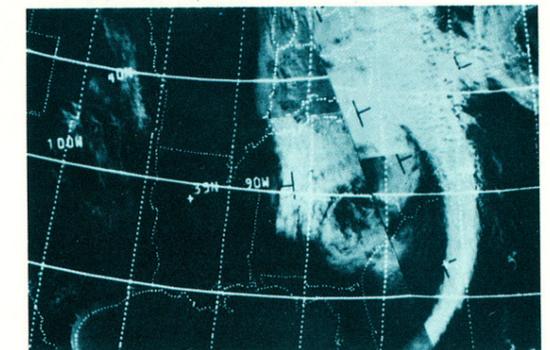
A winter storm caught by the cameras of a weather-monitoring satellite as the large cyclonic system moved from the Colorado Rockies toward the Great Lakes.



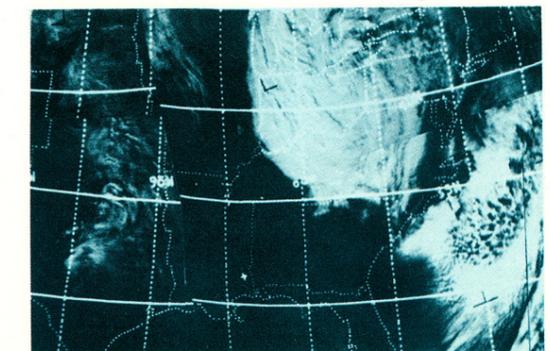
November 26, 1966



November 27, 1966



November 28, 1966

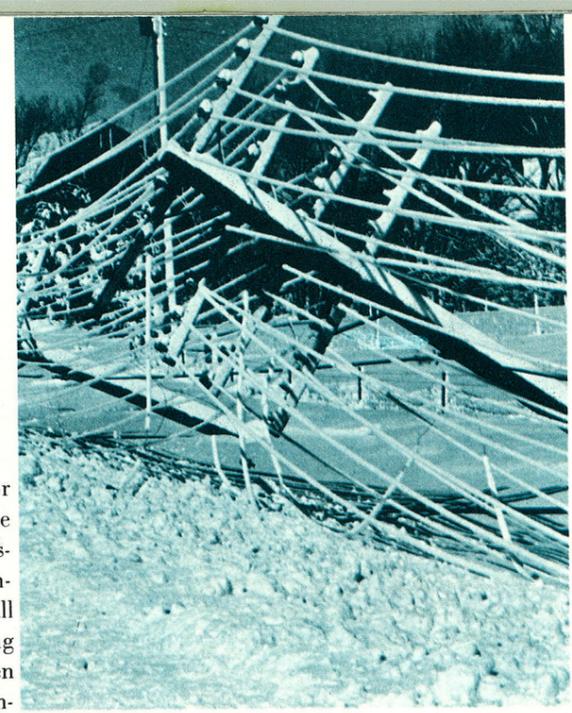


November 29, 1966

## Freezing Rain, Freezing Drizzle, and Ice Storms

FREEZING RAIN OR FREEZING DRIZZLE is rain or drizzle occurring when surface temperatures are below freezing (32° Fahrenheit, F). The moisture falls in liquid form but freezes upon impact, resulting in a coating of ice glaze on all exposed objects. The occurrence of freezing rain or drizzle is often called an *ice storm* when a substantial glaze layer accumulates. Ice forming on exposed objects generally ranges from a thin glaze to coatings about an inch thick; but much thicker deposits have been observed. For example, ice deposits to eight inches in diameter were reported on wires in northern Idaho in January 1961, and loadings of 11 pounds per foot of telephone wire were found in Michigan in February 1922. It has been estimated that an evergreen tree 50 feet high with an average width of 20 feet may be coated with as much as five tons of ice during a severe ice storm. A heavy accumulation of ice, especially when accompanied by high winds, devastates trees and transmission lines. Sidewalks, streets, and highways become extremely hazardous to pedestrians and motorists—over 85 per cent of ice-storm deaths are traffic related. Freezing rain and drizzle frequently occur for a short time as a transitory condition between the occurrence of rain or drizzle and snow, and therefore usually occur at temperatures slightly below freezing.

