ISWS/RI-117/2009
Report of Investigation 117

2008: A Record Wet and Stormy Year in Illinois

Stanley A. Changnon and Alan Black

Illinois State Water Survey
Institute of Natural Resource Sustainability
University of Illinois at Urbana-Champaign

2008: A Record Wet and Stormy Year in Illinois

Stanley A. Changnon and Alan Black

Report of Investigation 117

Illinois State Water Survey
A division of the Institute of Natural Resource Sustainability
Champaign, Illinois

ILLINOIS
UNIVERSITY OF ILLINOIS AT URBANA-CHAMPAIGN

Cover photo: Burlington Northern Railroad Bridge at East Hannibal, IL on June 19, 2008. The Mississippi River crested approximately 24 hours earlier at a level over one foot higher than shown in this photo. Photo by Amy Russell.

Published May 2009

Illinois State Water Survey
2204 Griffith Drive, Champaign, Illinois 61820
www.isws.illinois.edu

Printed with soybean ink on recycled paper

Abstract

Excessive precipitation in nine months of 2008 produced the second wettest year on record in Illinois. Annual precipitation amounts across the entire state were well above normal, ranging from 43 to 60 inches. Amounts in parts of central Illinois were the highest on record. Precipitation was especially heavy in February, March, and September. All three monthly amounts were the third highest on record. Only August, October, and November had less than average amounts.

La Niña conditions existing in the Pacific Ocean during January-July 2008 led to frequent low-pressure centers to develop and a strong jet stream that brought the lows across Illinois, creating numerous storms and heavy precipitation. These unstable atmospheric conditions produced 13 heavy rainstorms during April-July, plus four during January-March, an unusually high number. Atmospheric instability diminished during July and August, but the passage of the remnants of two Gulf hurricanes during September created heavy rains and a very wet September. In December, unstable atmospheric conditions created several low-pressure centers in Colorado, leading to their passages across the Midwest, and causing four winter storms and a wet December in Illinois.

Flooding had the most significant impacts in the wet year. Floods caused damages in various parts of Illinois during the January-June period, and 33 counties had major damages to communities, farms, and farmland. Then a very damaging flood occurred in September in northeastern Illinois, causing $155 million in damages in the Chicago urban and suburban areas.

The economic impacts of the wet 2008 are listed below:

- Property losses from flooding = $645 million
- Property losses from severe storms = $55 million
- Losses and costs to railroads = $154 million
- Government costs (local, state, federal) = $355 million

Total losses and costs from the wet year were $1.2 billion. These values do not include the losses and costs associated with the extreme cold, numerous winter storms, and high snowfall, which totaled $3.2 billion. In general, Illinois agriculture benefitted from the odd growing season conditions of 2008. The wet spring weather of the 2008 growing season was poor and delayed planting, but summer and fall conditions were adequate for growth and crop maturity. Corn yields were the second highest on record and soybean yields were higher than predicted, rated as the third highest on record. Water supply wells and reservoirs were recharged during 2008, a major benefit.

Contents

Introduction 1

Precipitation 3

Causes for Frequent Heavy Precipitation 7

Impacts 11
- Environment 11
- Agriculture 13
- Property 16
- Transportation 16
- Power 17
- Government 17
- Human Health and Welfare 18

Summary 19

Acknowledgments 21

References 21

Introduction

The year 2008 saw extremely heavy precipitation across Illinois, making it the state's second wettest year since quality weather records began in the 1880s (Changnon, 2008). The statewide average precipitation in 2008 was 50.7 inches, which is 11.4 inches above normal. The record wettest year was 1993 with a statewide average of 51.2 inches. The statewide average temperature for 2008 was 50.6 degrees, 1.1 degrees below normal and the 18th coldest year since 1895.

Large parts of central and northern Illinois had record or near-record high annual amounts, and elsewhere the 2008 totals were well above average. The abnormally wet conditions created major impacts, including floods, altered agricultural activities, and damages to transportation systems. The losses and costs associated with the wet conditions totaled more than $1.2 billion.

The statewide precipitation pattern based on the 2008 precipitation amounts is shown in Figure 1. The average annual precipitation has a latitudinal distribution across the state, totaling 32 to 34 inches in northern Illinois; 35 to 39 inches in central Illinois; and 40 to 45 inches in southern Illinois (Changnon et al., 2004). Values in 2008 ranged from a state low of 42.8 inches at La Harpe to a high of 62.6 inches in Jerseyville. Areas with the lowest 2008 amounts, less than 45 inches, existed in parts of west-central and east-central Illinois (Figure 1) but were still above average. Areas with the greatest 2008 amounts, values greater than 55 inches, extended across south-central Illinois. Importantly, precipitation at all weather stations was well above average. The 45- to 50-inch amounts in northern Illinois are 8 to 14 inches above average. The 50 to

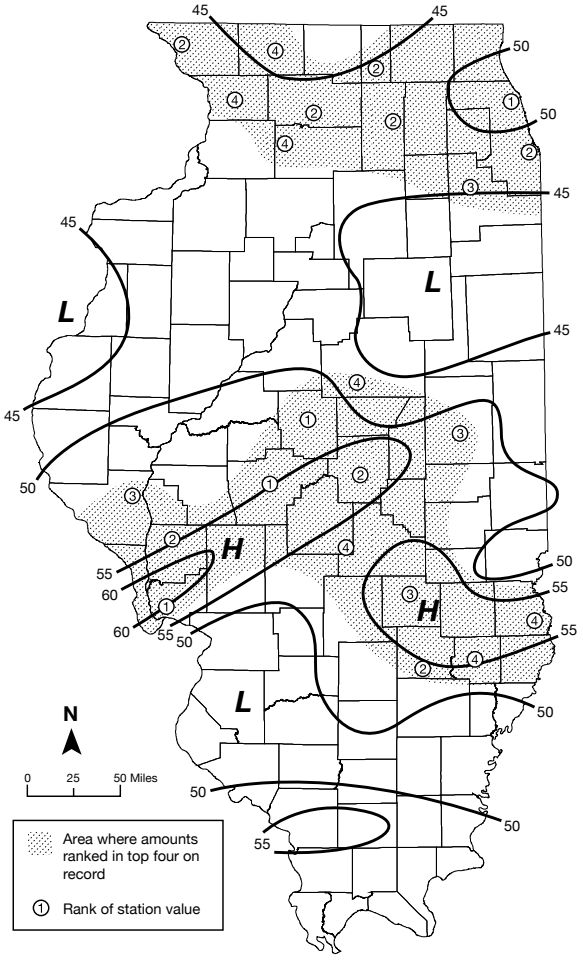

Figure 1. Annual precipitation (inches) for 2008, and areas where annual amounts were in the top four highest values on record.

55 inches in central and southern Illinois are 13 to 15 inches above average. Annual totals across Illinois in 2008 rate statistically as once in 50-year values (Changnon et al., 2004).

Snowfall in Illinois in 2008 was also much above normal. Totals ranged from 23 inches in southern Illinois to 67 inches in northern Illinois. A large number of winter storms, a total of 14, also occurred, as well as 19 rainstorms. Detailed information about the winter conditions during January-March and in December 2007 are already available (Changnon et al., 2008). Hence, this report does not focus on the snowfall and winter storms of 2008.

Areas where the 2008 annual amounts ranked as first, second, third, or fourth highest on record, which includes the years since 1890, are depicted in Figure 1. The rank of each station is also shown. Stations with rank 1 values included Springfield, Jerseyville, and Chicago O'Hare. Stations with ranks 1 and 2 and their amounts are shown in Table 1. Prior very wet years in Illinois were 1927 and 1993.

Table 1. Annual precipitation amounts for 2008 at stations where the record highest or second highest amounts on record occurred.

