Road Weather Decision Support

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Road Weather Management Program
Federal Highway Administration
August 11, 2015
Agenda

- Why do we care?
- What is the need?
- What are we doing about it?
  - Institution Building
  - ITS R&D
Average Annual Fatalities under Adverse Weather (2004 - 2013)

2004 - 2013

0 1000 2000 3000 4000 5000 6000 7000

Flood 75
Lightning 33
Tornado 109
Hurricane 108
Heat 123
Cold 27
Winter 25
Wind 51
Rip Currents 48
Total NWS Tracked* 1
Adverse Road Weather 599

2015 NRITS, Snowbird, UT
Weather-Related Crashes

Total Annual Crashes
Average = 6,301,000

Weather Related Crashes
By Road Weather Condition*

Other Crashes 76%
Weather Related Crashes 24%

Wet Pavement 75%
Snow/Slushy Pavement 11%
Icy Pavement 13%
Fog 1%

*Crashes that occurred under adverse conditions; additional factors such as rain, snow, and fog are not disaggregated from pavement conditions in this graphic. The percentage due to fog is for those crashes that occur under foggy conditions, but not wet, icy, or snowy pavement conditions.

Source: Road Weather Management Program, Table: Weather-Related Crash Statistics (Annual Averages), Available at: http://www.ops.fhwa.dot.gov/weather/q1_roadimpact.htm

2015 NRITS, Snowbird, UT
Trends of Fatal Crashes

Weather-Related Fatal Crashes

- MDSS
- Clarus
- WRTM Strategies
- VDT
- WxDE
- CV Applications

2015 NRITS, Snowbird, UT
What is Weather vs Road Weather?

<table>
<thead>
<tr>
<th>Weather Information</th>
<th>Road Weather Information</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Definition</strong>: the state of the atmosphere with respect to temperature, cloud cover, precipitation (type, intensity), wind, fog, atmos. pressure</td>
<td><strong>Definition</strong>: the state of the roadways with respect to wind, temperature, precipitation (type, intensity), pavement temp., subsurface temp. &amp; moisture, visibility, relative humidity, maintenance, traffic...</td>
</tr>
<tr>
<td>How will it affect me? Clothing, umbrellas, emergency shopping...</td>
<td>How will it affect me? Closed roads, reduced speeds, weight restrictions, tire friction loss, increase in travel time, increase in traffic incidents...</td>
</tr>
<tr>
<td>How do I get it? NWS, Radio &amp; TV broadcasters, Internet...</td>
<td>How do I get it? DOTs (511, DMS, web), apps...</td>
</tr>
</tbody>
</table>
“[W]e [forecasters] were very clear snow would begin between 4-6 a.m., which it did. We were very clear accumulating snow would coincide with commuting time - which it did. We were very clear the commute would be a difficult one - which it was.”

But in spite of this “clear” forecast, many motorists, school systems, and governments treated Tuesday morning’s rush hour like any other. Somehow the message that the roads would be horrible did not reach the masses.

But I think where we all erred was in the messaging. Our forecast wording - across the board - did not convey the necessary sense of urgency. We did not say in a consistent, unified way it could be really bad Tuesday morning: stay off the roads if possible and wait the storm out. - Washington Post 1/7/2015
Agenda

- Why do we care? (see slides 3-5)
- What is the need? (see slides 6-7)
- What are we doing about it?
  - Institution Building
  - ITS R&D
The Pathfinder Project

Objective: Build collaborative relationships between State DOTs and the Weather Enterprise to improve the weather message to the public

- Better public decision support
- Weather forecast translated to transportation impact message
- Data sharing and collaboration over the message
- Consistent message from all public sources

2015 NRITS, Snowbird, UT
Road Weather Capability Maturity Framework

- Product of SHRP2
- Organizational and institutional approaches that enhance highway operations via six dimensions:
  - Business processes
  - Systems and technology
  - Performance measurement
  - Culture
  - Organization and workforce
  - Collaboration
- Road Weather Capability Maturity Framework is now available and is being actively promoted
ITS R&D

- **Observing** weather and road conditions (esp. via connected vehicles)
- **Processing** and quality controlling that data
- Feeding that processed data into *applications* that enable road users and managers to make better decisions

2015 NRITS, Snowbird, UT
Vehicle Data
Integrated Mobile Observations (IMO)

Examining how data can be collected from vehicles and used to enhance decision making by traffic operators, maintenance managers and travelers.

IMO objectives:
- Better understand how to capture, communicate, and process data from the vehicle’s internal codes and external road weather sensors placed on the vehicle
- Identify uses for and incorporation of the data into new and established applications
- Assess the impact and results of the applications
<table>
<thead>
<tr>
<th>State DOT</th>
<th>Vehicles</th>
<th>Observations</th>
<th>Monitors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minnesota DOT</td>
<td>~550</td>
<td>Mobile</td>
<td>AVL Cellular</td>
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<tr>
<td></td>
<td></td>
<td>Observations</td>
<td>Bluetooth</td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>Accelerometer</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Air Temperature</td>
<td>Relative Humidity</td>
</tr>
<tr>
<td>Michigan DOT</td>
<td>~50</td>
<td>Mobile</td>
<td>Bluetooth Cellular</td>
</tr>
<tr>
<td></td>
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<td>Observations</td>
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<tr>
<td></td>
<td></td>
<td>Air Temperature</td>
<td>Relative Humidity</td>
</tr>
<tr>
<td>Nevada DOT</td>
<td>~20</td>
<td>Mobile</td>
<td>Radio Cellular</td>
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<td>Observations</td>
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Weather Data Environment

