Distribution of Winter Weather Losses in the United States

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1. INTRODUCTION

Winter weather is a hazard that has a large economic and social impact across the United States. Economic losses from winter storms have been increasing despite a drop in the number of storm events (Changnon 2007). Between 1949-2003, there were more than 200 storms that caused at least $1 million in damage, with a combined loss of $35.2 billion (Changnon 2007).

Winter weather is also responsible for many fatalities due to vehicle accidents, avalanches, carbon monoxide poisoning, and individuals slipping and falling on the snow or ice (Eisenberg and Warner 2005, Spencer and Ashley 2011, Spencer 2009). Snowfall across the United States leads to an additional 45,000 vehicle collision injuries and 150,000 property damage vehicle collisions, compared to dry days (Eisenberg and Warner 2005). Spencer (2009) estimates that carbon monoxide poisoning and slip and falls on snowy or icy surfaces lead to 30-40 fatalities a year, while another 30 perish in avalanches.

Vulnerability to these events is the product of exposure to winter weather and social vulnerability to these hazards. Given the large economic and human impact due to winter precipitation, it is critical to determine the characteristics of these losses to reduce vulnerability.

Figure 1. *Vehicles stranded along Lake Shore Drive in Chicago, IL during the 1-2 February 2011 event called "Snowpocalypse." Chicago O'Hare International Airport received over 20 inches of snow during the event.*

Figure 2. *Traffic crawls through Atlanta, GA after a 4.4 inch snowfall on 10 January 2011.*

2. BACKGROUND AND METHODOLOGY

Previous research has explored the characteristics of winter weather losses on different spatial scales. Changnon and Changnon (2006) addressed economic losses across broad regions for snowfall (Figure 3), while Changnon (2003) looked at regional ice storms losses (Figure 4). Broadly speaking, losses were greatest east of the Mississippi River where winter storms are frequent and greater amounts of property are at risk.

Figure 3. The loss (millions of dollars expressed in 2000 values) from snowstorms in each climate region during 1949-2000. Values in parenthesis are the average dollar losses per storm for each storm that produced at least $1 million in damage (Changnon and Changnon 2006).

Figure 4. The amount of loss (millions of dollars expressed in 2000 values) from ice-storm catastrophes in each climate region during 1949-2000. Values in parenthesis are the average dollar losses per storm for each storm that produced at least $1 million in damage (Changnon 2003).

Most of the studies that address fatalities from winter weather have focused on **direct** fatalities, where the winter weather is a direct agent in the death. An example of a direct fatality would be someone slipping and falling on a snowy sidewalk and sustaining a fatal head injury. Winter precipitation can also lead to **indirect** fatalities, where the storm creates circumstances which lead to the death. An example would be a fatal vehicle accident in the snow or carbon monoxide poisoning as a result of unsafe home heating after a power loss due to an ice storm.

The distinction between direct and indirect fatalities is important as *Storm Data*, the publication of the National Weather Service (NWS) that records weather injuries and fatalities, only includes direct fatalities. As a result, many previous studies of winter precipitation mortality do not address the indirect fatalities and therefore exclude a significant number of fatalities.

Information on losses due to winter precipitation were collected from several sources. Information on direct fatalities and economic losses was collected from the University of South Carolina's Spatial Hazard Events and Losses Database (SHELDUS) (Hazards & Vulnerability Research Institute 2011). Information on indirect fatalities due to traffic accidents was obtained using the National Highway Traffic Safety Administration's Fatality Analysis Reporting System (FARS) database. These data were then mapped using GIS and analyzed to determine temporal trends.

3. RESULTS: DIRECT vs. INDIRECT FATALITIES

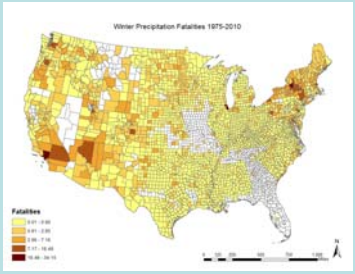

Figure 5. *Direct winter fatalities by county derived from the SHELDUS dataset, 1975-2010.*

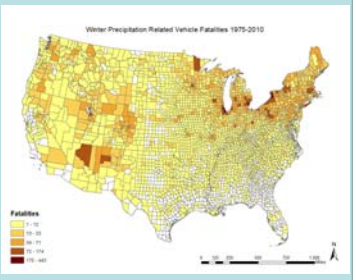

Figure 6. *Indirect Fatalities by county due to automobile accidents from the FARS dataset, 1975-2010.*