Station	*Amount, inches*	*Historical rank*
Jerseyville	62.6	1
Lincoln	56.2	1
Springfield	53.6	1
Tuscola	55.3	1
Chicago O'Hare	50.8	1
Decatur	59.7	2
White Hall	54.2	2
Flora	54.5	2
Chicago Midway	48.8	2
Galena	48.5	2
Belvidere	46.8	2
Oregon	45.8	2
De Kalb	46.5	2

Precipitation

Every month from January through July had above normal precipitation across the entire state. The precipitation for these seven months totaled 38.96 inches at Belleville, a record high amount. The state's precipitation for the January-May period averaged 22.3 inches, 7 inches above normal, and rated as the third highest January-May total on record. January-June precipitation was the highest ever for this period, totaling 28.3 inches statewide, an amount that is 7.9 inches above normal. The statewide monthly precipitation amounts in 2008, expressed as a departure from normal, appear in Figure 2.

After a moderately dry August, above normal rains occurred again in September and in December, creating the state's total of nine wet months in 2008. The only months with below normal precipitation were August, October, and November.

Precipitation in certain months was exceptionally high. Illinois averaged 4.5 inches in February, 2.5 inches above normal. It was the state's third wettest February on record. March averaged 4.5 inches, making it the third wettest March on record. March rains in Union County totaled 14 inches, creating severe flooding, and the local levee system was badly damaged.

Major rainstorms occurred in Illinois during May 22-31, triggering more flooding. A rainstorm on May 30-31 (Figure 3) produced totals of 3 to 6 inches in central Illinois. May rainfall averaged 5.8 inches across Illinois, ranking as the tenth wettest May on record. Spring (March-May) precipitation in southern Illinois rated as the second wettest spring on record. A persistent storm track existed for several months (February-June), leading

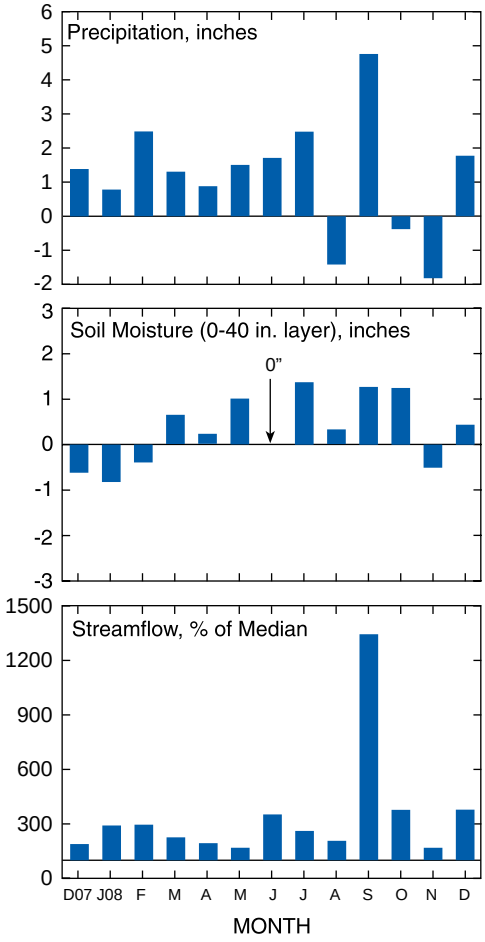

Figure 2. Departures from mean monthly values of precipitation, soil moisture, and streamflow for December 2007 through December 2008.

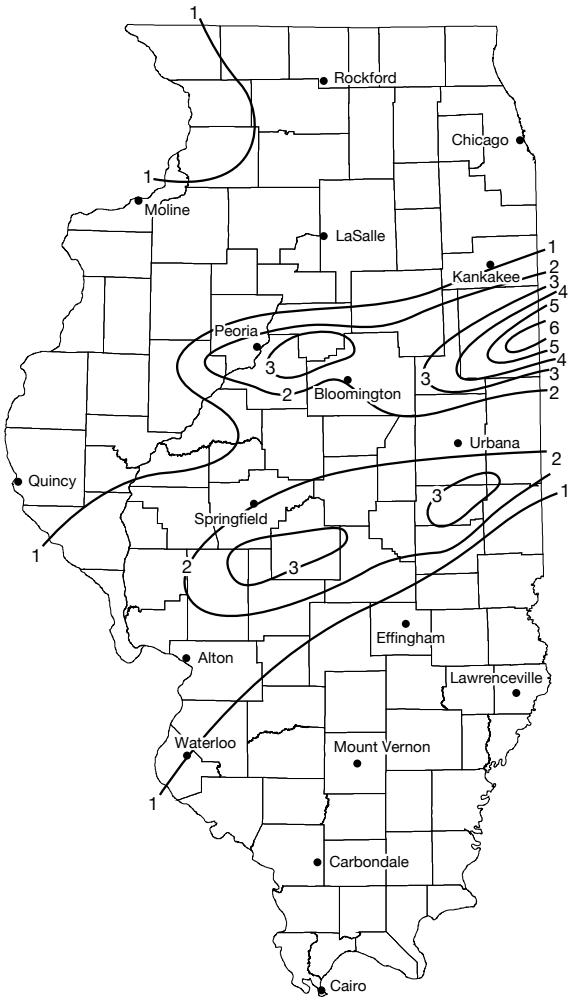

Figure 3. Rainstorm pattern (inches) on May 30-31, 2008.

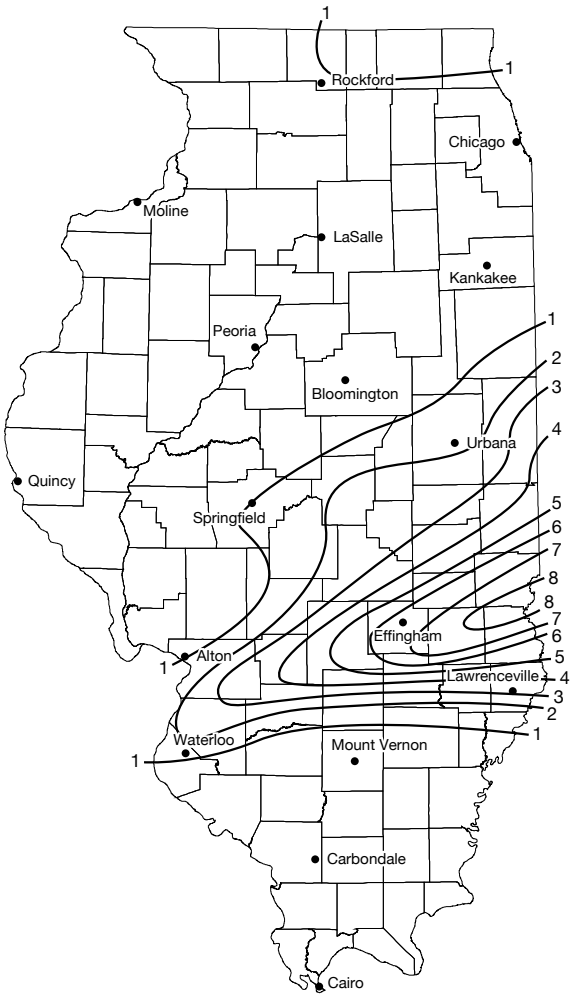

Figure 4. Rainstorm pattern (inches) for June 6-7, 2008.

to frequent storms and heavy rainfall across Illinois and the Midwest (Le Comte, 2009). These heavy rains set the stage for historically high floods in June. A heavy rainstorm on June 6-7 with 4 to 8 inches across south-central Illinois (Figure 4) led to some record flood levels in June, but most flood amounts were less than the record levels that occurred in 1993.

June averaged 5.8 inches, 43 percent above normal, and July averaged 6.4 inches across the state, 2.5 inches above normal. A major rainstorm on July 11-12 (Figure 5) produced 5 inches or more of rain in north and central Illinois. Major hail (hailstone diameters of 0.5 to 1.5 inches) and wind storms (speeds >70 mph) occurred with heavy rains in western Illinois on July 21. July was in the top five wettest Julys on record with more than 7 inches in central Illinois (Figure 6).

September averaged 7.9 inches, the third wettest September of record. Ironically, weather experts in August predicted a dry September (Farm Week, August 4a). The December statewide precipitation was 4.5 inches, 1.8 inches above normal, and the eighth wettest December on record (Figure 6).

