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A Record Sequence of Four Severe Winters in Illinois

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ABSTRACT

Four winters in Illinois during 2006-2010 caused high losses and were the only sequence of four severe winters since economic loss records began in 1949. Winter severity was defined by insured property losses of $100 million or more. The winter of 2006-2007 was severe largely because of major snowstorms and ice storms caused $118 million in property losses. The 2007-2008 winter had 14 winter storms creating record conditions coupled with low temperatures. Major losses occurred to transportation and extensive property losses totaled $253 million , the highest on record. The winter of 2008-2009 had near record low temperatures and heavy snowfalls that exceeded 50 inches across northern Illinois. The conditions killed 16 persons and created property losses of $172 million. The fourth winter, 2009-2010, had above normal snowfall in all parts of the state, and temperatures were below normal across the state. Impacts were very large on transportation systems, property, and power systems, property losses totaled $159 million. The 61 past winters during 1949-2010 had 15 winters with property losses >$100 million. The sequence of four such loss winters during 2006-2010 were a climate anomaly, potentially reflecting a shift in climate. Their property losses exceeded $0.7 billion.

INTRODUCTION

A series of four consecutive winters, each causing excessive property damages in Illinois, occurred during 2006-2010. The causes of the property losses and other impacts across Illinois in each winter were assessed. They were found to vary with some losses from major storms and others from extreme cold and/.or heavy winter snowfall. The winter loss data used was from the insurance industry and included all the insured property losses to homes, vehicles, and buildings. These data have been assessed and found to be carefully adjusted by insurance experts and allow justifiable temporal comparisons of losses in between years. Other impacts of the four winters were also identified including transportation systems, government expenditures, and human life.

The potential uniqueness of the four consecutive winters was assessed by comparing their high losses to property with past losses. Insurance records of property losses extend back to 1949, and the years with high losses comparable to those during 2006-2010. The potential relevance of the findings to the issue of climate change was considered.

DATA

The severity of Illinois winters was defined quantitatively using the economic losses caused during the winters. Historic records of the annual loss of lives due to winter conditions are not of sufficient quality to use in long-term temporal analyses of winter severity. Various measures of economic losses exist but the only measure that has quality and long duration is that recorded by the property insurance industry since 1949 (NRC, 1999). These records of property losses in each year have been systematically adjusted for changes over time and thus adjust for inflation, shifts in insurance coverage, and property changes over time in the storm areas.

The nation's property insurance industry in 1948 formed a group of specialists who had the responsibility of identifying all catastrophes, defined as events causing $1 million or more in insured property losses (PCS, 2007). For each such event in 1949 and all following years, they collected data on the date/s of occurrence, the state/s where the insured losses occurred, cause/s of losses, and amount of loss (dollars) of each catastrophe. Catastrophe losses have been found to represent 90 percent of all weather-produced property losses in the U.S. (Roth, 1996).

Experts in the property-casualty insurance industry have systematically analyzed, in each year since 1949, the historical catastrophe data to update the past catastrophe loss values to match the current year conditions. This annual assessment updated to 2010 resulted in a 61-year database allowing an unbiased comparison of recent catastrophe losses in Illinois with those in past years.

This annual loss adjustment effort is a sizable and complex task, requiring assessment of each past event. Three adjustment calculations are made to the original loss value for the year and locations of each catastrophe. One adjustment corrects for time changes in property values and the cost of repairs/replacements, and hence, this also adjusts for inflation. The second adjustment addresses the relative change in the size of the property market in the areas affected by the catastrophe using census data, property records, and insurance records. This action adjusts losses for shifts in the insured property between the year of a given storm's occurrence and the updated year (2010 in this study). The third adjustment is based on estimates of the relative changes in the share of the total property market that was insured against weather perils in the loss areas, done by using insurance sales records.

These adjustments were used to calculate a revised monetary loss value for each catastrophe so as to make it comparable to current year values. Thus, adjustments made in a recent year for all past catastrophes dating back to 1949 allow a fair assessment of their losses over time. An assessment of the insurance catastrophe values, and the temporal adjustment method used, found that demographic changes in various regions of the U.S. since 1949 were well related to the temporal adjustment values used by the insurance industry (Changnon and Changnon, 1998), and that the adjustment technique was financially sound (Changnon and Changnon, 2009). In 1999 the National Academy of Science assessed all types of hazard loss data in the U.S. and concluded that the property insurance data was the nation's best (NRC 1999).

The property losses in Illinois and estimated total loses for the winters of 2006-2010 are shown in Table 1. This reveals that each of the four winters had losses well in excess of $250 million and the 4-year total was $0.7 billion.

Table 1. Illinois property losses from the four winters between 2006 and 2010.

