CoreLogic®

WHITE PAPER ▸ January 2019

How Tornado Technologies Work

Table of Contents

Introduction

Every year tornadoes present significant risk to the population and infrastructure of the Continental United States. Understanding and assessing the damage likely caused by tornadic winds on building performance, and local infrastructure impacted, is critical for public safety and restoring those impacted. Being able to quickly distinguish who and what potentially has been impacted is crucial for providing immediate assistance from first responders, local agencies and insurance carriers that are dedicated to restoring these communities.

Like hail and wind storms, tornadoes contribute significantly to overall insurance losses annually from very small local events to very large catastrophic events. While hundreds to thousands of tornadoes are typically observed in the U.S. each year, a single tornado that hit Joplin, Mo. on May 22, 2011 caused an estimated $2.1 billion (2011USD) in insured losses according to the Insurance Information Institute.

Defining exactly where on the ground tornado damage has impacted properties and assets is critically important to understand exactly who and what may have suffered damage. Equally important is getting an accurate assessment as quickly as possible once the event is over. As part of CoreLogic's dedication to developing accurate weather verification products and services to meet the needs of the Insurance Community, it has developed Tornado Path Maps which provides the critical information needed to mobilize catastrophe managers, claims adjusters, and support personnel within minutes to hours of a tornadic event.

Similar to the use of Hail Size Maps and Wind Speed Maps from CoreLogic it is now possible to use Tornado Path Maps to improve policyholder experiences during catastrophe events. With this new technology, it will ultimately allow carriers to increase satisfaction of the insured party through faster service, and to provide emotional assurances to their policy holders that they are aware and responding to their needs in such a traumatic time.

The Challenge

Unlike hail and wind, the rapid evolution and small size of a tornado, compared to the parent thunderstorm, present unique challenges to automatically detecting the path. Most observers providing tornado reports are not located within the path and only provide visual descriptions of the tornado's appearance, which are often uncorrelated with tornadic intensity. Weather radars can observe a storm's rotation, but many strong rotation signatures are not associated with tornadoes and some tornadoes can be associated with weak rotation signatures, making it difficult to differentiate the tornadoes.

One of the most violent phenomena on earth, tornadoes are capable of completely destroying one house while leaving another untouched only a few blocks away.

With the proprietary Tornado Verification Science from CoreLogic, carriers can better understand the impact of each unique storm by comparing detailed storm maps and reports with their book of business. This enables a more proactive approach to claims management. By being able to accurately verify and pinpoint affected areas, insurance carriers can develop swifter, more targeted response plans to improve customer satisfaction, catastrophe response efficiency, and confidently detect fraudulent or unrelated claims.

Purpose

The goal of this paper is to explain how the proprietary Tornado Verification Science from CoreLogic works, and to highlight the unique approach developed to meet the specific needs of catastrophe event responders and insurance claims management. It is important to understand the limitation of other verification methods currently being used to see why such approaches are not the ideal methodology to meet the unique needs for the targeted CoreLogic customer's applications.

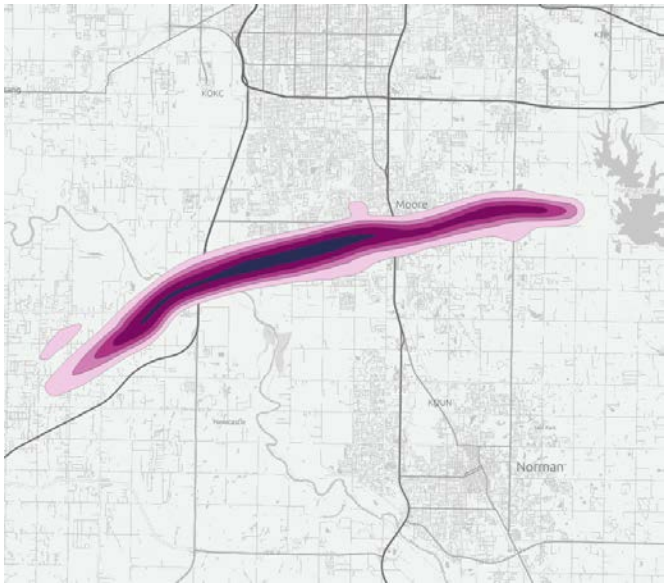
Limitations of Verification Methods

In this paper we will explore the following sources of data, and their effectiveness when used for forensic tornado verification:

- Visual Reports
- National Weather Service (NWS) Damage Surveys
- Radar-based Algorithms
- Drones and aerial imagery

Using Visual Reports for Tornado Verification

Visual tornado reports, of either the funnel or damage, are the most common and quickest source of information that a tornado has occurred or is currently occurring. Despite their limitations, they are often used by insurers to alert their catastrophe response teams to expect concentrated areas of impacted policyholders. The NWS collects reports from several volunteer sources, including law enforcement, emergency managers, trained spotters, storm chasers, media outlets, and the general public.



