



CoreLogic®



# Tornado and Hail Risk Beyond Tornado Alley

An Analysis of Weather Patterns  
Featuring CoreLogic® Wind  
Probability and Hail Probability



SPEED  
LIMIT  
35

EMERGENCY  
SNOW  
ROUTE



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## Executive Summary

The record-breaking series of natural disasters that struck the U.S. in 2011 has elevated national awareness and concern over weather-related risk and redefined how insurance companies, government officials, disaster response teams and other impacted parties plan for and manage natural hazard exposure. Though homeowners across the country have undoubtedly experienced the most immediate impact from these events, the recent and dramatic increase in the number of highly destructive severe weather outbreaks along with the availability of geospatial hazard risk modeling is leading to changes in risk management policy and procedure, particularly within the insurance industry.

Historically, insurers were primarily required to understand their exposure to earthquakes and hurricanes, while other environmental risk hazards received less attention. However, in response to the heightened financial risk that climate variability poses to insurers, three state insurance commissioners, California, New York and Washington, now require insurance companies to disclose response plans for a broader range of natural hazard risks, such as severe storms, wildfire, sea level changes and other risks driven by climate change.

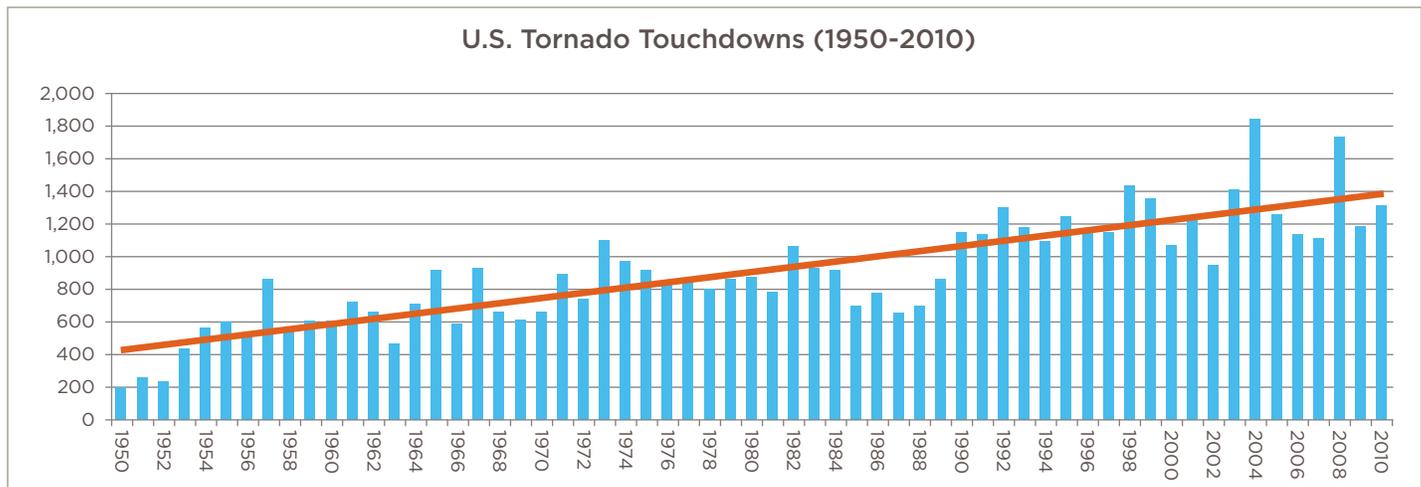
Damage from convective storms in particular, has captured the attention of both the public and insurers because of the increased number of incidents and shift in geographic distribution of losses. Convective storms produce hail and strong winds that generate tornados and can potentially bring about heavy rains that cause localized floods. Tornados and the storms that generate tornados account for more than half of the insured catastrophic losses (57%) that occur each year in the U.S.<sup>1</sup>

With these factors in mind, CoreLogic has developed a new methodology for predicting wind and hail probability that identifies the additional damage convective storms produce and the expanded geographic regions they encompass. Tornados and hail storms have long been believed to occur mostly within a narrow corridor in the middle of the continental U.S., known as “Tornado Alley,” stretching across Texas, Oklahoma, Kansas, Nebraska, Colorado, North Dakota, South Dakota and Illinois. However, the apparent increase in the number and frequency of severe weather outbreaks across the country in the last year is leading many experts to identify populated areas outside of Tornado Alley as susceptible to tornados and severe hail damage.