Some of the most destructive ice storms have occurred in the southern states, where neither buildings nor crops are designed with severe winter conditions in mind. The most damaging ice storm in the United States was probably that which struck the southland from January 28 to February 4, 1951, causing some \$50 million damage in Mississippi, \$15 million in Louisiana, and nearly \$2 million in Arkansas; this storm also caused 22 deaths. The region of greatest incidence, however, is a broad belt from Nebraska, Kansas, and Oklahoma eastward through the middle Atlantic and New England states.



Charles Hale, Rochester (Minn.) *Post-Bulletin*

*Ice storms* are sometimes incorrectly referred to as *sleet storms*. Sleet can be easily identified as frozen rain drops (ice pellets) which bounce when hitting the ground or other objects. Sleet does not stick to trees and wires; but sleet in sufficient depth does cause hazardous driving conditions.

The terms *ice storm*, *freezing rain*, and *freezing drizzle* warn the public that a coating of ice is expected on the ground and on other exposed surfaces. The qualifying term *heavy* is used to indicate ice coating which, because of the extra weight of the ice, will cause significant damage to trees, overhead wires, and the like. Damage will be greater if the freezing rain or drizzle is accompanied by high winds.

Any road-icing condition is extremely hazardous, as most drivers and pedestrians understand. Snow sometimes will provide traction even over an ice layer, and, at temperatures just under freezing, traffic churns the snow into slush. But under certain conditions a road-ice condition *not* readily recognized may occur, and set the winter stage for tragedy. Here, traffic melts the thin snow layer, which refreezes as ice and is polished by auto tires into a veritable skating rink. More light snow may obscure the layer of ice and lure unsuspecting drivers into mishaps—and pedestrians into overestimating how much control drivers have of their vehicles.

## Snow

THE WORD *snow* in a National Weather Service forecast, without a qualifying word such as *occasional* or *intermittent*, means that the fall of snow is of a steady nature and will probably continue for several hours without letup.

*Heavy snow forecasts* are issued by the National Weather Service to the public when a fall of four inches or more is expected in a 12-hour period, or a fall of six inches or more is expected in a 24-hour period. Some variations on these rules may be used in different parts of the country. Where four-inch snowfalls are common, for example, the emphasis on heavy snow is generally associated with six or more inches of snow. In other parts of the country where heavy snow is infrequent or in metropolitan areas with heavy traffic, a snowfall of two or three inches will justify a heavy snow forecast.

*Snow flurries* are defined as snow falling for short durations at intermittent periods; however, snowfall during the flurries may reduce visibilities to an eighth of a mile or less. Accumulations from snow flurries are generally small.

*Snow squalls* are brief, intense falls of snow and are comparable to summer rain showers. They are accompanied by gusty surface winds.

*Blowing and drifting snow* generally occur together and result from strong winds and falling snow or loose snow on the ground. *Blowing snow* is defined as snow lifted from the surface by the wind and blown about to a degree that horizontal visibility is greatly restricted.

*Drifting snow* is used in forecasts to indicate that strong winds will blow falling snow or loose snow on the ground into significant drifts. In the northern plains, the combination of blowing and drifting snow, after a substantial snowfall has ended, is often referred to as a *ground blizzard*.



Earl Johnson, Duluth Herald & News Tribune

*Blizzards* are the most dramatic and perilous of all winter storms, characterized by strong winds bearing large amounts of snow. Most of the snow accompanying a blizzard is in the form of *fine*, powdery particles of snow which are whipped in such great quantities that at times visibility is only a few yards.

*Blizzard forecasts* are issued when winds with speeds of at least 35 miles per hour are accompanied by considerable falling or blowing snow and visibilities are dangerously restricted making it very easy to become lost or stranded.

*Severe blizzard forecasts* are issued when blizzards of extreme proportions are expected and indicate wind with speeds of at least 45 miles per hour plus a great density of falling or blowing snow and a temperature of 10°F or lower.

