



ISWS/RI-118/2009
Report of Investigation 118

The Severe Winter of 2008-09 in Illinois

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A division of the Institute of Natural Resource Sustainability
Champaign, Illinois



I L L I N O I S

Cover photo: A rural home in central Illinois buried by a heavy snowfall on January 13-14, 2009.

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Any opinions, findings, and conclusions or recommendations expressed in this publication are those of the author(s) and do not necessarily reflect the views of the Illinois State Water Survey.

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Abstract

The winter of 2008-2009 in Illinois had 12 severe winter storms and many days with extremely low temperatures. Normally, the state has five severe storms in a winter. In northern Illinois the December-January period was among the state's ten coldest and snowiest winter periods on record. The climate winter, December-February, had a mean temperature that was 2.5° F below normal, and was the fifth coldest since 1890. The period of 2006-2009 is the second time since 1900 that Illinois has had three consecutive severe winters. The first trio of bad winters came during the 1976-1979 period. The 2008-2009 winter snowfall values ranged from 50 inches in the extreme north to less than 5 inches in southern Illinois. Snow amounts in the northern sections ranged from 10 to 25 inches above normal, but snowfall totals in central Illinois were near normal and those in the south were below normal.

In December 2008, seven winter storms occurred. Temperatures across Illinois were 3.5° F below normal and snowfall exceeded 20 inches. Four storms had heavy snows and freezing rain. The January average temperature statewide was 4.6° F below normal and snow was above normal across Illinois, with record low daily temperatures in mid-month and four winter storms. February had normal temperatures and no snowstorms, but

two heavy rainstorms occurred. March began with severe storms producing tornadoes, but ended with a sizable snowstorm.

Atmospheric conditions over the U.S. during December and January were unstable and very active. These conditions resulted in numerous low-pressure centers that developed over the Rockies and then moved east across or near Illinois, causing several winter storms. As the synoptic-scale flow field over the U.S. became more zonal late in the season, the number of cyclones affecting Illinois decreased.

The large number of storms and extremely low temperatures for two months resulted in major negative impacts in four sectors. Property damages totaled \$672 million, and all forms of transportation in Illinois suffered major problems and losses. Power systems were badly damaged with major outages producing losses and costs of \$512. The storms also created many state and local government responses that cost \$510 million. The winter also affected human health and welfare with 16 persons killed and thousands injured. Damage to the environment included excessive flooding. Many winter conditions also impacted agricultural activities and retail business, in which reductions in sales totaled \$292 million.

Introduction

The winter of 2008-2009 in Illinois had 12 severe winter storms and many extremely low daily temperatures. Normally, the state has five severe winter storms in a winter. In Chicago the December-January period was the ninth coldest and sixth snowiest period in the past 139 years. The climate winter, December-February, had a mean temperature that was 2.5 degrees below normal, and was the fifth coldest since 1890.

This winter of harmful and costly weather conditions was the third in a row, following the severe winter of 2006-2007 (Changnon and Kunkel, 2007) and bad winter conditions of 2007-2008 (Changnon et al., 2008a). This is the second time since 1900 that Illinois has had three consecutive severe winters. The first trio came during the 1976-1979 period (Changnon et al., 1980). Assessment of past winters revealed that there were three types of severe winters: 1) extremely low temperatures for 6 to 10 weeks with or without heavy snow, 2) severe ice and snowstorms occurring repeatedly but no severe cold period, and 3) a combination of the first two types—many storms and extended cold periods. The winter of 2006-2007 was a type 2; the winter of 2007-2008 was a type 3; and the winter of 2008-2009 was a type 3. Snowstorms are defined as events causing 6 or more inches of snow in one or two days (Changnon et al., 2008b).

This report presents a description of the surface weather conditions, including the temperatures, snowfall, winds, and storms that occurred during the December 2008-March 2009 period. These conditions are compared with historic data to assess their climatological relevance (LeComte, 2009). Then the atmospheric conditions that led

to the unusual and extreme weather conditions in Illinois are presented and compared with those in more normal winters. The third section of this report presents an assessment of the many impacts created by the severe winter conditions. All temperature conditions in this report are in degrees Fahrenheit unless noted otherwise.

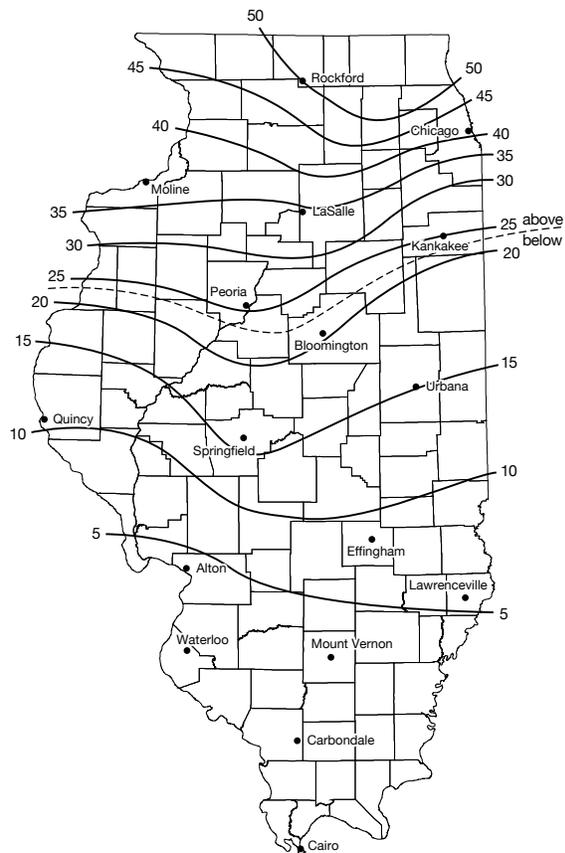


Figure 1. Pattern of total snowfall (inches) for winter 2008-2009

Figure 1 presents the snowfall pattern for the winter of 2008-2009. The winter values in Illinois ranged from 50 inches in the extreme north to less than 5 inches in southern Illinois. The northern sections had snow amounts that ranged from 10 to 25 inches above normal. Snowfall totals in central Illinois ranged from 10 to 25 inches, and were near normal. South of a line shown on Figure 1 from near Peoria to Kankakee, all points had below normal amounts, revealing a large contrast in the seasonal amounts across the state.

Weather Conditions

DECEMBER

The statewide mean monthly December temperature was 3.5 degrees below normal. Temperatures in northern Illinois were 5 to 6 degrees below normal, and those in southern Illinois were 2 to 3 degrees below normal. The average monthly temperatures were 34 degrees in southern Illinois and only 20 degrees in northern Illinois. At most locations in Illinois, 28 to 30 days in December had high daily temperatures that were below freezing.

Precipitation was much above normal, 4.5 inches statewide, which is 1.8 inches above normal for December. Snowfall was low in southern Illinois with only 1 to 2 inches, and most locations in central Illinois had only 3 to 5 inches, well below normal amounts. However, totals in northern Illinois were 20 inches or more, which are well above normal. Chicago had 21.9 inches, and the state's two largest December totals were at Crystal Lake, which had 32.9 inches, and at Belvidere, which had 34.7 inches of snow.

The winter's first snowstorm occurred on November 30-December 1 (Figure 2), and locations in northern Illinois had 5 to 6 inches of snow. Ironically, the two prior winters each began with a winter storm on November 30-December 1. A second snowstorm in December occurred on December 17-18 with 10 inches in northern Illinois (Figure 3). This storm also included considerable freezing rain across central and northern Illinois. This storm was followed by severe cold, and temperatures across northern Illinois fell below zero degrees. The month's third snowstorm also occurred in northern Illinois on December 23-24 (Figure 4).