## The Story Behind Increased Outbreaks

Severe wind and hail weather (excluding hurricanes) is defined as one or more of the following: 1) Straight-line winds greater than 65 knots, the speed at which severe damage starts to occur; 2) Hail with a 1-inch diameter or greater, the size at which severe damage starts to occur; and 3) Tornadoes categorized as F1 or greater on the Fujita Scale of Tornado Intensity with winds reaching 73-112 mph. There is no question that the number of recorded severe weather events has increased over the past few decades as illustrated by the frequency of tornado touchdowns recorded by the National Oceanic and Atmospheric Association (NOAA) and its predecessors from 1950 through 2010 (Figure 1). The real question is whether the actual number of severe weather outbreaks is truly on the rise or merely reflecting a swell in the number of observations.

**Figure 1 – U.S. Tornado Touchdowns (1950-2010)**



Source: NOAA Storm Events Data, 2011

The frequency of individual observations can be impacted by a number of factors. The number of potential observers can increase, or the observers could be more evenly distributed geographically. Either of these conditions could be a contributing factor today, considering the doubling of the U.S. population since 1950 and the growing number of people moving outward to suburban areas from urban population centers. Also, better observational tools are now available, including the growing number of modern Doppler radar stations and broadened spatial distribution, especially since 1980. Taking all of these factors into account, it is likely that the number of tornado observations has risen considerably in the U.S. over the last 60 years.

There is also growing scientific evidence of an increase in the actual number of severe weather outbreaks as the result of rising global temperatures.<sup>2</sup> In addition, 24-7 news coverage of disasters via television, online and in social media has not only heightened public awareness but also likely added to the perception that severe weather events have been increasing in recent years. Upon closer examination, historic data suggests that the frequency and severity of storms is much more widespread beyond the traditional Tornado Alley states.

<sup>2</sup> Munich Re has said that climate-related events serious enough to cause property damage have risen significantly since 1980 and that extreme floods have tripled and extreme windstorms nearly so. The head of Munich Re's Corporate Climate Center stated that "there is definitely a plausible link to climate change." New York Times, February 12, 2011, "Huff and Puff and Blow Your House Down".

## Storms Strike Outside Of Tornado Alley

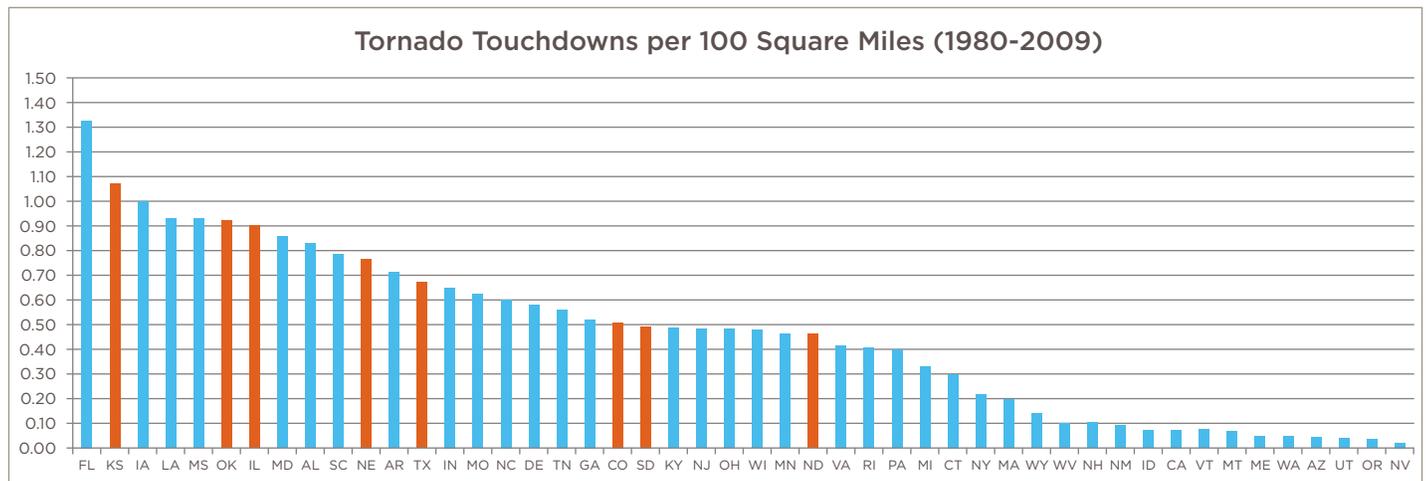
The “Super Outbreak” between April 25-28, 2011, was the largest tornado outbreak ever recorded in the U.S. It significantly impacted Alabama, Arkansas, Georgia, Mississippi, Tennessee, Virginia, and other areas across the southern and eastern parts of the country from Texas to New York. NOAA officially categorized the outbreak as the fourth deadliest in U.S. history.<sup>3</sup> In terms of cost, it was the most expensive tornado outbreak ever recorded.<sup>4</sup>