While these reports are the only publicly available source of ground truth, they have several major limitations. The first, is that initial reports do not provide any information on the intensity, length or width of the tornado, making it impossible to estimate what assets or how many policies could have been impacted. Moreover, visual confirmation is hindered in many cases due to terrain, vegetation, heavy rainfall, and darkness[1]. The second limitation is the ambiguous location of the initial tornado report, which, depending on the description, could be located within the path or at the observer's location outside the path. Finally, most tornadoes are associated with a single tornado report, but some tornadoes are associated with multiple initial reports, complicating the estimate of the number of tornadoes that actually occurred.

Using NWS Damage Surveys

Ground surveys of damage are carried out by NWS personnel for some tornadoes with the goal of establishing the maximum intensity, maximum width, and the beginning and ending points. For a subset of tornadoes, the survey contains sufficient detail to derive shapefile polygons outlining the different levels of damage. These detailed surveys provide the best representation of damage that has occurred on the

ground and can be used to estimate the number of impacted homes and assets. Unfortunately, these detailed surveys are only produced on a case-by-case basis depending on the level of impact and the availability of personnel to conduct the survey. Furthermore, these surveys are usually not made available until the day(s) following the event, greatly delaying impact and exposure estimates.

Using Weather Radar for Tornado Verification

Providing the public with sufficient warning lead time for potential tornadoes is a crucial role of the NWS. Although storm spotters provide valuable information on the visual appearance of the storm, these observations are inconsistent and carry the same limitations previously mentioned with tornado reports. Therefore, weather radars are used extensively to find and diagnose storms that are capable of producing a tornado. Weather radars can cover large areas by transmitting energy into the atmosphere and measuring the return echo (reflectivity) and the component of the wind blowing towards or away from the radar (radial velocity). Weather radars are an invaluable tool in consistently estimating precipitation and wind speeds across larger areas of the country that would otherwise be absent of observations.

To this end, several automated algorithms have been developed by the National Severe Storm Laboratory (NSSL) to diagnose the presence and characteristics of rotation in thunderstorms. The first is the Tornado Detection Algorithm (TDA[2]) developed to alert NWS forecasters of developing or ongoing tornadic storms. The algorithm triggers a tornado detection based on wind data at different altitudes and times. Because the algorithm was designed as an aid to forecasters, it maximizes detection at the expense of increased false alarms, depending on the human forecaster to mentally remove false signatures.

Another NSSL product, Rotation Tracks[3], was developed to deliver a more comprehensive but simplistic view of storm rotation. By tracking the strongest low-level rotation from neighboring weather radars over a specified time interval, coherent swaths of rotation can be highlighted rather than individual tornado detection points. When compared to the detailed NWS damage surveys, experimental tornado paths using the Rotation Tracks product demonstrates large variability in skill and suggests the product is more useful as an aid for manually drawn paths than automated paths[4]. Although several quality control measures were introduced, the algorithm still misidentifies areas of rotation due to anomalous rotation signatures created when thunderstorms move over wind turbine farms and rotation in portions of the thunderstorm that are not capable of producing tornadoes.

Between 2012 and 2013, the NWS enhanced the capability of their radar network by adding dual polarization technology. It works by measuring the difference between horizontal and vertical energy waves that each behave differently depending on the size and shape of the particles in the air. The upgrade allows the radar to identify areas of hail and rain and even differentiate between big drops and small drops. In the case of tornadoes, debris, such as leaves, dirt, or building material, is often lofted into the air, producing a distinct signal from hail and rain[5]. Unfortunately, an operational tornado debris detection product has not yet been implemented by the NWS.

Using Drones and Aerial Imagery

- Data capture / processing
  - Expensive
  - Time lag
  - Ongoing inclement weather hindering data capture
  - Requires platform / software to view data

The CoreLogic Solution

To combat these challenges with tornado verification, CoreLogic has built a tornado verification model that takes advantage of the best aspects of radar data and reports. Our novel comprehensive approach to using all the available radar data with the ability to use public/social media reports and the expertise of experienced meteorologists consistently provides 250-meter resolution with neighborhood-level detail across most of the country.

