TOWARD A BETTER UNDERSTANDING OF TORNADO FATALITIES

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Abstract

Between the years 1991 through 2010 there were over 400 tornadoes that directly caused the deaths of over 1130 people. Although the details surrounding the deaths are available, they are by no means easy to locate, and over 10% of the information was completely missing. By collecting this historical data from numerous sources, including Storm Data, the Storm Prediction Center (SPC) web page, the National Climatic Data Center (NCDC) database, and various newspaper articles, a single, searchable database was created. With this information all in one place, the circumstances concerning United States tornado fatalities were able to be analyzed with a more accurate data set for the years involved. In this study the United States was divided into three predetermined regions. Region one, the southeast, contains the states: Alabama, Florida, Georgia, Mississippi, North Carolina, South Carolina and Tennessee. Region two, the south plains consists of: Arkansas, Louisiana, Oklahoma and Texas. The remaining states make up the third region. The tornado fatality demographics from these regions were compared to each other as well as information from the United States 2010 Census data. It can be concluded from the data that in all regions men were preferentially killed over women, elderly people died at a greater rate than those who were younger, people in were in mobile homes died more than any other circumstance and on average just as many fatalities occurred between 8am-8pm as 8pm to 8am. The purpose of this paper is to raise awareness amongst both the public and the meteorological community, by exploiting the differences and similarities of age, gender, circumstance and time of day of those fatalities across the different regions.

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1. INTRODUCTION

The historical record surrounding killer tornadoes and the fatalities they caused are kept in *Storm Data,* a publication from the National Climatic Data Center (NCDC). The local National Weather Service Forecast Offices (NWSFO) is responsible for filing the reports with the NWS Office of Climate, Weather and Water Services (OCWWS). Then the end result is kept by the Storm prediction Center (SPC) and the NCDC (McCarthy). *Storm Data* contains a narrative description of the demographics and a circumstance surrounding the fatalities individually by each tornado.The problem with the narrative is the amount of information that is missing in some cases. Over 10% of the information between the years 1991–2010 concerning gender, age, and circumstance was not included or unknown. This makes it difficult to get accurate results with research and analysis of aspects surrounding killer tornadoes. Changes made to tornado fatality records have been examined before (e.g., Brooks and Doswell 2001). The purpose of the paper is to raise awareness to the vulnerability to tornadoes with a more complete data set. It has been stated that "without enhanced knowledge of

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severe weather occurrences it impossible to evaluate or improve both warnings and techniques for severe-weather forecasting" (Lemon 1979). The remaining sections of this paper will include the data retrieval process, along with locating missing data and the results of analyzing that data.

2. DATA and METHODS

Every tornado from the SPC database combined with those from *Storm Data* that had a fatality associated with it from 1991–2010 was recorded into a separate database. The killer tornadoes were then cross checked with the NCDC database. We only concentrated on the 412 tornadoes that were directly responsible for each one of the 1131 fatalities over the 20 year period. The narratives for each event were thoroughly examined for three major criteria, gender, age, and circumstance, which will be shown in the next section. As much of the missing data as possible was then located by searching Google and archived newspapers and added to the data set. For example see (figure 1a, 1b), this is the actual circumstance information from the May 27th 1997, Jarrell Texas event and what it should look like. The data was then given to the SPC, so a searchable online data base for killer tornadoes can be developed.

??PH, ??PH, ??PH, ??PH, ??PH, ??PH, ??PH, ??PH, ??PH, ??PH, ??PH, ??PH, ??MH, ??MH, ??MH, ??MH, ??MH, ??MH,??MH, ??MH, ??MH, ??MH, ??MH, ??MH, ??MH, ??MH, ??MH

Figure 1a: Actual missing information from Jarrell Texas May 27 1997 in *Storm Data.*

F34PH, M15PH, F13PH, F37PH, M11PH, M46PH, F45PH, F17PH, M15PH, M15PH, M41PH, F40PH, M40MH, F40MH, M16MH, F15MH, F44MH, M5MH, M22MH, F50MH, M15MH, M14MH, F36MH, F13MH, F10MH, F36MH, M16MH

Figure 1b: Actual Information filled in on missing gender and age. First on top left stands for Female, 34 years of age, died in a permanent home.