To many people, this horrific outbreak was perceived as an anomaly occurring outside the confines of the traditional Tornado Alley, in part due to the reality that both national and local media coverage often cite the Great Plains and surrounding areas as the epicenter of tornado and hail disasters. But contrary to this popular belief, these types of severe weather have not been exclusive to the Tornado Alley region.

### Tornado Damage Beyond Tornado Alley

Data recently released by NOAA paints quite a different picture of the frequency and location of severe storms over the past 30 years than most would expect. Figure 2 shows the frequency of tornados by state from 1980-2009, the era of increased Doppler radar observation, with traditional Tornado Alley states shown in orange. The graph clearly illustrates the geographic distribution of tornados measured at the state level, which is far less concentrated than generally thought. In fact, of the top ten states with the highest number of tornado touchdowns, only three fall within Tornado Alley.

**Figure 2 - Tornado Touchdowns per 100 Square Miles with “Tornado Alley” States Indicated by Orange Bars**



Source: NOAA Storm Events Data, 2011

<sup>3</sup> NOAA, 2012 ([http://www.noaanews.noaa.gov/2011\\_tornado\\_information.html](http://www.noaanews.noaa.gov/2011_tornado_information.html))

<sup>4</sup> A.M. Best Company, Inc. (<http://www.insurancenewsnet.com/article.aspx?id=261515&type=propertycasualty>)

Evaluation of tornado activity in recent years for the states listed in Figure 2 reveals that between 2000-2011, there were 6,779 tornado touchdowns per 100 yards in the eight states typically identified as comprising Tornado Alley. The 16 states with the next highest numbers of touchdowns over that 11-year period were Iowa, Louisiana, Mississippi, Alabama, North Carolina, South Carolina, Arkansas, Indiana, Missouri, Georgia, Ohio, Wisconsin, Minnesota, Florida, Tennessee and Kentucky. These states had a combined total of 8,875 tornados over that same 12-year period. Comparing NOAA property damage totals between these two areas, it is clear that Tornado Alley is not the only region in the U.S. that is susceptible to high levels of property damage. Estimated property damage within the eight Tornado Alley states from 2000 to 2011 was approximately \$2.5 billion, while the 16 states with the next highest number of touchdowns totaled nearly \$15.5 billion in property damage by comparison. Though the NOAA storm event data is not a complete tally of the damage amounts due to privacy concerns regarding claims, it does serve as a representative sample when comparing these areas.

