

Online/Internet Damage Summary
of the 15th May, 2013 North Texas Tornado Outbreak



(Image Courtesy of <http://www.vancouver.sun.com/news/world/cms/binary/8398822.jpg>)

University of Florida Wind Hazard Damage Assessment Team

PI: David O. Prevatt, Ph.D,
dprev@ce.ufl.edu

Contributing Authors:

David Roueche
Tuan Vo
Ashlie Kerr
Austin Thompson
Xinlai Peng
Alyssa Egnew



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Summary of North Texas Tornado Outbreak on May 15th, 2013

This summary report was prepared from online sources by University of Florida civil engineering students in Prof. David O. Prevatt's Research Group. Students gathered information from online sources including the National Weather Service, twitter profiles of storm chasers, the US Census Bureau and local media reports.

Within 8 hours 16 tornadoes were spotted within an area located two hours west of Dallas, TX. Within that time there were at least 6 fatalities, over a hundred injuries and dozens of single-family homes damaged or destroyed. Mobile homes were blown off their foundations, and the slab of site-built homes were swept clean. The National Weather Service assigned an EF-4 rating to the most powerful tornado in Granbury, TX, and lower ratings to others. At this time, there's limited photographic evidence available online for most of the damage but from the available information, similar failure patterns as were observed in the 2011 tornado outbreaks in Tuscaloosa, AL and Joplin, MO are apparent. The damaged homes, constructed as light-framed wood structural systems, lack component of a vertical load path (i.e. metal hurricane ties, large steel washers on wall plate anchor bolts) that could have given some homes a "fighting chance" to survive a tornado.

Researchers at the University of Florida and elsewhere will continue to document tornado outbreaks as they occur, and in parallel our research to understand and quantify the strength of tornado loads and their interaction with vulnerable wood-framed structures is continuing. It is our thesis, that engineering solutions can be found to improve the tornado-resistance of houses. These solutions come at a price, yet to be determined, once scientists have a better idea of the loads, and society determines what risks are acceptable. Stronger buildings can be built quite economically today that would mitigate structural damage and provide better life safety protection – it is up to communities and their leaders to decide whether they wish to pursue such resilient and sustainable approaches or whether to continue with the status quo.

Please visit our website, for further information <http://windhazard.davidoprevatt.com>. Background information and our previous damage survey blogs can be found on Dr. Prevatt's webpage, www.davidoprevatt.com, including the Tuscaloosa Tornado Damage Survey Report. A list of helpful references are included at the end of this report.

Your questions and comments on any aspects of our work are most welcome. Please direct your enquiries to NSF Graduate Research Fellow, and PhD Graduate Student, Mr. David B. Roueche, who can be reached at david.roueche@ufl.edu.

About the Wind Hazard Damage Assessment Team

The Wind Hazard Damage Assessment Team was created through support from the NSF Award #. Its mission is to train university students interested in building construction, engineering and architecture in the forensic engineering and techniques for post-hazard damage surveys and data collection. The team has surveyed damage after several Florida tornadoes and it continuously monitors the prevalence of tornadoes worldwide. Ultimately the Team hopes to inspire upcoming engineers and building professional and change the paradigm of widespread catastrophic damage to houses in tornadoes. Mr. Jeandona (JD) Doreste, is a civil engineering undergraduate student at UF and Webmaster of the site. JD is actively recruiting other UF students to join the team, and he can be reached at jdoreste1@ufl.edu.

Predictions

Initial expectations for tornado risk on May 15th were very small (Figure 1), with the SPC tornado outlook for this day only showing a 5% probability of tornado genesis in North/Central Texas.