	Losses in millions of dollars				
Sector	2006-07	2007-08	2008-09	2009-10	Total
Property losses	118	253	172	159	702

WEATHER CONDITIONS IN THE FOUR WINTERS

The weather conditions in the four severe winters during the 2006-2010 period were assessed based on the departures from normal values for the winter months and the season. These departures for the mean temperatures, total snowfall, and number of severe winter storms in each winter are listed in Table 2. The ice storm severity is based on areal extent of ice in Illinois with a value of 1 when most (90%) of the state experienced ice storms, 2 when approximately 50% of Illinois had ice storms, 3 when ice storms covered 5 to 30 percent of the state, and 0 when none occurred. All four winters had above normal numbers of storms, above normal snowfall amounts, and below normal temperatures. Two winters had extensive ice storms and two had none. The magnitude of the winter values varied considerably between the four years.

Table 2. Departures from normal values for the four winters.

Conditions	2006-2007	2007-2008	2008-2009	2009-2010
Mean Temperature, °F				
December	+5.4	+0.0	-3.5	-1.0
January	-4.7	+1.4	-4.6	-3.8
February	-8.9	-5.2	+1.2	-5.1
Winter	-2.3	-2.2	-2.5	-3.3
Snowfall, inches				
December	-0.6	+5.5	+5.2	+5.7
January	-3.9	+0.2	+2.7	-0.7
February	+6.3	+8.2	-3.0	+5.2
Winter	+0.6	+4.5	+1.7	+3.4
Snowstorms, number				
December	+1	+6	+3	+2
January	-1	+1	+1	-1
February	+2	+3	+1	+2
Winter	+2	+10	+3	+3
Ice storm severity	1	2	0	0

2006-2007 Winter

The winter 2006-2007 brought several major winter storms across the United States. An early season, damaging winter storm occurred in Illinois on November 30-December 1, and it caused $54 million in losses. It brought thick layers of glaze in central and northern Illinois. In the ensuing 3 months more major storms occurred in Illinois. Two February storms in Illinois were very large and had very damaging snow and ice storms (Changnon and Kunkel, 2007).

The nation's 29th largest snowstorm on record (areal extent of snow) came on February 12-15. This storm brought heavy snowfalls, thick icing, and extremely high winds across central Illinois. Power outages and damages to telephone systems amounted to sizable losses and repair costs of $175 million, and total inured property damages of $0.35 billion. The state's third bad storm in 2006-2007 occurred on February 22-26. The resulting total winter snowfall in the northern third of Illinois was above 10 inches and a major ice storm occurred in northern Illinois, and this storm produced property losses of $29 million.

The winter caused thousands of homes to be without power for several days, and travel was difficult and dangerous from all three storms. Property losses in all three storms were classed as catastrophes by the insurance industry and totaled $118 million. Assessment of losses from the storms revealed 40 percent were to property. Transportation losses were 22 percent of the total, utilities losses and costs were 23 percent, government losses and costs were 8 percent, and retail business losses accounted for 7 percent of the winter total. The Chicago area experienced the greatest losses. Chicago's O"Hare Airport, the nation's busiest terminal, had 55 percent of its February flights delayed or cancelled.

2007-2008 Winter

The December 2007-February 2008 period in Illinois experienced a near record number of winter storms, plus a record number of rainstorms, several tornadoes, and every other form of severe weather that can occur in Illinois (Changnon et al.,2008). As a result, the state had 26 weather-related deaths, double the normal number, and excessive damages to vehicles, residences, and business. Communities and government agencies faced costly repair efforts, and many persons lost their homes due to major flooding from melting snow.

December had six winter storms, a new record high, and February had five winter storms, a value that tied as a record high. The 14 winter storms during the winter were one less than the record high value set in the winter of 1977-1978, and five storms in 2007-2008 had blizzard conditions.

The unique array of numerous storms, plus the extremes of temperature and numerous fogs, resulted in major losses and costs in four sectors. Property damages due to heavy snows, icing, and flooding led to losses of $520 million. Insured property losses were $253 million, the state's greatest winter loss in the 1949-2010 period. All forms of transportation suffered major losses and added costs that were estimated to be $435 million. Damages to power and communication systems led to repair costs totaling $492 million. Local, state, and federal agencies had to expend major sums for removal of snow and ice, and for road and highway repairs, and government expenditures totaled $217

million. Losses and costs resulting from the winter weather conditions in Illinois totaled $1.66 billion.

2008-2009 Winter

The winter of 2008-2009 in Illinois had several (nine) severe winter storms and many extremely low daily temperatures. Normally, the state has 4 severe winter storms in a winter. In northern Illinois 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° below normal and the fifth coldest since 1890 (Changnon and Kristovich, 2009).

This winter of bad weather conditions was the third in a row, following after the severe winter storms of 2006-2007 and the bad winter conditions of 2007-2008. The snowfall totals for the winter of 2008-2009 ranged from 50 inches in the extreme north to less than 5 inches in extreme 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 20 inches, and were near normal. But south of a line from Quincy to Mattoon, all points had below normal amounts, revealing a large contrast across the state.