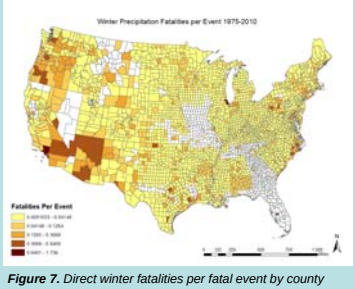

Figure 7. *Direct winter fatalities per fatal event by county derived from the SHELDUS dataset, 1975-2010.*

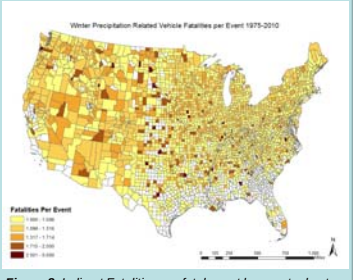

Figure 8. *Indirect Fatalities per fatal event by county due to automobile accidents from the FARS dataset, 1975-2010.*

4. RESULTS: EVENTS AND LOSSES BY MONTH AND YEAR

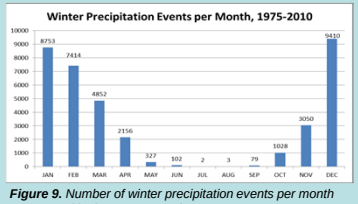

Figure 9. *Number of winter precipitation events per month as reported in the SHELDUS dataset, 1975-2010.*

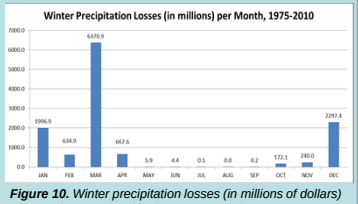

Figure 10. *Winter precipitation losses (in millions of dollars) per month as reported in the SHELDUS dataset, 1975-2010.*

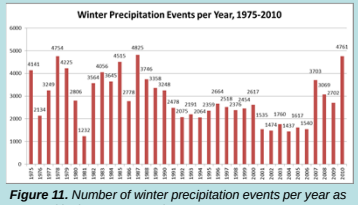

Figure 11. *Number of winter precipitation events per year as reported in the SHELDUS dataset, 1975-2010.*

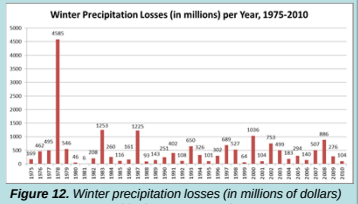

Figure 12. *Winter precipitation losses (in millions of dollars) per year as reported in the SHELDUS dataset, 1975-2010.*

5. RESULTS: SPATIAL CHARACTERISTICS OF LOSSES

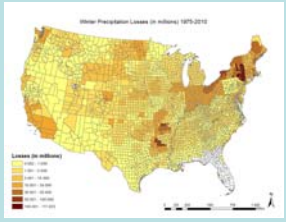

Figure 13. *Losses by county, in millions of 2011 dollars, for the period 1975-2010.*

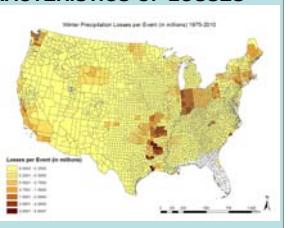

Figure 14. *Losses by county per event, in millions of 2011 dollars, for the period 1975-2010.*

6. CONCLUSIONS

- Even when only considering one category of indirect winter fatalities (automobile accidents), indirect fatalities were more numerous than direct fatalities.
- When normalized by number of events, areas such as the Southeast and Great Plains see more fatalities per event. **This may indicate increased vulnerability to winter precipitation in these regions.**
- Following the climatology of winter weather, the greatest number of events are found in October-March, with March having the greatest amount of losses during the 1975-2010 period.
- There does not appear to be a clear trend in the number of winter events per year; 1978 saw the greatest amount of losses during the study period.
- Generally, losses were greatest in the Northeast, where winter precipitation is common and large amounts of property are at risk.
- When examined on a per event basis, the greatest losses were found in the mid-South. **This coincides with an area that had many vehicle fatalities per event, giving further indication that population may be more vulnerable to winter precipitation in this region.**
  - **Possible explanations are socio-economic factors or a lack of experience with winter weather due to relatively infrequent winter precipitation.**

7. FUTURE WORK

- Examination of additional causes of indirect winter precipitation fatalities to construct a more comprehensive dataset of these deaths.
- Assessment of indirect fatalities per event to highlight vulnerable areas and assessment of the factors that contribute to their vulnerability.
- Collection of economic loss data from additional sources.

8. REFERENCES

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