The wet year had many days with precipitation. For example, Urbana had 138 days of measurable amounts, and this was 14 days above average. Some days had exceptionally heavy rains. For example, Lincoln had 2.8 inches on January 7, the highest on record. Springfield had a record amount on June 2 when 4.7 inches fell, and Chicago O'Hare had 6.6 inches on September 13, the highest daily

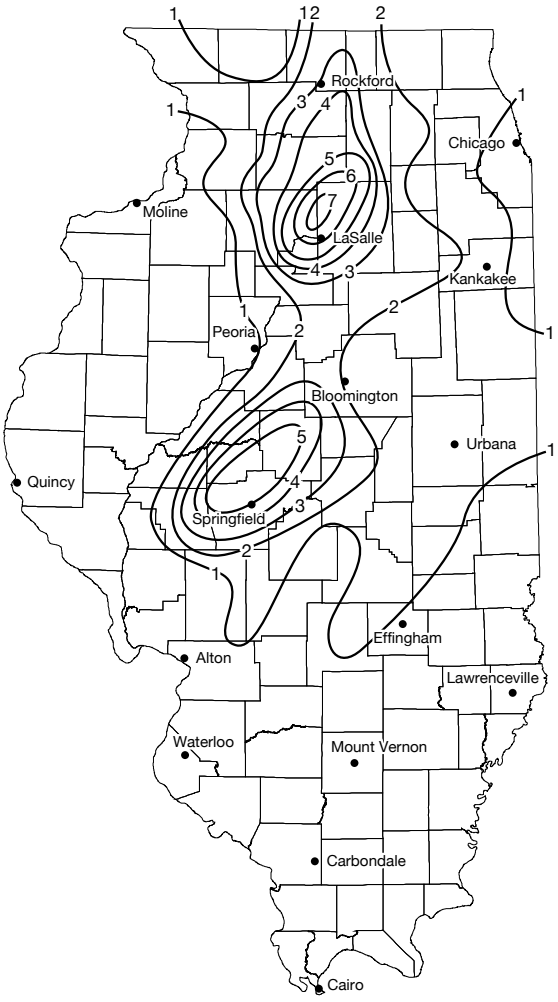

Figure 5. Rainstorm pattern (inches) on July 11-12, 2008.

amount on record for the station (Figure 7). Every wet month in 2008 had several storms including at least one heavy rainstorm. Examples of three such storms appear in Figures 3, 4, and 5. A heavy rainstorm was defined as one in which the one-day rainfall equaled or exceeded 4 inches, the once in 5-year amount at most Illinois locales.

Locales with record high annual amounts are listed in Table 1. Five locales had top ranked amounts, and eight locales had amounts rated as their second highest on record. As shown on Figure 1, several locales had third ranked values, including Urbana, which had 55.2 inches, the third highest amount since records began there in 1888.

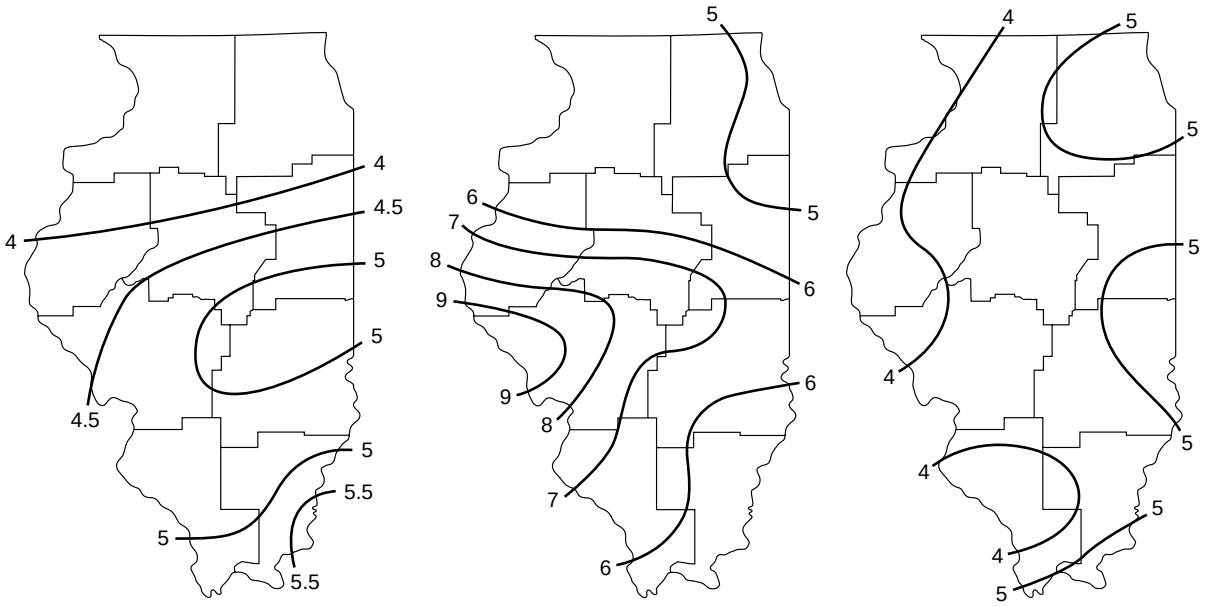

Figure 6. Monthly precipitation patterns (inches) for February, July, and December 2008.

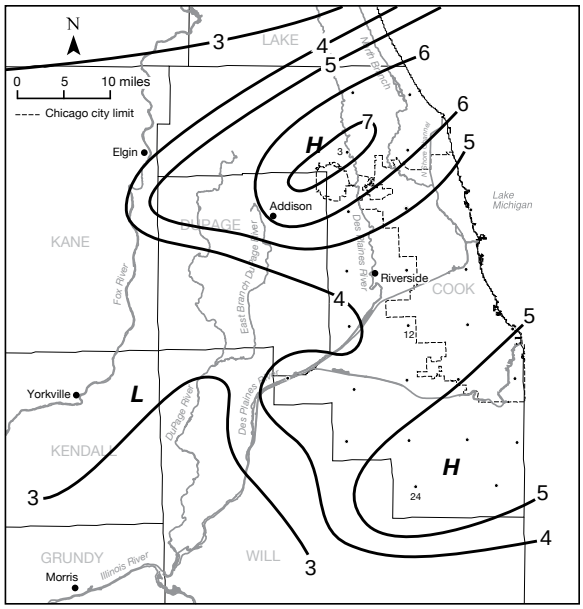

Figure 7. Heavy rainfall (inches) in the Chicago area on September 13, 2008.

Causes for Frequent Heavy Precipitation

The frequent precipitation events in the winter-spring of 2008 were related to a persistently strong and active polar jet stream with imbedded progressive troughs over the United States. These jet stream characteristics led to the frequent development of surface low-pressure areas east of the Rockies. These low-pressure areas intensified as they moved across the country, and they often incorporated large amounts of water vapor from the Gulf of Mexico. Thus they frequently produced large precipitation totals over broad regions. The progressive nature of the jet stream ridge/trough pattern allowed for warm air mass incursions into Illinois, creating broad temperature swings through the winter-spring 2008.

The primary causes of the active and persistent storm track over the U.S. during January-May 2008 are difficult to determine with confidence. However, there were a few prominent features that contributed to the situation. First and foremost, a moderate La Niña event was occurring. La Niña events are characterized by below normal sea surface temperatures in the eastern and central equatorial Pacific and enhanced convection over the western equatorial Pacific. Associated with this, upper-level pressure is anomalously high in the north Pacific and anomalously low over western North America from the northwest U.S. to Alaska. This reflects a jet stream pattern that is shifted northward from its normal winter position over the North Pacific and southward over western North America. During most of 2008 this pattern was in place and in fact was stronger and more persistent than the climatological average for La Niña events. In addition, the upper-level low-pressure area over western North America extended even further to the south than the typical La Niña pattern. Thus in the winter-spring of 2008, the average location of the jet stream was from the Aleutian Islands into the western U.S. A second notable feature was anomalously high pressure over the western Atlantic Ocean, reflecting a shift northward in the jet stream from its average position.

