Cold Hard Facts About Winter Storms

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As the sun gradually lowers in the sky in the Northern Hemisphere during the fall, cold arctic and polar air masses intrude farther and farther south into the United States. Disturbances forming along the boundary between the cold polar air and the relatively warm, tropical air sometimes turn into winter storms. These are usually large, intense low pressure systems that may cover tens of thousands of miles. Illinois' location in the Midwest and its great north to south extent place it in the path of many of these storms. When conditions are right, these storms can strike Illinois hard, leaving snow and ice over all or parts of the state.

Severe winter storms in Illinois produce more total damage than any other form of short-term severe weather including tornadoes, lightning, and hail. Central Illinois has the distinction of being in the nation's primary area for severe freezing rain (ice) storms. However, any part of the state is apt to have a severe snow storm or ice storm.

What is a severe winter storm? How does it impact on our daily lives? How can we prepare for it? What should you do and not do when a winter storm strikes?
How Many Storms and When?

Illinois, on the average, experiences five severe winter storms during the November-April period. These storms may be those with only heavy snow, or with snow and ice mixed, or with ice (glaze) only. Although the average is five per winter, as many as 18 have occurred in one winter (1977-1978) and as few as two (1921-1922). The number of times severe winter storms have occurred in the various sections of Illinois is shown in Figure 1.

January is the most favored month for severe winter storms, although December, February, and March are close behind in numbers of storms. The earliest a severe winter storm ever hit Illinois was on October 28-30, 1925, and the latest one ever to hit was on May 1-2, 1929. The maps in Figure 2 depict the snowfall patterns resulting from these storms.

A study of the number of times that severe winter storms have occurred on each date reveals that December 24, 25, and 26, and March 2 and 3 are high incidence periods. There are 2 chances in 10 that a severe winter storm will occur somewhere in the state on these dates. In contrast, the low storm incidence periods are December 3-4, December 15-16, January 3-5, January 22-28 (normally the January thaw period), February 20-24, March 15-17, and March 21-24. Although historically these are low incidence periods, this does not mean that storms will never occur on these dates. In fact, in 1977 two severe winter storms hit Illinois during the December 2-6 period.

A Typical Severe Winter Storm

Scientists at the Illinois State Water Survey studied 304 severe winter storms that occurred in the years 1900 to 1960. Some features of these storms were averaged together to form a "model" of the typical severe winter storm in Illinois. The model (Figure 3) depicts the patterns of freezing rain, sleet, and snow that typically exist with severe winter storms. The snow area of 4 inches or more is about 215 miles long and 70 miles wide, lying with a southwest to northeast axis somewhere in Illinois.

Many severe winter storms that strike Illinois will probably not have the exact rain, sleet, and snow patterns depicted by this model. However, the model is useful in that it shows us several relationships. First, the very heavy snowfall
Earliest storm of season, October 28-30, 1925

Latest storm of season, May 1-2, 1929

FIGURE 2. Snowfall patterns (in inches) for the earliest and latest severe winter storms

The National Weather Service issues WATCHES and WARNINGS for hazardous winter weather events.

A WINTER STORM WATCH: hazardous winter weather conditions may affect your area.

A WINTER STORM WARNING: hazardous winter weather conditions are threatening your area.
end their travels in the mountainous Southwest, dying out as they cross the rough terrain. Some, however, do make it over the mountains and redevelop just east of the Rockies.

One of the most favored areas for this re-development is in Colorado and the surrounding region. Water Survey climatologists discovered that this area was where most of our severe winter storms in Illinois come from. There are also two other areas that favor development of severe winter storms, although to a lesser extent. These areas are the Province of Alberta (just east of the Canadian Rockies) and the Texas Gulf Coast. As shown on the map in Figure 4, there are five storm types for Illinois based on:

- The source of the storm — and
- The track the storm follows

Not all low pressure systems that develop in the favorable areas during the winter become severe storms. Thankfully, only a relatively small percentage of all lows that form, regenerate, or intensify in these three source areas actually lead to severe winter storms in Illinois.

Storms tend to form where there are great contrasts in temperature. During the winter months the lee side of the Rockies and the western Gulf coast provide these battlegrounds for the air masses. Once the storms have developed, the winds in the upper atmosphere determine where and how fast they move, and ultimately if Illinois will be their target.

The severe winter storms that affect Illinois tend to follow certain paths. The most damaging storms, on the average, are those that originate
in Colorado and end up moving just south of Illinois (Types 2 and 4 on the map in Figure 4). Cold air north of the storm center in the Great Lakes or upper Midwest can then feed into the storm — the necessary ingredient for snow or ice.