Warm air surging northward ahead of a strong cold front, causing temperatures to rise from 10 to more than 20 degrees above normal, set the stage for severe weather. A tornado occurred on

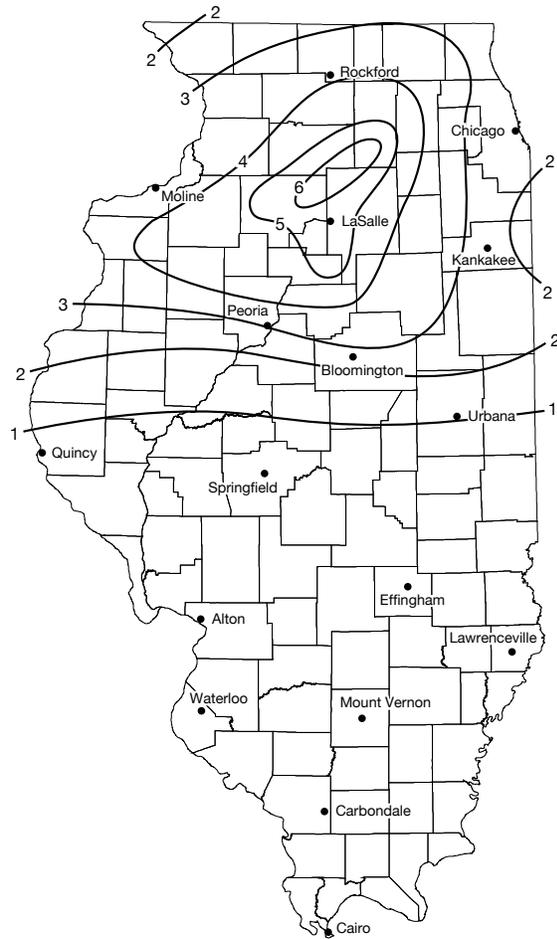


Figure 2. Snowfall (inches) for storm on November 30-December 1, 2008

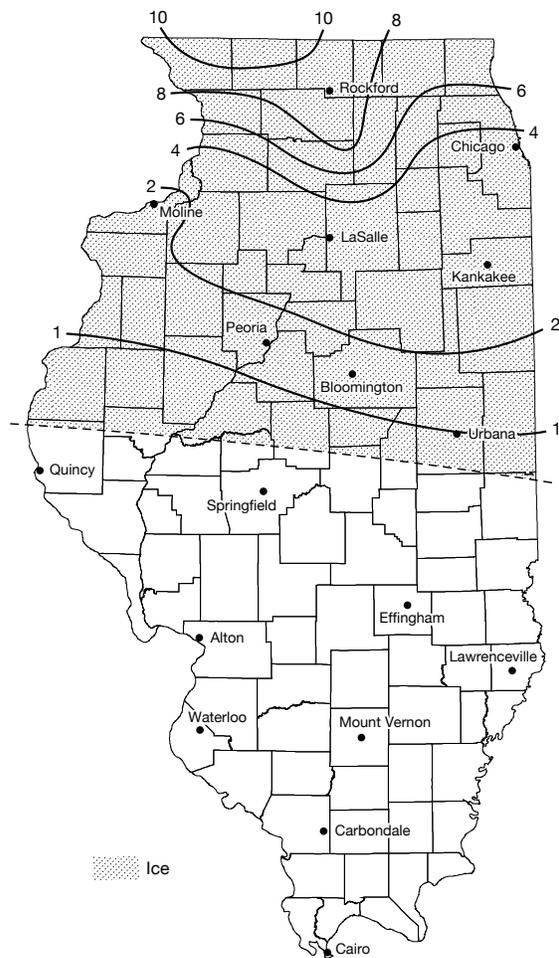


Figure 3. Snowfall (inches) and ice storm area for storm on December 17-18, 2008



Figure 4. Snowfall (inches) for storm on December 23-24, 2008

December 27 in Adams County, and high winds occurred across the entire state on this date, creating widespread damages. Wind speeds in December across Illinois were well above normal.

Freezing rain occurred in parts of central and northern Illinois on December 8-9. A very damaging freezing rain storm struck northern and central Illinois on December 26 (Figure 5), producing glaze layers one-fourth- to one-half-inch thick. Freezing rain occurred on five to six days at most locales in central Illinois, twice the normal number.

In summary, December was a cold, stormy, and windy month across Illinois, and snowy in northern Illinois.



A rural home in central Illinois buried by a heavy snowfall on January 13-14, 2009.

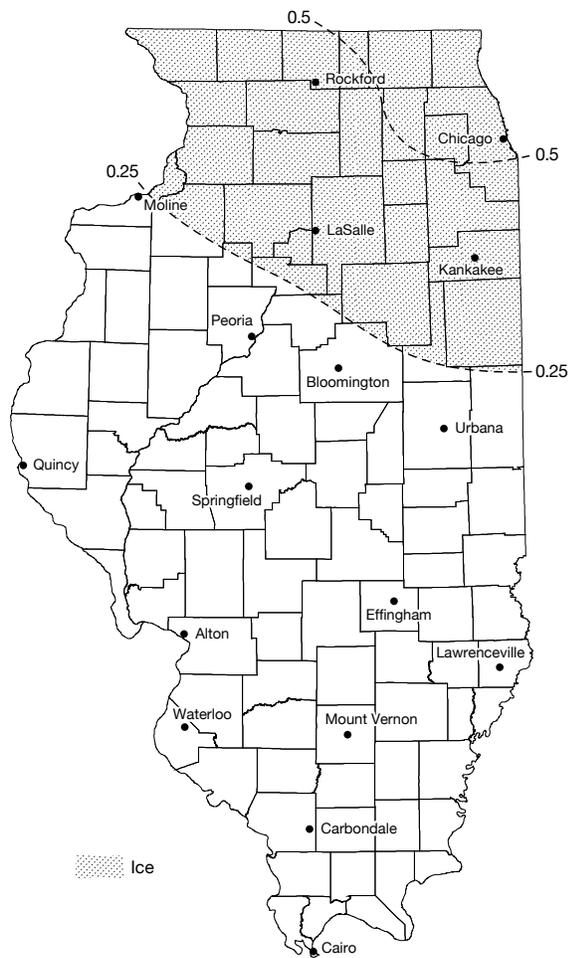


Figure 5. Ice storm on December 26, 2008, and glaze thickness (inches)



Figure 6. Snowfall (inches) for storm on January 9-10, 2009

JANUARY

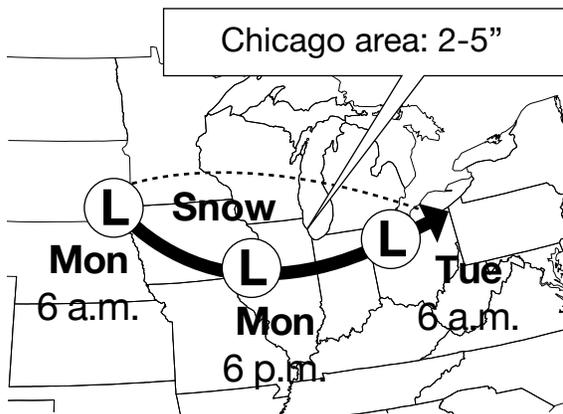
The statewide mean temperature for January was 19.3 degrees, which is 4.6 degrees below normal. January 2009 was the 12th coldest on record, extending the cold temperatures prevalent in December. Snowfall during January was above normal in all portions of the state. Locales in southern and central Illinois had 6 to 15 inches, and most of northern Illinois had 12 to 24 inches with more than 30 inches in a few locales near the Wisconsin border. The highest monthly total was 41.4 inches at Rockford.

A sequence of three snowstorms began on January 9. On January 9-10, the month's first major snowstorm struck northern Illinois, depositing 10 inches in Chicago (Figure 6). It was a result

of the Polar Express jet stream being locked in place. The continuing strong flow brought another Alberta Clipper and it deposited 2 to 8 inches of snow in northern Illinois on January 12-13. It was closely followed by the third storm, which occurred on January 14. Storm tracks are shown on Figure 7. The third storm in this sequence, which occurred on January 14, produced snow across central and northern Illinois. The combined total snowfall amounts of these two clipper storms on January 12-14 are shown in Figure 8, indicating their closeness in time and space.

This sequence of three January snowstorms was followed by an invasion of very cold Arctic air (Figure 9), which created near record low temperatures across Illinois during January 14-17.