#### Hail Damage Beyond Tornado Alley

Also according to NOAA, hail storms in the eight-state Tornado Alley region caused approximately \$4.3 billion in property damage and nearly \$1 billion in crop damage between 2000 and 2011.<sup>5</sup> Based on that same report, the 16 states with the next highest amounts of hail damage located outside of Tornado Alley were Iowa, Louisiana, Mississippi, Alabama, South Carolina, Arkansas, Indiana, Missouri, Georgia, Kentucky, Ohio, Wisconsin, Minnesota, Wyoming, Montana and New Mexico. The combined damage estimates in these states was approximately \$3.2 billion in property damage and \$400 million in crop damage during the same time period. Again, NOAA damage estimates are typically lower than what is actually experienced, but as a sample data set are valuable in determining the damage ratio between these two areas. Based on these figures, along with the number of recorded storms that produced 1-inch diameter or larger hail during this 12-year period (42,200 for the eight states in Tornado Alley versus 55,602 for the 16 states outside this region) it is clear that property damage from hail is not limited to a small section of the country.<sup>6</sup>

<sup>5,6</sup> NOAA Storm Events Data, 2011

## Emerging Risk In 2012

Actuarial analyses of claims losses associated with severe weather events in 2011 has upended policies and procedures for many insurers and enterprise risk managers. Many companies will be reevaluating their “book of business” in 2012 and approaching their state Department of Insurance Commissioners with rate change requests. As a result, geospatial data and severe weather risk projections, particularly for tornado and hail disasters, will be an increasingly crucial element in determining hazard exposure and insurance rates for properties in newly identified high-loss potential risk areas over the coming years.

CoreLogic developed a proprietary dataset using advanced modeling techniques to project the probability of a tornado or hail event for states and local Core-Based Statistical Areas (CBSAs) across the U.S. For each of the two hazard types, the dataset includes both event probability and six risk categories—very low, low, moderate, high, very high and extreme—for 10 kilometer x 10 kilometer (6.2 x 6.2 miles) areas.

To illustrate the full extent of tornado risk within Tornado Alley and beyond, Figure 3 shows the varying levels of risk for each state across the U.S., excluding Alaska and Hawaii, according to the CoreLogic wind and hail probability data. Also depicted in Figure 3 are a number of areas identified as Special Wind Regions—isolated areas designated by the Federal Emergency Management Agency (FEMA) in which the magnitude of the local wind speeds is affected by local conditions. These areas are often associated with mountainous terrain that, given meteorological conditions, may create higher than normal wind velocity for a relatively short period of time.

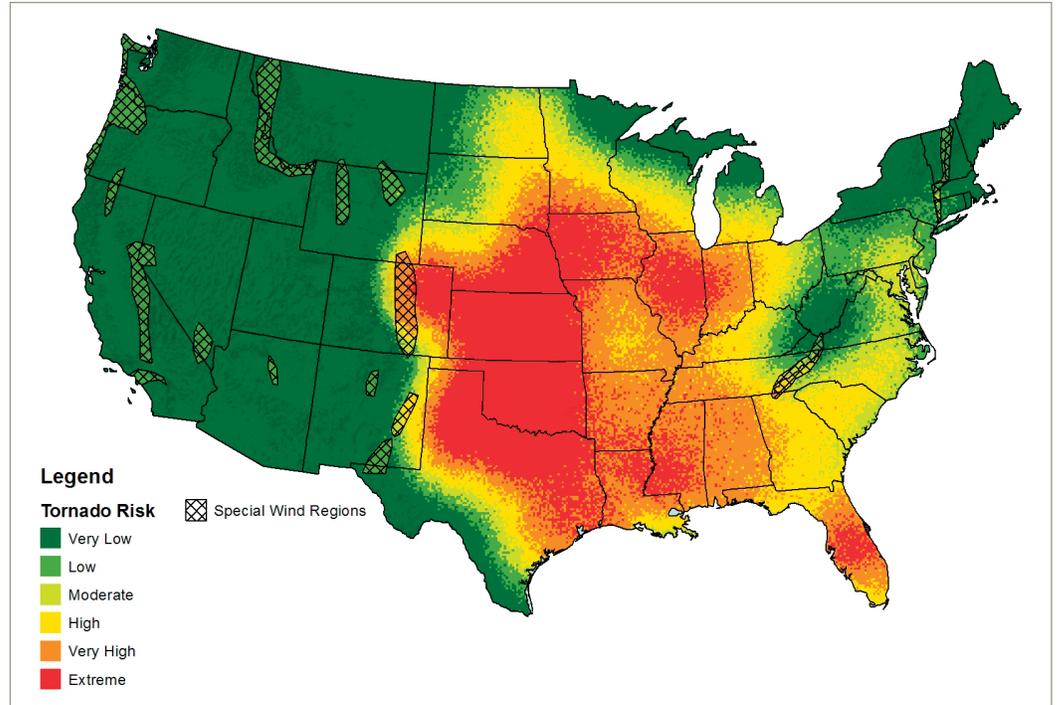
As expected, the traditional Tornado Alley region in Figure 3 shows very high to extreme risk exposure, but that risk also extends deep into the Midwest and several southeastern states, including Florida. This illustration suggests that the extreme weather outbreaks of 2011 were not geographic anomalies when compared to the long-term probabilities of predicted risk.

