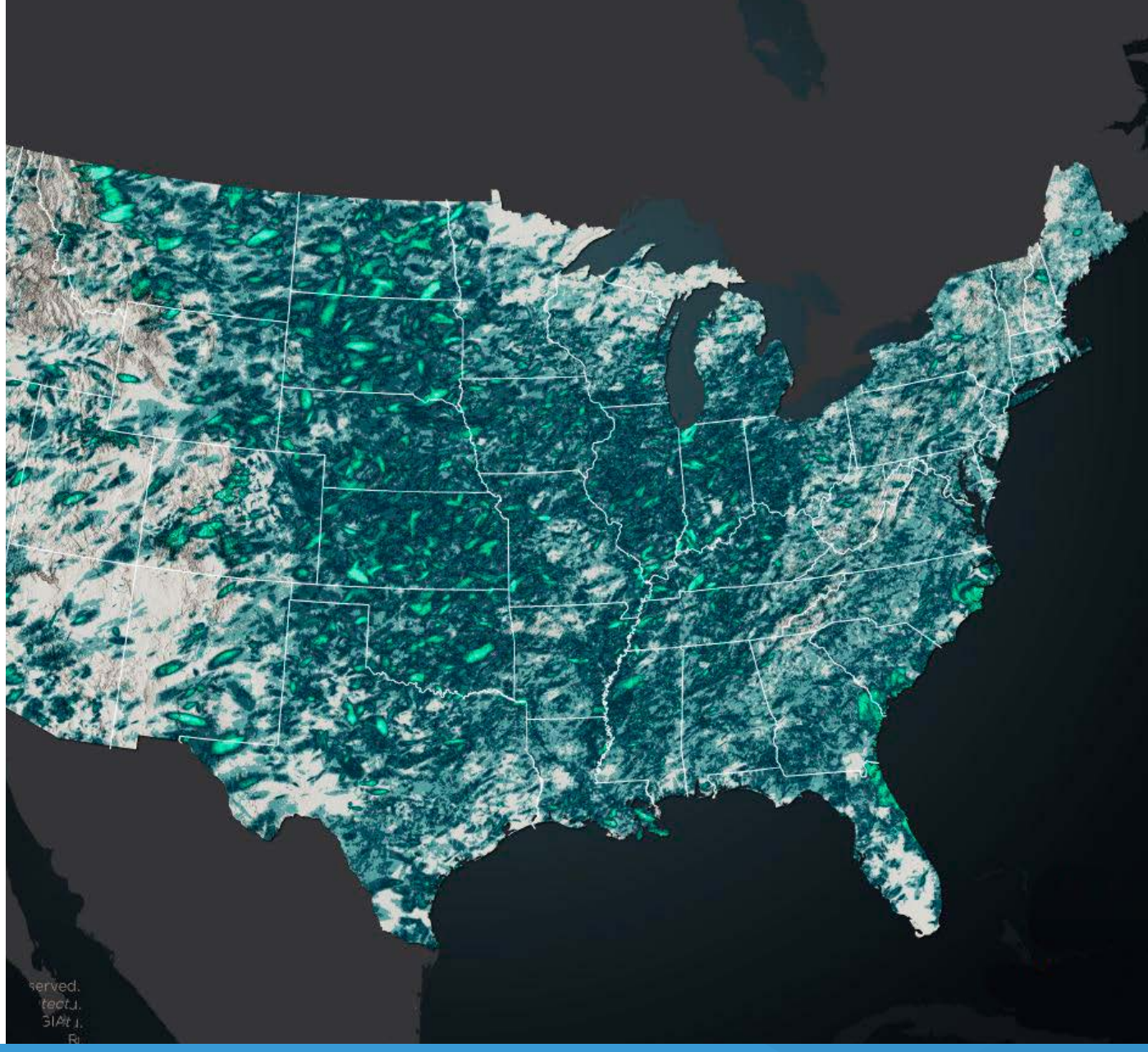

Whitepaper | April 2017

How Wind Technologies Work

CoreLogic®

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Introduction

Extreme weather events pose a growing threat to property and casualty insurers in the United States, costing billions in insured losses every year. Wind damage in particular can go undetected for months, causing considerable collateral damage, resulting in very long claims cycles. To document a claim file, insurance claims adjusters have relied on public reports from the National Oceanic and Atmospheric Administration (NOAA) and nearby airport observations. Because neither of these sources represents wind at or near the precise location of interest, claim denial or approval decisions can often lead to misinterpretation, leading carriers to approve claims that were not necessarily valid.