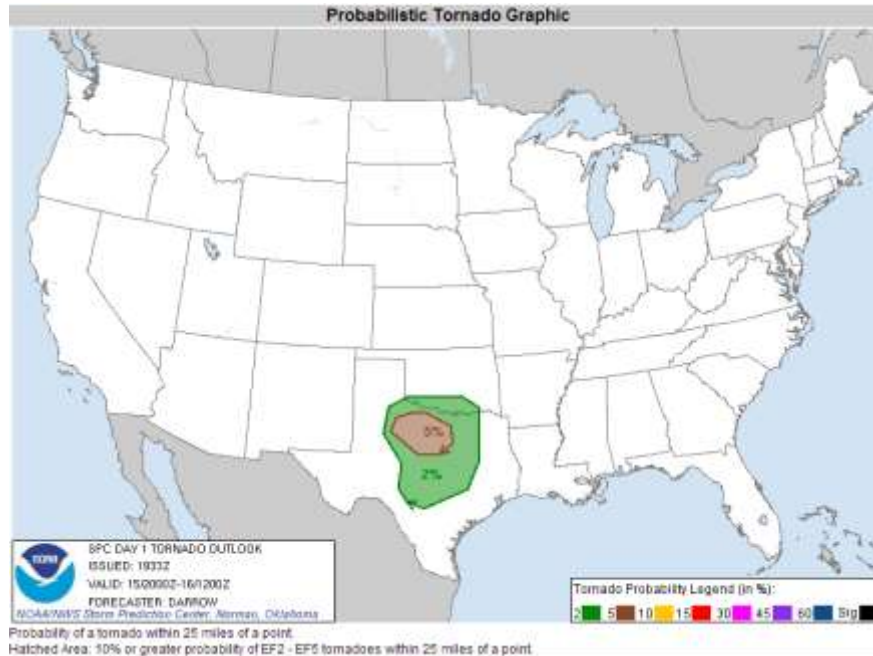
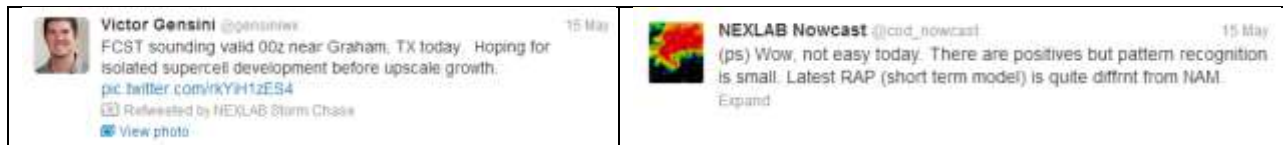


Figure 1: Tornado Probability for May 15, 2012 as Issued by the NWS SPC at 3:33 PM EDT on Same Day (Source: http://www.spc.noaa.gov/products/outlook/archive/2013/day1otlk_20130515_2000.html)

TWEETS

Stormchaser tweets suggested low expectations for tornado formation – with potential for one or two tornadoes from isolated supercell east of the Dallas/Forth Worth metro area.



Timing of Outbreak

3:27 PM - Severe Thunderstorm Watch issued for the Dallas/Fort Worth metroplex (DFW) and surrounding areas

5:07 PM - Golf ball size hail was reported in Montague County, and soon after first tornado warning was issued.

5:40 PM - First tornado confirmed, 1 mile west of Belcherville, TX (2 hours north of DFW), easterly heading. Soon after, two more tornadoes spotted; one a large cone tornado between Millsap and Weatherford.

8:15 PM - Tornado warning issued for NE Hood County for tornado developing on the north side of Granbury, TX, moving East. Grapefruit size hail reported in Granbury and soon after, strong circulation was noted in the rear-flank of the thunderstorm, indicative of a large tornado.