*Travelers' (Hazardous Driving) Advisories* are issued to indicate that falling, blowing or drifting snow, freezing rain or drizzle, sleet or strong winds will make driving difficult.

*Stockmen's (Livestock) Advisories* alert ranchers and farmers that livestock will require protection from wet, windy, chilling conditions. Advisories are not issued when other winter warnings are in effect.

## Chill Index

A VERY STRONG WIND combined with a temperature slightly below freezing can have the same chilling effect as a temperature nearly 50°F lower in a calm atmosphere. Arctic explorers and military experts have developed what is called the *wind-chill factor*, which shows the combined effects of wind and temperature as

equivalent calm-air temperatures.\* In effect, the index describes the cooling power of the air on exposed flesh. The wind-chill table provided here shows this cooling power for various combinations of wind and temperature, and will help you gauge how much protection you really need.

Read right and down from calm air \* line. For example, a calm-air temperature of zero degrees Fahrenheit (0°F) has an equivalent cooling effect of minus 40°F at a wind speed of 20 miles per hour.

Calm (4 mph.)*		Equivalent Temperature (°F)																	
		5	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
Wind speed (Miles per hour)	5	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45	
	10	21	16	9	2	-2	-9	-15	-22	-27	-31	-38	-45	-52	-58	-64	-70	-77	
	15	16	11	1	-6	-11	-18	-25	-33	-40	-45	-51	-60	-65	-70	-78	-85	-90	
	20	12	3	-4	-9	-17	-24	-32	-40	-46	-52	-60	-68	-76	-81	-88	-96	-103	
	25	7	0	-7	-15	-22	-29	-37	-45	-52	-58	-67	-75	-83	-89	-96	-104	-112	
	30	5	-2	-11	-18	-26	-33	-41	-49	-56	-63	-70	-78	-87	-94	-101	-109	-117	
	35	3	-4	-13	-20	-27	-35	-43	-52	-60	-67	-72	-83	-90	-98	-105	-113	-123	
	40	1	-4	-15	-22	-29	-36	-45	-54	-62	-69	-76	-87	-94	-101	-107	-116	-128	
	45	1	-6	-17	-24	-31	-38	-46	-54	-63	-70	-78	-87	-94	-101	-108	-118	-128	
	50	0	-7	-17	-24	-31	-38	-47	-56	-63	-70	-79	-88	-96	-103	-110	-120	-128	

\* "Calm-air" as used in wind-chill determinations actually refers to the conditions created by a person walking briskly (at 4 miles-per-hour) under calm wind conditions.

## If A Blizzard Traps You:

**Avoid overexertion and exposure.** Exertion from attempting to push your car, shovel heavy drifts, and perform other difficult chores during the strong winds, blinding snow, and bitter cold of a blizzard may cause a heart attack—even for persons in apparently good physical condition.

**Stay in your vehicle.** Do not attempt to walk out of a blizzard. Disorientation comes quickly in blowing and drifting snow. Being lost in open country during a blizzard is almost certain death. You are more likely to be found, and more likely to be sheltered, in your car.

**Don't panic.**

**Keep fresh air in your car.** Freezing wet snow and wind-driven snow can completely seal the passenger compartment.

**Beware the gentle killers: carbon monoxide and oxygen starvation.** Run the motor and heater sparingly, and only with the downwind window open for ventilation.

**Exercise** by clapping hands and moving arms and legs vigorously from time to time, and do not stay in one position for long.

**Turn on dome light at night,** to make the vehicle visible to work crews.

**Keep watch.** Do not permit all occupants of car to sleep at once.



## What About Us?

BLIZZARDS take a terrible toll in livestock. For both humane and economic reasons, stockmen should take necessary precautions in advance of severe winter storms.

