Road Weather Decision Support

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Road Weather Management Program

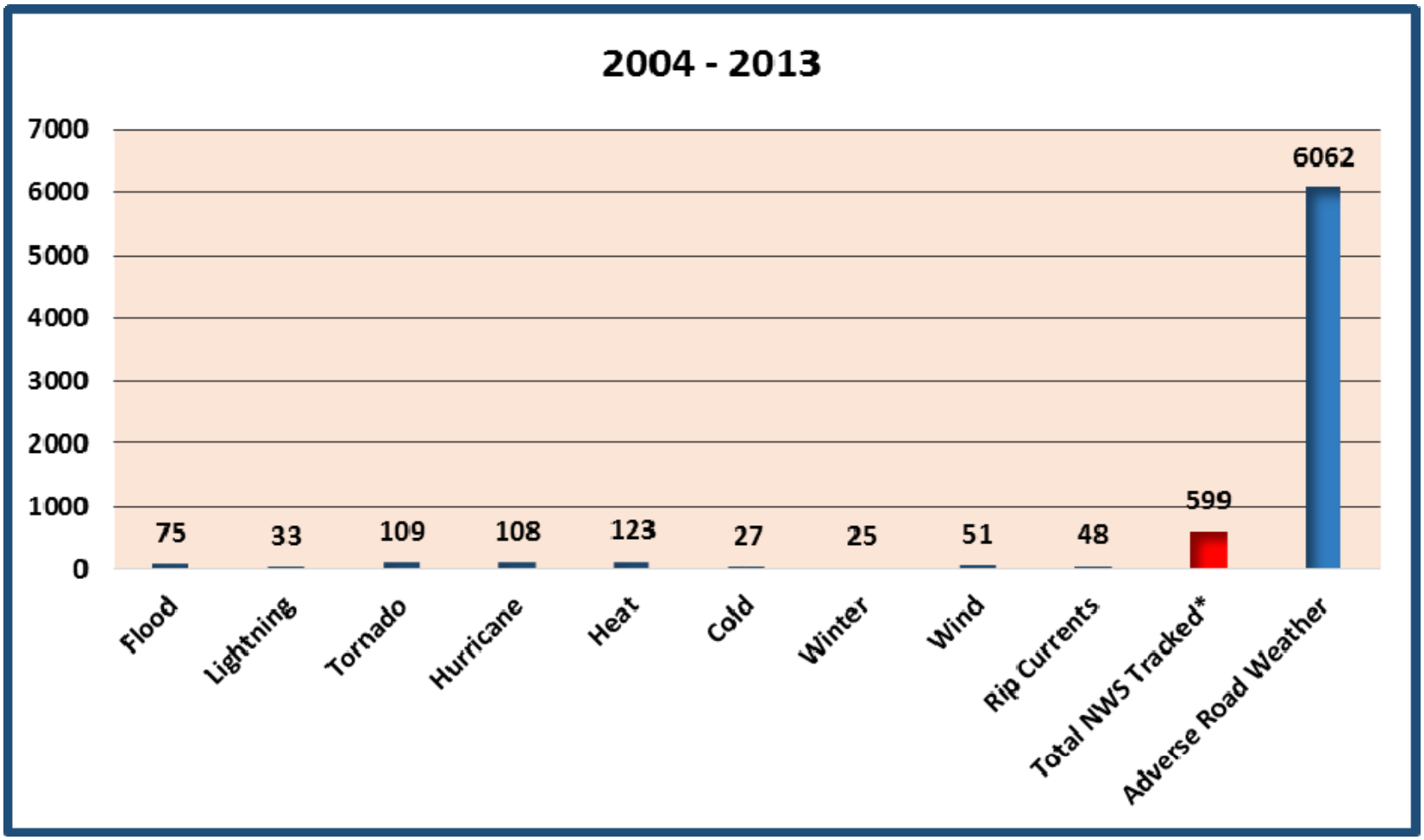
Federal Highway Administration

August 11, 2015

Agenda

- Why do we care?
- What is the need?
- What are we doing about it?
  - Institution Building
  - ITS R&D