The proprietary radar algorithm was designed to preserve the high-resolution of the radar-based estimates while mitigating their limitations. Unlike operational algorithms, the negative influence of wind turbines and other ground contamination has been limited and the algorithm appropriately focuses only on areas of the storm that can produce tornadoes. This is done by developing a proprietary radar wind processing techniques and uniquely taking advantage of the dual polarization data through advanced machine learning techniques.

Finally, when present, valuable information from visual reports can be ingested by the algorithm to further refine the tornado paths. This allows us to include valuable visual reports that would otherwise be excluded, increasing the accuracy of the tornado path.

CORELOGIC TORNADO VERIFICATION ADVANTAGES

- Comprehensive processing of wind and tornado debris signatures from radar.
- Advanced quality control process that allows public reports of damage and visual appearance to be combined with the radar data.
- Damage model trained to estimate actual tornado path rather than the presence of a tornado.
- Using advanced machine learning techniques to produce probabilistic tornado damage paths with nationwide coverage in real time.

Summary

The Property & Casualty industry is exposed to billions in insured losses every year due to tornadoes. Knowing the location and scope of the damage from tornadoes allows insures to respond within minutes to hours rather than days.

Verify Tornado Claims to Improve Customer Satisfaction and Profitability

With Tornado Verification Technology from CoreLogic, carriers can compare detailed storm maps to their book of business to better understand the impact of each unique storm, fast-track obvious claims, and allocate appropriate resources toward more difficult or suspicious claims. Because our Tornado Verification provides precise knowledge of when tornadoes likely impacted a specific property, insurance claims adjusters can:

- Objectively handle, document, and communicate tornado claim decisions
- Triage resources to the greatest impacted areas
- Proactively reach out to insureds for emotional goodwill and build stronger brand loyalty
- Close claims faster for improved customer satisfaction
- Correctly identify losses that were potentially caused by pre-policy storms

A Powerful Combination

Weather Verification Services represent a powerful dataset for property and casualty insurers. With the information provided by these databases, insurance companies can create new solutions and workflows to close claims faster, ultimately increasing customer satisfaction and brand loyalty, while more accurately identifying suspicious claims.

Sources

[1] Blair, S.F. and J.W. Leighton, 2014: Assessing Real-Time Tornado Information Disseminated through NWS Products. *Wea. Forecasting*, **29**, 591–600

[2] Mitchell, E.D., S.V. Vasiloff, G.J. Stumpf, A. Witt, M.D. Eilts, J.T. Johnson, and K.W. Thomas, 1998: The National Severe Storms Laboratory Tornado Detection Algorithm. *Wea. Forecasting*, **13**, 352–366

[3] Miller, M.L., V. Lakshmanan, and T.M. Smith, 2013: An Automated Method for Depicting Mesocyclone Paths and Intensities. *Wea. Forecasting*, **28**, 570–585

[4] Karstens, C. D., and Coauthors, 2016: Evaluation of near real-time preliminary tornado damage paths. *J. Oper. Meteor.*, **4**, 132–141

[5] Ryzhkov, A.V., T.J. Schuur, D.W. Burgess, and D.S. Zrnic, 2005: Polarimetric Tornado Detection. *J. Appl. Meteor.*, **44**, 557–570

About CoreLogic

CoreLogic (NYSE: CLGX) is a leading global property information, analytics and data-enabled services provider. The company's combined data from public, contributory and proprietary sources includes over 4.5 billion records spanning more than 50 years, providing detailed coverage of property, mortgages and other encumbrances, consumer credit, tenancy, location, hazard risk and related performance information. The markets CoreLogic serves include real estate and mortgage finance, insurance, capital markets, and the public sector. CoreLogic delivers value to clients through unique data, analytics, workflow technology, advisory and managed services. Clients rely on CoreLogic to help identify and manage growth opportunities, improve performance and mitigate risk. Headquartered in Irvine, Calif., CoreLogic operates in North America, Western Europe and Asia Pacific. For more information, please visit corelogic.com.

CoreLogic
40 Pacifica, Ste. 900
Irvine, CA 92618

For more information please call 888.929.4245 or visit hazardrisk@corelogic.com.

17-TORNTECH-0119-00

CoreLogic®
corelogic.com