

A Decision-support System for Winter Weather Maintenance of Bridges, Roads, and Runways

Michael Chapman, Seth Linden, Jim Cowie, Sheldon Drobot, Eric Haave, William Mahoney

NCAR - Research Applications Laboratory



U.S. Department of Transportation
Federal Highway Administration



NCAR

History

- Began after a study discovered a disconnect between road weather forecasts and the road maintenance community
- A system was developed that translates current and predicted road & weather information into recommended maintenance actions
- **Goal** - improve the productivity and cost efficiency of transportation agencies
- A prototype was built [**Maintenance Decision Support System; MDSS**] based on open system principles, which fostered an MDSS market by making that prototype freely available

What is MDSS?

Strategic Decision-making tool (12-48 hours)



Weather Information:

- Air temperature**
- Relative humidity**
- Wind speed/direction**
- Precipitation type, rate, accumulation**

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Road Surface Information:

- Road temperature**
- Bridge temperature**
- Bridge frost potential**
- Blowing snow potential**

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Road Surface Information:

- Road temperature
- Bridge temperature
- Bridge frost potential
- Blowing snow potential



Treatment recommendations:

- Treatment type (plow, chemical, pre-treat)
- Treatment amount
- Treatment location

What is MDSS?

Tactical Decision-making tool (0-12 hours) - Currently



Observations:

- Air Temp**
- Pavement/Bridge temp**
- Wind speed/direction**
- Relative Humidity**
- Precipitation**

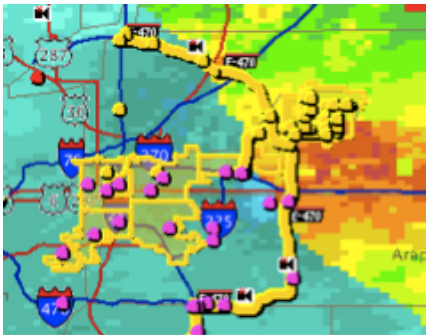
What is MDSS?

Tactical Decision-making tool (0-12 hours) - Currently



Observations:

- Air Temp
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- Wind speed/direction
- Relative Humidity
- Precipitation



Remotely Sensed Observations:

- Radar
- Satellite

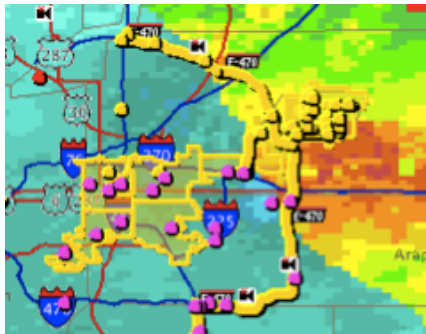
What is MDSS?

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Observations:

- Air Temp
- Pavement/Bridge temp
- Wind speed/direction
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- Precipitation

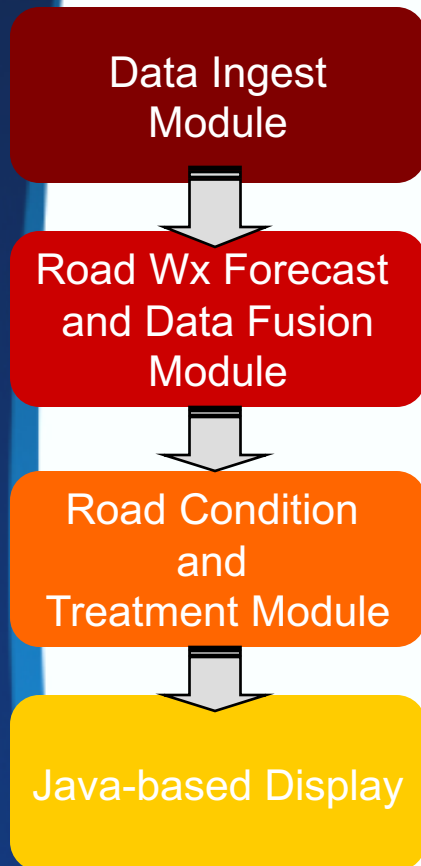


Remotely Sensed Observations:

- Radar
- Satellite

Other Enhancements: Traffic Cams, AVL...

What is MDSS?