Precipitation with most major low pressure systems tends to fall east and north of the storm center (see Figure 5). If the air is cold enough in the winter, the precipitation will be snow, sleet, or freezing rain. The reason the Type 2 and 4 storms usually result in the most damages is that the paths they follow tend to keep Illinois in the area of maximum precipitation for the greatest amount of time. In the record-breaking winter of 1978-1979, nine of the 18 severe winter storms were Types 2 and 4, and five of the seven most damaging storms during that winter were Types 2 and 4.

What About Snow?

When the word “snow” appears in a weather forecast, it arouses a great deal of concern among most people, no matter what amount is expected. One inch of snow may result in minor travel delays, while 10 inches can close down a city.

One type of severe storm in Illinois produces a snowfall of 6 inches or more in 48 hours or less somewhere in the state. However, the severity of a particular snow storm is not measured solely by the amount of snow that falls, but also by:

- The temperature at which it falls — and
- Whether or not it is accompanied by high winds

The amount of water in a snowflake is determined largely by the temperature of the air.
it forms in. If snow is falling with the air temperature at 32°F, 1 inch of that snow, if melted down, would yield on the average 0.10 inch of water. However, if the snow was falling at, say, 10°F, that 1 inch of snow would yield on the average only 0.05 inch of water if melted. In other words, at lower temperatures a given amount of snow contains less water — making it lighter and fluffier — than the same amount of snow at higher temperatures.

Many of us know what it is like to shovel a heavy, wet snow from the sidewalk or driveway, and how comparatively easy it is to clear the same amount of snow when it is much drier and lighter. This same relationship also makes it easier for the wind to pick up snow from the ground. Snow rarely drifts when the temperature is near the freezing point as the snow is falling. As the temperature falls farther below freezing, however, the snow is prone to being blown into drifts.

Our typical severe storm — 6 inches or more of snowfall — that occurs when the temperature is near freezing will result in considerable inconvenience and disruption of daily activities, but the snow can normally be cleared from roads and walks without too many problems. But a 6-inch snowfall at a temperature of 10°F with strong winds is going to result in considerable blowing and drifting of snow which will choke highways, strand travelers, and isolate towns. Even after the snow stops falling, the snow on the ground may continue to blow and drift for hours and perhaps days, depending on how long the winds remain high. Conditions may be just as bad as when the snow was falling, preventing snow removal from streets and highways.

The Worst of Winter — Freezing Rain

Freezing rain occurs when rain developing in a relatively warm (above freezing) layer of air falls through a layer of air that is below freezing (25-32°F). The rain is "supercooled" (still liquid) as it falls through the cold layer near the surface of the earth. When the supercooled but still liquid raindrops strike the ground or an object already below freezing, they freeze on contact. The resulting coating of ice is commonly known as glaze.

A heavy accumulation of ice can topple power and telephone lines, television towers, and trees. Highways become impossible to travel on, and even stepping outdoors on foot can be an extremely risky undertaking. If you have lived through an Illinois winter, chances are very good that you have already had some encounter with freezing rain.

The severity of an ice storm (that is, the amount of damage) depends on:

- The amount of rain and thus the icing taking place
- The strength of the wind — and
- Whether the storm strikes an urban or rural area

Urban areas tend to suffer more damage than rural areas because of the concentration of utilities and transportation systems (aircraft, trains, buses, trucks, and cars), all of which may be affected to a great degree by the icing.

The area most likely to experience freezing rain in Illinois is a west-southwest to east-northeast band extending from Pike County in western Illinois to Iroquois and Vermilion Counties in eastern Illinois (see Figure 6). This area corresponds well with the average motion of ice storms. The worst icing situations tend to result from storm Types 2 and 5 (Figure 4), moving from the west-southwest or southwest. In a study of 86 ice storms, the maximum number of storm motions were from the west-southwest. Ice-only storms (no snow) tended to move from the southwest. On the average here in Illinois, we will experience 15 severe ice storms in a 10-year period.
Recent Severe Winter Storms in Illinois

Since 1976, residents of Illinois have lived through three of the most severe winters of the century. The winter of 1977-1978 holds the distinction of being the worst, followed by the winter of 1981-1982 and then the winter of 1978-1979. These winters produced a total of 53 severe winter storms.

One of the most severe ice storms to hit central Illinois since 1967 began the morning of March 24, 1978. Freezing rain continued until the morning of March 25th, and by the time the rain ended one-half to 2 inches of ice coated a 90-mile-wide belt west to east across central Illinois. One million people were without power at least 24 hours, and some outages took up to two weeks to repair. Over 1000 auto accidents occurred, and there was an estimated $20 million in tree losses. Twenty-four counties in Illinois were declared disaster areas. Figure 7 shows the snow and ice pattern for this storm.