Late Monday into Early Tuesday



Wednesday into Wednesday Night

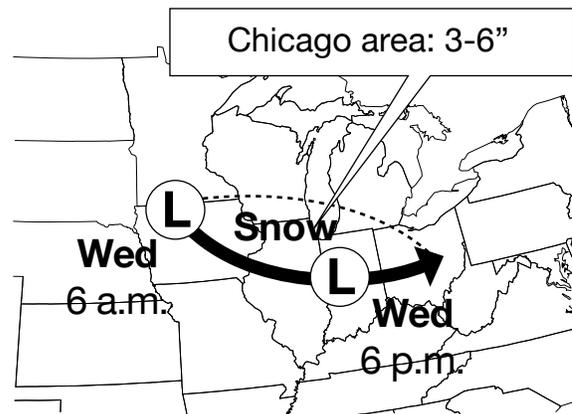


Figure 7. Tracks of low-pressure systems on January 12 and 14, 2009

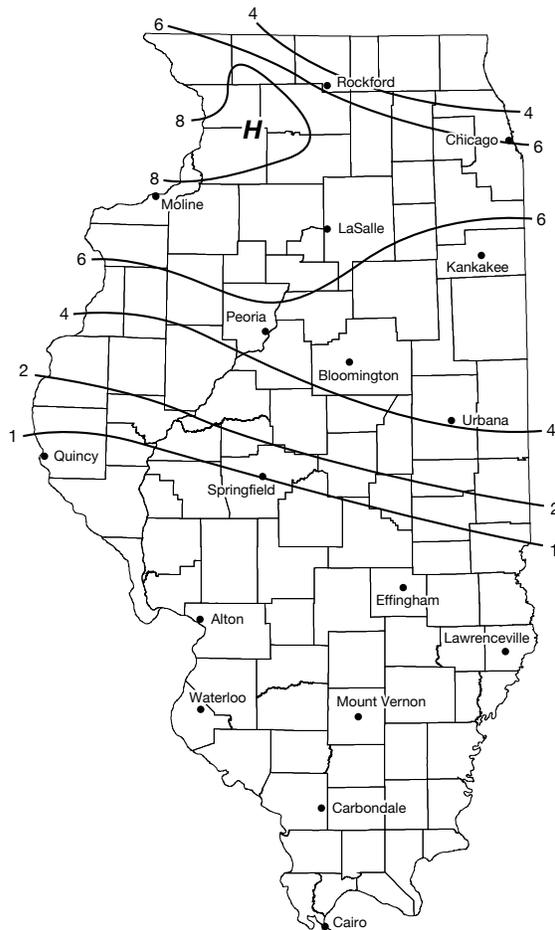


Figure 8. Snowfall (inches) from two storms during January 12-14, 2009



A country road covered by a deep snow with some broken tree branches, seen in southern Illinois on January 28, 2009.

The state's lowest temperature at this time was -33 degrees recorded at Mt. Carroll and Elizabeth. These temperatures came close to the all-time lowest temperature in the state, which is -36 degrees set at Congerville on January 5, 1999. In central and southern Illinois the low temperatures were not as low, but a new record low was set at Urbana when -17 degrees occurred on January 16 (Figure 10).

Weather conditions causing the fourth major storm during January led to freezing rain, sleet,

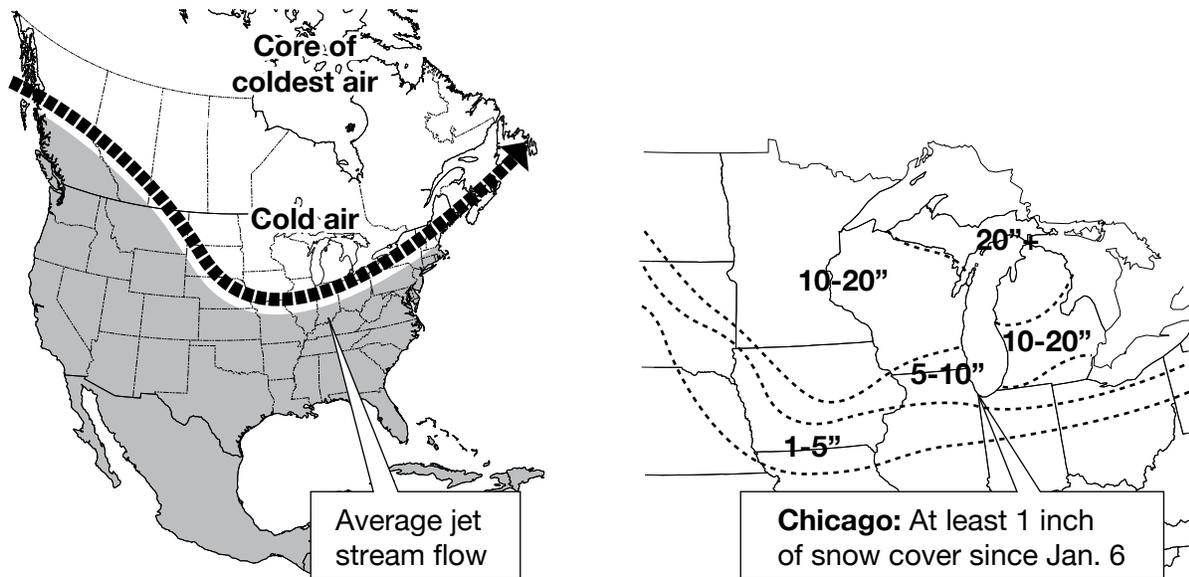


Figure 9. Pattern of cold air in January and map of snow depth in late January

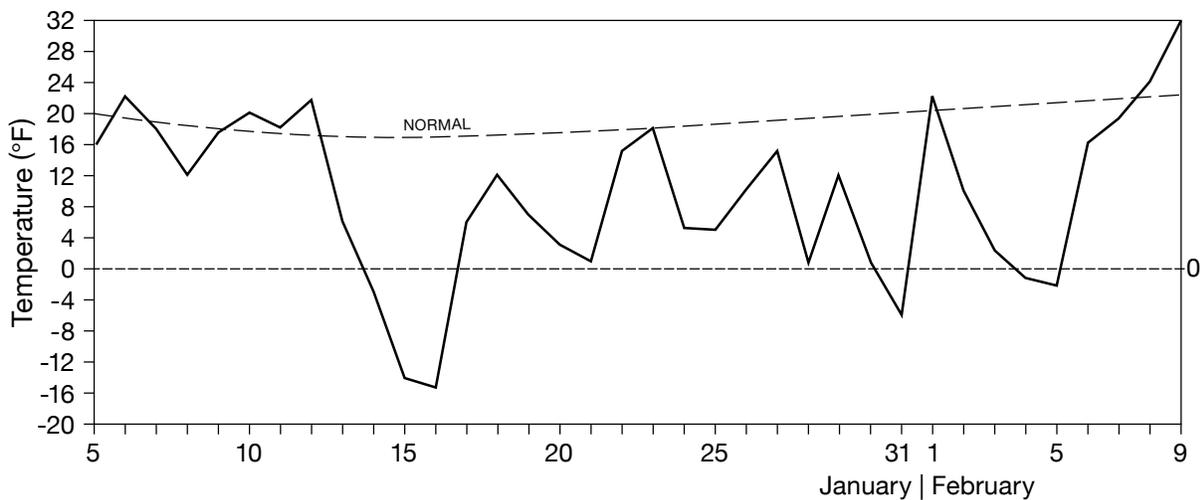


Figure 10. Minimum temperature values for January 5-February 9, 2009 at Urbana

and snow in the southern half of Illinois on January 27-28. (Figure 11). The storm deposited 3 to 4 inches of sleet across most of southern Illinois, followed by 2 to 10 inches of snow (Figure 12). The extreme southern end of the state also had a major ice storm. Glaze was more than 1-inch thick in extreme southern Illinois with ice of one-half-inch thick north of there (Figure 12). Snow also fell across central Illinois with amounts ranging from 1 to 4 inches.

The December-January snow accumulation at Chicago O'Hare is indicative of conditions in northern Illinois. On January 15 there had been 40.5 inches of snow since December 1, and by February 4 the seasonal total was 44 inches, nearly double the average of 22.7 inches. Snow on the ground in northern Illinois during the January 5-February 5 period ranged from 4 to 12 inches deep; depths at the end of January are shown in Figure 9.

The seasonal (December-January) mean temperature at Chicago was 19.3 degrees, as compared to an average of 26.6 degrees, revealing a 7.3 degree below average value. In January the daily temperatures in Chicago were below freezing from January 5 until February 6. There were 12 days with temperatures below 0 degrees, the most in the city since 1980. Figure 10 shows the daily low temperatures at Urbana, a site representative of central Illinois. The values remained well below freezing from January 5 to February 9. Most Urbana values were below normal, and values below zero degrees occurred on six days, January 14, 15, 16, and 31, and on February 4 and 5.

FEBRUARY

The statewide average precipitation in February was 2.43 inches, which is 0.5 inch above normal. Snowfall during February was below normal in the southern two-thirds of Illinois, at less than 1.5 inches at all locations. Snow amounts in northern Illinois ranged between 3.0 and 7.0 inches, and some were above normal. No snowstorms occurred in Illinois during February. The average statewide temperature for February was slightly above normal. The value was 31.4 degrees, which is 1.2 degrees above normal.