The Challenge

Wind is one of nature's most difficult hazards to measure. Unlike hail, which can be visually seen and tends to concentrate in the center of severe storms, wind is invisible and can vary widely over small geographic areas. Historically, wind data has been obtained from airport and private weather station observations, which can cause significant ambiguity, as these observations represent a single stationary location, and are usually not representative of what happens in surrounding areas.

This wind uncertainty often makes storm impacts unpredictable and distributes claims irregularly. Additionally, the uncertainty surrounding storm impacts can create situations where post-storm exposure is poorly understood, leading to significant challenges calibrating storm response, and estimating Incurred but Not Reported (IBNR) Reserves. With the proprietary Wind Verification Science from CoreLogic®, carriers can compare detailed storm maps and reports with their book of business to better understand the impact of each unique storm, enabling a more proactive approach to claims management. 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 claims.

Purpose

The goal of this paper is to explain how the proprietary wind verification science from CoreLogic works, and to highlight the unique differentiators the CoreLogic method has to offer. By understanding how an array of wind technologies work, industry leaders can confidently choose the appropriate technology to meet specific needs.

Limited Data Sources

There are three sources of wind data, all of which, for various reasons, are often ineffective when it comes to claims verification. In this paper we will explore the following sources of data, and their effectiveness when used for forensic wind verification:

- Point measurements
- Models
- Radar

Using Point Measurements for Wind Verification

A point measurement is defined as any measurement taken at a single location using a weather station, either public or privately owned, with most stations using a cup or propeller anemometer to estimate the wind speed. Publicly run point measurements are predominately taken by Automated Surface Observing Systems (ASOS), which make up the primary weather observation network of the National Weather Service (NWS), Federal Aviation Administration (FAA), and the Department of Defense (DOD). In addition to publicly run observational networks, many private individuals make data available from their own weather stations that they setup.

Wind is extremely difficult to verify—according to a competitor, high-resolution wind analysis is "nearly impossible."

Although helpful for establishing an accurate depiction of what is going on at a specific stationary location, point

measurements are often limited in availability and therefore unable to provide a clear and accurate picture of localized wind events.

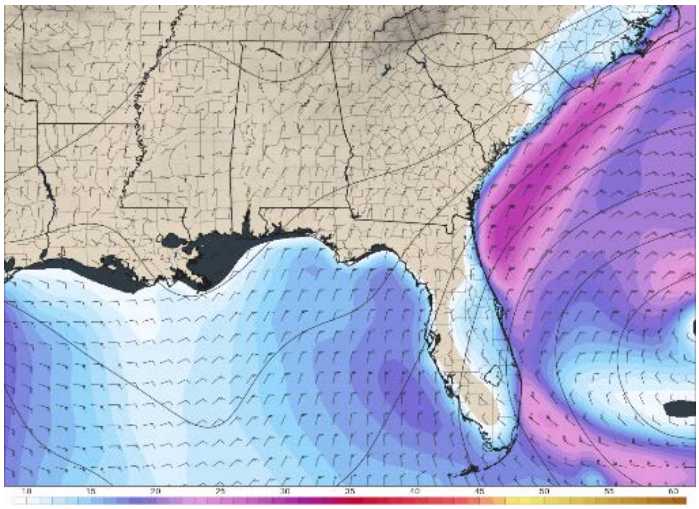
ASOS stations are of very high quality, properly calibrated, and placed, yet are located at airports (generally next to runways in flat, well-exposed areas), and not in population dense areas, such as neighborhoods, where claims activity is most present. Additionally, wind can vary greatly (+/− 50 percent or more) across 100 feet or less, so using just airport observations for forensic verification is likely unrepresentative of what nearby properties may have actually experienced. This influence by geography also varies widely at different elevations over the same point on the earth, further compounding the problem. Finally, non-airport observations, such as home weather stations, can also be unreliable due to major siting errors, obstacles, non-standard heights, and not being maintained or routinely calibrated. Thus, the misrepresentation or under representation of errors associated with surface weather stations prevents the generation of a wind analysis useful for accurate verification.