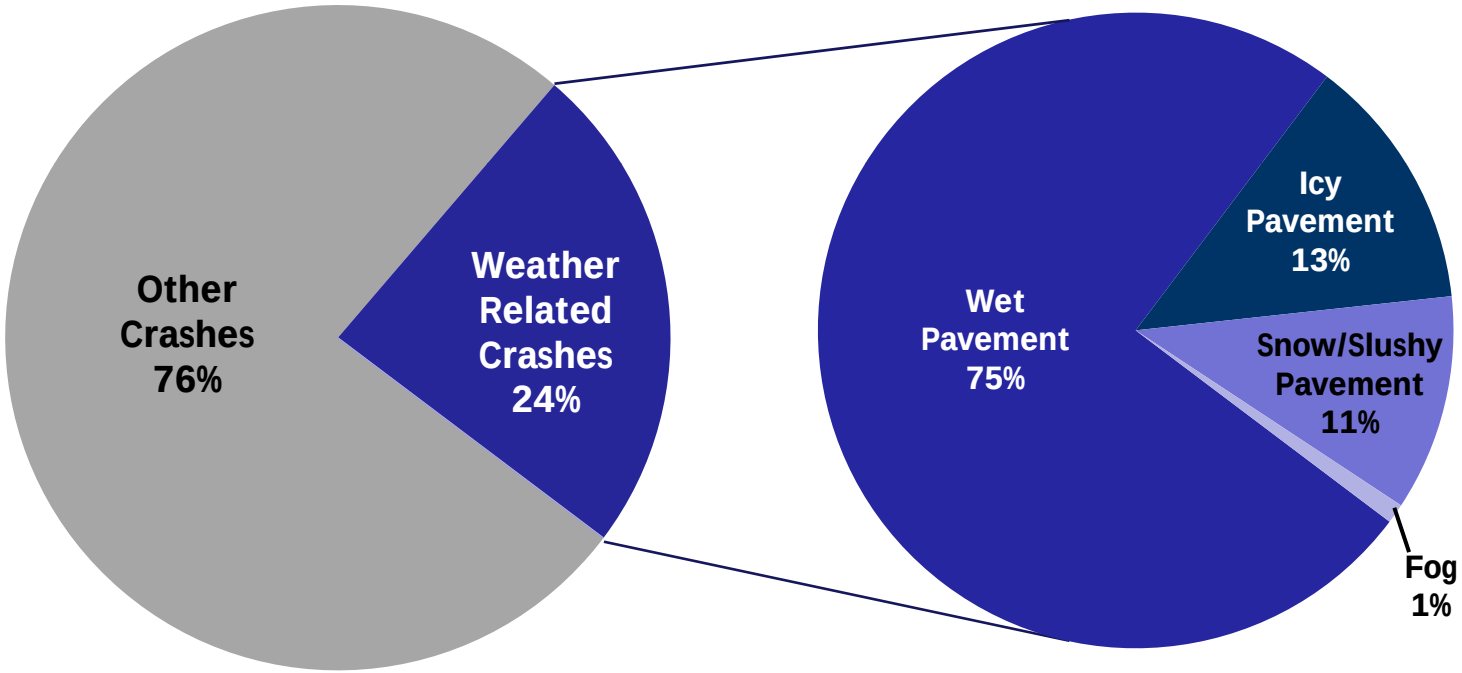
Average Annual Fatalities under Adverse Weather (2004 – 2013)