Exceptionally cold temperatures occurred in early February (see Figure 10), followed by temperatures much above normal from February 6 to 13. An unusually warm period occurred in mid-February, with values of 60 degrees over most of the state on February 10. New record high values occurred in many locales. Some of these were at Springfield (66 degrees), Cairo (72 degrees), Chicago Midway (62 degrees), and Quincy (68 degrees).

This warm period was ended by a strong cold front that brought thunderstorms in parts of southern and central Illinois on February 11-12, and heavy rains occurred across most of Illinois. Rainfall in northern Illinois ranged from 0.3 to 1.2 inches, but amounts in the southern half of the state ranged from 2 to 4 inches (Figure 13). The only February snowfall of consequence occurred on February 20-21. Highest amounts were 4 inches in extreme northern Illinois. This event did not qualify as a snowstorm, an event in which amounts must be 6 inches or more. On February 26, convective

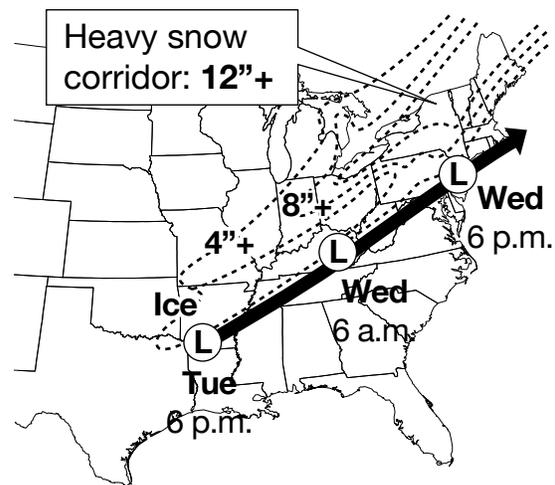


Figure 11. Track of low-pressure system during January 27-28, 2009

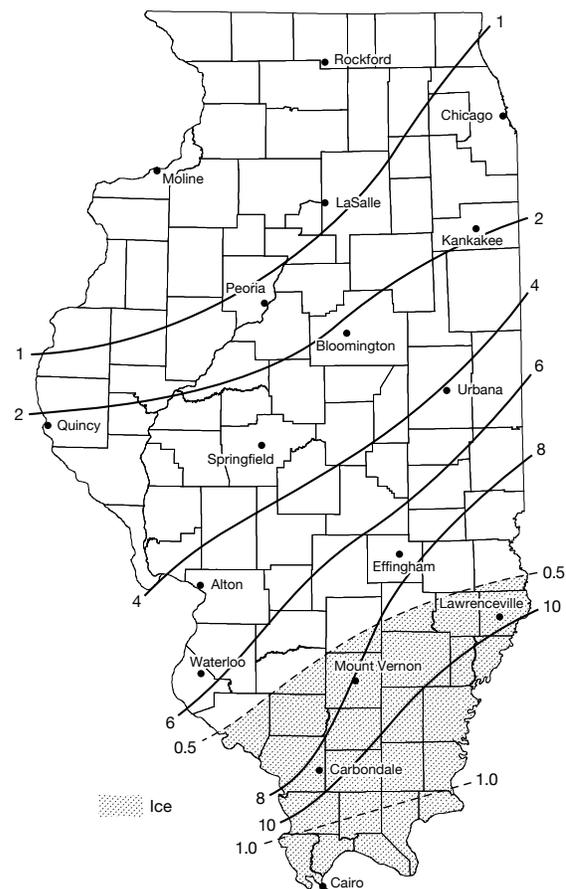


Figure 12. Snowfall (inches) and ice storm on January 27-28, 2009

storms occurred in northern Illinois with thunder reported at Chicago and other northeastern Illinois locales. The rainfall amounts across northern Illinois ranged from 0.5 to 2.5 inches, adding to the flooding potential on regional rivers.

MARCH

The month began with temperatures 10 to 15 degrees below normal across Illinois. However, by March 5, temperatures rose 20 to 25 degrees above normal, with values of 60 degrees or higher that set records across central and southern Illinois. Stormy conditions developed on March 7-8, and thunderstorms occurred at many locales with seven tornadoes in central and southern Illinois on March 8. Rainfall amounts varied from 0.5 to 3.0 inches. On March 9-10 more storms marched across central and northeastern Illinois, depositing 0.5 to 3.0 inches of rain.

The statewide March temperature was 2.1 degrees above normal, and the statewide precipitation was 1 inch above normal. Monthly values were greatest in central Illinois; Peoria had 7.49 inches, a new record for March. March had no major winter storms until one occurred on March 29. Temperatures fluctuated considerably during the month and were typical of spring conditions. The typical sequence involved a few days with temperatures above normal, then a few days with below normal temperatures, and then back to days above normal. The shifts between temperature regimes were often accompanied by a period of showers and thunderstorms producing amounts between 0.2 and 2.0 inches.

The last winter storm in January had occurred on January 27-28. Amazingly, no winter storms occurred in February nor during the first 28 days of March. Then on March 29, two months after the last storm had occurred in Illinois, another storm hit. The pattern of snowfall on March 29 (Figure 14) shows a maximum of 3 to 6 inches extending from central Illinois northeastward to the Illinois-Wisconsin border where amounts exceeded 7 inches. Above freezing temperatures after the storm caused the snow to melt by March 31.

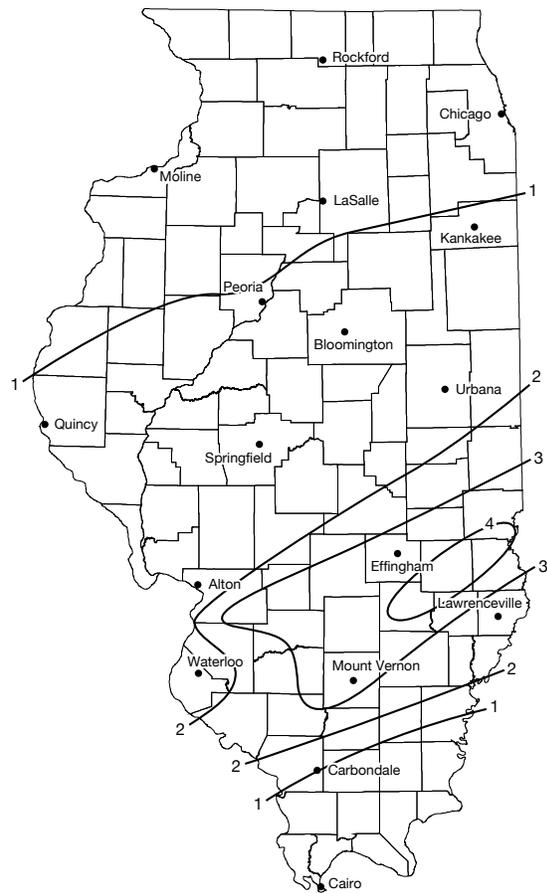


Figure 13. Rainfall (inches) from storm on February 11-12, 2009



A towering cumulus cloud producing heavy rain over southern Illinois on February 11, 2009.

SEASONAL VALUES

The climatological winter (December 2008-February 2009) in Illinois was cold. In Chicago the three-month seasonal average was 22.1 degrees, which is 4.6 degrees below normal. The statewide seasonal average temperature was 25.5 degrees, which is 2.3 degrees below normal. This was the coldest winter in Illinois since that in 1985-1986.

The three-month snowfall total at Chicago O'Hare was 48.5 inches, which is 18.4 inches above normal. Values at selected other locales included 49.3 inches at Rockford (22.3 inches above normal), and 37.9 inches at Moline (13.9 inches above normal). Stations farther south in central Illinois had much less snow during December-February. For example, Peoria had 20.8 inches (normal), Springfield had 9.8 inches (7 inches below normal), and Urbana had 16.1 inches (4 inches below normal).