These features are consistent with the stormy conditions in Illinois in 2008. The jet stream over the north Pacific and western North America was a focal point for the generation of storms and guidance of these and existing storms into the central and southern Rocky Mountains. Many of these intensified on the lee side of the Rockies, which is a very typical characteristic of the life cycle of winter-spring storms affecting the Midwest. These storms then traveled into the central U.S. following an easterly to northeasterly path, ending up in the northeastern U.S. or southeastern Canada. Many followed a curved path, traveling on an easterly path across the Great Plains and then gradually curving more northeasterly with a northward-shifted jet stream (Figure 8).

Thus the winter-spring-summer storminess of 2008 can be attributed in part to the jet stream patterns caused by the La Niña event. The similarity in the paths of many of these storms across the U.S. may have been influenced by the high pressure over the western Atlantic. The clockwise circulation around this anomalously high pressure area also was conducive to the flow of moisture from the Gulf of Mexico into these systems.

An evaluation of the surface low-pressure characteristics (track, minimum pressure, and

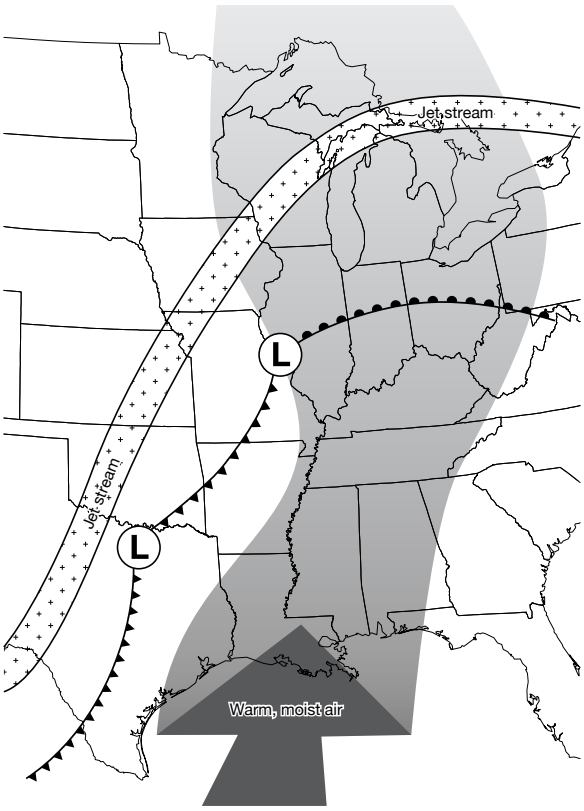

Figure 8. Atmospheric conditions on March 18-19, 2008, showing movement of a low center and jet stream that led to heavy rainfall in Illinois.

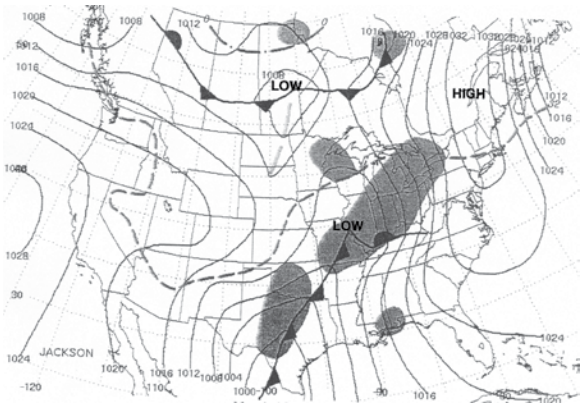

Figure 9. The surface weather map at 7 a.m. on February 4, 2008, a situation that led to heavy rains on February 4-6, 2008.

movement) uncovered some interesting findings. In terms of cyclone tracks, 70 percent (23 of 33) of the surface cyclones in January-May moved through a part of Illinois as they migrated from west to east. This is twice the normal number of cyclones crossing Illinois. The track of the storm-producing cyclone during March 18-19, 2008 appears in Figure 8. An increased cyclone frequency was also experienced in areas south of Illinois. Cyclone tracks that move across the United States through or south of Illinois enhance the likelihood that more precipitation will occur over the state. Cyclone minimum pressures and movement characteristics were similar to those described for winter snowstorms by Changnon et al. (2008). Fourteen of the 23 surface cyclones with the Illinois storms were deepening as they moved over or near Illinois (Figure 9), revealing that the storm dynamics were strengthening as the systems passed through the region, which also enhanced precipitation amounts. The rainstorm resulting from this low passage (Figure 9) occurred on February 4-6 (Figure 10).

A period of very unstable weather conditions extended from May 22 to June 9. Late May experienced two low-pressure systems with cold fronts that created severe storms and heavy rains. Then a mesoscale convective system (MCS) in late May created 6 inches of rain in two hours at Milford with 2 to 3 inches in other parts of central Illinois (Figure 3).

June and July 2008 each had periods lasting 6 to 10 days with very unstable weather and several major atmospheric disturbances (cold fronts, low-pressure centers, and mesoscale convective systems) that produced several heavy rain events in Illinois. The June 2-8 period had three cold front passages, with heavy rains on June 6-7 (Figure 4) plus seven tornadoes and 9 inches of rain in parts of southern Illinois. Then heavy rains on June 25-28 came from a MCS and two cold-frontal passages. Three more cold-front passages occurred during July 2-10, creating severe storms and heavy rains in various parts of the state. A low center led to 5-inch rains in north-central Illinois on July 11-12 (Figure 5). The passage of the remnants of Hurricane Dolly across southern Illinois in late July resulted in heavy rain in southern Illinois on July 29-30.

The remnants of Hurricanes Gustav and Ike passed through Illinois during September, both producing heavy rains. Chicago had a record high daily rainfall on September 13 as a result of Ike's

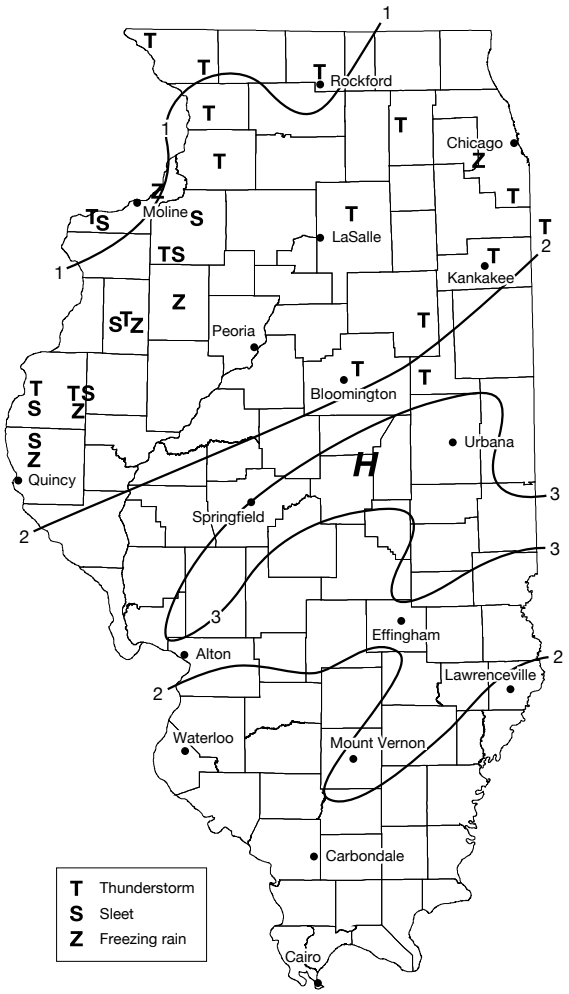

Figure 10. Rainstorm (inches) on February 4-6, 2008.

passage (Figure 7). These heavy rains created a very wet September. The atmosphere became unstable again in December. Three deep lows developed in Colorado, and their passages across the Midwest led to heavy precipitation in Illinois on December 1-2, 9-10, 14-15, and 18-19. Table 2 presents the monthly frequencies of winter storms and rain storms during 2008. The winter storm total of 14 is four less than the record set in 1977-1978, but is eight more than the average number. Eleven of the 19 rainstorms occurred during the May-July period. Illinois normally has only 10 rainstorms per year (Changnon, et al. 2004), and hence the 2008 frequency was nearly double the average. The incidence of three rainstorms in January-February is also unusual.