3. RESULTS

Once the data set was as complete as possible, the 3 parameters were then divided over one of three predetermined regions The regions were as follows; Region 1: the southeast from Mississippi and Tennessee to the East, region 2: the south plains from Arkansas and Louisiana to New Mexico and all the other states as the 3rd region (figure 2).
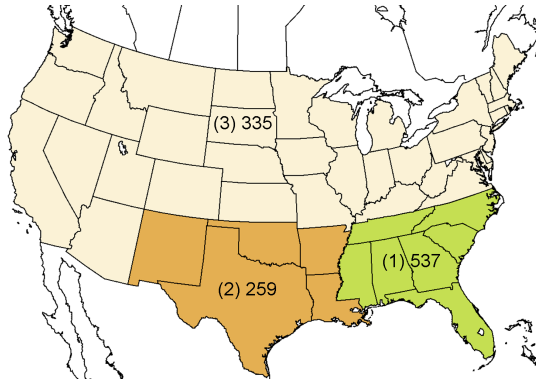

Figure 2: U.S. map divided into regions and the number of fatalities in each region.

The number of fatalities in each region was first analyzed. With 537, region one had the 47% of the deaths, region 2 came in third with 259, 23% and finally region 3 had 335, 30%.

Next, gender was analyzed. Males died more often than females in all three regions. The break down of male/female fatalities in all three regions is 51%–49%, 51%–49%, 52–48%, respectively (figure 3a, 3b, 3c).
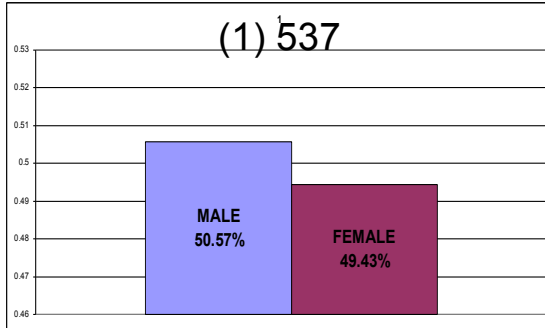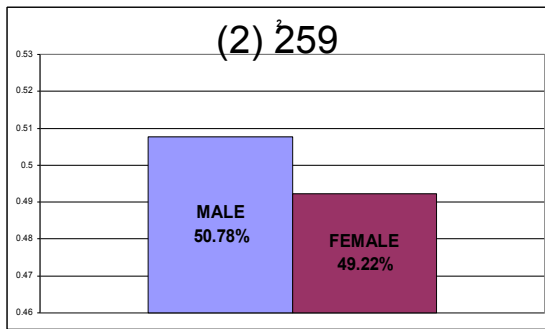

Figure 3a: males–female death ratio for region 1

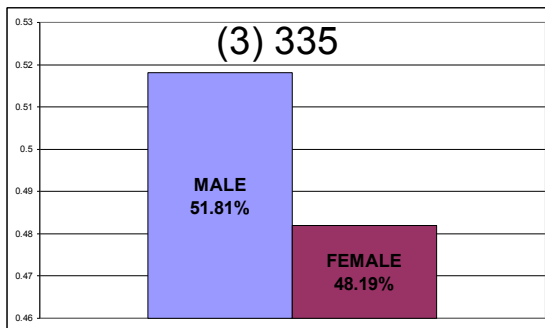
Figure 3b: males–female death ratio for region 3

Figure 3c: males–female death ratio for region 3

When the regions are compared to the 2010 U.S. Census Data we see that there are more females than males, with a ratio of 51% to 49%. So from this we can conclude that males die preferentially to females (figure 4).
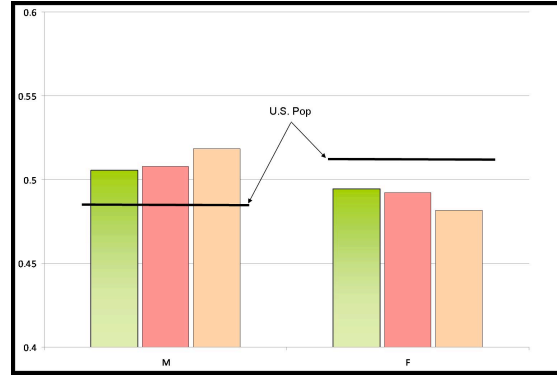
Figure 4: Males–female compared to U.S. population