Weather-Related Crashes

Total Annual Crashes
Average = 6,301,000

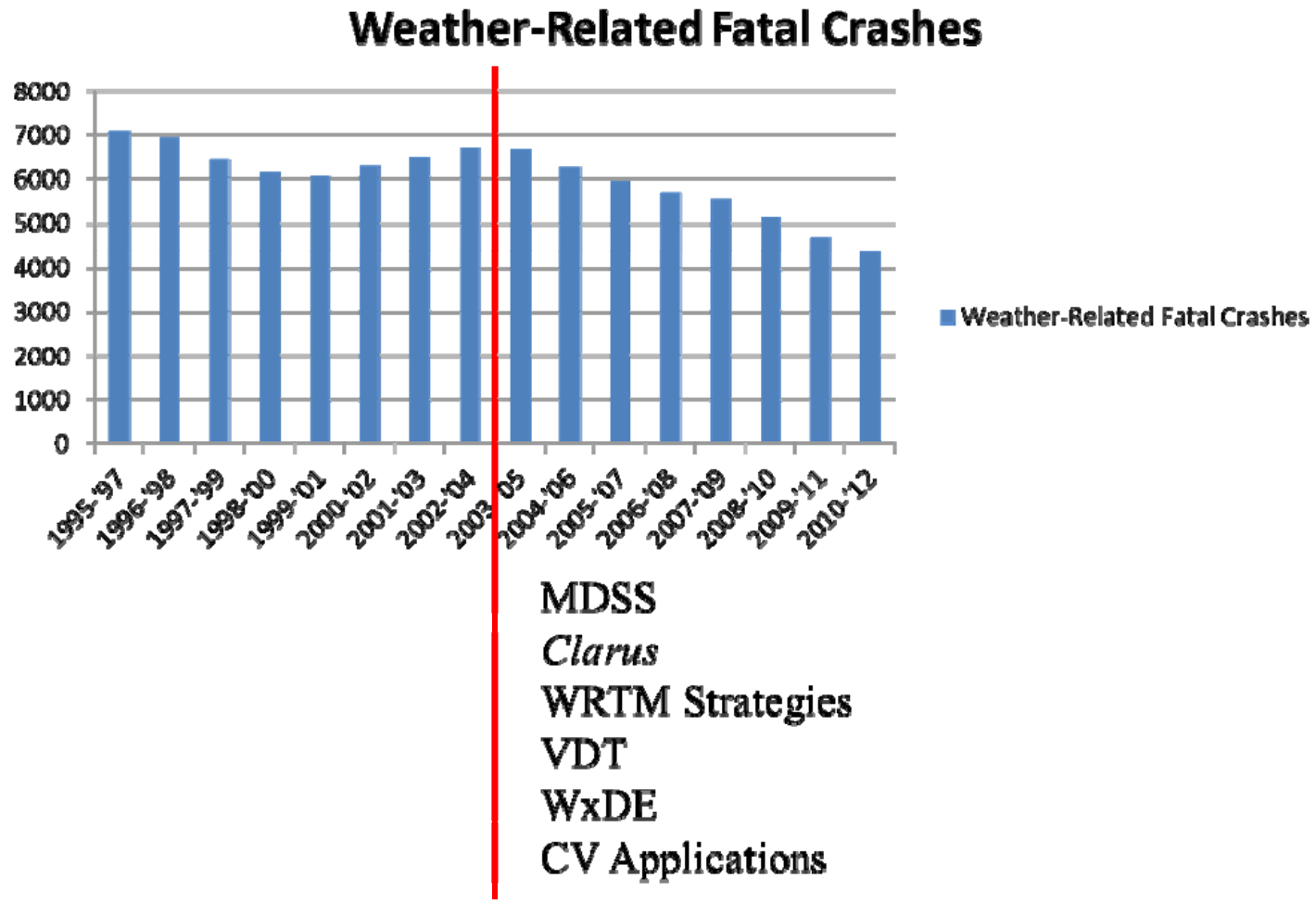
Weather Related Crashes
By Road Weather Condition*



*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*

Trends of Fatal Crashes



What is Weather vs Road Weather?