Using Numerical Weather Prediction Models for Wind Verification

Due to the lack of point measurements and public reports, high-resolution numerical weather models can be used to give a forecast of future damaging wind speeds at the surface. These short-term severe wind forecasts are then used to help estimate regions where severe winds occurred.

The publically available nature of numerical weather models makes them an attractive alternative to surface observations for verification purposes, however, they were originally designed to support the forecasting of severe weather phenomena on a high enough resolution to get storm-specific information. Yet since they were designed to forecast future events, they have not been optimized to estimate wind speeds from current thunderstorms and therefore dangerous to use for forensic verification. Because of this, the output of these models provides very coarse resolution, and yields extremely low accuracy when used for verification purposes. This low resolution also makes it impossible for computer based models to resolve most weather phenomena that cause wind damage, such as thunderstorm wind gusts.

Surface Pressure and Winds



Source: Pivotal Weather

Using Radar for Wind Verification

While point measurements and reports are randomly scattered across the country, 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. Weather radars are invaluable tools in consistently estimating precipitation and wind speeds across larger areas of the country, that would otherwise be absent of observations. The radar network and scanning strategy have been optimized to estimate rainfall and not surface winds, resulting in several unfortunate limitations.

The largest limitation in using radar estimated winds is that the radar only measures the component of wind blowing toward or away from the radar. If the wind was blowing across the radar beam, it would be invisible. Therefore, it doesn't measure the full wind speed, even at radar beam height, offering an incomplete picture of wind activity in the area.

Additionally, as the distance away from the radar increases, the radar wind estimate is valid at increasingly higher altitudes above the surface. This occurs for two reasons:

1. The lowest radar beam is tilted slightly upwards to limit interference by tall objects on the ground, such as buildings, so the tilt causes the beam to gain altitude with distance (Figure 1).
2. Even if the beam was not actually tilted upwards, it would still gain altitude with distance, due to the curvature of the earth. The combination of these two effects, which can vary from a few hundred feet to thousands of feet, means that the radar beam becomes less representative of the winds speeds at the ground with increasing distance from the radar (Figure 2).

The increased altitude with distance from the radar is especially problematic because the resulting radar beam ends up being significantly higher than the standard observation height of 10 meters, which also happens to be similar to the height of the average residential roof. Thus, it is very difficult to verify radar wind estimates with ground measurements and roof damage reports, which provide the closest insight into actual ground truth and insight into potential impact to homes and property.

All three limitations cause the radar estimated winds to be unrepresentative of wind activity near the ground, and thus, not representative of what could potentially be affecting property or infrastructure.

Using The National Weather Service Real-Time Mesoscale Analysis (RTMA)

Another approach often used for surface wind estimation is the Real-Time Mesoscale Analysis (RTMA), generated by the NWS. This analysis combines observations from point measurements, radars, and satellites, in addition to output from numerical models to generate a gapless map of the current weather conditions across the continental United States.

Figure 1.