We now come to the ages that the people were at time of death. Looking at the graphs, we see that the most common age to die in region 1 from a killer tornado is between 40–50 years of age. Region 2 would be 30–40 years and finally region 3 is back up between 40–50 years (figure 5a, 5b, 5c). However by taking the base age population by single year from the 2010 U.S. Census and dividing the number of deaths by the number of people in that age cohort, we can normalize by setting the average death rate from 0–40 to be 1and then we see that older people die more often than younger people (figure 6). If an accurate evaluation is going to be done, one really needs to consider getting the actual population of the area surrounding the path of each of these tornadoes.
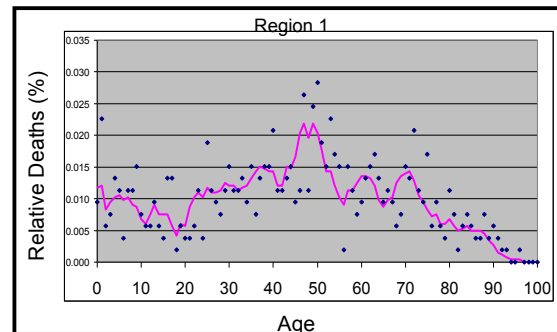

Figure 5a: Region 1 each dot represents how often that age of death occurred. All dots add up to equal 1. The solid line is a running mean.
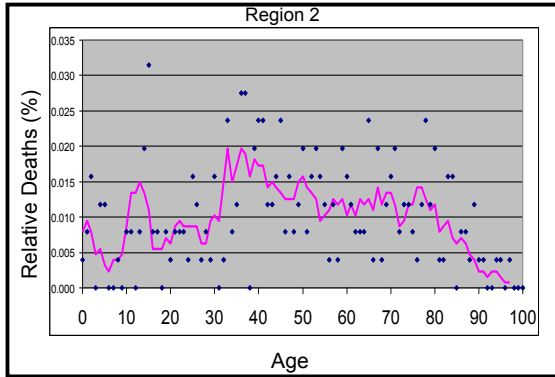
Figure 5b: Region 2 each dot represents how often that age of death occurred. All dots add up to equal 1. The solid line is a running mean.
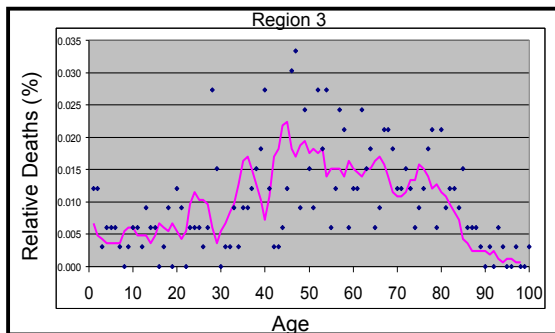

Figure 5c: Region 3 each dot represents how often that age of death occurred. All dots add up to equal 1. The solid line is a running mean.
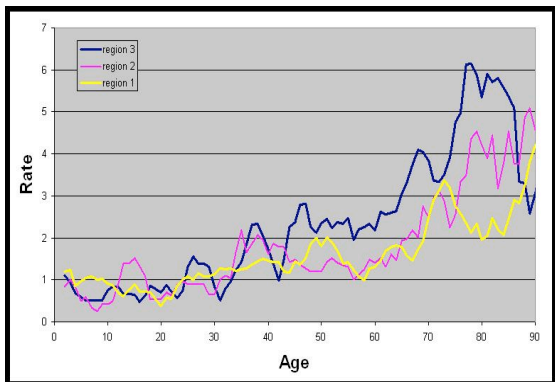

Figure 6: Normalized rate of death by age with 1-40 equaling 1

We also looked at the circumstances of the 1131 deaths. As expected more people died in mobile homes than in any other building or structure. The amount of mobile home deaths at almost 57% was more than double of those in permanent homes at almost