Weather Information

- Definition: the state of the atmosphere with respect to temperature, cloud cover, precipitation (type, intensity), wind, fog, atmos. pressure
- How will it affect me?
  Clothing, umbrellas, emergency shopping…
- How do I get it?
  NWS, Radio & TV broadcasters, Internet…

Road Weather Information

- Definition: the state of the roadways with respect to wind, temperature, precipitation (type, intensity), pavement temp., subsurface temp. & moisture, visibility, relative humidity, maintenance, traffic…
- How will it affect me?
  Closed roads, reduced speeds, weight restrictions, tire friction loss, increase in travel time, increase in traffic incidents…
- How do I get it?
  DOTs (511, DMS, web), apps±

Case in Point

"[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

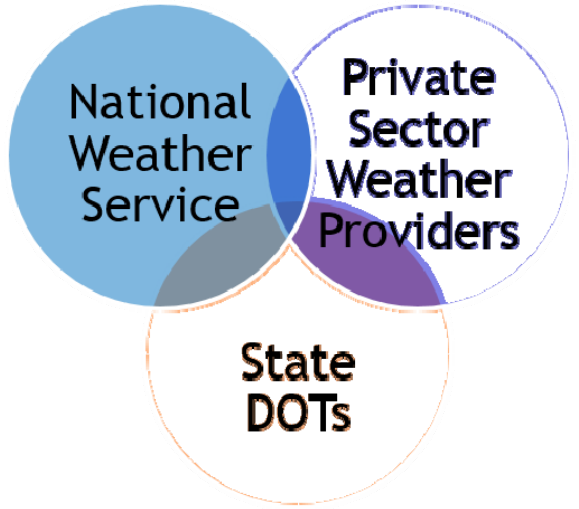
Agenda

- 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



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

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

IMO Partners

Minnesota DOT

- ~550 Vehicles
- Mobile Observations
  - Air Temperature
  - Relative Humidity
  - Surface Temperature
  - Wiper Status
  - Brake Status
- AVL with Cellular transmission

Michigan DOT

- ~50 Vehicles
- Mobile Observations
  - Air Temperature
  - Relative Humidity
  - Surface Temperature
  - Brake Status
  - Accelerometer
- Bluetooth with Cellular transmission

Nevada DOT

- ~20 Vehicles
- Mobile Observations
  - Air Temperature
  - Relative Humidity
  - Surface Temperature
  - Wiper Status
  - Maintenance Status
- Radio & Cellular transmission