### **Key findings include:**

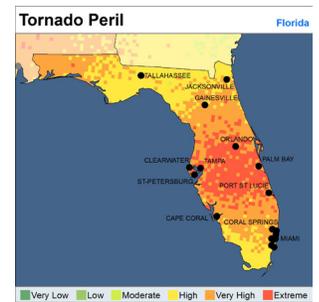
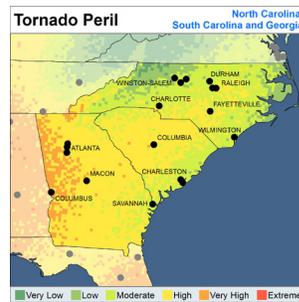
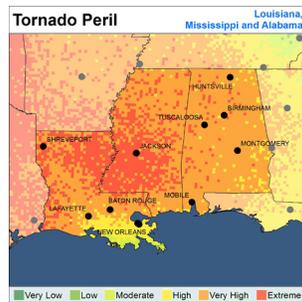
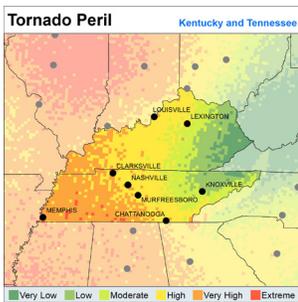
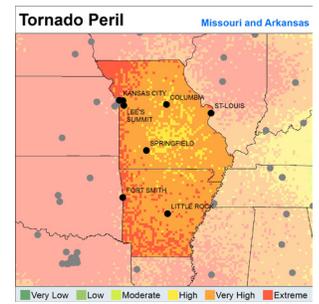
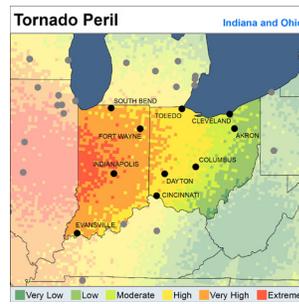
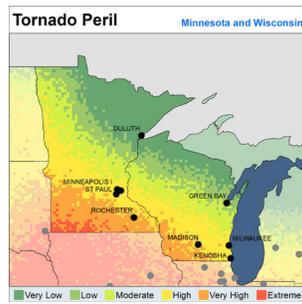
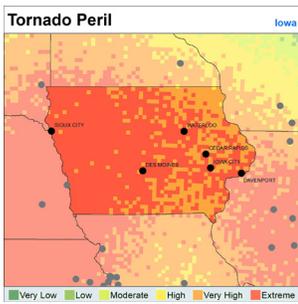
- ▶ Higher risk for tornado touchdowns is not limited to the central Great Plains states, as commonly thought.
- ▶ Tornado risk extends across most of the eastern half of the U.S.
- ▶ Extreme tornado risk affects at least part of 26 states nationwide.
- ▶ At least 15 states contain significantly large regions facing very high or extreme tornado risk.

### Figure 3 - U.S. Tornado Risk

Source: CoreLogic, 2012



The following state maps were generated using the proprietary CoreLogic Wind and Hail Probability layers, and show tornado peril for the 16 states with the highest number of touchdowns outside of traditional tornado alley from 2000-2011 at a more localized level.