- Numerical model data
- Road Weather Information System (RWIS) data
- Miscellaneous observations (e.g., airport)

- Consensus forecast generation

- Road temperature and condition forecasts
- Rules of practice for anti-icing and deicing operations
- Treatment recommendations

- Delivery of information and data from upstream modules to end users via an interactive Graphical User Interface



What is MDSS?

Colorado MDSS - v5.3.2
Monday 2/9/09 15:34:39 MST

File Configuration Help

Selected Maintenance Area:
Denver International Airport

Denver International Airport Alerts:

	0-12 Hrs	12-24 Hrs	24-48 Hrs
Weather	Green	Green	Yellow
Road	Green	Green	Yellow
Blowing SN	Green	Green	Green
Bridge Frost	Green	Green	Green

14 Mon 2/9 2 Tue 2/10 14 Wed 2/11 14

No Frozen Precipitation Observed Road(s) > 32°F

Map Products:

Weather Forecasts: Air Temperature
Road Forecasts: Mobility Alerts
Point Observations: Air Temperature
Area Observations: None
Overlays: Click to select...

Selected Plow Route:
Runways 16/34

Event Summary...
Forecast History...
Treatment History...
Treatment Selector...

Blowing Snow Alerts: [Green bars]
Bridge Frost Alerts: [Green bars]

Current Treatment: No New Treatments Scheduled

Selected Time and Animation:

Observations Only
 Forecast Only
 Observations and Forecast

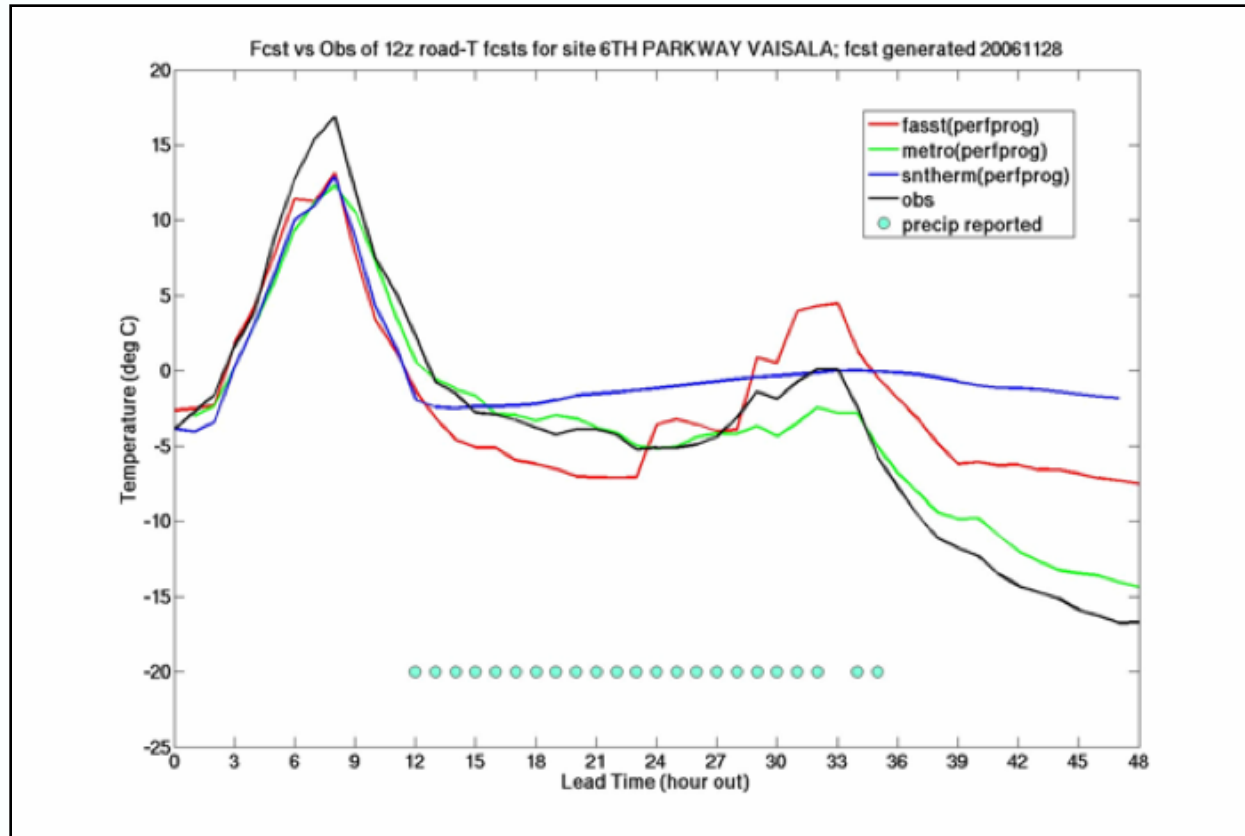
GO

14:00 17:00 20:00 23:00 2:00 5:00 8:00 11:00 14:00 17:00 20:00 23:00 2:00
2/9 2/10 2/11

