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AIR POST-DISASTER SURVEY OF THE TUSCALOOSA-BIRMINGHAM TORNADO AND REFLECTIONS ON THE SEASON SO FAR

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The spring of 2011 has been plagued by extremely large and violent tornado outbreaks. In April alone, there were 875 preliminary reports of tornadoes—many of which were both powerful and long-lived. While the final confirmed count for the month will probably be somewhat lower, it is likely that April will establish a new record for the highest number of tornadoes in the United States during any month. (The previous record, set in May 2003, was 542.)

May, meanwhile, started quietly but roared to life on the 20th. Over the next seven days, more than 150 confirmed tornadoes—one of which was the now infamous EF-5 Joplin tornado—impacted more than 20 states from central Texas to the East Coast. Just a week later, on the first of June, several tornadoes struck Massachusetts, a state in which strong and long-lived tornadoes are relatively infrequent.

But it is not only the number of tornadoes that is notable this year, it is their urban trajectory. Many of this season's storms have carved tracks through highly populated towns and cities. The result has been significant destruction in terms of commercial and residential properties and, tragically, a very high death toll: as of June 11, 536 people have been killed as of June, according to the National Weather Service (NWS), making this the deadliest tornado year since 1936.

Of these fatalities, more than half occurred during a particularly fierce outbreak across the southeastern United States from April 25th to 28th. During this event, dubbed the "Super Outbreak", 65 deaths were attributed to a single storm: the Tuscaloosa-Birmingham tornado in Alabama. AIR sent a survey team to investigate the damage path of the Tuscaloosa-Birmingham tornado. Their findings are discussed in greater detail in the following article and slideshow.

THE TUSCALOOSA-BIRMINGHAM TORNADO

Although there have been several notably damaging severe thunderstorm outbreaks in the United States this Spring, the cluster of tornadoes that struck Alabama in late April rendered the biggest hit. These twisters were part of the Super Outbreak, the death toll of which was staggering; approximately 345 people were killed—more than 200 of these in Alabama alone. It was the largest loss of life from a natural disaster since Hurricane Katrina.

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The most devastating tornado was the one that touched down on April 27th in Alabama's Greene County, proceeded to rip through the city of Tuscaloosa, and continued on to the suburbs of Birmingham, in Jefferson County. As many as 5,000 properties in Tuscaloosa were destroyed, according to data compiled by the American Red Cross.

At its most intense, the Tuscaloosa-Birmingham tornado is estimated to have had wind speeds of 190 miles per hour, making it a strong EF-4 on the Enhanced Fujita Scale. (EF-5 is the highest possible rating on this scale, with estimated wind speeds of at least 200 miles per hour.) The monstrous tornado carved a damage path 80.3 miles long, according to the NWS. At its widest, it stretched 1.5 miles across and, overall, it stayed on the ground for about 90 minutes. AIR sent a survey team to investigate.

ESTIMATING INSURED LOSSES FOR THE SUPER OUTBREAK IN NEAR REAL TIME

On May 9th, AIR estimated that the severe thunderstorm outbreak that spanned April 22-28 would cost the insurance industry between USD 3.7 billion and USD 5.5 billion.

Estimating losses from severe thunderstorm events in real time is an extremely challenging task, requiring a substantial amount of data cleaning and validation before an event set can be created and run through the AIR U.S. Severe Thunderstorm Model. AIR's research team processed data from the Storm Prediction Center on literally hundreds of "microevents" (individual tornadoes, hailstorms, and straight-line winds) that comprised the outbreak, or "macroevent", and removing, where appropriate, duplicates.

Further complicating matters, most such microevents occur out of the range of weather stations or anemometers. Therefore, in general, exact intensities associated with these localized events—such as wind speeds and hailstone size—are not known. For tornadoes, storm parameters like damaging wind speeds and tornado path length and width, are often estimated only based on damage observed during post-event NWS surveys, which can take weeks to complete.

To produce the AIR ALERT™ estimate, detailed information from the NWS and the AIR damage survey was assigned to the raw data where available. For the many storm parameters that remained missing, AIR simulated the missing parameters using the distributions of event characteristics that are built into the AIR Severe Thunderstorm Model for the U.S., guided by the available meteorological information about the event.

On May 15th, ISO's Property Claims Services preliminarily estimated that this outbreak would cost insurers USD 5.05 billion.

THE AIR POST-DISASTER SURVEY

AIR atmospheric scientist Dr. Brian Zachry and structural engineer Matthew Maddalo—began their survey on May 4, about a week after the Tuscaloosa-Birmingham tornado touched down and after most of the recovery efforts by local officials had been completed. They logged their initial observations southwest of Tuscaloosa, where the EF-4 tornado began to produce damage to major structures. The attached slideshow highlights specific instances of damage along the tornado's lengthy path.

Before departing for Alabama, aerial images of the affected areas (available from the National Oceanic and Atmospheric Administration) coupled with Google Earth photos at the "street view" level were used to plan the survey route. These provided guidance as to the locations they should visit, as well as a good indication of the types of structures affected. Because the NWS had pegged the overall category for the Tuscaloosa-Birmingham storm at EF-4, the survey team knew to expect significant damage, both to residential and commercial properties.