27% in region 1. This could be expected as it has been said before that mobile homes are greatly increasing in the southeast (Brooks and Doswell 2001). Region 2 had the highest amount in mobile homes and permanent homes also with 45% and 34%. The same went for region 3, although it was closer with 35% and 34% (figure 6).
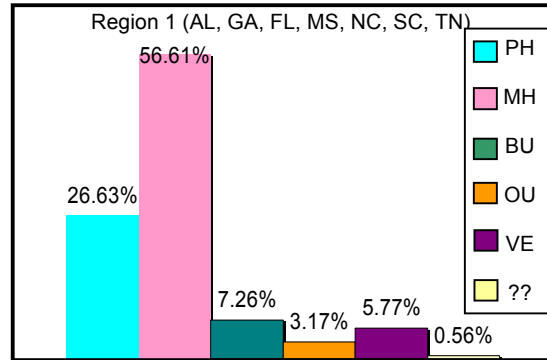

Figure 7a: Region 1 comparison of circumstances by region: permanent home, mobile home, building, out side, vehicle, unknown, respectively.
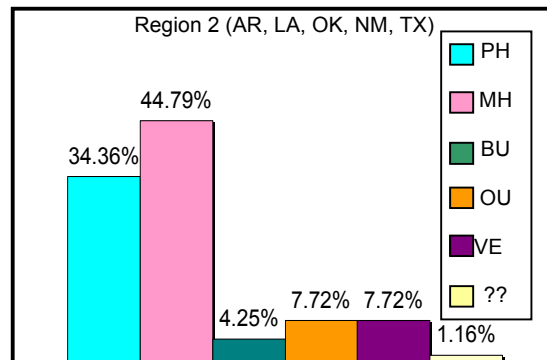

Figure 7b: Region 2 comparison of circumstances by region: permanent home, mobile home, building, out side, vehicle, unknown, respectively.
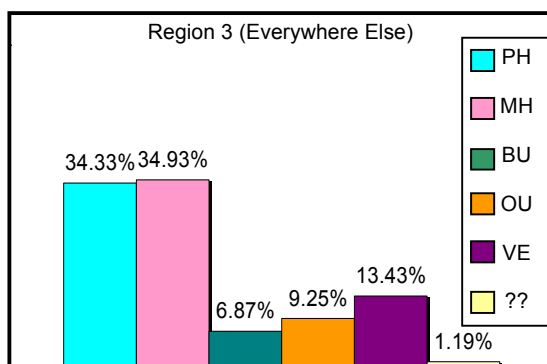
Figure 7c: Region 3 comparison of circumstances by region: permanent home, mobile home, building, out side, vehicle, unknown, respectively.

As a nation more fatalities occurred in mobile homes staying true to the previous results with 47% (figure 8).
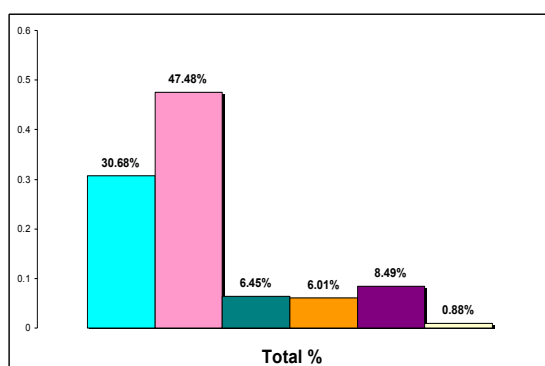

Figure 8: Comparison of circumstance as a whole nation.

The time of day was split into two periods, 8am-8pm and 8pm-8am. We discovered that more fatalities occurred during the nighttime within all three regions. Region 1 night time fatalities came in at 53%, region 2, 80%, and region 3 at 68%.

4. DISCUSSION

This project was only done over a 20 year period. The *Storm Data* Publication goes back online to the 1950's. If an accurate account concerning killer tornadoes and their fatalities is to be made, then all the missing information needs to be filled in. Still here in more recent events like the outbreak of April 2011 there is vital information on circumstance that has not yet been included.

5. SUMMARY

There were 412 killer tornadoes between the years 1991–2010. The information from *Storm Data* concerning those tornados and their fatalities was collected along with missing information from numerous other sources including the SPC database and the NCDC database, Google and various archived newspapers. After having as much accurate information as possible the demographics and circumstances were analyzed to see if any trends lied within the data. In general most of the fatalities occurred in the Southeast, males died preferentially over females, elderly people die more than younger people, more deaths occur in mobile homes than in any other circumstance and most fatalities occurred during the night.

6. AKNOWLEDGMENTS

7. REFERENCES

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