Traffic Safety Under Reduced Visibility

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Florida is among the top states in the US regarding traffic safety problems resulting from adverse visibility conditions due to fog/smoke and heavy rain.

Number of Fatal Crashes due to Fog/Smoke/Rain in 2001-2010:
- Texas: 2,664
- Florida: 2,052
- California: 2,021
Recently, 10 people were killed and another 18 were injured from fog/smoke related pile-up crash on I-75 near Gainesville (Jan 29, 2012).
Generally, Crashes due to reduced visibility from fog/smoke are more severe compared to non-fog related crashes.
• Hourly distribution of fog crashes shows that early hours of dawn & subsequent hours where fog is prominent (5-8 AM).
Hourly distribution of smoke crashes does not show any obtrusive patterns, which implies smoke crashes do not occur at specific time period.
Monthly distribution of fog crashes indicated nearly 60% of fog crashes occurs during the winter period, from Dec to Feb.
- Monthly distribution of smoke crashes showed it most frequently occurs in May which is the dry period.
• Kernel density estimation was used to identify fog/smoke crash hotspots.

<table>
<thead>
<tr>
<th>Cluster</th>
<th>County</th>
<th>Cluster</th>
<th>County</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Pinellas, Hillsborough &amp; Pasco</td>
<td>7</td>
<td>Miami-Dade &amp; Broward</td>
</tr>
<tr>
<td>2</td>
<td>Polk &amp; Osceola</td>
<td>8</td>
<td>Lee &amp; Charlotte</td>
</tr>
<tr>
<td>3</td>
<td>Duval</td>
<td>9</td>
<td>Glades &amp; Hendry</td>
</tr>
<tr>
<td>4</td>
<td>Leon</td>
<td>10</td>
<td>Bay</td>
</tr>
<tr>
<td>5</td>
<td>Alachua</td>
<td>11</td>
<td>Brevard &amp; Orange</td>
</tr>
<tr>
<td>6</td>
<td>Orange</td>
<td></td>
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</tbody>
</table>
11 hotspots were magnified and divided highways into one mile segments and thus FS crashes were counted based on the segments.
Spatial Distributions (3/3)

- Segment 2 on I-75 were identified as a fog/smoke crash hotspot using previous crash data (2005-2010), the pile-up crash occurred due to fog & smoke involving large trucks at the very same location.

- Thus, this crash could be avoided if appropriate treatments were conducted, proactively.

Cluster 5: Alachua

Legend

- Crash/Mile
• Fog crashes are more frequent at the roadway with poor lighting condition, divided median, and at segments (not intersections) in the rural area.
CONTRIBUTING FACTORS (2/3)

Fog crashes by roadway types

- State Highway: 54% Fog, 59% CV
- Local Roadway: 46% Fog, 41% CV

Fog crashes by community types

- Urban: 48% Fog, 52% CV
- Rural: 85% Fog, 15% CV

Fog crashes by median types

- Divided: 41% Fog, 55% CV
- Undivided: 59% Fog, 45% CV

Fog crashes by locations

- Segment: 56% Fog, 45% CV
- At intersection: 45% Fog, 39% CV
- Influenced by intersection: 47% Fog, 5% CV

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CONTRIBUTING FACTORS (3/3)

- Smoke crashes are more frequent at the roadway with poor lighting condition, and at segments (not at intersections) in the rural area.
Frequent Crash Types in Fog Crashes

- Fog crashes lead to more severe injuries and are associated with rear-end crashes compared to crashes in clear vision (CV) conditions.
- Moreover, multivehicle, rear-end, head-on or angle crashes occurring in foggy conditions have significantly higher probability to result in severe crashes.

**Odds ratio of crash types and their interactions in fog to CV crash**

<table>
<thead>
<tr>
<th>Crash Type</th>
<th>Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe injury</td>
<td>1.88</td>
</tr>
<tr>
<td>Rear-end</td>
<td>1.40</td>
</tr>
<tr>
<td>Severe injury × Multiple</td>
<td>2.06</td>
</tr>
<tr>
<td>Severe injury × Rear-end</td>
<td>2.04</td>
</tr>
<tr>
<td>Severe injury × Head-on</td>
<td>1.63</td>
</tr>
<tr>
<td>Severe injury × Angle</td>
<td>1.81</td>
</tr>
</tbody>
</table>
• Smoke crashes lead to more severe injury crashes and are associated with multiple, rear-end and head-on crashes.

• In addition, multivehicle, rear-end or head-on or angle crashes occurring in smoky conditions have higher probability to result in severe crashes.

Odds ratio of crash types and their interactions in smoke to CV crash

<table>
<thead>
<tr>
<th>Crash Type</th>
<th>Odds Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Severe injury</td>
<td>1.21</td>
</tr>
<tr>
<td>Multiple vehicle</td>
<td>1.10</td>
</tr>
<tr>
<td>Rear-end</td>
<td>1.15</td>
</tr>
<tr>
<td>Head-on</td>
<td>1.03</td>
</tr>
<tr>
<td>Severe injury × Multiple vehicle</td>
<td>2.99</td>
</tr>
<tr>
<td>Severe injury × Rear-end</td>
<td>1.64</td>
</tr>
<tr>
<td>Severe injury × Head-on</td>
<td>1.07</td>
</tr>
</tbody>
</table>
• Florida is among the top state in the US regarding traffic safety problems resulting from adverse visibility conditions due to fog/smoke and heavy rain.
• Crashes due to reduced visibility from fog/smoke are more severe compared to non-fog related crashes.
• Fog crashes occur mostly in the morning in Dec to Feb, whereas smoke related crashes occur most frequently in May.
SUMMARY (2/3)

- Roadway with poor lighting condition, undivided segments (not at intersection) in the rural area has the increased probability of fog/smoke crash occurrence.
- Through the macroscopic analysis, we can understand the big picture of fog/smoke crashes, and more specific segments with frequent fog/smoke crashes can be identified through micro-level analysis.
Both fog and smoke crashes lead to more severe injuries compared to crashes in CV conditions.
Furthermore, multivehicle, rear-end, head-on or angle crashes occurring in foggy conditions have significantly higher probability to result in severe crashes.
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