The winter of 1981-1982, the second most severe winter of this century, featured 18 severe winter storms, 8 in January alone. The most damaging storm of that winter struck on January 29-31, 1982. Ten to twenty inches of snow fell on an area extending from the southwestern counties of the state to eastern central Illinois (figure 7). The storm resulted in ten deaths, and the National Guard was called out to help with snow removal in southern Illinois. In the ten days following this storm these same areas received another 5 to 15 inches of snow, leading the Governor to declare 15 southern Illinois counties disaster areas.

The Impacts of Winter Storms

The disabling effects of large amounts of snow or ice on daily activities are quite extensive. Metropolitan transportation systems are usually affected first and hardest. Transportation is the backbone of our economy, and the storm effects on it lead to impacts on domestic and commercial activities.

Losses due to a major winter storm may result from lost revenue to the state from people not working and businesses closed (lost taxes) and from increased expense for snow removal and salting operations. The delivery of goods
and services may be sharply curtailed. The effects of a severe winter storm may impact on many facets of our lives.

However, not all the impacts are detrimental. A bad winter storm keeps people indoors. Crime rates tend to drop (although police are kept busy with accident calls), and the incidence of colds and flu may sometimes be reduced because people have to stay indoors and public meetings or other gatherings are called off. Stores may profit from sales of sleds, toboggans, snowmobiles, and skis. Sales of snow shovels, snow blowers, and snow tires typically increase, especially if the storm occurs early in the winter. However, the undesirable impacts of these storms far outweigh the desirable ones.

Preparing for Winter — Some Common Sense Suggestions

The inconvenience and hardship that often result from a winter storm can be lessened if you take the time to be prepared. Most of these preparations should be made in the late fall or early winter, before the first heavy snowfall. Consider these activities:

At Winter’s Start —

★ Make sure you have a snow shovel and a supply of salt or sand before the first storm.
★ Have your furnace checked for proper and safe operations. If your furnace breaks down after a heavy snow, service personnel may not be able to reach you.
How A Severe Winter Storm Can Impact on Our Lives

- Highways closed or difficult to travel on
- Airports closed, business and pleasure trips cancelled or delayed
- Commuter trains and buses delayed
- Mail delayed
- Difficulty in obtaining medical care (unable to get to hospital — ambulances blocked by snow-covered roads)
- Shipment of food and other goods delayed
- Schools closed
- Businesses closed
- Stores lose business because patrons unable to get there
- Power and communications disrupted because of downed lines
- Fire and police delayed in responding to emergencies
- Cars hard to start, need assistance (often extra costs)
- Increased auto accidents
- Large costs to state, county, and local highway departments for snow removal

Winterize your car. Make sure it is in top running condition for the long winter ahead.

Check the following items:
- anti-freeze
- battery and ignition system
- exhaust system
- heater and defroster
- wiper blades
- winter weight oil in crankcase (will permit easier starts)
- snow tires on car
- all lights in working order

Know which radio stations broadcast your school closings. Avoid calling radio stations during storms as they are extremely busy trying to gather and broadcast storm-related information.

When A Storm Is Forecast —

Again, the watchword is “be prepared.” When a winter storm is forecast to hit your area, keep the following rules in mind.

Check battery-powered equipment before the storm arrives. Make sure radios and flashlights are in working order in case the power goes out.

If you heat with wood, oil, or bottled gas, check your fuel supply. Fuel carriers may not be able to make deliveries if a winter storm dumps a large amount of snow or ice on your area.

Check your food and stock an extra supply. Include plenty of food that requires no refrigeration or cooking.

Make trips for supplies before the storm develops.

Check your home to prevent fire hazards due to overheated stoves, furnaces, fireplaces, or portable heaters.

Stay indoors during the storm unless you are in excellent physical condition.

Don’t kill yourself shoveling snow! It is difficult and heavy work and not a job for someone in poor physical shape. Heart attacks while shoveling snow are a major cause of death during and after winter storms.

Dress properly. Layers of protective clothing are more effective and efficient in keeping the body warm than one heavy garment. The entrapped insulating air warmed by body heat is the best type of protection against cold. Remove layers of clothing as necessary to prevent perspiring and possible chill.
If A Storm Traps You in Your Car...

Despite any precautions you may take, it is still possible to be caught in the middle of a bad storm.