Table 2. The number of storms during 2008.

Month	*Winter Storms**	*Rain Storms***
January	2	1
February	4	2
March	4	1
April	0	2
May	0	4
June	0	4
July	0	3
August	0	0
September	0	2
October	0	0
November	1	0
December	3	0
Totals	**14**	**19**

Note: * = 6 inches or more in 1 or 2 days.
** = 4 inches or more in one day.

Impacts

The wet conditions of 2008 created major impacts on the environment and society. The conditions resulted in much flooding, the most negative outcome. Although early expectations for crop production outcomes were negative (Farm Week, July 7a), the wet conditions and low temperatures during summer led to high crop yields. Hence, farming was an area of major positive impacts from the unusual 2008 weather. Transportation systems were damaged from the flooding, resulting in several persons killed and more than 300 injured from vehicular wrecks.

The severe winter conditions, many storms, and above normal snowfall also created a set of impacts, which are described in another publication (Changnon et al., 2008). The winter extremes led to $781 million in losses and costs in the energy/communication sectors, and $687 million in losses in the transportation sector. Total winter losses were $3.2 billion. These winter impacts are not described in this report.

ENVIRONMENT

Figure 2 shows the monthly departures in statewide streamflows, revealing that every month in 2008 had flows that averaged above normal. The greatest departures occurred in February, June, and September. Flooding was present at locations along the Illinois River from February through October (Figure 11). Flooding also occurred along the Mississippi River from April through July (Figure 11). By June 20, the Mississippi River was near the record high levels set in 1993. Figure 12 shows the days in June when the Mississippi River crested alongside the Illinois border.

Flooding began on January 7-8 when a heavy rainstorm (Figure 13) produced record high levels on the Iroquois, Kankakee, and Vermilion Rivers, leading to extensive flood damages in Pontiac and Watseka. Property losses from these floods amounted to $62 million. Shortly after these early floods peaked, the Illinois River was raised above flood stage from LaSalle south to Grafton (Figure 11). Flooding in many other Illinois rivers had begun in February or March, and the ensuing heavy snows and heavy rains in March-June brought the floods to significant levels (Le Comte, 2009).

Heavy winter-spring rainstorms also occurred, including storms on January 29, February 4-6 (Figure 10), February 17-18, and March 17-18 (Figure 14). The heavy rains on March 17-18 in southern Illinois, producing 4 to 10 inches, led to flash floods that caused major damage to railroads by washing out tracks, causing three train wrecks, and killing two persons.

The wet spring brought severe flooding to several tributaries of the Mississippi River in Iowa and Illinois. This situation, plus the heavy rainfall in late May and early June, created major flooding along the Mississippi River from Fulton south to Chester (Figure 11). River levels rose to near record highs set in 1993, and this created several serious impacts. The U.S. Army Corps of Engineers had closed 13 river locks by June 12, stopping all barge movements (Figure 15). Damages were considerable as 29 Illinois levees gave way (Figure 16), and 22 Illinois counties along the river were declared disaster areas. More than 400 farms were flooded. Headlines from several Illinois newspapers illustrate some of the flood impacts (Figure 17). Heavy

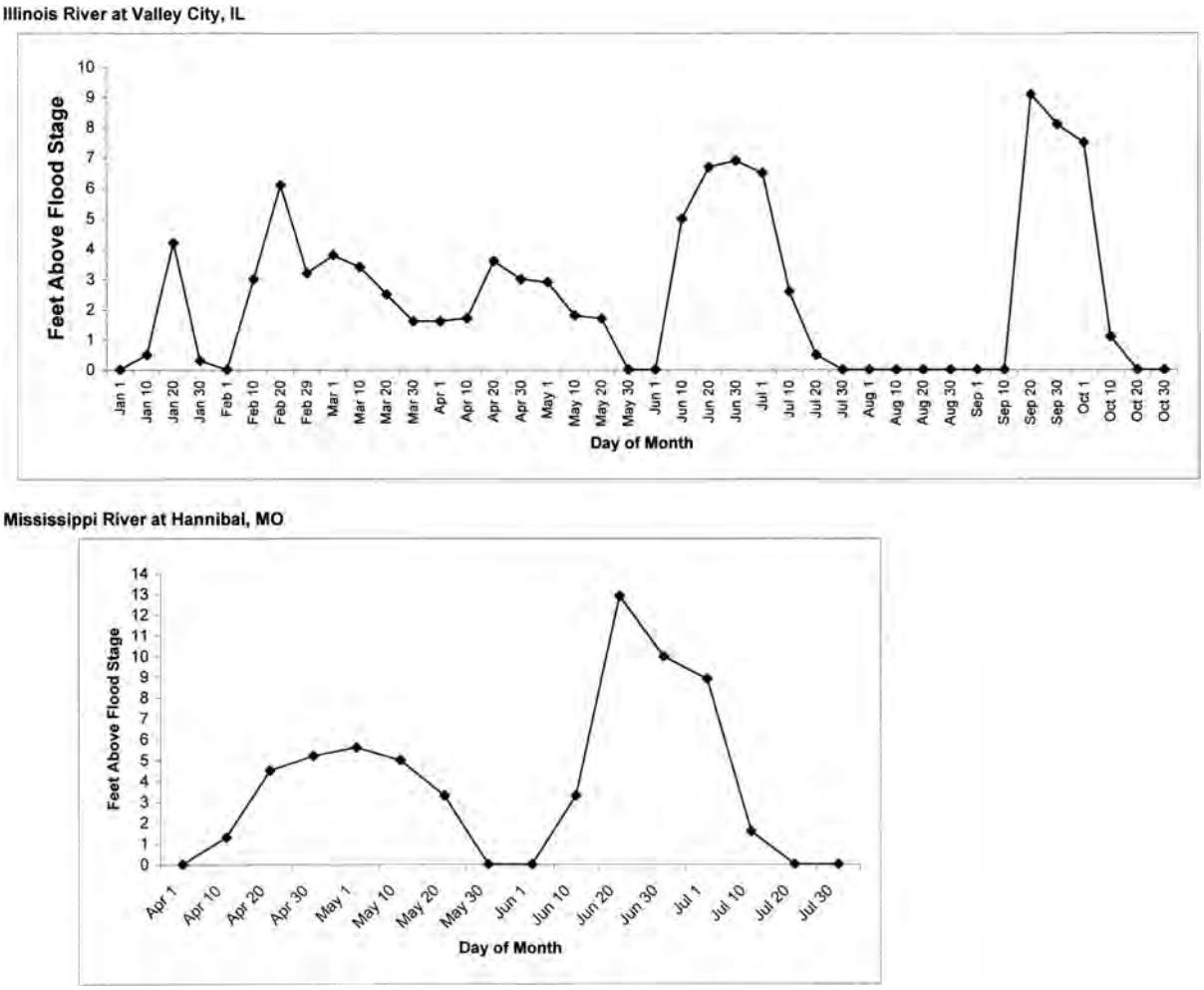

Figure 11. The periods during 2008 when the Illinois River at Valley City, Illinois, and the Mississippi River at Hannibal, Missouri, exceeded their flood stages. River levels above the flood stages are in feet.

rains, including 6 inches in two hours at Milford, created flash floods in parts of east-central Illinois in late May (Figure 3). Flood disaster aid had been made available in 74 Illinois counties by the end of July.

Heavy rains in northern Illinois in late May-early June led the Fox River to flood by June 16. Flooding also occurred alongside the Kishwaukee and Rock Rivers in June. Flooding from May 29 to June 8 caused massive property damages with losses totaling $318.5 million.