Source: CoreLogic, 2012

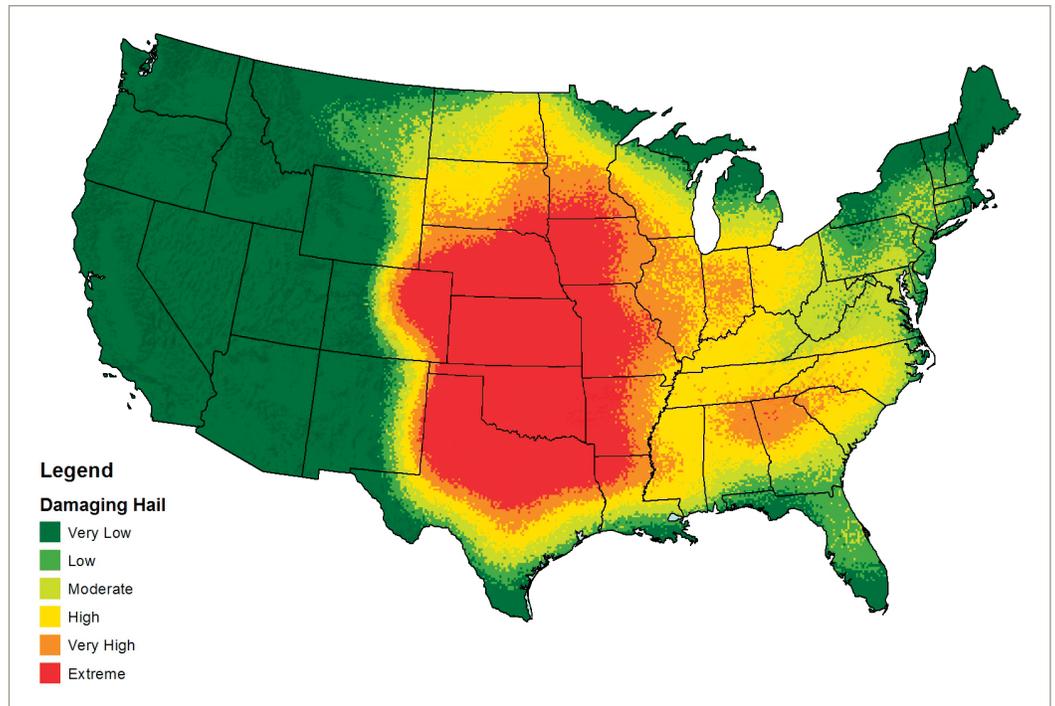
Nationwide damaging hail risk is depicted in Figure 4, which indicates that the risk of hail damage is more widespread in the U.S. east of the Rocky Mountain front than either tornados or straight-line winds.

