Weather Impacts on Highway Safety

- The toll during adverse weather conditions
  - Over 1,500,000 weather-related crashes per year
  - 7,130 fatalities per year
  - Over 629,000 injuries per year
- 24% of all crashes occurred on slick pavement or under adverse weather conditions
Weather Impacts on Highway Mobility

- 15% of Total Delays and 25% of Non-Recurring Delays are Weather-Related
FHWA Road Weather Management Program RD&D

- Road Weather Data Capture and Management (DCM)
- Road Weather Dynamic Mobility Applications (DMA)
- Weather Responsive Traffic Management
- Performance Evaluation and Management

*ITS Connected Vehicles Program*
WRTM Program Goals

- Transportation agencies use current and forecast weather and traffic conditions to manage traffic flow and highway operations.
- Motorists receive and respond to road weather and traffic information.
- Weather impacts incorporated in traffic analysis and engineering models.
- Enhanced safety and mobility during weather events.
WRTM Strategies

- Advisory
  - Warning Systems
  - Traveler Info. Systems

- Control
  - Signal Timing
  - Ramp Metering
  - Variable Speed Limit
  - Road/Lane Closure

- Treatment
  - Maintenance
  - Obstruction Removal

FHWA-JPO-11-086 – Developments in WRTM Strategies
Traffic Analysis and Modeling

- Empirical Studies of Weather and Traffic
  - Speed, Volume, Capacity, Density

- Microscopic Analysis of Traffic in Inclement Weather
  - Car Following, Gap Acceptance, Lane Changing

- Traffic Estimation and Prediction
  - Weather-Sensitive Traffic Estimation and Prediction System (TrEPS)
# Empirical Studies on Weather and Traffic

<table>
<thead>
<tr>
<th>Traffic Parameter</th>
<th>Weather Condition</th>
<th>Range of Impact</th>
</tr>
</thead>
<tbody>
<tr>
<td>Free-Flow Speed</td>
<td>• Light Rain (&lt;0.01 cm/h)</td>
<td>- 2 % to - 3.6%</td>
</tr>
<tr>
<td></td>
<td>• Rain (~1.6 cm/h)</td>
<td>- 6% to - 9%</td>
</tr>
<tr>
<td></td>
<td>• Light snow (&lt;0.01 cm/h)</td>
<td>- 5% to - 16%</td>
</tr>
<tr>
<td></td>
<td>• Snow (~0.3 cm/h)</td>
<td>-5% to - 19%</td>
</tr>
<tr>
<td>Speed at Capacity</td>
<td>• Light Rain (&lt;0.01 cm/h)</td>
<td>- 8% to - 10%</td>
</tr>
<tr>
<td></td>
<td>• Rain (~1.6 cm/h)</td>
<td>- 8% to - 14%</td>
</tr>
<tr>
<td></td>
<td>• Light snow (&lt;0.01 cm/h)</td>
<td>- 5% to - 16%</td>
</tr>
<tr>
<td></td>
<td>• Snow (~0.3 cm/h)</td>
<td>- 5% to - 19%</td>
</tr>
<tr>
<td>Capacity</td>
<td>• Light Rain (&lt;0.01 cm/h) and Rain (~1.6 cm/h)</td>
<td>- 10% to - 11%</td>
</tr>
<tr>
<td></td>
<td>• Light snow (&lt;0.01 cm/h)</td>
<td>- 12% to - 20%</td>
</tr>
</tbody>
</table>
Traffic/Weather Data Collection and Integration

- Weather Integration in TMC’s
  - TMC Self-Evaluation and Planning Guide
  - Sacramento, Kansas City, CO Springs, Wyoming, Louisiana

- Data Sources for WRTM
  - Data Mining and Gap Analysis for WRTM
  - Application of Mobile Data for WRTM Studies

- Baselining Current Road Weather Information
Human Factors Analysis

- Traveler Requirements for Road Weather Advisory and Control Information
- Guidelines for Disseminating Road Weather Messages
Recent Activities

- 2nd National WRTM Workshop/Stakeholder Meeting, Sept 26-27, Salt Lake City UT
- Guidelines for VSL Implementation during Wet Weather
- WRTM Webinar Series (NTOC, ITS T3 Program)
- Advanced WRTM Strategies Implementation
  - Citizen Reporting Program (Utah DOT)
  - Traffic Signal Control (Utah DOT)
- Weather Responsive Traffic Estimation and Prediction System at Utah DOT
Utah DOT Citizen Reporting Program

The goal of this Program is to allow trained Citizen Reporters to transmit road condition information (and possibly other information) to the UDOT TOC for inclusion into the TATS road reporting system.
Utah DOT Mobile Citizen Reporting App
Traffic Signal Timing at Utah DOT

- Road Weather Information System
- Video Surveillance System
- Traffic Sensor System
  - Traffic Sensor Data
- Traffic Estimation and Prediction System (TrEPS)
  - Traffic Sensor Data
- UDOT Signal Systems Performance Metrics System
  - Link Speed Approach Volumes
  - Purdue Coordination Diagrams
  - Link Speed Approach Volumes
- Traffic Sensor Data
- Traffic Sensor Data
- Traffic Estimation and Prediction System (TrEPS)

- UDOT Meteorologist
- UDOT Signal Systems Operator

- Current Weather Conditions
- Video Images
- Road Weather Forecasts

---

- Proposed System Links
- Future System Links
Current/Future Activities

- Implementation and Evaluation of WRTM Strategies
  - Oregon
  - Michigan
  - Wyoming
  - South Dakota

- CITE Web-based Training Course (every April)

- T3 Webinar
  - July 8, 2014: Performance Measures and Benefit Cost Analysis for WRTM

- Analysis, Modeling and Simulation Test Beds for RW Connected Vehicle Applications

- 3rd National WRTM Workshop (Sept. 2015)
Michigan DOT Traveler Info System
Road Weather Management
Anytime, Anywhere Road Weather Information

Contact Information:

• roemer.alfelor@dot.gov
• 202-366-9242
• www.ops.fhwa.dot.gov/weather