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

Weather Data Environment

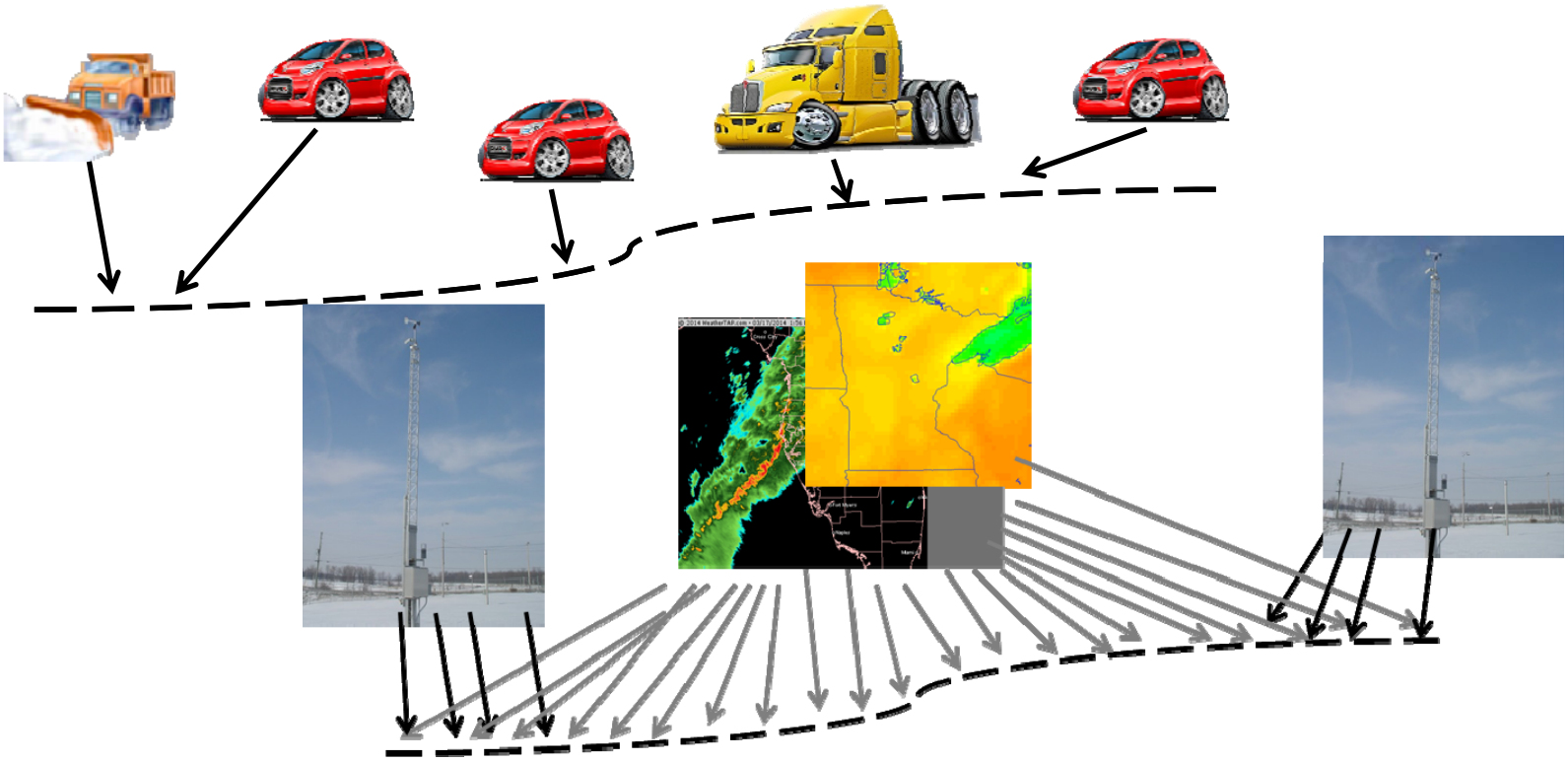
Pikalert®
Vehicle Data Translator

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



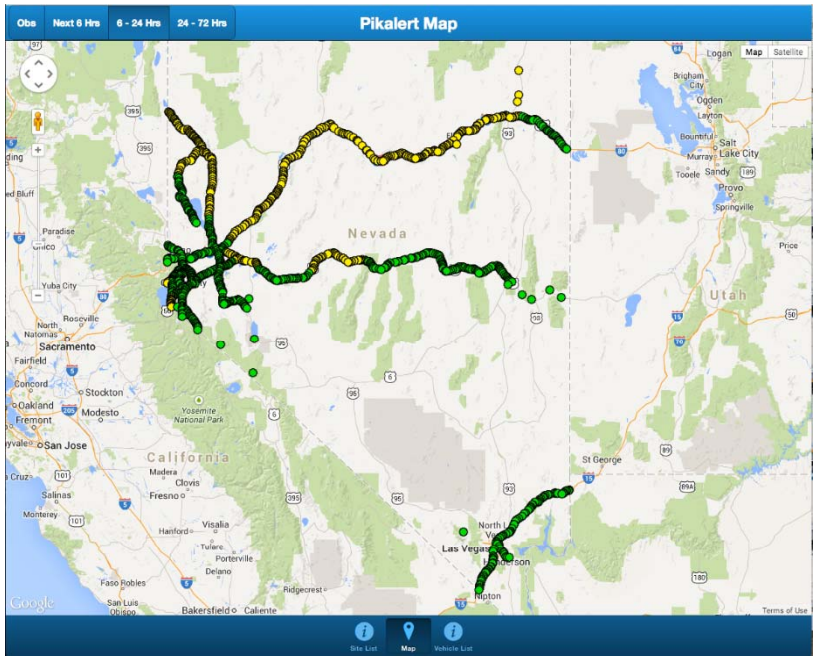
Road Weather Applications

- 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

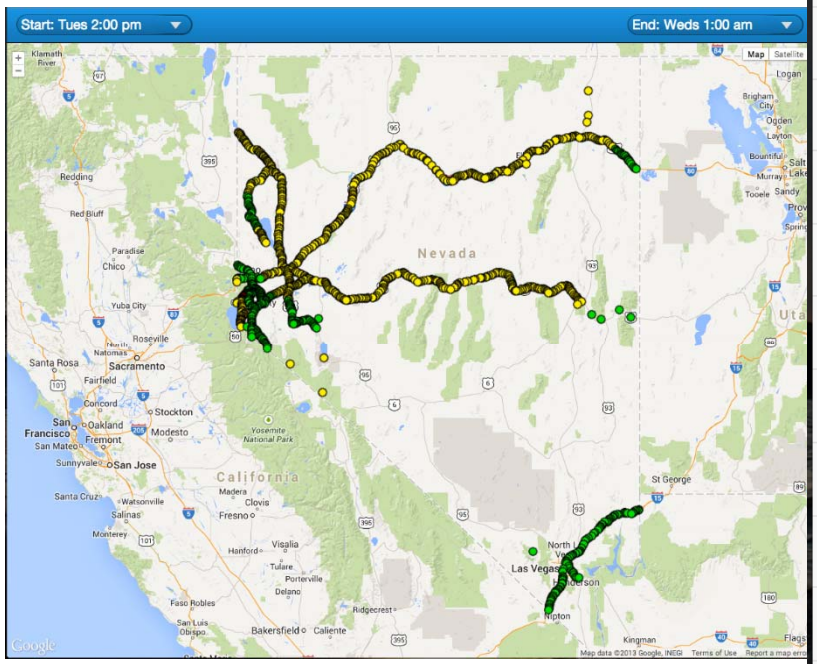
EMDSS Display



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

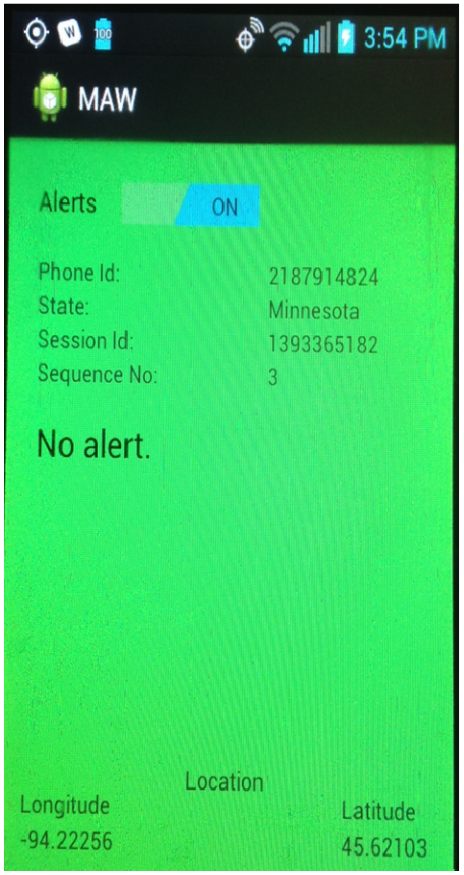