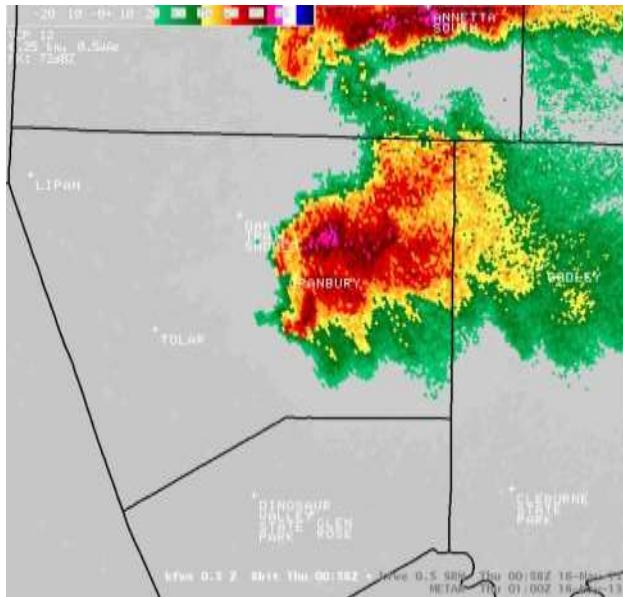


Figure 2: Base Reflectivity Data at 7:58 PM CDT

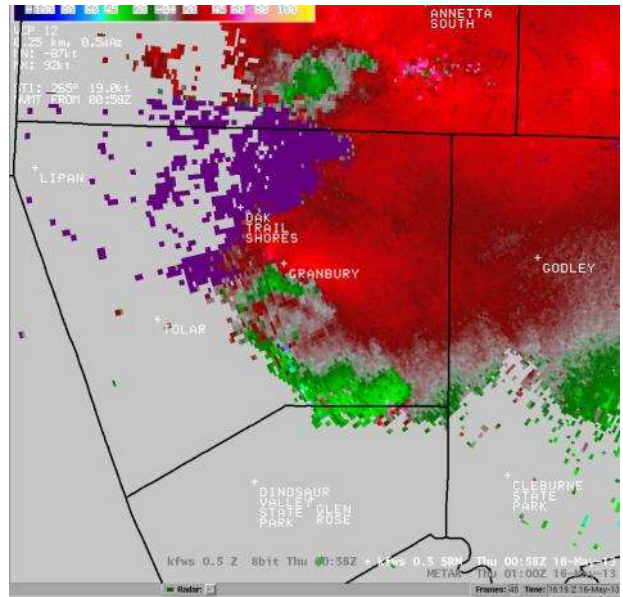


Figure 3: Storm Relative Velocity Data at 7:58 PM

Tornado warnings and confirmed sightings continued to come in throughout the night in this same region, west of DFW, until the last warning was cancelled at 1:00 AM.

Confirmed Tornado Strikes

NWS survey teams confirmed 16 tornadoes in all from the outbreak, the first occurring in Montague County at 5:38 PM CDT and the last reported at 1210 AM in Ennis, TX. The locations of the confirmed tornadoes are shown in Figure 4. A summary of the preliminary impacts of each tornado is given in Table 1. All information in this table was compiled from the preliminary NWS survey available at <http://www.srh.noaa.gov/fwd/?n=tornadoes051513> unless otherwise noted.