- **DON'T PANIC.**
- **Stay** in your vehicle. Do not attempt to walk out of a storm. Disorientation comes quickly in blowing and drifting snow. Being lost in open country during a snow storm is almost certain death. You are more likely to be found and more likely to be sheltered in your car.
- **If you have a CB radio, try to obtain help by contacting** the State Police on Channel 9, the emergency channel.
- **Keep fresh air in your car.** Freezing wet snow and wind-driven snow can completely seal the passenger compartment.
- **Beware of carbon monoxide**— run the motor and heater sparingly. Open only the "downwind" window for ventilation.
- **Exercise by clapping hands and moving arms and legs vigorously from time to time.** Don't stay in one position for too long.
- **Avoid over exertion and exposure** trying to shovel snow or push your car out of a drift.
- **Turn on an interior light at night.** Your vehicle will be more visible.
- **Keep watch—don't permit all occupants of your car to sleep at the same time.**

- **Keep abreast of the latest storm information by TV or radio.** The National Weather Service operates 12 radio stations in or around Illinois (see Figure 8) that provide continuous weather information. Special radios that receive these broadcasts can be purchased for as little as $10 to $15.

**If Traveling by Car—**

- **If storm conditions have worsened to the point that you doubt your ability to continue traveling,** seek refuge immediately.
- **Plan ahead and select alternate routes.**
- **Check latest weather and road conditions.**
- **Try not to travel alone.** Two or more persons to a vehicle are preferable.
- **Travel in a convoy with another vehicle if possible.**
- **Always have a full tank of fuel** before entering open country, even for a short distance.
- **Carry a winter storm car kit consisting of the following as a minimum:** blanket, shovel, bag of sand, flashlight, booster cables, windshield scraper. Also, carry a small supply of high-calorie, non-perishable food such as nuts or candy bars.
- **Always dress as if you were going to be in a non-heated car.** If you become stranded in a storm, a light jacket or sweater will not be enough to keep you warm!

**What They Mean . . .**

Here are the meanings of some common terms used by the National Weather Service in referring to winter weather.

**HEAVY SNOW**—refers to either the intensity or amount of snow. When used in reference to intensity, heavy snow is that which reduces visibility to less than 5/16 statute mile (about 1/4 mile). The National Weather Service issues a heavy snow warning if amounts of 4 or more inches are expected in a 12-hour period, or 6 or more inches in a 24-hour period. In areas where this amount of snow is infrequent, a snowfall of 2 or 3 inches would qualify as heavy snow.
SNOW FLURRIES — snow falling for short durations at intermittent periods, and resulting in generally small or no accumulation. Flurries may at times be heavy enough to greatly reduce visibility for brief periods.

SNOW SQUALL — a brief, intense fall of snow of a showery nature, usually accompanied by gusty surface winds.

BLOWING SNOW — snow lifted from the surface by the wind and blown about to a degree that horizontal visibility is reduced.

DRIFTING SNOW — strong winds blowing falling or loose snow into significant drifts.

BLIZZARD — a winter storm characterized by winds of at least 35 mph and accompanied by considerable falling and/or blowing snow. A severe blizzard is a storm with winds of at least 45 mph, a great amount of falling or drifting snow, and temperatures 10°F or lower.

FREEZING RAIN — rain falling in a liquid form through a shallow below-freezing layer of air near the ground. The rain (or drizzle) freezes on impact with the ground or other objects, resulting in a clear coating of ice known as glaze.

ICE STORM — freezing rain resulting in a substantial accumulation of ice.

SLEET — also called ice pellets. Sleet is formed when raindrops or melted snowflakes freeze as they pass through a below-freezing layer of air near the earth's surface. Sleet does not stick to trees and wires, and usually bounces on hitting the ground. An accumulation of sleet often has the consistency of dry sand.

COLD WAVE — a rapid fall of temperature in a 24-hour period, usually signifying the beginning of a period of very cold weather.

WIND CHILL INDEX — also called wind chill temperature. The effective temperature on the human body of the combination of air temperature and wind. It is an approximation only for the human body, and has no meaning for cars, buildings, or other objects. (See table.)

Wind Chill Table

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Example: The air temperature is 20°F and the wind is 25 mph. Locate 20°F in the top row of the table and go down the column to the row marked 25 mph on the left. The number in the table (−14) is the wind chill temperature. This says that at 20°F with a wind of 25 mph, the cooling effect on bare skin is the same as if the air temperature was −14°F with calm air.
This is the fourth in a series of pamphlets describing in popular language our research findings about water resources and weather in Illinois and current issues concerning them.

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Steven Hilberg is a meteorologist and Extension Services Coordinator at the Illinois State Water Survey. The Water Survey, as the Illinois Climate Center, maintains the climate records for more than 70 National Weather Service stations in Illinois, as well as extensive research information about our weather and climate. Stanley A. Changnon, Jr., is Chief of the Water Survey and State Climatologist.

Much of the material in this pamphlet was based on research described in the following Water Survey publications:


Some of the information included was taken in part from materials supplied by the National Oceanic and Atmospheric Administration, National Weather Service.

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FIGURE 8. NOAA weather radio stations in Illinois. The stations broadcast on the FM band on frequencies from 162.40 to 162.55 MHz. They have a range of about 40-50 miles.