MAW Web-based Display

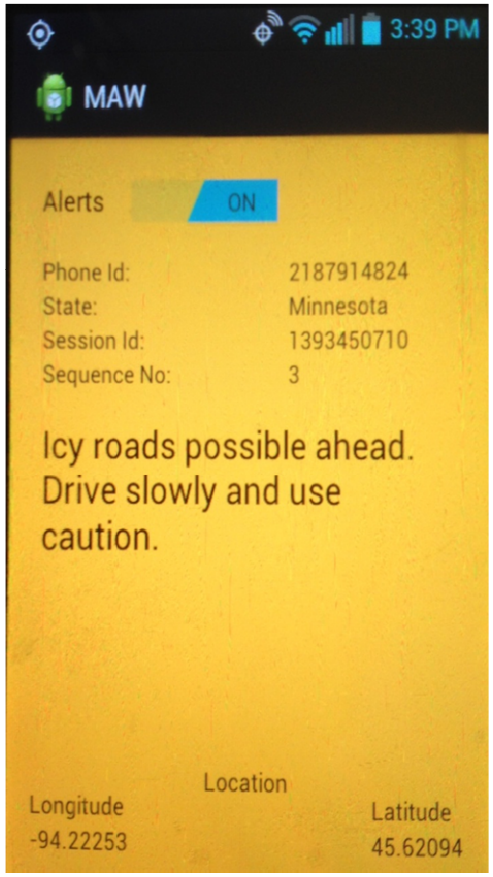


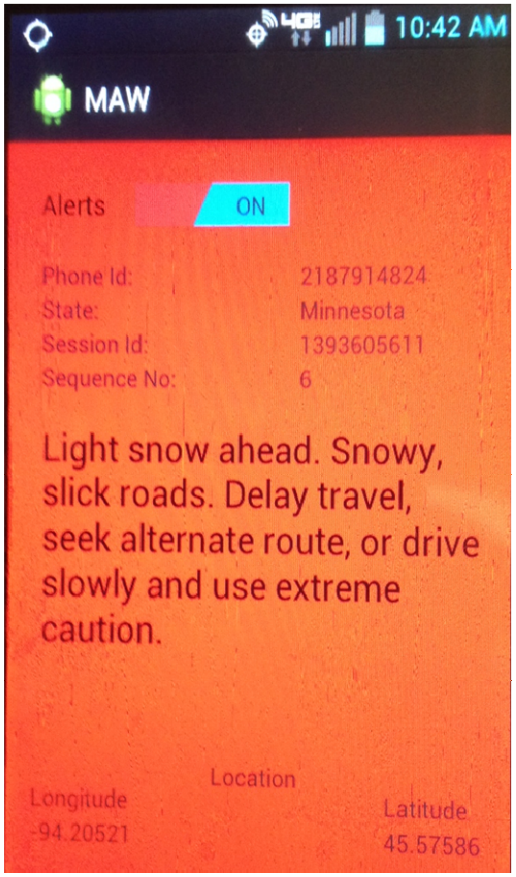
Back

Tues 11/19 2:00 pm	●	no advisories
Tues 11/19 3:00 pm	●	**Advisory:** moderate rain, wet, normal
Tues 11/19 4:00 pm	●	**Advisory:** moderate rain, wet, normal
Tues 11/19 5:00 pm	●	**Advisory:** moderate rain, wet, normal
Tues 11/19 6:00 pm	●	**Advisory:** moderate rain, wet, normal
Tues 11/19 7:00 pm	●	**Advisory:** moderate rain, wet, normal