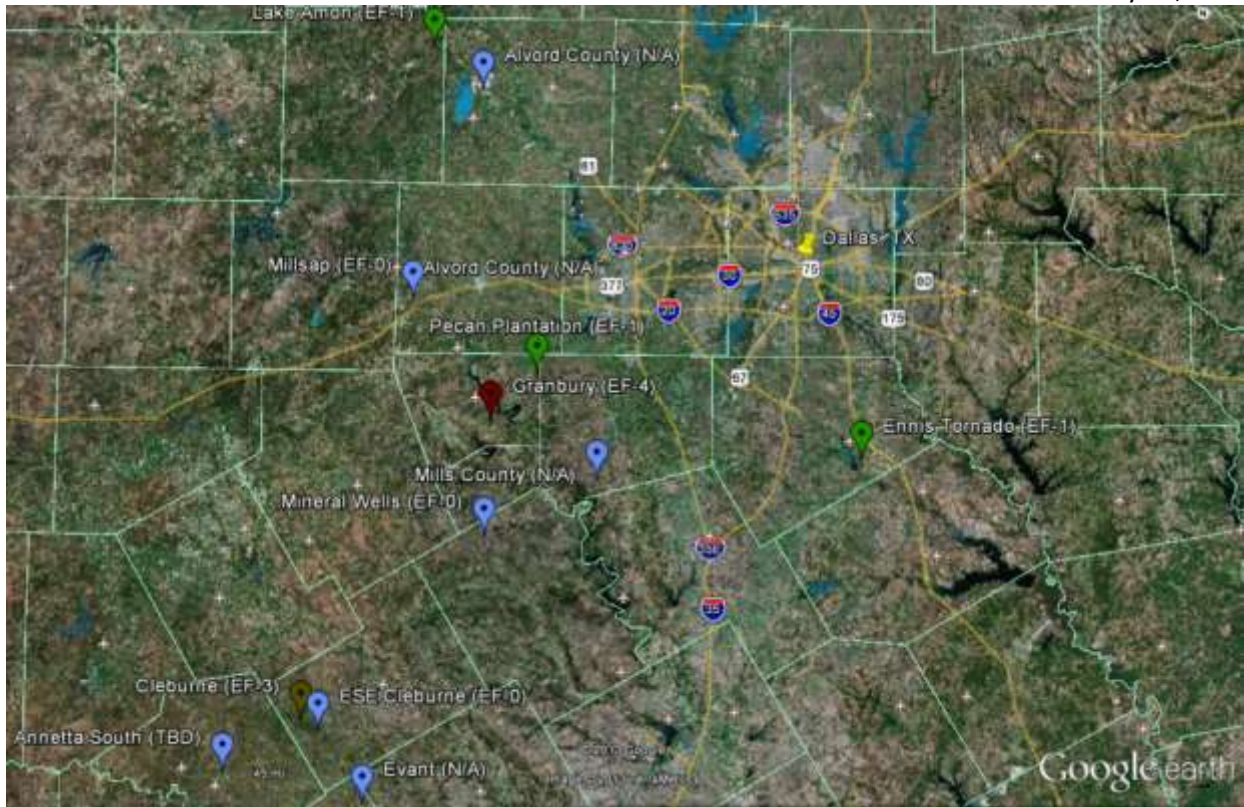


Figure 4: Locations of Confirmed Tornadoes

Table 1: Summary of Confirmed Tornadoes

Town	EF Rating	Est. Peak Wind (mph)	Path Length (miles)	Path Width (miles)	Injuries	Fatalities	# Buildings Damaged	# Buildings Destroyed
Belcherville	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Lake Amon	EF-1	100	TBD	TBD	1	0	4	1
Alford	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Millsap	EF-1	100	TBD	TBD	TBD	TBD	5	0
Granbury	EF-4	180	2.75	0.5	Dozens	6	>47 [1]	36 [1]
Pecan Plantation	EF-1	100	TBD	TBD	TBD	TBD	TBD	TBD
Annetta South	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Cleburne	EF-3	140	8.5	0.6	9	0	600 [2]	24 [2]
ESE Cleburne	EF-0	85	TBD	TBD	0	0	5	0
Mills County	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Evant	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Ennis	EF-1	90	6	TBD	N/A	0	72	4
Mineral Wells	EF-0	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Millsap	EF-0	TBD	TBD	TBD	TBD	TBD	TBD	TBD
Nocona Lake	TBD	TBD	TBD	TBD	TBD	TBD	TBD	TBD

[1] <http://www.star-telegram.com/2013/05/16/4860509/tornado-watch-issued-for-north.html>

[2] <http://www.wfaa.com/news/local/Cleburne-declares-disaster-cancels-school-after-tornado-207678601.html>

Information Related to Impacted Towns

This tornado outbreak affected a population of 87,000 persons in 12 towns within 10 counties (Table 2.) Statistically, 80% of the homes were built before 2000. The complete distribution of home ages is illustrated in Figure 5, showing the majority of the counties have similar distributions. The communities are relatively new, with over 50% of existing homes were built after 1989 (i.e. less than 25 years old) in four of the five affected counties. It should be noted that the 2000 International Residential Building Code was adopted by two of the three largest towns that were affected by the strongest tornadoes (Table 3).