**Key findings include:**

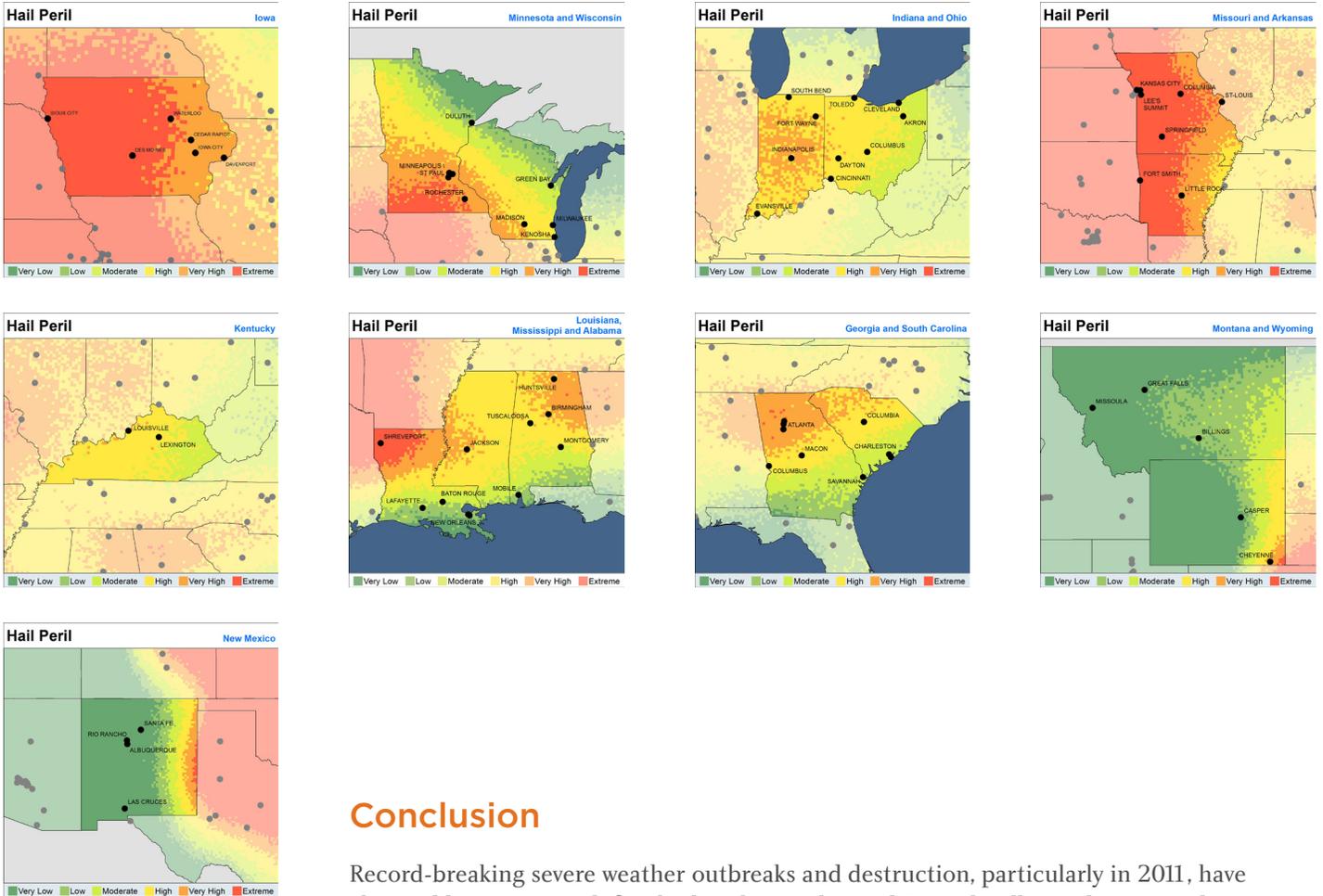
- ▶ The area of highest hail risk extends outward from the central Great Plains to include states as far east as Georgia and the Carolinas.
- ▶ At least 11 states contain significant areas facing extreme hail risk, with Nebraska, Kansas and Oklahoma nearly entirely exposed to extreme risk.
- ▶ Almost every state east of the Rocky Mountains faces hail risk of moderate or higher in some part of the state.

**Figure 4 -  
U.S. Damaging Hail Risk**

Source: CoreLogic, 2012



The following state maps were generated using the proprietary CoreLogic Wind and Hail Probability layers, and show hail peril for the 16 states with the highest amounts of damage outside of traditional tornado alley from 2000-2011 at a more localized level.



Source: CoreLogic, 2012

## Conclusion

Record-breaking severe weather outbreaks and destruction, particularly in 2011, have changed how insurers define high-risk areas beyond Tornado Alley and measure damage from all levels of storms. Insurers are now placing particular emphasis on improving their understanding of the geographic distribution and frequency of tornados and hail storms, which in turn provides a more accurate and complete analysis of risk potential. As more precise geospatial hazard risk modeling is used to fine tune this risk analysis, the way in which policies and rates are constructed will be affected.

Insurance companies, enterprise risk managers and even state Departments of Insurance are becoming more attuned to changing climate conditions, population dispersion and new patterns in hazard-related losses. The result will continue to be more accurate predictive risk analysis leading to better informed decision making within the insurance industry.



For more information, please call 855.267.7027  
or visit [corelogic.com/spatialsolutions](http://corelogic.com/spatialsolutions)



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