- Move livestock, especially young livestock, into sheltered areas. Shelter belts, properly oriented and laid out, provide better protection for range cattle than shed type shelters, which may cause cattle to overcrowd, with consequent overheating and respiratory disorders.
- Haul extra feed to feeding areas before the storm arrives. Storm duration is the largest determinant of livestock losses; if

the storm lasts more than 48 hours, emergency feed methods are required. Range cattle are hardy and can survive extreme winter weather providing they have some non-confining type of shelter from the wind and are able to feed at frequent intervals.

Autopsies of cattle killed by winter storms have shown the cause of death to be dehydration, not cold or suffocation. Because cattle cannot lick enough snow to satisfy their thirst, stockmen are advised to use heaters in water tanks to provide livestock with water and feed after prolonged exposure to winter storm conditions.

Ken Norgard, Rapid City (S.D.) *Daily Journal*

# Winter Storm Safety Rules

Keep ahead of the winter storm by listening to the latest weather warnings and bulletins on radio and television.

- Check battery powered equipment before the storm arrives. A portable radio or television set may be your only contact with the world outside the winter storm. Also check emergency cooking facilities and flashlights.
- Check your supply of heating fuel. Fuel carriers may not be able to move if a winter storm buries your area in snow.
- Check your food and stock an extra supply. Your supplies should include food that requires no cooking or refrigeration in case of power failure.
- Prevent fire hazards due to overheated coal or oil burning stoves, fireplaces, heaters, or furnaces.
- Stay indoors during storms and cold snaps unless in peak physical condition. If you must go out, avoid overexertion.
- Don't 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.
- Rural residents: Make necessary trips for supplies before the storm develops or not at all; arrange for emergency heat supply in case of power failure; be sure camp stoves and lanterns are filled.

*Dress to fit the season.* If you spend much time outdoors, wear loose-fitting, lightweight, warm clothing in several layers; layers can be removed to prevent perspiring and subsequent chill. Outer garments should be tightly woven, water repellent, and hooded. The hood should protect much of your face and cover your mouth to ensure warm breathing and protect your lungs from the extremely cold air. Remember that entrapped, insulating air, warmed by body heat, is the best protection against cold. Layers of protective clothing are more effective and efficient than single layers of thick clothing; and mittens, snug at the wrists, are better protection than fingered gloves.

U.S. DEPARTMENT OF  
COMMERCE  
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Administration  
National Weather Service

Your automobile can be your best friend—or worst enemy—during winter storms, depending on your preparations. Get your car winterized before the storm season begins. Everything on the checklist shown below should be taken care of before winter storms strike your area.

<input type="checkbox"/> ignition system	<input type="checkbox"/> heater
<input type="checkbox"/> battery	<input type="checkbox"/> brakes perfectly adjusted
<input type="checkbox"/> lights	<input type="checkbox"/> wiper blades
<input type="checkbox"/> tire tread	<input type="checkbox"/> defroster
<input type="checkbox"/> cooling system	<input type="checkbox"/> snow tires installed
<input type="checkbox"/> fuel system	<input type="checkbox"/> chains
<input type="checkbox"/> lubrication	<input type="checkbox"/> antifreeze
<input type="checkbox"/> exhaust system	<input type="checkbox"/> winter-grade oil
<input type="checkbox"/> tight	

Keep water out of your fuel by maintaining a FULL tank of gasoline.

*Be equipped for the worst.* Carry a winter storm car kit, especially if cross country travel is anticipated or if you live in the northern states.

Suggested Winter Storm Car Kit: blankets or sleeping bags, matches and candles, empty 3-pound coffee can with plastic cover, facial tissue, paper towels, extra clothing, high-calorie, nonperishable food, compass and road maps, knife, first aid kit, shovel, sack of sand, flashlight or signal light, windshield scraper, booster cables, two tow chains, fire extinguisher, catalytic heater, axe.

*Winter travel by automobile is serious business.* Take your travel seriously.

- If the storm exceeds or even tests your limitations, seek available refuge immediately.
- Plan your travel and select primary and alternate routes.
- Check latest weather information on your radio.
- Try not to travel alone; two or three persons are preferable.
- Travel in convoy with another vehicle, if possible.
- Always fill gasoline tank before entering open country, even for a short distance.
- Drive carefully, defensively.