Table 2: Local Census Info

Town	County	Population	# of Homes	Source
Belcherville	Montague	50	N/A	http://en.wikipedia.org/wiki/Belcherville,_Texas
Lake Amon	Montague	N/A	N/A	
Alvord	Wise	1,334	N/A	http://www.city-data.com/city/Alvord-Texas.html
Millsap	Parker	409	N/A	http://www.freebase.com
Granbury	Hood	8,049	4,419	http://quickfacts.census.gov
Pecan Plantation	Hood	5,294	2,466	http://quickfacts.census.gov
Annetta	Parker	1,305	N/A	http://www.freebase.com
Cleburne	Johnson	29,681	11,418	http://quickfacts.census.gov
N/A	Mills	4,828	2,854	http://quickfacts.census.gov
Evant	Coryell	431	N/A	http://www.freebase.com
Ennis	Ellis	18,901	6,641	http://quickfacts.census.gov
Mineral Wells	Palo Pinto	16,793	6,331	http://quickfacts.census.gov

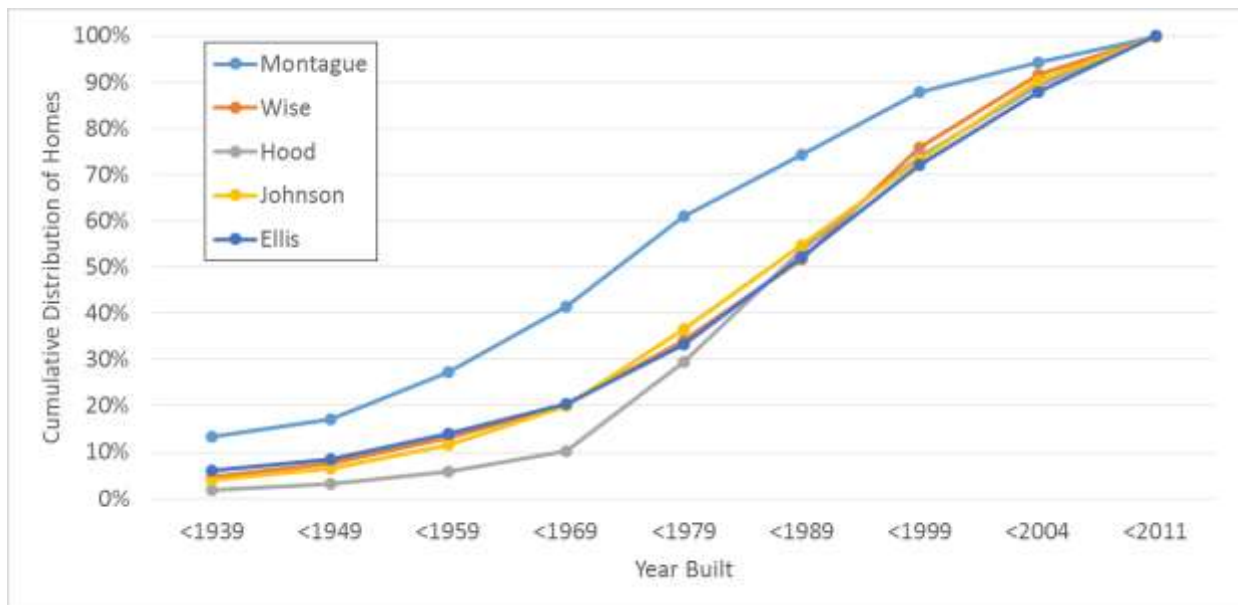


Figure 5: Distribution of Home Age in Impacted Counties

Quality of construction is somewhat reflected by adoption of building codes, which is shown in Table 3 for the three primary towns impacted by this tornado outbreak.