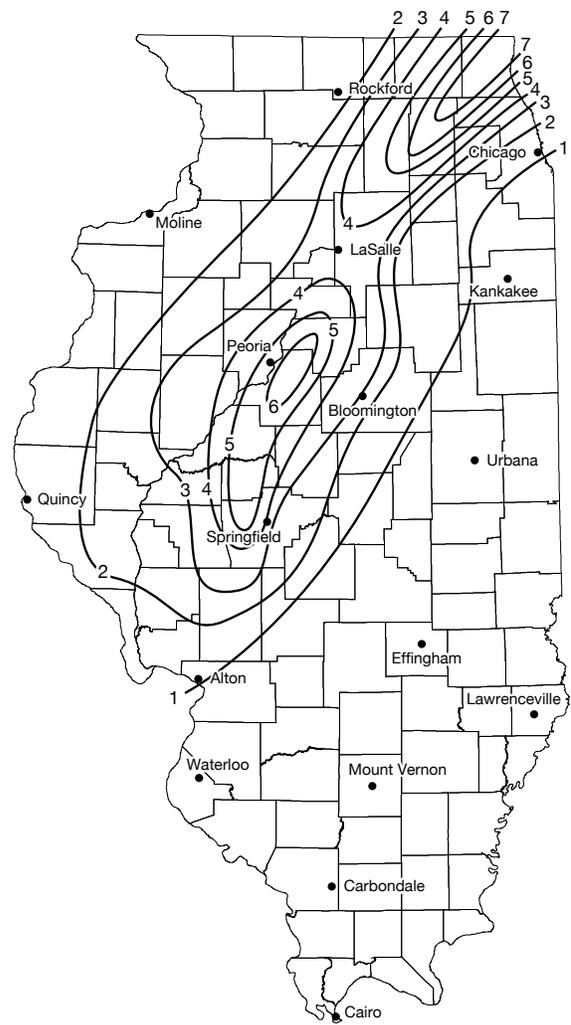


Figure 14. Snowfall (inches) for storm on March 29, 2009

Synoptic Weather Conditions

Atmospheric conditions over the U.S. during December and January were unstable and very active. These conditions resulted in numerous low-pressure centers that developed over the Rockies and then moved east across or near Illinois, causing several winter storms. As the synoptic-scale flow field over the U.S. became more zonal late in the season, the number of cyclones affecting Illinois decreased.

DECEMBER

Throughout much of the atmosphere over the North Pacific and off the mid-Atlantic Coast, atmospheric pressures (measured as “heights” of specific pressures at levels above the ground) were unusually high during December 2008. Between these two areas of higher pressure, a trough of low pressure extended from about Hudson Bay to the U.S. Southwest. During December, this pattern resulted in more frequent occurrences of northerly winds in western North America accompanied by colder than average temperatures in the northern Plains and western Canada, and more southerly winds along the mid-Atlantic and New England states accompanied by warmer than average temperatures.

This wind flow field is often called an “amplified wave” pattern, which generally is associated with the development of more frequent cyclones. For the Midwest, perhaps the most important implication of this pattern was an increase in the average winter temperature gradient from the northern Plains to the East Coast region and a northward displacement of the polar jet stream over the eastern half of the U.S. (Figure 15). Increased horizontal

temperature gradients and a northward movement of the jet stream to a corridor from Illinois to Maine gave rise to frequent strong cyclones, which are described in more detail below.

The first storm came from an intense weather system from the Rockies that passed south of Illinois on December 1-2, creating heavy snow. Then, Arctic air plunged south after its passage, bringing near record low temperatures across the state. A second December weather system, a strong surface low, moved from Colorado to Missouri on December 10 (Figure 16), and the cold front brought heavy snow to western Illinois. On December 14 a Colorado-generated low system moved to Iowa, bringing warm air into southern Illinois and snow

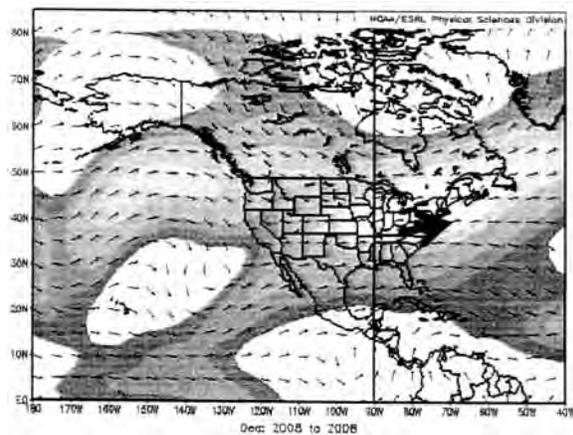


Figure 15. Mean wind speed and direction map for 250 hPa altitude, averaged over the month of December 2008. The thick black arrow shows the approximate location of the 1968-1998 average maximum wind velocity (NCEP/NCAR re-analysis).

in northern Illinois, thus becoming December's third winter storm. A fourth major winter storm occurred in Illinois on December 17-18. It resulted from a deep low-pressure system that developed in Arizona and moved into the St. Louis area by December 18. Freezing rain occurred first in the area north of the warm front laying across central Illinois, followed by snow. A fifth winter storm produced heavy snow across extreme northern Illinois on December 20-21 with blizzard conditions that closed major highways. A sixth storm followed on December 23-24, bringing 6 inches of snow to northern Illinois. December's final storm resulted from an upper-level trough and low-pressure system that was in Colorado on December 27 (Figure 17) and then moved eastward to the lower Great Lakes by December 29. It created a major ice storm in northern Illinois.

JANUARY

As the new year started, circulation patterns averaged over the month of January 2009 were similar to the previous month, but shifted further to the east. High pressure was centered over the northeastern Pacific Ocean with positive height anomalies spreading inland from western Canada to the southwestern U.S. Anomalously low pressure had moved from north-central North America to the Canadian and U.S. East Coastal and Great Lakes regions. Higher pressures were centered well east of the U.S. southeast coast. For the Midwest, this highly amplified flow field resulted in more northerly winds than usual from north-central Canada into the Midwest, extending down to Texas. This arctic flow pattern resulted in colder than normal temperatures throughout the U.S. Northeast.

While the high-level jet stream extended in a similar pattern as the long-term average flow field over North America (Figure 18), the jet stream was generally stronger with a maximum extending further to the east-northeast from the mid-Atlantic states. The overall result of this flow field was more frequent cold air outbreaks and cyclones that more often moved from western Canada into the U.S. Midwest and Northeastern states. Each of the major cyclone events affecting Illinois are discussed below.

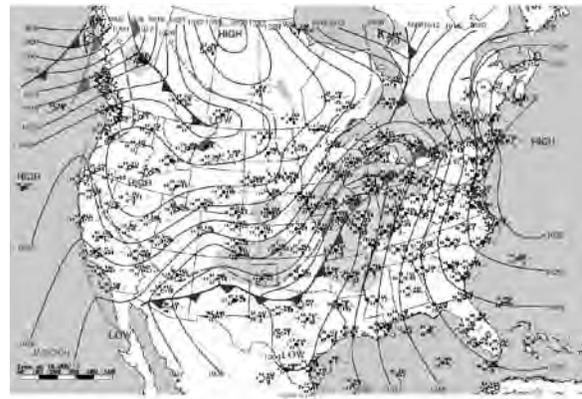


Figure 16. Surface weather map for 0700 EST on December 10, 2008 (National Weather Service)

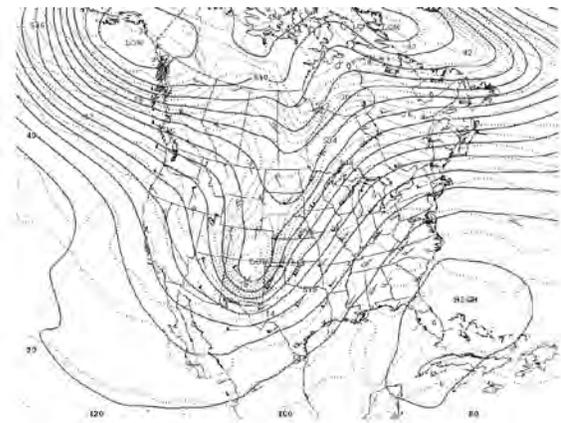


Figure 17. The 500-millibar level map for 0700 EST on December 27, 2008 (National Weather Service)



A suburban yard with trees and bushes covered with ice from a storm on December 28.

