Latest Results from FHWA’s Road Weather Management Program

National Rural ITS Conference
August 23-27, 2009 • Seaside, Oregon

Ray Murphy, ITS Specialist
Latest Results from FHWA’s Road Weather Management Program

Overview

- Clarus
- IntelliDrive
- Vehicle Data Translator
Clarus
Nationwide
Surface
Transportation
Weather Observing
& Forecasting System
The **Clarus Initiative**

- **Clarus** is an R&D initiative to demonstrate the value of “Anytime, Anywhere Road Weather Information”
- The objective is to enable **public agencies and the private weather enterprise** to meet the information needs of all transportation users and operators
- To do so, we needed to create a robust
  - data assimilation,
  - quality checking, and
  - data dissemination
- system that provides near real-time atmospheric and pavement observations from the collective states’ investments in environmental sensor stations (ESS).
Participants in the **Clarus Multi-State Regional Demonstration Concept of Operations Development**

- Create a Nationwide Surface Transportation Weather Observing and Forecasting System
- Provide information to all transportation managers and users
- Alleviate the affects of adverse weather
Clarus Regional Demonstration
5 Use Case Scenarios

1. Enhanced Road Weather Forecasting Enabled by Clarus
2. Seasonal Weight Restriction Decision Support Tool
3. Non-winter Maintenance & Operations Decision Support Tool
4. Multi-state Control Strategy Tool
5. Enhanced Road Weather Content for Traveler Advisories

Meridian team
Scenarios 1, 2, 5

Mixon/Hill team
Scenarios 1, 3, 4

State Transportation Agency Partners
Participation Status for Clarus as of July 31, 2009

Local DOT Participation
- City of Indianapolis, IN
- McHenry County, IL
- City of Oklahoma City, OK
- NY State Thruway
- City of Denver, CO
- Washington, DC

Clarus Connection Status
- Connected (32 States, 3 Locals, 3 Provinces)
- Pending (4 States, 2 Locals)
- Considering (6 States, 1 Local)

Sensor & Station Count
1,897 Sensor Stations (ESS)
42,149 Individual Sensors
The Clarus System is an experimental product and is being used for evaluation and demonstration purposes only. This is provided as a public service. No warranties on accuracy of data are intended or provided. See link to contributor's data disclaimer in metadata file contrib.csv.
Reports, Subscriptions, Metadata, User Guide, and Archived Data

Reports and Subscriptions

Get Observations by:
Contributor  Geospatial Coordinates

View Metadata  View Subscriptions

NEW View User Guide  NEW Link to Archive Data
Environmental Sensor Stations

http://www.clarus-system.com
Clarus in Wisconsin

Wisconsin has been connected to Clarus since 2007 - our 4th state to join!

Wisconsin DOT operates 58 sites/stations with 1599 sensors.
# Quality Checked Observations

<table>
<thead>
<tr>
<th>Timestamp (UTC)</th>
<th>Observation Type</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009-05-12 14:08</td>
<td>essAirTemperature (C)</td>
<td>15.70</td>
</tr>
<tr>
<td>2009-05-12 14:08</td>
<td>essDewpointTemp (C)</td>
<td>5.10</td>
</tr>
<tr>
<td>2009-05-12 14:08</td>
<td>essPrecipRate (cm/h)</td>
<td>0.00</td>
</tr>
<tr>
<td>2009-05-12 14:08</td>
<td>essRelativeHumidity (%)</td>
<td>49.00</td>
</tr>
<tr>
<td>2009-05-12 14:08</td>
<td>essSubSurfaceTemperature (C)</td>
<td>18.20</td>
</tr>
<tr>
<td>2009-05-12 14:08</td>
<td>essSurfaceTemperature (C)</td>
<td>19.90</td>
</tr>
<tr>
<td>2009-05-12 14:08</td>
<td>essSurfaceTemperature (C)</td>
<td>18.80</td>
</tr>
<tr>
<td>2009-05-12 14:08</td>
<td>essSurfaceTemperature (C)</td>
<td>18.90</td>
</tr>
<tr>
<td>2009-05-12 14:00</td>
<td>wind3SensorAvgDirection (deg)</td>
<td>145.00</td>
</tr>
<tr>
<td>2009-05-12 14:08</td>
<td>windSensorAvgSpeed (m/s)</td>
<td>6.67</td>
</tr>
<tr>
<td>2009-05-12 14:08</td>
<td>windSensorGustDirection (deg)</td>
<td>141.00</td>
</tr>
<tr>
<td>2009-05-12 14:08</td>
<td>windSensorGustSpeed (m/s)</td>
<td>8.89</td>
</tr>
</tbody>
</table>
SURFACE TEMPERATURES... not only can you see the surface temperatures from your own state, but across jurisdictional boundaries. For road-weather operations, you can watch surface observations change in near-real time to better plan your activities.