Tues 11/19 8:00 pm	●	**Advisory:** moderate rain, wet, normal
Tues 11/19 9:00 pm	●	**Advisory:** moderate rain, wet, normal
Tues 11/19 10:00 pm	●	**Advisory:** moderate rain, wet, normal
Tues 11/19 11:00 pm	●	no advisories
Weds 11/20 0:00 am	●	no advisories
Weds 11/20 1:00 am	●	no advisories

MAW Phone Application



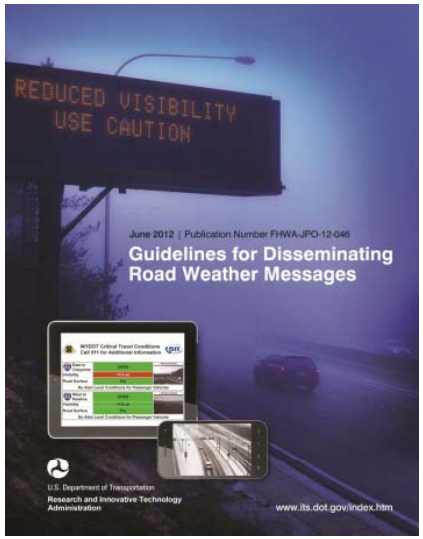




Weather-Responsive Traffic Management

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

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