Heavy rains in east-central and southeastern Illinois (4 to 11 inches) fell during June 8-15, causing the Embarras and Wabash Rivers to rise above flood stages, flooding many farmlands and communities (Farm Week, June 16a). Many levees along the Embarras in Crawford and Jasper Counties gave way, leading to flooding of over 10,000 acres of farmland on June 15-16. Property damages totaled $19.5 million. Six counties were declared disaster areas, including Coles, Clark, Crawford, Cumberland, Jasper, and Lawrence.

Flash floods in eastern and southern Illinois on August 4 caused property losses totaling $90 million. Remnants of Hurricanes Ike and Gustav each brought 3 to 6 inches of rain across parts of central and northern Illinois in mid-September (Figure 18). Flooding was excessive in northeastern Illinois after a record rainstorm on September 13 in the Chicago urban area (Figure 7). Stormwaters overwhelmed the city and 90 million gallons of water were diverted into Lake Michigan to lessen the

Figure 12. Map of the crests along the Mississippi River from June 18 (Wednesday) at Burlington, Iowa, to June 22 (Tuesday) at Chester, Illinois.

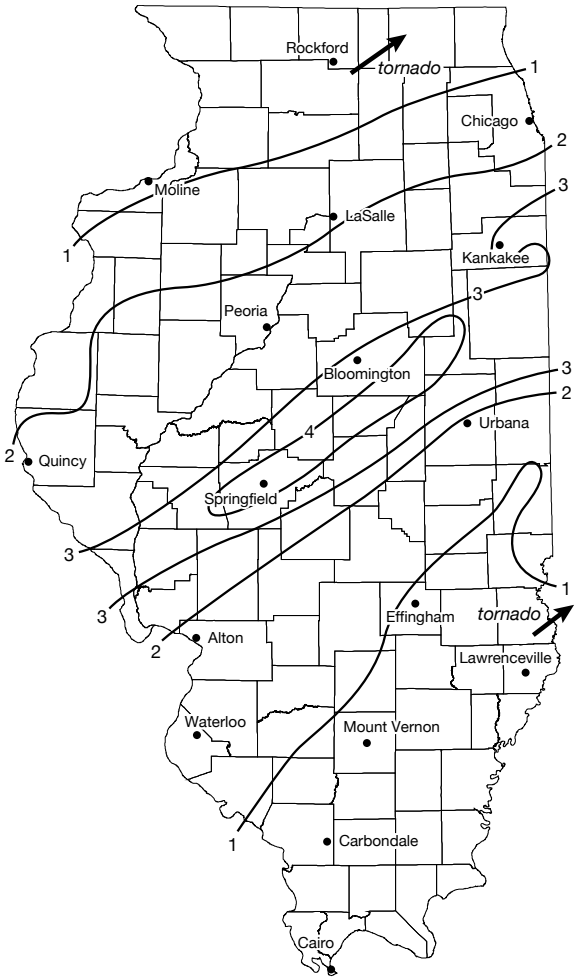

Figure 13. Rainstorm pattern (inches) for January 7-8, 2008.

flooding. The property insurance industry reported flood-related losses totaling $155 million. Some of the impacts from the flooding in Chicago are shown in Figure 19.

The first half of December had heavy snowfalls and a major ice storm on December 18. Then, warming temperatures led the vast amounts of snow and ice to melt, creating flooding in late December at numerous locales in central and northern Illinois.

A positive environmental impact of the wet year was the filling of the state's 36 major water supply reservoirs. In January 2008 levels of 27 of the reservoirs were below normal, often 2 to 3 feet down. However, at the end of 2008, levels of 33 reservoirs were at or above normal levels. Only three small reservoirs in southern Illinois (Salem, Sparta, and Nashville) had levels slightly below normal. The wetness also impacted groundwater supplies. Shallow groundwater levels in 17 wells distributed across the state showed levels below average in 12 of the 17 wells in January 2008. However, by December 2008, levels of all wells were well above average by 2 to 7 feet.

AGRICULTURE

Heavy rains and flooding caused considerable soil erosion. The wet spring delayed planting by three to four weeks, and most corn was not planted until late May (Farm Week, May 26). Large amounts of costly fertilizer were washed away by the heavy rains. By May 31 only 80 percent of the Illinois corn crop had been planted, as compared

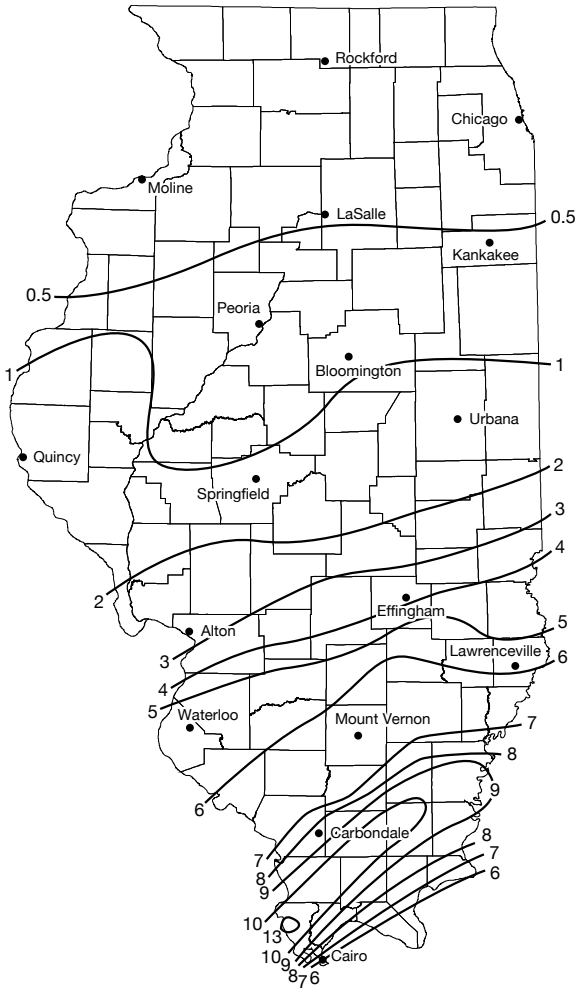

Figure 14. Rainstorm pattern (inches) on March 17-18, 2008.

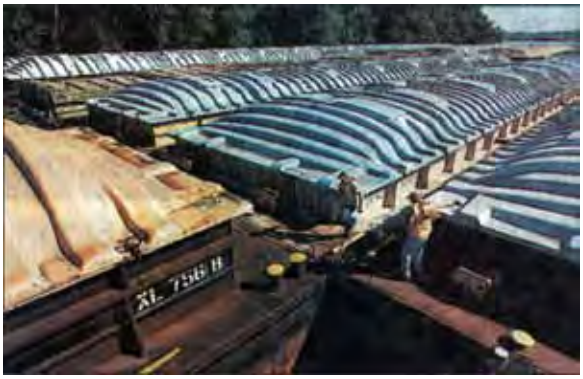

Figure 15. A group of barges anchored alongside the Mississippi River and not allowed to move on the river in June 2008.

Figure 16. A levee breach that occurred near Quincy, Illinois, on June 19.

to the average of 98 percent on that date. Figure 20 shows a central Illinois tractor ready but unable to plant soybeans in the flooded fields on June 5.

Continuing rains in May drowned some of the emerging corn crop, and in many places, numerous farmers had to replant their crops (Farm Week, June 2). The flooding and wet fields led many farmers to switch from corn to soybeans. A crop expert in mid-June stated that the chance of above average yields in 2008 had diminished greatly (Farm Week, June 16b). Another crop expert stated that 2008 was the worst crop start in 15 years in central Illinois. These evaluations helped lead crop prices to soar with corn rising from $4 per bushel to $7.8, and soybeans from $11 per bushel to $15. The U.S. Department of Agriculture projected less corn production than in 2007 by more than 5 bushels per acre. In June, agricultural experts estimated that Illinois crop losses due to soil wetness and field flooding would amount to $1.3 billion (Farm Week, June 30). Some of the impacts of rural flooding and damage to crops are illustrated in Figure 21. The winter wheat crop in southern Illinois was badly damaged by drowning. Flooding of farm lands along the Mississippi River, due to many levee failures, inundated 30,000 acres near Quincy.