The winter of 2008-2009 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. Numerous power outages occurred, and the high costs of natural gas for heating impacted all residents. All forms of transportation were seriously affected, a key problem for Illinois since Chicago serves as the nation's hub for rail, airline, and truck operations. Many trains were delayed and some halted; vehicle traffic was slowed and often halted; and air travel was delayed at the state's major airports. Local and state government agencies suffered very high costs to remove snow and repair damaged roadways. The insured property losses totaled $172 million, and the winter's total losses and costs were estimated as $1.4 billion

2009-2010 Winter

This winter had six severe snowstorms but no ice storms. The winter's total snowfall ranged from 8 inches at Cairo to over 50 inches in Chicago, and all parts of Illinois had snowfall totals well above normal. Amounts in northern Illinois ranked as eighth largest in past 125 years. Continuous low temperatures led to a snow cover in central and northern Illinois that lasted for more than two months, from late December until the end of February. The number of days with snowfall exceeded normal values across Illinois. Monthly temperatures were below normal in all three months Changnon, 2010). The statewide winter snowfall total was 28.8 inches which is 3.4 inches above normal (Table 2).

The storms on December 7-8 and December 21-22 were confined to the northern third of the state. The December 25-26 storm was larger, and it produced totals above 10 inches in northern Illinois. The storm on January 6-8 was widespread, as was the storm on February 7-9. This storm produced more than 12 inches of snow in northeastern Illinois.

The impacts of the storms, cold, and snow cover led to $159 million in losses to property (houses, vehicles, and businesses). The heavy snows, numerous storms, low temperatures

statewide, and long-lasting snow cover in central and northern Illinois produced a myriad of other impacts in Illinois, some of a serious nature. These included damages to various property, transportation problems, power outages, and costly efforts to deal with the weather problems. Anther problem included flooding that resulted from the melted snowfall.

HISTORICAL PERSPECTIVE

The insured property losses during the winters of the 1949-2010 period were examined to gain a perspective on the 4-winter sequence of high losses during 2006-2010. Insurance loss experts indicated that property losses over $100 million in a winter were truly major, severe seasonal losses. Inspection of the 61 winter loss values revealed that more than 50 percent (34) were $25 million or less. Fifteen winters had losses of $100 million or more, and the next highest losses were $81 million and $78 million. This information suggested that winters with losses greater than $100 million could be considered extremely severe.

The 15 winters with losses >$100 million are listed in Table 3. Inspection of the temporal distribution of the 15 winters reveals there were four periods when two consecutive winters occurred and three years were single events. The 2006-2010 sequence was the only 4-winter sequence in the past 661 years.

Table 3. Winters during 1949-2010 that had property losses of $100 million or more in Illinois.

Winter	Property Loss	Winter	Property Loss	Winter	Property Loss
1949-50	$227	1965-66	$135	2004-05	$113
1950-51	$136	1970-78	$129	2006-07	$118
1956-57	$238	1978-79	$211	2007-08	$253
1959-60	$115	1992-93	$159	2008-09	$162
1960-61	$115	1993-94	$186	2009-10	$159

The eight most damaging winters are listed in Table 4. This reveals that three of the four winters during 2006-2010 had extremely high losses. Clearly the winters of 2006-2010 were unique in timing and in the magnitude of their damages.

Table 4. Eight winters with the greatest losses during 1949-2010.

Rank	Loss, $millions	Winter	Rank	Loss, $millions	Winter
1	253	2007-2008	5	211	1978-1979
2	238	1956-1957	6	186	1993-1994
3	227	1949-1950	7	162	2008-2009
4	224	1959-1960	8	159	2009-2010

SUMMARY

This study assessed four recent consecutive severe winters in Illinois, those during 2006-2010. Winter severity was defined by the magnitude of property losses, and winters with $100 million or more in insured property losses were identified as being severe.

The winter of 2006-2007 was severe largely because of major snowstorms and extensive ice storms, causing $0.9 billion in losses, mainly to property, power systems, and transportation systems. The 2007-2008 winter had 14 winter storms creating record stormy conditions coupled with low temperatures. Major losses occurred to property and transportation in Illinois, and the losses totaled $3.5 million, the highest winter loss during 1949-2010. The winter of 2008-2009 had near record low temperatures and heavy snowfalls that exceeded 50 inches in northern Illinois. The winter conditions impacted eight sectors, killed 16 persons, and created property losses totaling $172 million. The next winter in 2009-2010 had above normal snowfall in all parts of Illinois and winter temperatures were below normal. Resulting impacts were very large on transportation systems, property, and power systems, and property losses were $159 million.

Examination of past winters during 1949-2010 showed that 15 winters had caused >$100 million in insured property losses. On four occasions there had been two consecutive winters. The four consecutive winters during 2006-2010 formed the only four in a row sequence found in the past 61 years, revealing a climate anomaly6. The four winters also caused very high losses. Collectively, their occurrences may be a reflection of an on-going change in climate.

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