January also experienced frequent storm systems with cold and snowy conditions across Illinois. A weak weather system developed in the High Plains on January 3 (Figure 19), and its low moved east to lower Lake Michigan by January 4. This storm produced some light freezing rain in Illinois. During the week of January 8-14, a series of low-pressure systems moved east across or near Illinois. A storm on January 9-10 (Figure 20) resulted in heavy snows in northern Illinois. Then in the following four days, three Alberta Clippers came out of the northwest, each bringing heavy snow to Illinois. The first struck on January 11 (Figure 21), and the third passed on January 13 (Figure 22). These were followed by an extremely cold Arctic air mass that became centered over the Midwest (Figure 23), bringing record low temperatures in parts of the state and two deaths. On January 26 a low-pressure system developed in Colorado (Figure 24) and moved from the Oklahoma area



A tree split near Mt. Vernon by the weight of ice from a freezing rainstorm on January 29, 2009.

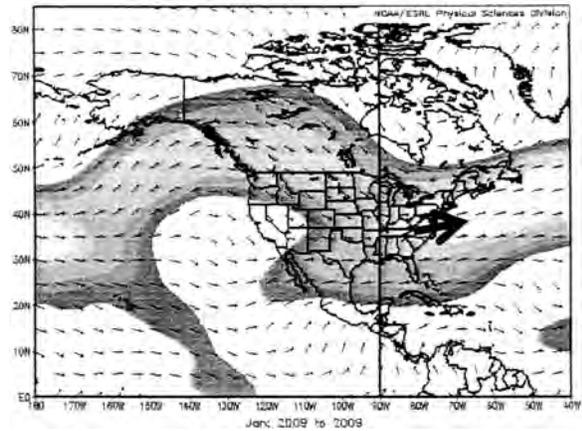


Figure 18. Mean wind speed and direction map for 250 hPa altitude, averaged over the month of January 2009. The thick black arrow shows the approximate location of the 1968-1998 average maximum wind velocity (NCEP/NCAR re-analysis).

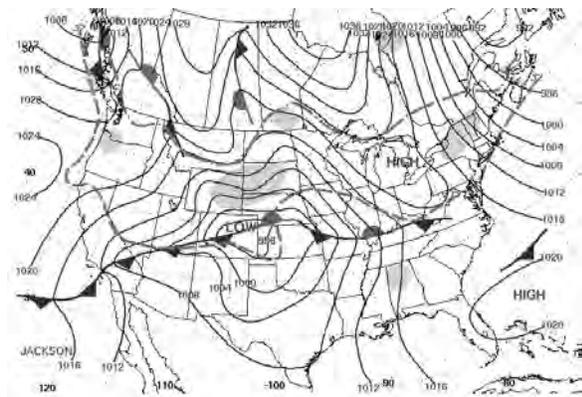


Figure 19. Surface weather map for 0700 EST on January 3, 2009 (National Weather Service)

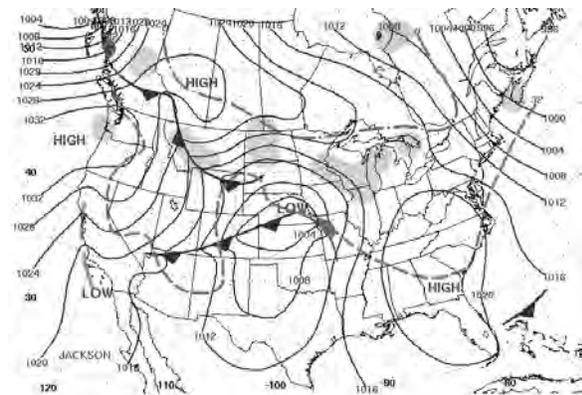


Figure 20. Surface weather map for 0700 EST on January 9, 2009 (National Weather Service)

northeast during January 27-28 (Figure 25). This storm brought damaging freezing rain and up to 10 inches of snow to the southern half of Illinois.

FEBRUARY

The large-scale wind pattern during February 2009 became much more zonal, with monthly mean wind directions at high altitudes from west-to-east in most locations. This was reflected in the pressure field by fewer strong perturbations in North America. The region of abnormally high pressure, which had been close to the Pacific Northwest coast, had moved over 1,000 miles westward to a location south of Alaska. Weak areas of pressure anomalies were present along the south and west coasts of the U.S., but pressure and wind flow patterns in the U.S. Midwest were near normal.

A zonal flow pattern, as seen in February (Figure 26), is usually associated with few cold- or warm-air outbreaks and fewer extratropical cyclones. This change in the weather pattern to more zonal flow generally led to far fewer cyclones affecting the Midwest than were seen in December and January.

February had stable weather conditions during the first ten days, then an intense low-pressure center developed along a cold front lying across Missouri and Illinois. As the low moved northeast, it brought heavy rains (>4 inches) and thunderstorms across central Illinois. No other storms occurred in Illinois during February with a major high-pressure center over the Midwest during the last two weeks.



Heavy snow in the woods near Kankakee on January 15, 2009.

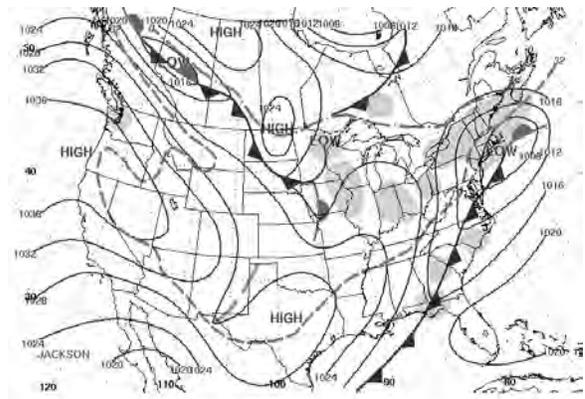


Figure 21. Surface weather map for 0700 EST on January 11, 2009 (National Weather Service)

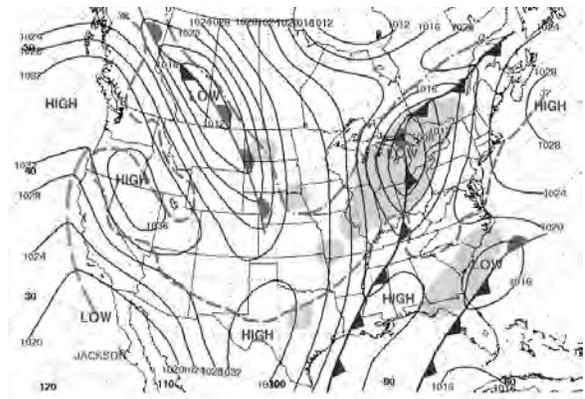


Figure 22. Surface weather map for 0700 EST on January 13, 2009 (National Weather Service)

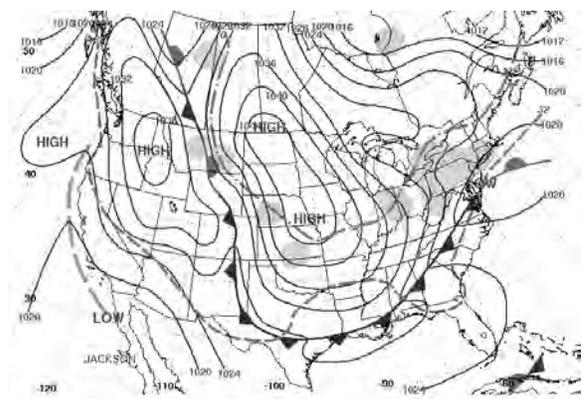


Figure 23. Surface weather map for 0700 EST on January 15, 2009 (National Weather Service)

MARCH

The monthly mean pressure fields during March 2009 showed a return to a more amplified wave pattern than in the previous month. Anomalously high pressure continued to be present south of southwest Alaska, but a region of lower pressure in western regions of Canada was considerably deeper than was seen in February. Relatively higher pressure was seen from the U.S. Midwest to off the East Coast. This resulted in a northward displacement of the jet stream, which, on average, extended from approximately Nebraska to the New England coast (Figure 27).

The more amplified wave flow pattern and tendency for ridging from the Midwest to the U.S. East Coast had several effects. First, the increase in pressure gradient (as well as horizontal temperature gradient) resulted in a more active pattern, with more cyclones affecting the Midwest.

March was free of winter storms during the first three weeks. On March 9-10 a low moved across the upper Midwest, bringing 0.5- to 1-inch rains across the northern fourth of Illinois. High pressure then dominated the Midwest during March 11-24. However, at the end of the month, major changes in atmospheric conditions occurred. Two major low-pressure systems moved through the Midwest during March 25-31 (Figure 28). Heavy wet snows fell across central and northern Illinois on March 29, as a low that had developed to the south on March 27 moved northeast across southern Illinois. This was the first major winter storm to affect Illinois since the end of January, an absence of two months.

