Overview

☑ Quantify the frequency of tornadoes crossing Interstates in “Tornado Alley”

☑ Occurrences of vehicles/people impacted by interstate-crossing tornadoes

☑ Investigate any additional factors that increased probability for impact

☑ Examine the recommended protective actions for motorists (e.g. car or ditch)

☑ What can be done to improve message/services to travelers
Why Interstate Tornadoes?
Why Interstate Tornadoes?

“We’re from Missouri and we get tornadoes. We have a basement but not on the highway.”

Cassie Barker, Lebanon, MO (KMB-9 Kansas City)
Why Interstate Tornadoes?

59.3% growth rate interstate travel since 1990 (3.3% annual increase)
Why Interstate Tornadoes?

Motorists on Interstates have increased vulnerability to weather hazards!

- Motorists lack immediate access to a suitable shelter.
- Few opportunities to change direction of travel or exit off the Interstate.
- Limited ability to obtain convective “warnings” or unaware/unable to access existing mobile services that provide warning information.
- Travelers likely unfamiliar with local towns and counties referenced in warnings, even if they have access to warning information.
- Interstates hold a relatively constant stream of vehicles (*e.g.* potential for many eyewitnesses). May offset some traditional undercounting of rural tornado events.
Methodology

1 Jan 1990 to 31 Dec 2008

Total number of Interstate Routes: 115
Total number of Interstate miles: 24,009
Interstate Tornadoes (1990-2008)

Total Tornadoes: 19,069 (1,004/year)
Interstate Tornadoes: 678 (36/year) (~4% all tornadoes)

1 Jan 1990 to 31 Dec 2008
Total number of Interstate Routes: 115
Total number of Interstate miles: 24,009
Normalized Distribution by State per 100 Miles of Road
Motor Vehicle Impacts

**Defined as any motor vehicle “impacted” on an Interstate by a tornado.**

(Broken windows, body damage, vehicles shifted or blown off the road, vehicle rolled, overturned, tossed, or destroyed.)

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**113 Vehicle Impact Tornadoes**

Accounts for **17%** of Interstate tornadoes

(~ 1 in 5 tornadoes struck vehicles based on the “existing” record)

*Impacted Vehicles:*

- **311 Total Vehicles**
- **181 Semi-trailer Trucks**
EF-Scale Distribution

52.2% 43.7% 11.1%
Hourly Tornado Distribution

- Interstate Tornadoes
- Vehicle Impact Tornadoes

Graph showing the distribution of hourly tornadoes with peaks during certain hours.
8 tornadoes resulted in 9 direct fatalities on the interstate.

Arkansas 3/1/97 F4 day
Arkansas 11/27/05 F3 night
Georgia 12/15/07 EF1 night
Illinois 4/19/96 F3 night
Illinois 6/1/99 F3 day
Oklahoma 5/3/99 F5 day
Oklahoma 5/3/99 F4 night
Wisconsin 8/27/94 F3 night

~ 7% killer tornadoes per vehicle impact tornadoes
~ 1% killer tornadoes per all interstate tornadoes

(88% killer tornadoes EF3 or greater intensity)
## Interstate Killer Tornadoes

Were there specific circumstances that enhanced threat?

<table>
<thead>
<tr>
<th>Fatality Location</th>
<th>Mitigated?</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 deaths under overpass</td>
<td>Outside of vehicles</td>
</tr>
<tr>
<td>2 deaths from debris inside vehicle</td>
<td>Body below windows?</td>
</tr>
<tr>
<td>1 death in semi at a rest area on Interstate</td>
<td>Was driver asleep?</td>
</tr>
<tr>
<td>1 death in the sleeper portion of a semi</td>
<td>No seat belt, asleep?</td>
</tr>
<tr>
<td>1 death in van with person ejected</td>
<td>No seat belt?</td>
</tr>
<tr>
<td>1 death from vehicle thrown upside down</td>
<td>---</td>
</tr>
<tr>
<td>1 death semi rolled down 15m embankment</td>
<td>---</td>
</tr>
</tbody>
</table>
Recommended Protective Actions
Recommended Protective Actions

What would I do if this storm produces a tornado?

Urban or Rural Area?
Recommended Protective Actions

First Steps

- Attempt to identify nearby suitable shelter
- Make every effort to drive away from a tornado

LAST RESORT Situation

If no shelter available and tornado nearing

- Traffic Issues
  (rush hour, accidents, overpass congestion)
  - No Turning Around
    (turnpikes, center medians)

Your Action = Your Specific Circumstances
Recommended Protective Actions

NWS and ARC Joint Statement – Summer 2009

If you are caught outdoors, you should seek shelter in a basement, shelter or sturdy building. If you cannot quickly walk to a shelter:

- Immediately get into a vehicle, buckle your seat belt and try to drive to the closest sturdy shelter.

- If flying debris occurs while you are driving, pull over and park. Now you have the following options as a last resort:
  - Stay in the car with the seat belt on. Put your head down below the windows, covering with your hands and a blanket if possible.
  - If you can safely get noticeably lower than the level of the roadway, exit your car and lie in that area, covering your head with your hands.

- Your choice should be driven by your specific circumstances.
Recommended Protective Actions

If flying debris occurs while you are driving, pull over and park. Now you have the following options as a last resort:

- Stay in the car with the seat belt on. Put your head down below the windows, covering with your hands and a blanket if possible.

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Your choice should be driven by your specific circumstances.
Recommended Protective Actions

Highway Overpasses

NOT An Option
Recommended Protective Actions

Highway Overpasses

NOT An Option
Recommended Protective Actions

Remain Inside Vehicle

Shelter In a Deep Ditch
Recommended Protective Actions

Last resort options aren’t without high risks
Recommended Protective Actions

Additional research will help develop a best recommendation for the *safest* last-resort option.
Support Services and Technologies

Interstates are crucial points of reference to both travelers and local residents.
NWS Support to Interstate Travelers

**Mile markers (MM) are the universal language!**

*Initial tornado warnings (2005-2008) for confirmed Interstate tornadoes*

- **161** Interstate Tornadoes
  - **145** Tornado Warnings
  - **16** No Tornado Warning
- **Mile Markers / Interstates**
  - **114** No MM / Interstate Mention
  - **22** MM Mention
  - **9** Interstates mentioned in text

*Only 21% tornadoes with reference to Interstates mentioned in TOR warnings*
Future Tools - Collaboration Possibilities

Dynamic Message Signs
511 Service
Media/DOT Radio Broadcasts
Law Enforcement Road Closures
Cell Phones/Graphical Tools
Motorists traveling on interstates (other roadways) have increased vulnerability to weather hazards.

Interstates and mile markers serve as important references in disseminated warning information.

Multi-agency collaboration and future technologies may help lessen casualties/damage.

Paradigm shift: New “last-resort” safety actions.

EJSSM Paper to summarizes results and recommendations.

Thank You!

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