"Everyone can get the temperature from around the country, but Clarus is the place to see near real-time road weather."
Quality Checks

✓ Manual
✓ Sensor Range
✓ Climate Range
✓ Step
✓ Like Instrument
✓ Persistence
✓ Barnes Spatial
✓ Dewpoint
✓ Sea Level Pressure

Barnes Spatial – test to compare observations with nearby neighbors

Sensor Range – test to determine if the value is within the specifications of the specific sensor. If this test does not pass, then no other tests are run

Persistence – test to evaluate whether an observation has changed over a defined amount of time

Sea Level Pressure – test to calculate the sea level pressure using the atmospheric pressure observation and then compare the results with nearby neighbors
Annual Stakeholder Meetings

- Clarus ICC
  - September 14-15, 2009
- MDSS
  - September 16-17, 2009

Hilton - University Place
Charlotte, NC

Reimbursement for travel expenses for one State DOT representative per state is authorized by FHWA.
Some highlights from the draft agenda include:

- Progress report on the *Clarus* Multi-state Regional Demonstrations from both development teams
- Progress report on the creation of enhanced quality checking algorithms for *Clarus*
- Panel and group discussions on user experiences
- Status on the convergence of *Clarus* and similar efforts at NOAA
- An update on IntelliDrive
  (formerly Vehicle Infrastructure Integration initiative)
Prospective topics include:

- An update on Federal MDSS activities
- Results from MDSS Cost/Benefit Analyses
- Progress on the development of MODSS
  ...which expands MDSS functionality beyond snow and ice
- Roundtable discussions by State DOT
  …their MDSS experiences & upcoming plans
- Private sector forum to highlight MDSS updates & innovations
Why connect to *Clarus*?

- **Better manage your ESS network**
  - Eases your access to multiple state ESS networks via one Internet site
  - Allows for continuous monitoring of your ESS network health (communication status, ESS sensor status)
  - Uses quality checking algorithms which will show the quality of individual observations

- **Leads to better road weather information for improved:**
  - transportation system operations
  - road weather forecasts, and
  - products from service providers

**Open database:** The *Clarus* database is a one-stop portal for surface transportation observations; which includes all RWIS as well as new products from the *IntelliDrive* initiative.
Vehicle Infrastructure Integration is now

Announcing:

IntelliDrive℠

http://www.its.dot.gov/intellidrive/

- leading edge technologies,
- advanced wireless communications,
- on-board computer processing,
- advanced vehicle-sensors,
- GPS navigation and
- smart infrastructure.
What is IntelliDrive℠?

• IntelliDrive℠ is a suite of technologies and applications that use wireless communications to provide . . .

• With and between vehicles;
• Between vehicles and roadway infrastructure;
• Among vehicles, infrastructure and wireless consumer devices.
IntelliDrive℠ Taxonomy

• Groups
  – Applications (current and potential); and
  – Technical Requirements.

• Shows how stakeholder interests relate to the various applications and technical requirements.