Currently deployed over City/County of Denver, E470, and DIA

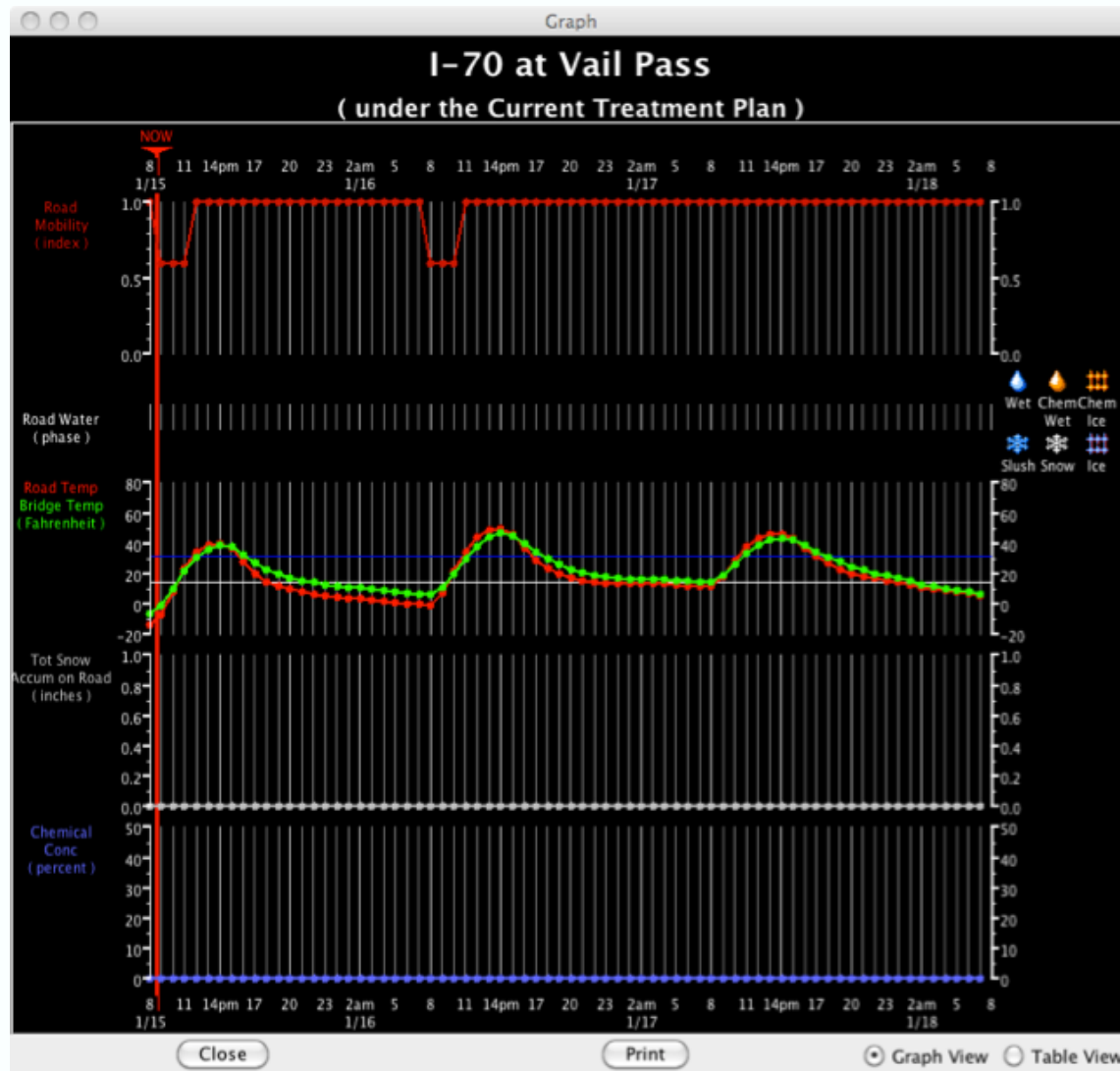
Strategic Enhancements

METRo (Model of the Environment and Temperature of Roads)*



* Environment Canada

Strategic Enhancements



1-h updated forecast out to 72-h

Tactical Enhancements

Traffic Cameras:

Selected Maintenance Area:

Colorado

Colorado Alerts:

	0-12 Hrs	12-24 Hrs	24-48 Hrs
Weather			
Road			
Blowing SN			
Bridge Frost			

15 Fri 4/17 3 Sat 4/18 15 Sun 4/19 3 Sun 4/19 15

Frozen Precipitation Observed Road(s) > 32°F

Map Products:

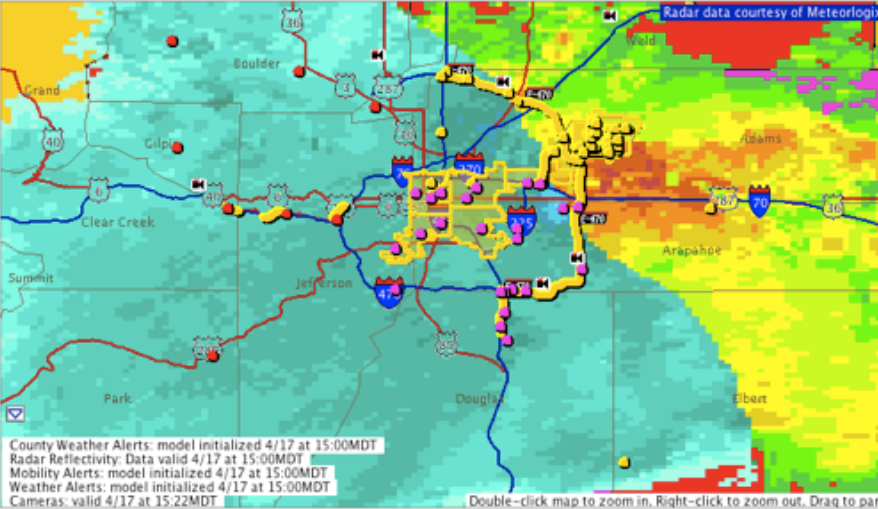
Weather Forecasts: Weather Alerts

Road Forecasts: Mobility Alerts

Point Observations: None

Area Observations: Radar Reflectivity

Overlays: Click to select...



County Weather Alerts: model initialized 4/17 at 15:00MDT
Radar Reflectivity: Data valid 4/17 at 15:00MDT
Mobility Alerts: model initialized 4/17 at 15:00MDT
Weather Alerts: model initialized 4/17 at 15:00MDT
Cameras: valid 4/17 at 15:22MDT

Double-click map to zoom in. Right-click to zoom out. Drag to pan.

Selected Plow Route:

Select a route...

Selected Time and Animation:

Observations Only Forecast Only Observations and Forecast

GO

15:00 18:00 21:00 0:00 3:00 6:00 9:00 12:00 15:00 18:00 21:00 0:00 3:00
4/17 4/18 4/19

Tactical Enhance

Traffic Cameras:



Selected Maintenance Area:
Colorado

Colorado Alerts:

	0-12 Hrs	12-24 Hrs	24-48 Hrs
Weather	Yellow	Orange	Red
Road	Yellow	Orange	Red
Blowing SN	Green	Yellow	Orange
Bridge Frost	Green	Yellow	Orange

15 Fri 4/17 3 Sat 4/18 15 3 Sun 4/19 15

Frozen Precipitation Observed Road(s) > 32°F

Map Products:

- Weather Forecasts: Weather Alerts
- Road Forecasts: Mobility Alerts
- Point Observations: None
- Area Observations: Radar Reflectivity
- Overlays: Click to select...

Selected Plow Route:
Select a route...