The Weather Data Environment (WxDE) provides a data platform that includes atmospheric and road weather observations from permanent, transportable and mobile stations/platforms.

www.its-wxde.net
Pikalert®
Vehicle Data Translator

The Pikalert Vehicle Data Translator (Pikalert VDT) is software that turns observations into useful information:

- Inputs include vehicle-based measurements (i.e., vehicle actions, road conditions, and the surrounding atmosphere)
- Other, more traditional weather data sources
- Output is road segment-by-road segment characterizations of weather and road conditions (i.e., “nowcasts” and forecasts)
VDT Matches Vehicle & Weather Data to the Road

- Vehicle data are assigned to user-configured road segments based on GPS
- Road segments are configurable (default: 1-mile and 5-min update)
- Weather data are assigned to same road segments

2015 NRITS, Snowbird, UT
Road Weather Applications

• Enhanced Maintenance Decision Support
• Motorist Advisories and Warnings
• Weather-Responsive Traffic Management
  - Speed Management / Variable Speed Limiting
  - Traveler Information
  - Traffic Signal Timing
  - Citizen Reporting of Road Conditions
• Road Weather Performance Management
Enhanced Maintenance Decision Support System

- Produces road weather forecasts and treatment recommendations to aid maintenance managers and other personnel in key decisions of treatment type, timing, rates, and locations
- EMDSS builds on traditional MDSS by incorporating VDT output, giving high resolution forecasts that make use of mobile data
EMDSS Display

Name of Event: 2015 NRITS, Snowbird, UT
Motorist Advisory and Warning (MAW) System

- Displays road weather alerts and forecasts of hazards to provide traveler information to decision makers from DOT personnel to the traveling public.
- Uses VDT output and a road weather forecast to provide these alerts.
- A web-based display can be used for decisions before traveling, a phone application provides information on the road.
MAW Web-based Display

<table>
<thead>
<tr>
<th>Time</th>
<th>Advisory</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tues 11/19 2:00 pm</td>
<td>no advisories</td>
</tr>
<tr>
<td>Tues 11/19 3:00 pm</td>
<td><strong>Advisory:</strong> moderate rain, wet, normal</td>
</tr>
<tr>
<td>Tues 11/19 4:00 pm</td>
<td><strong>Advisory:</strong> moderate rain, wet, normal</td>
</tr>
<tr>
<td>Tues 11/19 5:00 pm</td>
<td><strong>Advisory:</strong> moderate rain, wet, normal</td>
</tr>
<tr>
<td>Tues 11/19 6:00 pm</td>
<td><strong>Advisory:</strong> moderate rain, wet, normal</td>
</tr>
<tr>
<td>Tues 11/19 7:00 pm</td>
<td><strong>Advisory:</strong> moderate rain, wet, normal</td>
</tr>
<tr>
<td>Tues 11/19 8:00 pm</td>
<td><strong>Advisory:</strong> moderate rain, wet, normal</td>
</tr>
<tr>
<td>Tues 11/19 9:00 pm</td>
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</tr>
<tr>
<td>Tues 11/19 10:00 pm</td>
<td><strong>Advisory:</strong> moderate rain, wet, normal</td>
</tr>
<tr>
<td>Tues 11/19 11:00 pm</td>
<td>no advisories</td>
</tr>
<tr>
<td>Weds 11/20 0:00 am</td>
<td>no advisories</td>
</tr>
<tr>
<td>Weds 11/20 1:00 am</td>
<td>no advisories</td>
</tr>
</tbody>
</table>
MAW Phone Application

- Alerts: ON
  - Phone Id: 2187914824
  - State: Minnesota
  - Session Id: 1393365182
  - Sequence No: 3
  - Location: -94.22256 45.62103

- Alerts: ON
  - Phone Id: 2187914824
  - State: Minnesota
  - Session Id: 1393460710
  - Sequence No: 3
  - Location: -94.22253 45.62094

- Alerts: ON
  - Phone Id: 2187914824
  - State: Minnesota
  - Session Id: 1393605611
  - Sequence No: 6
  - Location: -94.20521 45.57586

Icy roads possible ahead. Drive slowly and use caution.

Light snow ahead. Snowy, slick roads. Delay travel, seek alternate route, or drive slowly and use extreme caution.

2015 NRITS, Snowbird, UT
Weather-Responsive Traffic Management

WRTM Strategies:
• Motorist advisory and alert/warning systems
• Speed management strategies
• Vehicle & road restriction strategies
• Traffic signal control strategies

Ongoing Field Tests:
• Utah
• Oregon
• Wyoming
• South Dakota
• Michigan

FHWA-JPO-11-086 - Developments in WRTM Strategies
Other Projects

- Integrated Modeling for Road Condition Prediction
- Regional Assessment of Weather and Freight Impacts
- Prediction of Roadway Surface Conditions Using On-Board Vehicle Sensors
- Automated Vehicles and Weather
- Analysis, Modeling & Simulation (AMS) Testbed
- Optimal Messaging to Affect Traveler Behavior
- Climate Resilience and Operations & Maintenance
- Connected Vehicle Data for Numerical Weather Prediction
Connected Vehicles and Numerical Weather Prediction

- Improving weather-based mapping of fire danger and fire emissions inventories
- Architecture concepts for high-impact connected vehicle observations
- On-demand probabilistic quality control for connected vehicle observations
- Improving road weather and visibility forecasts by assimilating mobile observations with WRF-Chem
Contact Information

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