Late planting of corn and soybeans can be threatening to yields if summer brings high temperatures and low rainfall, but as shown in Figure 2, rainfall was ample in June and July and temperatures were below normal. Soil moisture values across Illinois were above normal throughout the growing season

Figure 17. Impacts from floods illustrated by material appearing in state newspapers.

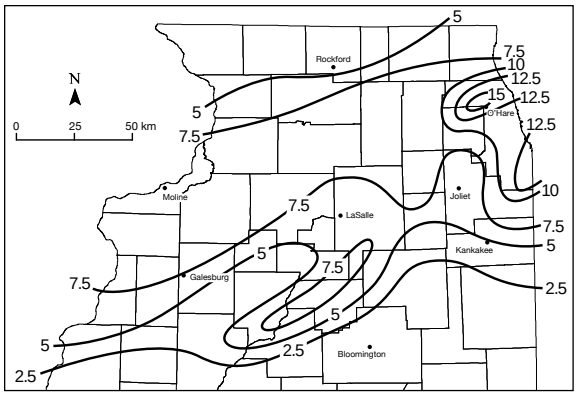

Figure 18 Rainfall (inches) on September 12-13, 2008.

Figure 19. Impacts from flooding in the Chicago area illustrated by news headlines.

(Figure 2). By early July, the USDA upped its corn yield forecast despite the flood losses in June (Farm Week, July 7b). The USDA released lands under its Conservation Reserve Program to assist livestock feeding in the state's 48 disaster counties. Agricultural experts stated that the rain in June, coupled with the warm and sunny days in August, were good for the Illinois corn crop (Pantagraph, 2009). The dry August was hard on soybeans, but the September rains and a lack of early frosts kept the soybean crop from becoming a disaster.

Experts announced in early August that the "favorable weather" in July, including cool temperatures and timely rains, had benefitted agricultural production in Illinois (Farm Week, August 4b). Nevertheless, large amounts of uncertainty existed in the crop yield estimates issued in August. In early August, the USDA predicted the Illinois corn yield would be 152 bushels per acre (bu/acre) and soybeans would average 42 bu/acre. These relatively higher yield predictions led to major decreases in crop prices. Corn prices fell from $8 to $5 bu/acre, and soybeans from $16 to $12 per bushel. By August 18, the USDA had raised its estimate of the Illinois corn yield to even higher levels, to 172 bu/acre (Farm Week, August 18). During the summer, flooding from the Mississippi and Illinois Rivers halted delivery of grains to user plants along the rivers, including ethanol manufacturing plants.

Harvest delays were caused by the late planting and thus immature crops in September, more rain and floods, and a slow rate of drydown. Early October showers further delayed the harvest around Illinois. However, the generally dry fall

Figure 20. A tractor seeking to plant soybeans in central Illinois but unable to move through the flood waters.

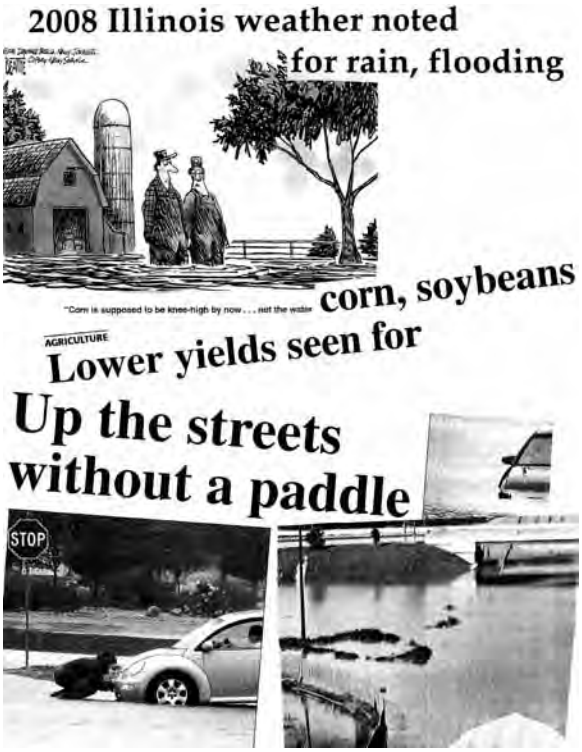

Figure 21. Impacts in rural areas and crop yields, as illustrated by news headlines.

conditions without an early frost allowed farmers to harvest their delayed crops, and many reported record high yields.

The statewide average corn yield for 2008 was 179 bu/acre, the second highest on record and just one bushel less than the record highest yield of 180 bu/acre set in 2004. The statewide soybean yield in 2008 was 47 bu/acre, which is much above average, but less than the record of 50 bu/acre set in 2004. The quite high crop yields greatly affected their prices. When crop conditions looked poor due to the weather in May-June, the price of corn was raised to $8 a bushel and soybeans went to $16 a bushel. After the higher-than-expected yields were recognized in the fall, crop prices fell dramatically: corn to $3.50 a bushel and soybeans to $8 a bushel.

.

PROPERTY

The flooding created insured property damages in 33 counties scattered throughout the state. The community of Antioch was totally flooded by the Fox River in mid-June, and most residents had to be evacuated. Flooding alongside the Mississippi River in June (Figure 11) badly damaged 400 farms (houses and farm buildings). The total insured property losses in Illinois from flooding and heavy rain damages in 2008 were $645 million. The year had a considerable number of severe weather events that also produced property losses totaling $55 million. Tornadoes in Perry and Jackson Counties on May 26 were damaging, and seven tornadoes in northeastern Illinois occurred on June 7 (Figure 4). Illinois had 88 tornadoes in 2008, well above the average of 26. The state also had 408 reports of hail damage, and 663 reports of high wind damage. Hail and wind damages on July 2-3 caused $21.5 million in losses. Then, severe storms on July 21 caused $33.3 million in losses in western Illinois.

TRANSPORTATION

The flooding led to blocked highways and country roads, and greatly curtailed vehicle traffic in counties along the major rivers (Figure 22). Highway bridges across the Mississippi from Illinois to Burlington, Iowa, to Hannibal, Missouri, and to Keokuk, Iowa, were closed for four to five weeks for fear of flood-related collapses. More than 300 persons were injured by flood-related auto accidents. The heavy snows and high winds on December 20-21 in northern Illinois led to closures of several interstate highways, including I80 and I74, and several snowplows became stuck in snow drifts.

Figure 22. A roadside sign noting road closure due to flooding.

The flooding caused major impacts on six railroads in Illinois (Changnon, 2009). Floods in southern Illinois in March caused closures of the main lines of the Canadian National, and led to washouts of two rail lines, one causing a train accident on the Union Pacific (UP) line with two crewmen killed. Amtrak trains scheduled to move between Chicago and New Orleans were stopped in Carbondale, and for five days passengers were hauled by bus between Carbondale and Memphis. Flooding closed the UP and CSX lines just south of Chicago with a train derailed. The lines were closed four days and the trains had to be rerouted over other lines. The Iowa, Chicago and Eastern (IC&E) rail lines in northern Illinois were flooded. One train was wrecked near Galena, and the IC&E line was closed for four days in June. A bridge on the Norfolk Southern mainline east of Hannibal, Missouri, was washed out, causing a train wreck and line closure for three days. The losses and costs of repairs to the railroads in Illinois totaled $85 million, and revenue losses from accidents and delayed shipments totaled $69 million.

The airlines also were hurt by heavy rains and storminess. In June and July several storms caused numerous two- to three-hour delays in flights leaving O'Hare and Midway. Much longer delays occurred on June 28 and July 10.

POWER

Heavy rains and high winds on June 28 (74 mph at De Kalb) created power outages for 28,700 customers in the Chicago area. Then on July 10, severe storms and heavy rains caused power outages for 24,000 customers in the Chicago suburbs. The heavy and extensive freezing rain on December 18-19 caused power outages for 100,000+ customers in central Illinois.