Table 3: Adoption of Codes in Impacted Towns

Codes Adopted	Town		
	Granbury, TX	Cleburne, TX	Ennis, TX
2006 International Building Code		x	x
2006 International Existing Building Code		x	x
2009 International Energy Conservation Code	x	x	x
2006 International Fire Code		x	x
2006 International Fuel Gas Code		x	x
2006 International Mechanical Code	x	x	x
2006 International Plumbing Code	x	x	x
2000 International Residential Code	x	x	

Source: <http://www.iccsafe.org/gr/Pages/TX.aspx>

Observed Damages

The most significant damage was observed in the towns of Granbury and Cleburne, in both of which strong tornadoes tracked significant lengths through populated areas. Six fatalities occurred in the town of Granbury, when the approximately half-mile wide tornado tracked through the Rancho Brazos Estates subdivision. The majority of the homes in this subdivision were built by Habitat for Humanity. The preliminary tornado track is shown below in Figure 6. The Cleburne, TX tornado first caused significant damage in a Mobile Home park before causing the worst damage just as it moved ashore after passing over Lake Pat Cleburne located west of the town. The preliminary tornado track is shown in Figure 7.

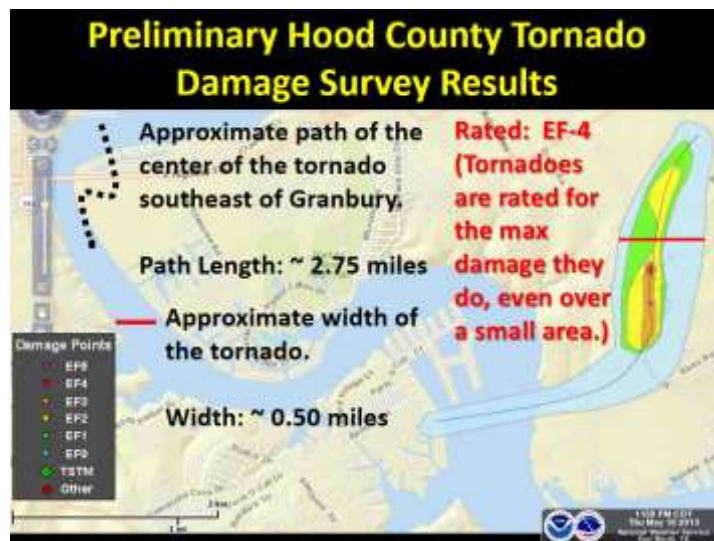


Figure 6: Preliminary Track for Granbury, TX Tornado
http://www.srh.noaa.gov/images/fxc/fwd/graphiccast/image_full2.gif



Figure 7: Preliminary Track for Cleburne, TX Tornado

(<https://www.facebook.com/photo.php?fbid=525859357450682&set=a.140805919289363.12590.138923789477576&type=1&theater>)

Lakecrest Ct

(See Figure 9a)

Overview photographs of damage are shown in Figures 8 and 9. Figure 9a shows damage to homes built in the mid-1990s, although exact ages are not known, at this time.



Figure 8: Aerial View of Granbury, TX



Figure 9: Observed Damage in Cleburne, TX (Credit: WFAA)

Additional photos of interest are shown in Figures 10-12. The damage shown in Figures 9 and 10 were the justification for the EF-4 rating in the Granbury tornado. Although anchor bolts were used, the use of small washers reduced the impact of this reinforcement. Further, the lack of metal ties connecting the studs to the sill plate resulted in a weak link in the vertical load path from the studs to the sill plate.



Figure 10: Complete destruction of home with anchor bolts just south of Hwy 377 & N. of Acton Highway in Granbury, TX (Image Courtesy of <http://www.srh.noaa.gov/fwd/?n=tornadoes051513>)



Figure 11: Complete destruction of home just south of Hwy 377 & N. of Acton Highway in Granbury, TX (Image Courtesy of <http://www.srh.noaa.gov/fwd/?n=tornadoes051513>)



Figure 12: Damage in Cleburne, TX (Credit: WFAA)

It is interesting to note in Figure 12 that a significant portion of the upper story of this home was demolished, even though the asphalt shingle roof was only partially removed and trees, bushes and even fence panels nearby are still standing.

Acknowledgements

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About the PI

David O. Prevatt is an **Assistant Professor of Civil** & Coastal Engineering, in the Engineering School of Sustainable Infrastructure & Environment, University of Florida, Gainesville, FL, and he can be contacted at dprev@ufl.edu.

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