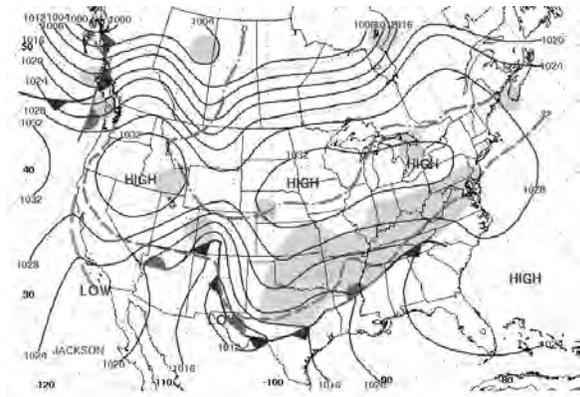


Figure 24. Surface weather map for 0700 EST on January 27, 2009 (National Weather Service)

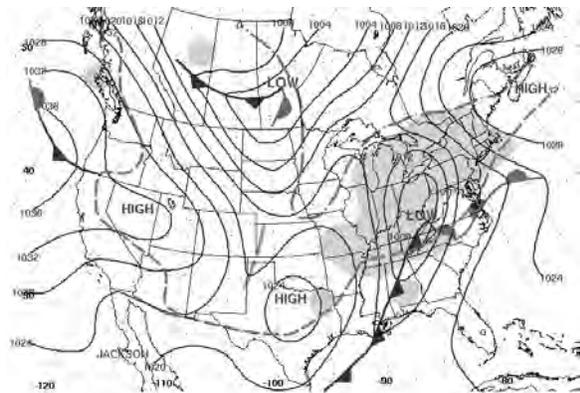


Figure 25. Surface weather map for 0700 EST on January 28, 2009 (National Weather Service)

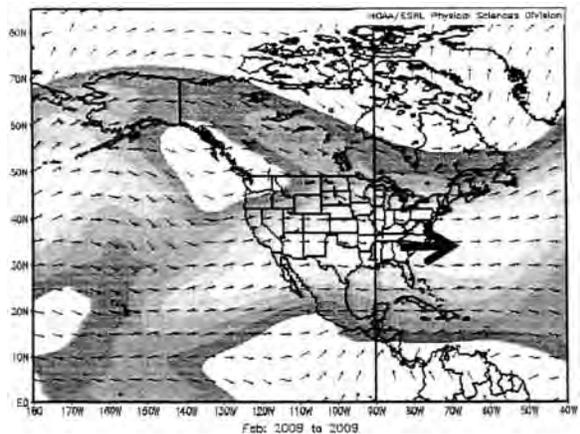


Figure 26. Mean wind speed and direction map for 250 hPa altitude, averaged over the month of February 2009. The thick black arrow shows the approximate location of the 1968-1998 average maximum wind velocity (NCEP/NCAR re-analysis).

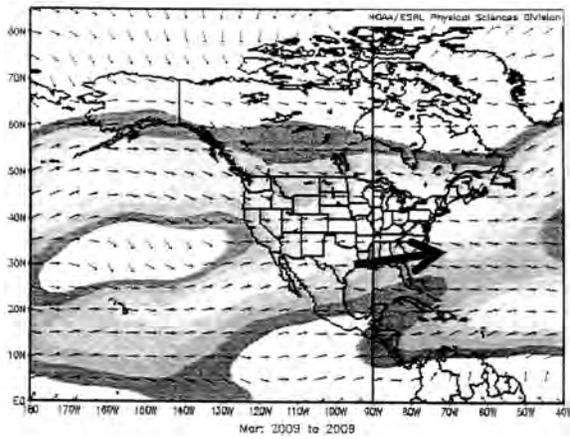
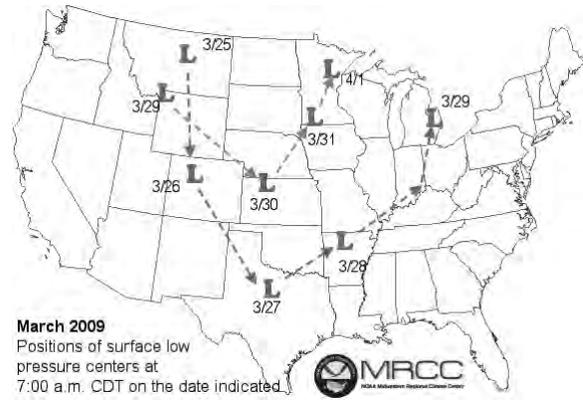


Figure 27. Mean wind speed and direction map for 250 hPa altitude, averaged over the month of March 2009. The thick black arrow shows the approximate location of the 1968-1998 average maximum wind velocity (NCEP/NCAR re-analysis).



March 2009
Positions of surface low pressure centers at 7:00 a.m. CDT on the date indicated. (Midwestern Regional Climate Center)

Figure 28. Positions of two low-pressure centers that occurred during March 25-April 1, 2009. All positions are at 0700 CST on the dates indicated (Midwestern Regional Climate Center).

Impacts

A severe winter in Illinois creates damaging impacts in several sectors (Changnon et al., 2008a). Those created in 2008 were defined as “classic” (Chicago Tribune, January 13). Many of the impacts are illustrated in Figures 29 and 30. The impacts, sorted according to major sectors, included:

- Transportation—vehicles, trains, and aircraft
- Health and welfare—several killed, thousands injured, and high costs
- Environment—floods, vegetative damage
- Power production and usage—high costs, utility profits
- Government—added costs for snow removal and road repairs
- Agriculture—crops and livestock damaged
- Property—houses and buildings damaged
- Retail business—sales diminished

However, some sectors benefitted from the harsh winter conditions. These included utilities with large sales of natural gas and electricity, and private snow removal firms. Some construction firms also benefitted from the added business of repairing storm damages.

TRANSPORTATION

The January 13 storm caused many vehicle accidents and problems for trains. Chicago’s Metra and CTA operations were hurt by cold temperatures that froze rails and switches, limiting commuter travel (Chicago Tribune, January 15). The severe winter also hurt Amtrak operations across the state. Many trains were delayed by several hours and some were canceled, greatly impacting travelers.

The cold conditions damaged many Amtrak cars (Chicago Tribune, February 2).

The poor weather conditions in December (storms, poor visibility, high winds) caused 45 percent of all flights to be delayed at Chicago’s O’Hare Airport for December 2008, rated as the worst delay record in the U.S. (Chicago Tribune, February 10). Midway Airport had 42 percent of its December flights delayed, the second worst record in the nation. The numerous winter storms, including many with ice from freezing rain, created major delays and increases in accidents for the trucking industry. Losses and costs in the transportation industry totaled \$436 million.

PROPERTY

Winter storms with heavy snowfalls and freezing rain damaged many homes and businesses. Numerous autos were damaged in accidents caused by the winter conditions. Icicles in Chicago were a problem in late January (Chicago Tribune,



Metra trains trapped in their storage yard in Chicago by heavy snow and frozen switches on January 15, 2009.

January 22). They grew large, then fell, damaging roofs and structures. The January sleet, ice, and snowstorm across southern Illinois (Figure 12) caused major damages to roofs, including collapsed roofs on many farm buildings. The state's property losses during the December-March period totaled \$672 million, the largest sector loss.

POWER USE AND PRODUCTION

Various ice storms during the winter caused numerous power outages in different parts of the state. The January ice storm in southern Illinois was very damaging to power lines. Outages lasted for four to five days in many areas south of Carbondale. High prices for natural gas, coupled with a huge demand resulting from below average temperatures, created huge costs to residents in northern Illinois. One person reported home costs for gas during November 2008-January 2009 were



Trees and wires bent down by heavy snow and ice loads, as seen in central Illinois on December 18, 2008.