SURVEY GOALS

The team had several goals, the first of which was to inspect commercial structures, the main occupancy type along the damage path. These included a wide variety of occupancies, including small retail buildings (e.g., fast food restaurants), small professional buildings (e.g., doctors' offices), and large isolated retail facilities (e.g., Wal-Mart).

AIR was interested in the relative performance of these structures in the direct path of the tornado and along its periphery. While not exposed to extreme tornadic winds, structures along a tornado's periphery can experience weaker vortices spun off the main tornado, missile impacts from airborne debris, and strong inflow winds. (Inflow winds are usually 30-50 mph and flow into the main updraft of the storm. These winds can cause minor damage, such as downed trees and roof damage, but not the significant damage you see associated with the tornadic winds.)

All of the commercial structures described above should experience significant damage in the direct path of EF-4 winds (166-200 miles per hour), although exterior walls could remain standing in some instances. It should be noted that the tornado did not deliver EF-4 level winds throughout its entire lifetime; wind speeds varied between EF-0 and EF-4. On the periphery of the path, where EF ratings below 4 were common, the survey team expected to see structures mostly intact, with damage to windows, openings and nonstructural elements.

The team also wanted to examine residential structures impacted by the tornado, particularly their performance in areas that featured large numbers of trees. Trees can significantly widen the damage footprint of a tornado by providing the materials that become airborne missiles. When these materials breach a home's roofs and windows, they leave the structure more susceptible even to weaker tornadic winds, thereby playing a major role in exacerbating the damage.

Another goal of the team was to examine the width of the damage path and the variability in wind speeds along and across the path. While the NWS had already provided EF rankings for some buildings, others, including many of those on the periphery of the storm, had not been assessed.

An overview of the team's findings can be found in the slideshow available from this page. Ultimately, the survey largely confirmed expectations, both from the meteorological and engineering perspectives.

PEOPLE AND CITIES WHERE THERE ONCE WAS OPEN SPACE

The Tuscaloosa-Birmingham tornado would have been far less destructive in terms of lives and property had it traveled outside the city limits of Tuscaloosa and Birmingham, instead of going directly through these highly populated areas. The same is true for the devastating May 22 Joplin EF-5 tornado, the deadliest since modern recordkeeping began in 1950.

Indeed, fatalities this spring were as high as they were in part because storms in 2011 impacted an unusually high number of cities and towns; this activity serves to dispel the myth that tornadoes do not impact urban locations. If previously this seemed to be the general rule, it was because open land was vast compared to urbanized centers. But today, cities and suburbs in the Midwest, South and Southeast are growing—expanding into areas previously unpopulated, providing ever bigger targets for tornadoes.

Contributing to the rate at which tornadoes impacted cities this year was the movement of the jet stream farther east, which positioned the core of storms closer than normal to the Eastern Seaboard. With a substantially higher number of people per square mile in the eastern part of the country than in the heart of Tornado Alley and the High Plains, tornadoes were bound to hit population centers.

BUILDING SAFER BUILDINGS

Tornadoes are and will continue to be a part of the risk landscape in the United States. As cities and suburbs continue their expansion into tornado-prone areas, new rebuilding and fortification methods are being investigated. Currently, one of the best methods for tornado resistance is insulated concrete forms, or ICF. Here, walls are built of Styrofoam blocks with 6 inches of concrete poured inside. While ICF makes the frame of the house less likely to sustain damage, roofs and windows will still be vulnerable (roofs remain the weakest link in any home in the face of a tornado). Furthermore, for many homeowners the cost of ICF—which adds about 3% to 6% to the construction cost of a house—is too much, particularly when they know their home may never be in the path of a tornado.

Another less costly option for home and business owners is to build a safe room in their building. A safe room is a location either in the interior or basement, fortified with concrete and steel. According to the Institute for Business and Home Safety, "a safe room should be able to withstand the impact of a two-by-four piece of wood flying through the air at 100 mph."

MODELING IS CRITICAL TO OBTAINING A COMPLETE VIEW OF RISK FROM SEVERE THUNDERSTORMS

While there is nothing to suggest that the higher-than-normal activity seen in April and May 2011 will continue for the remainder of the season, it behooves insurers to take this opportunity to consider how they are managing their severe thunderstorm risk, which—as this season has proved—can be truly catastrophic; AIR's real-time estimates of insured losses ranged from USD 3.7 billion and USD 5.5 billion for April's Super Outbreak, and from USD 4 billion and USD 7 billion for the severe thunderstorms that struck between May 20th and 27th, making these the largest insured occurrence losses in U.S. history.

With losses this large, leading insurers are transitioning from treating severe thunderstorm losses as a cost of doing business to integrating state-of-the-art modeling techniques in order to obtain a complete view of their risk from this important peril.

The AIR Severe Thunderstorm Model for the United States, which overcomes inaccuracies that would result from using historical data to predict future severe thunderstorm activity, stands ready to assist today's insurers in thoroughly preparing for losses from damaging outbreaks to come.

A slideshow of AIR's damage survey are available at this link: http://www.air-worldwide.com/presentations/public/20776/post-disaster%20survey%20of%20the%20tuscaloosa-birmingham%20tornado.player

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