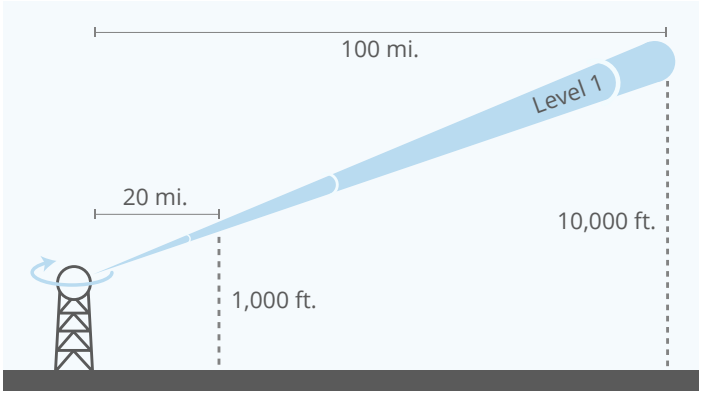
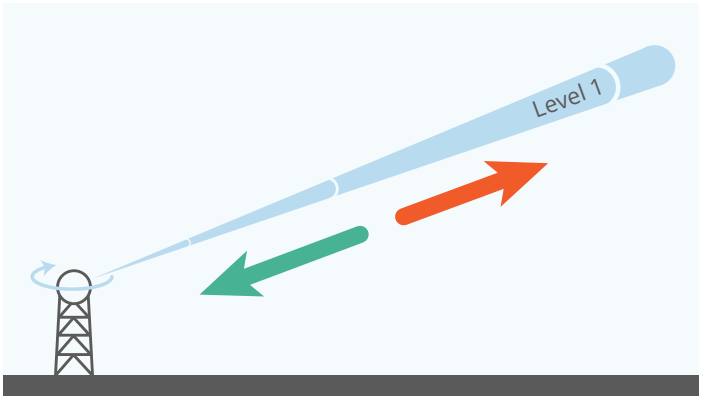


Figure 2.

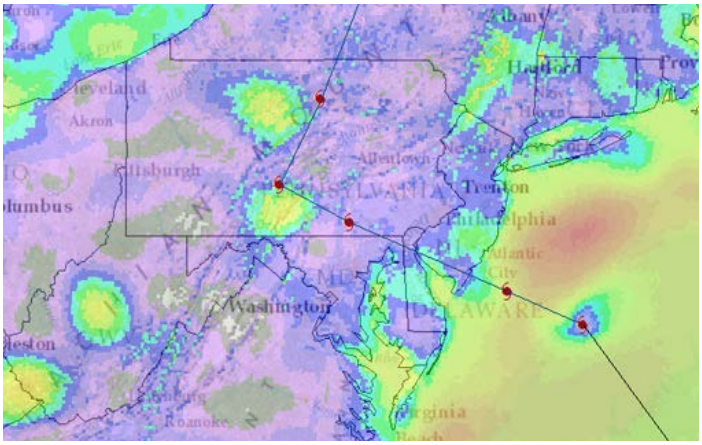


Previously to RTMA, NWS forecasted for single points (i.e. major cities) and verified those forecasts using observations at the nearest airport, or point measurements, as we referred to in a previous section. In 2003, the NWS began issuing gridded forecasts, which cover the entire country in 5-km grid boxes. Thus, RTMA was developed to verify forecasts based on this national grid.

National Weather Service: Real-Time Mesoscale Analysis

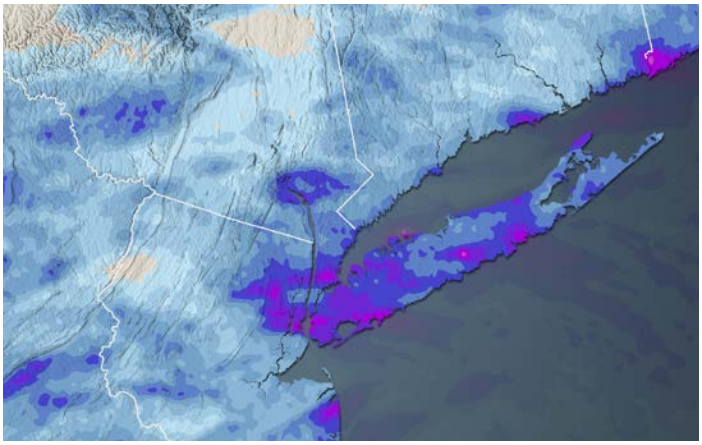
Although technically accurate, the goal of these forecasts is not to pick out maximum wind from individual storms. Rather, RTMA offers a broad approximation of the average wind over a large area, rendering it not ideal for accurate verification:

Wind Speeds



Source: www.gonzaleztennant.net/mapping-hurricane-sandy

CoreLogic Wind Verification Technology: Hurricane Sandy 2012



- Although RTMA is technically 2.5-km resolution, the data necessary for accurate verification, i.e. airport observations, are approximately 100-km resolution. This also depends on the part of the country, and density of civic areas and airport locations.
- Airport are surrounded by "bull's eyes," which is the result of the airport observation having a circular radius of influence. All areas within this radius are given the same wind speed value which is not representative of reality and is an example of the limitation of using such widely spaced measurements on such a high-resolution grid.

CoreLogic Solution

CoreLogic uses both radar and observations, taking advantage of the best aspects of each in the proprietary algorithm: the high-resolution patterns of radar, and the accuracy of observations. This provides 500-meter resolution with neighborhood-level detail.

Proprietary algorithms have been developed to handle suboptimal observations and the major limitations associated with radar wind estimates. Specifically, our radar algorithm can estimate the full 2-dimensional wind vectors, so we are able to use radar to derive the full wind speed rather than just the components blowing towards or away from the radar. Also, by using bias-correction to overcome some of the limitations of observations, we can utilize tens of thousands of additional wind observations that would otherwise be too inaccurate for use in verification.

Our robust radar processing system determines which areas of radar-detected winds are likely and unlikely to be present near the ground, so we're able to use radar even where beam height is very high. Through a morphing algorithm (similar to our hail algorithm) we determine radar-derived wind speed in between radar scans (i.e., every second), and then combine observational and radar-based wind data to create the final wind speed estimate.

CoreLogic Wind Verification Advantages

- Resolution and accuracy are light years ahead of the competition.
- It's the only product with neighborhood-level resolution.
- We can detect and resolve ALL types of severe non-tornadic wind.
- We do not rely on model forecasts of wind speed.
- Our method covers 100% of the continental U.S.
- CoreLogic verification ingests far more wind observations than competitors.
- Only product with sufficient resolution and accuracy for verification.

Summary

The P&C industry is exposed to billions in insured losses every year due to wind. Wind damage in particular can go undetected for months, causing considerable collateral damage and resulting in very long claims tails.

Address-Level, Forensic-Quality Severe Windstorm Event Data

Wind Verification Reports and Impact maps from CoreLogic provide precise, location-specific historical wind speed information, enabling insurance adjusters to document claim files with severe windstorm data. CoreLogic Wind Verification provides verification of windstorm events back to January 1, 2009, with estimated maximum wind speed magnitudes at the location of interest, as well as within one, three and ten miles of the location.

Verify Wind Claims to Improve Customer Satisfaction and Profitability

With CoreLogic Wind Verification Science, 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 CoreLogic Wind Verification provide precise knowledge of when severe winds likely impacted a specific property, insurance claims adjusters can:

- Objectively handle, document, and communicate wind claim decisions
- Close claims faster for improved customer satisfaction
- Correctly identify losses that were likely caused by pre-policy storms

A Powerful Combination

Wind Verification combined with Hail Verification from CoreLogic 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 while more accurately identifying suspicious claims.

Industry leaders can confidently choose the wind verification model from CoreLogic

Wind Verification Built on Proprietary Science

CoreLogic Wind Verification Reports and Impact Maps are powered by a fully-automated, severe wind verification system from CoreLogic. This system combines proprietary, three-dimensional storm models with artificial intelligence, radar data, and true quality controlled observations to analyze what actually happened. CoreLogic is the leading provider of wind-speed maps and address-level wind verification data dating back to 2009.

About CoreLogic

CoreLogic (NYSE: CLGX), the leading provider of property insights and solutions, promotes a healthy housing market and thriving communities. Through its enhanced property data solutions, services and technologies, CoreLogic enables real estate professionals, financial institutions, insurance carriers, government agencies and other housing market participants to help millions of people find, acquire and protect their homes. For more information, please visit www.corelogic.com.

For more information, please call 888-929-4245.

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