Figure 29. Various winter impacts based on headlines from newspapers in Illinois published during winter 2008-2009

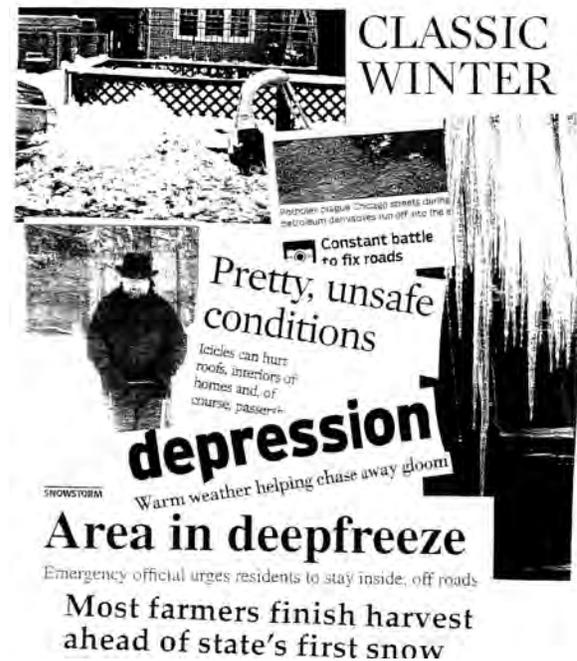


Figure 30. Impacts illustrated by headlines from newspapers in Illinois published during winter 2008-2009

\$1,265 (Chicago Tribune, February 14). Losses to the power industry and the increased costs to consumers totaled \$512 million.

GOVERNMENT

The winter was costly for many communities and the state. Many communities had frequent snow removal activities plus battles with the large number of potholes that developed in January. Costs exceeded budgets in many places, and the cost of asphalt for pothole repairs increased by 70 percent since 2008. Figure 31 shows the pothole areas in Chicago in December 2008. State funding for road resurfacing has declined in the past three to four years, and as a result, potholes had become a much bigger problem because of deteriorating pavements (Chicago Tribune, March 17a). In April the city of Chicago added several new work crews to help patch potholes, claiming the many potholes were the result of the severe 2008-2009 winter (Chicago Tribune, April 12). By early April the city had already repaired 300,000 potholes during the winter and estimated another one million existed. The Illinois Department of Transportation crews began work on repairing designated state roads, and many communities repaired damaged streets later in 2009.

Urban salt supplies for road clearance ran low in many towns by mid- to late-January. Some could not obtain more salt, and other communities had inadequate funds to buy more salt (Pantagraph, January 27). Snow removal was also a costly endeavor for the state. Government-related costs from the winter of 2008-2009 totaled \$510 million.

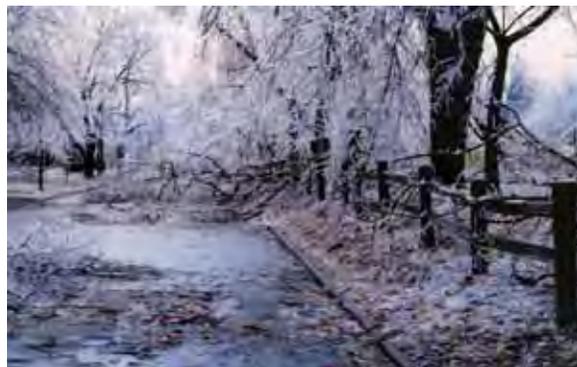
ENVIRONMENT

The above normal amounts of snowfall in December and January, coupled with several rain events, led to flooding in several parts of Illinois. Above normal temperatures occurred in late December and early January, resulting in rapid melting of the snow cover and producing several floods in Illinois and surrounding states (LeComte, 2009). The flow in the Rock River during January was the highest on record.

The Illinois River was 5 to 6 feet above flood stage during most of January and from mid-February through March from LaSalle south to Hardin.



Figure 31. Map of unrepaired potholes in Cook County on February 5, 2009 (Chicago Tribune, February 10, 2009)



A roadway in Bloomington on December 18 covered by ice from a bad storm.

The Illinois River at Valley City went above flood stage on December 28, then peaked at 7.5 feet above flood stage during January 5-7, and fell below flood stage on January 22. It rose again above flood stage on February 16, peaked 10.3 feet above flood stage during March 16-21, and remained in flood stage through the end of March. The Mississippi River at Hannibal, Missouri, rose above flood stage on March 10 and then fell below flood stage on March 17. The unusual warm spell in mid-February caused all the snow cover to melt, and then a heavy rainstorm on February 11-12 produced rains of 3 to 4 inches in parts of southern Illinois. Flash floods resulted along many rivers and streams. Local flooding occurred along the Big Muddy, Cache, Saline, and several other southern Illinois streams. Damages from the winter flooding are included in the property losses listed in Table 1.

The unusual winter weather conditions of 2008-2009 produced several other environmental impacts (Chicago Tribune, March 17b). High winds damaged evergreen trees by evaporating their moisture. The early warmth in March led to early budding of trees and bushes, which were susceptible to death or damages due to later cold temperatures. Freezing rains in December led to deaths of many squirrels that nest in trees (Chicago Tribune, March 17b).

HEALTH AND WELFARE

The winter conditions led to 16 deaths in Illinois. More than 1,800 persons were injured in auto accidents and by falls on slick surfaces. Several people in the Chicago area were hurt by falling icicles. Most deaths resulted from either over exposure to the cold or vehicle accidents.

Prolonged severe winter conditions—low temperatures, high winds, and storms—during December and January elicited depression in many people, including those clinically depressed (Pantagraph, February 17). The warm and sunny period that developed during mid-February led to improved attitudes, according to clinic counselors and many doctors.

RETAIL BUSINESS

The adverse winter weather conditions during December and January, including low temperatures and frequent storminess, kept shoppers from pursuing retail shopping at normal levels. Hence, sales were down as a result of the weather plus the tough economic conditions in the nation. This economic depression persisted during the entire winter season, but in February, retail sales were higher than expected. The increased shopping was attributed to the mild weather in February (Chicago Tribune, March 6). The winter contributed to losses in retail sales that totaled \$292 million.

AGRICULTURE

The 2008 growing season in Illinois had been delayed by excessive moisture during the planting season, leading to a late fall harvest. Fortunately 95 percent of the crops had been harvested when the November 30 snowstorm hit Illinois (Farm Week, December 8). Livestock in northern Illinois suffered broken legs and major bruises from the cold and slippery conditions during January (Farm Week, February 9). Losses in the agricultural sector amounted to \$315,000.

Summary

The winter of 2008-2009 in Illinois had 12 severe winter storms and many extremely low daily temperatures. Normally, the state has five severe storms in a winter. The December-January period was the ninth coldest and sixth snowiest in the past 139 years. The climate winter, December-February, had a mean temperature that was 2.5 degrees below normal, and was the fifth coldest since 1890.

This winter of bad weather conditions was the third in a row, following the severe winter storms of 2006-2007, and the very bad winter conditions of 2007-2008. This is the second time since 1900 that Illinois has had three consecutive severe winters. The first trio came during the 1976-1979 period. The winter of 2008-2009 snowfall across Illinois ranged from more than 50 inches in the northern boundary to less than 5 inches in southern Illinois. The northern third of Illinois had snowfall totals that were 10 to 25 inches above average, but amounts in the southern half of Illinois were below average.

In December and January a north-south oriented trough of low pressure existed in North America, bringing north winds to Illinois, an amplified wave pattern in the atmosphere, and an increase in the winter temperature gradient from the northern Plains to the East Coast. These atmospheric conditions created a northerly displacement of the polar jet, giving rise to frequent strong cyclones across the Midwest and numerous winter storms in Illinois. In February, the large-scale wind pattern over North America changed, becoming more zonal, leading to few storm perturbations and bringing near normal weather conditions across the Midwest. March saw a return to the amplified

wave pattern with relatively high pressure in the Midwest, shifting the jet stream northward. More cyclones affected the U.S., often bringing rainstorms to Illinois.

The winter created a myriad of impacts in eight sectors ranging from agriculture to retail business. The bad weather led to 16 deaths and injuries to 1,800 persons. There were numerous major power outages, and high costs of natural gas impacted all residents. All forms of transportation were affected. Trains were delayed or halted, vehicle traffic was slowed and subject to many accidents, and air travel was delayed at the state's major airports, resulting in the worst delay records in the nation. Local and state government agencies suffered very high costs to remove snow and ice from roads and then to repair damaged highways and streets that developed many potholes.

The financial outcomes of the winter conditions in Illinois are shown in Table 1. The 2008-2009 winter total losses were \$2.4 billion.

Table 1. The Losses and Costs from Winter Weather Conditions during December 2008-March 2009

<i>Sector</i>	<i>Losses, \$ millions</i>
Property losses	672
Power production and usage	512
Government costs	510
Transportation	436
Retail sales	292
Total	2,422

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We wish to credit Maria Peters and Alan Black for providing the raw weather and climate data needed for this study. The Property Claims Services provided data on property losses. Sara Olson did an

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