• Facilitates organization of research.
IntelliDrive™ Taxonomy

Level 1
Non-Vehicle-Based Data

Level 1.A
Non-Time Sensitive
Level 1.B
Time Sensitive

Level 2
Vehicle-Based Data

Level 2.A
Non-Time Sensitive
Non-Proprietary Vehicle Data
Level 2.B
Non-Time Sensitive
Proprietary Vehicle Data
Level 2.C
Time Sensitive
Proprietary Vehicle Data

Application Areas

Situational Awareness Safety

Active Safety (V2V, V2I)

Weather

“Here I Am” Messages

Emissions & Energy

Real Time Traffic & Transit Management

Commercial Vehicle Enforcement & Fleet Management
Near Term Research Priorities

• Application Area Roadmaps:
  – V2V Safety (draft available)
  – V2I (summer 2009)
    • Safety
    • Mobility
    • Environment
  – Policy (draft available)
  – Transit (2010)
  – Freight (2010)
Near Term Research Priorities

• Cross Cutting Research
  – Systems Engineering
    • Concept of Operations
    • System Requirements
  – Proof of Concept Testing Follow-On Research
  – International Standards Harmonization
  – Technology Scanning and Analysis
  – Michigan Test Bed
Michigan POC
Test bed

- 55 RSEs
- 45 square miles
- 32 interstate miles
- 43 arterial miles

Safety link testing
Speed limit, icy bridge, curve ahead

Tolling

Next exit services, traveler information
Navigation, rerouting
Parking

- 2 Service Delivery Nodes
- 1 Operations Center
- 3 types of backhaul

Test Fleet
- 25 Vehicles of 4 different makes
- 10 OEM vehicles

School zone

IntelliDrive
Safer. Smarter. Greener.
NCAR Tests System to Steer Drivers Away from Dangerous Weather

For the road weather portion of IntelliDrive, vehicles will use sensors to measure atmospheric conditions such as temperature, pressure, and humidity.

An onboard digital memory device will record that information, along with indirect signs of road conditions, such as windshield wipers being switched on or activation of the antilock braking system.
## Research Plan

### VDT Enhancement - Data

<table>
<thead>
<tr>
<th></th>
<th>FY09</th>
<th>FY10</th>
<th>FY11</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Product Milestone</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Data Quality Assessment</strong></td>
<td>1.1</td>
<td>1.2</td>
<td>1.1</td>
</tr>
<tr>
<td><strong>Data QC Algorithms</strong></td>
<td>2.2</td>
<td>2.2</td>
<td>2.1</td>
</tr>
<tr>
<td><strong>Derived Products</strong></td>
<td>3.1</td>
<td>3.1</td>
<td>3.3</td>
</tr>
<tr>
<td><strong>Data Collection</strong></td>
<td>4.1</td>
<td>4.2</td>
<td>4.1</td>
</tr>
<tr>
<td><strong>OEM Sensors</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Diagram Notes:
- Each step represents a milestone or phase in the research plan.
- Arrows indicate the sequence and dependencies between different phases.
- 

---

The research plan is divided into distinct stages, each with specific milestones and timelines for FY09, FY10, and FY11.
## Demonstration Plan

### Real-time Regional Demonstration

<table>
<thead>
<tr>
<th>Product</th>
<th>Milestone</th>
<th>FY11</th>
<th>FY12</th>
<th>FY13</th>
<th>FY14</th>
</tr>
</thead>
<tbody>
<tr>
<td>Q2</td>
<td>Q3</td>
<td>Q4</td>
<td>Q1</td>
<td>Q2</td>
<td>Q3</td>
</tr>
</tbody>
</table>

- **Real-time VDT**
  - 8.1
  - 9.1
  - 10.1

- **NWS Assimilation**
  - 8.2
  - 9.2
  - 10.2

- **Regional Demonstration**
  - 9.3
  - 10.3
  - 9.5
IntelliDrive weather observations complement the *Clarus* database

*Improved Characterization of Boundary Layer Conditions For Weather Models*

As weather models increase in resolution, observations will increase as well to better define the regional/local state of the atmosphere.

NCAR's work is part of FHWA's Road Weather Management Program that complements and leverages the IntelliDrive program, to use new technologies to make driving safer and improve mobility.
Thank you for your time & attention!

Any Questions?

Ray Murphy, ITS Specialist
US DOT – FHWA
ray.murphy@dot.gov