GOVERNMENT

Numerous damages from excessive moisture led to many government actions. President Bush gave support by raising disaster payments from 75 percent to 90 percent of the damages in 13 flood-damaged Illinois counties. Congress approved a $300 million bill to rebuild levees and locks damaged by the 2008 floods. The June floods brought considerable debris into several counties, including Henderson and Calhoun, and USDA provided $800,000 to repair the many conservation areas damaged by flood waters and debris, and the ruined waterways in Illinois. Major sandbagging efforts occurred along the Mississippi and other rivers, representing huge costs to local communities and the state of Illinois (Figure 23).

The sizable floods of 2008 on the Mississippi River led Illinois to send 1,100 National Guardsmen to help residents in flooded areas. The many

Figure 23. A resident of Meyer places sandbags to combat rising waters of the Mississippi River.

damages and losses from flooding helped gain political support in Congress for a plan of the U.S. Army Corps of Engineers to conduct costly improvements in flood control and lockages on the Upper Mississippi. The flood control efforts pursued by Illinois during 2008 cost the state $15.4 million. The U.S. Environmental Protection Agency helped with the removal of the flood debris in counties along the Mississippi River.

Flooded lands along Illinois rivers and protected by levees will be subject to higher risk payments in 2009 if the damaged levees are not adequately rebuilt and the flood-damaged soils are not restored to pre-flood yield potential (Farm Week, February 23, 2009). Congress allotted $2 billion to the U.S. Army Corps of Engineers in February for levee repairs. This was badly needed support since many levee districts in western and southeastern Illinois were out of funds for 2009.

HUMAN HEALTH AND WELFARE

The floods led to 24 deaths in the Midwest and four in Illinois. Two were killed by a flood-induced train wreck in southern Illinois, and a man was killed by the floods in Ford County on June 3. A man drowned in the flooded Fox River in June. Several persons were injured by the seven tornadoes on June 7. Then, 20 persons were injured by the high winds that hit northeastern Illinois on June 28 with gusts to 74 mph. Two were killed in auto accidents resulting from a heavy ice storm on December 20-21. Levee failures along the Mississippi River led to the inundation of Meyer, Illinois, and the entire community had to be evacuated. State officials estimated that several thousands of persons were forced out of their homes during May-July 2008.

Summary

Above normal precipitation in nine months of 2008 produced the second wettest year on record in Illinois. Only 1993 was wetter than 2008. Annual precipitation amounts across the state were well above normal, ranging from 43 to 60 inches. Amounts in parts of central Illinois were the highest on record. Precipitation was especially heavy in February, March, and September. All three monthly amounts were the third highest on record. Only August, October, and November had less than average amounts. All months in the January-July period had above normal precipitation with a statewide total of 34.5 inches, a new record.

Many locales experienced 140-150 days or more with measurable precipitation (≥0.01 inch) representing 40 percent of all days in 2008. The key to the extreme wetness was the 19 heavy rainstorms, each providing 4 or more inches in one or two days. This is nine storms more than normal. Each winter month had one heavy rainstorm, a highly unusual situation. The worst rainstorms in 2008 included ones on May 30-31 (highs of 3 to 6 inches), June 6-7 (4 to 8 inches), July 11-12 (5 to 6 inches), July 21 (4 to 5 inches), and September 12-13 (4 to 7 inches). Record high one-day rainfalls occurred at many locations, including Springfield, Ottawa, Lincoln, and Chicago. Snowfall in 2008 also was much above normal with 23 inches in extreme southern Illinois and 67 to 70 inches in northern Illinois. The year had 14 winter storms, only four less than the record set in 1977.

La Niña conditions existing in the Pacific Ocean during January-July 2008 led to frequent low-pressure centers to develop and a strong jet stream that brought the lows across Illinois, creating numerous storms and heavy precipitation. These unstable atmospheric conditions produced 13 heavy rainstorms during April-July, plus four during January-March. Atmospheric instability diminished during July and August, but the passage of the remnants of two Gulf hurricanes during September created heavy rains and a very wet September. In December unstable atmospheric conditions created several low-pressure centers in Colorado, leading to their passages across the Midwest, and causing four winter storms and a wet December in Illinois.

The most major impact of the wet year was flooding. Floods caused damages in various parts of Illinois during the January-June period, and 33 counties had major damages to communities, farms, and farmland. Then a very damaging flood occurred in September in northeastern Illinois, causing $155 million in damages in the Chicago urban and suburban areas.

The economic impacts of the wet 2008 are listed below:

- Property losses from flooding = $645 million
- Property losses from severe storms = $55 million
- Losses and costs to railroads = $154 million
- Government costs (local, state, federal) = $355 million

Total losses and costs from the wet year were $1.209 billion. These values do not include the losses and costs associated with the extreme cold, numerous winter storms, and high snowfall, which totaled $3.2 billion. Property damages were high as a result of the widespread flooding and because many rainstorms also had severe local storms with

high winds, hail, and tornadoes. Flooding led to the closure of three bridges from Illinois across the Mississippi River. Six major railroads experienced major flood damages, many train delays, and seven train accidents. The numerous impacts seriously affected local, state, and federal agencies, including the Department of Agriculture, Environmental Protection Agency, and Army Corps of Engineers. Illinois experienced $15.4 million in costs for extensive sandbagging and road and levee repairs.

In general, Illinois agriculture benefitted from the odd growing season conditions. Initially, the wet weather conditions of the 2008 growing season were poor due to excessive soil moisture and flooding, which delayed planting, but summer and fall conditions were adequate. Corn yields were the second highest on record and soybean yields were higher than predicted, rated as the third highest on record. Another positive outcome from the 2008 wet conditions were major increases in the levels of water supply wells and in most water supply reservoirs across Illinois.

The numerous costly impacts caused by flooding suggest more efforts are needed to improve the levees along the Illinois and Mississippi Rivers. The failure of agricultural experts to correctly predict the high yield outcomes in 2008 suggests that more study of crop-weather relationships is needed.

Acknowledgements

We appreciate the scientific reviews of Nancy Westcott and Jim Angel. Mike Demissie provided an excellent review with positive suggestions for improving the report. Sara Olson developed the illustrations, and Lisa Sheppard performed a final edit of the manuscript. Eileen Deremiah assisted with computer issues and developed figures.

References

Changnon, S.A., 2008: The development of knowledge about the climate of Illinois. *Transactions Illinois Academy of Science*, 101, 205-216.

Changnon, S.A., 2009: Impacts of 2008 floods on railroads in Illinois and adjacent states. *Transactions Illinois Academy of Science*, 102, 68-79.

Changnon, S.A., J. Angel, K. Kunkel, and C. Lehmann, 2004: *Climate Atlas of Illinois.* Illinois State Water Survey, Champaign, 309pp.

Changnon, S.A., K. Kunkel, and D. Changnon, 2008: *Winter 2007-2008: Record setting storms caused major damages in Illinois.* Data/Case Sturdy 2008-2, Illinois State Water Survey, Champaign, 45 pp.

Farm Week, May 26, 2008: Planting conditions favorable up north, sloppy in south. Page 1.

Farm Week, June 2, 2008: Southern Illinois farmers facing replant decisions. Page 1.

Farm Week, June 16, 2008a: Historic flood inundates southeastern Illinois. Page 1.

Farm Week, June 16, 2008b: Sloppy situation persists: Southeastern Illinois pummeled. Page 3.

Farm Week, June 30, 2008: Crop losses exceed $8 billion nationwide. Page 2.

Farm Week, July 7, 2008a: Market watch: All eyes shift to the weather. Page 7.

Farm Week, July 7, 2008b: USDA ups corn forecast despite flood losses. Page 1.

Farm Week, August 4, 2008a: Meteorologists see shift to warmer, drier weather. Page 1.

Farm Week, August 4, 2008b: Favorable weather benefits ag production. Page 7.

Farm Week, August 18, 2008: Near-record crop could boost feed use, reduce prices. Page 1.

Farm Week, February 23, 2009: Floodplain farmers subject to higher premiums. Page 6.

Le Comte, D., 2009: U.S. weather highlights 2008: Winter wins. *Weatherwise*, March-April, 15-21.

Pantagraph, March 4, 2009: Corn yields better than expected. Section C, pages 1-2.