Selected Time and Animation:

- Observations Only
- Forecast Only
- Observations and Forecast

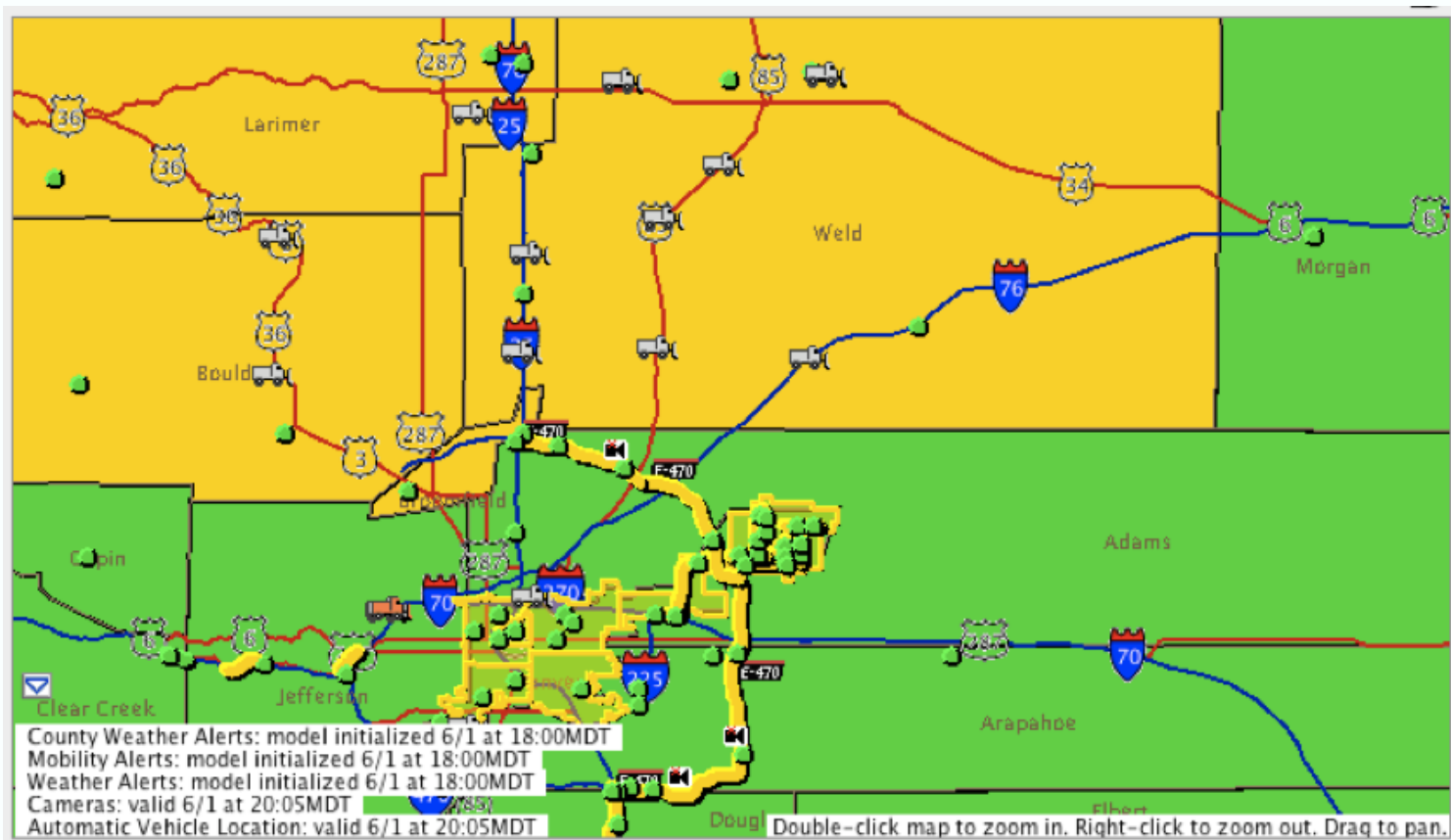
GO

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4/17 4/18 4/19



Tactical Enhancements

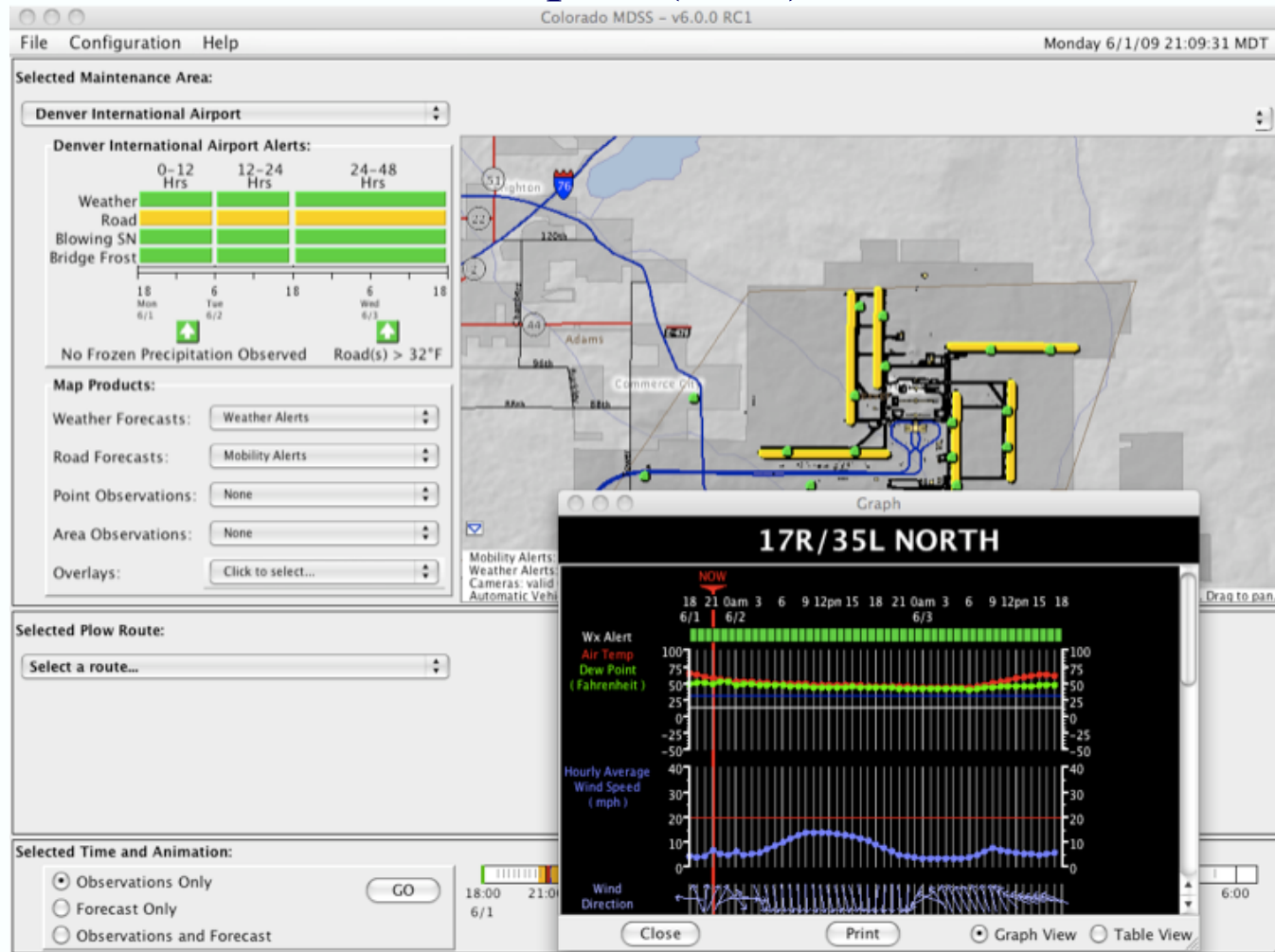
AVL:



Plow diagnostics (speed, blade status, treatment rate) and dashboard cameras

New Deployments

Denver International Airport (DIA)



*Need has arisen to increase skill of 0 – 4 hour precipitation forecasts

New Deployments

New Jersey

Development of Maintenance Decision Support System for New Jersey

NJ-MDSS Main Display

The screenshot shows the NJ-MDSS Main Display interface. It features a central map of New Jersey with color-coded regions (yellow, green, red) representing different alert zones. To the left, there are panels for 'Road and Weather Alerts' and 'Observations & Forecast Parameters'. At the bottom, there is a 'Forecast time & Animation Control' section with a timeline and a 'No New Treatments Scheduled' message.

Road and Weather Alerts

Map of Routes and Alerts Zones

Forecast time & Animation Control

Observations & Forecast Parameters

Selected Maintenance Area: New Jersey

New Jersey Alerts:

Weather	10/22	10/23	10/24
Wind	Green	Green	Green
Temp. 10-20	Green	Green	Green
Dr. Sp. Frost	Green	Green	Green

Map of Routes and Alerts Zones

Forecast time & Animation Control

No New Treatments Scheduled

Selected Time Period: 10/22 10/23 10/24

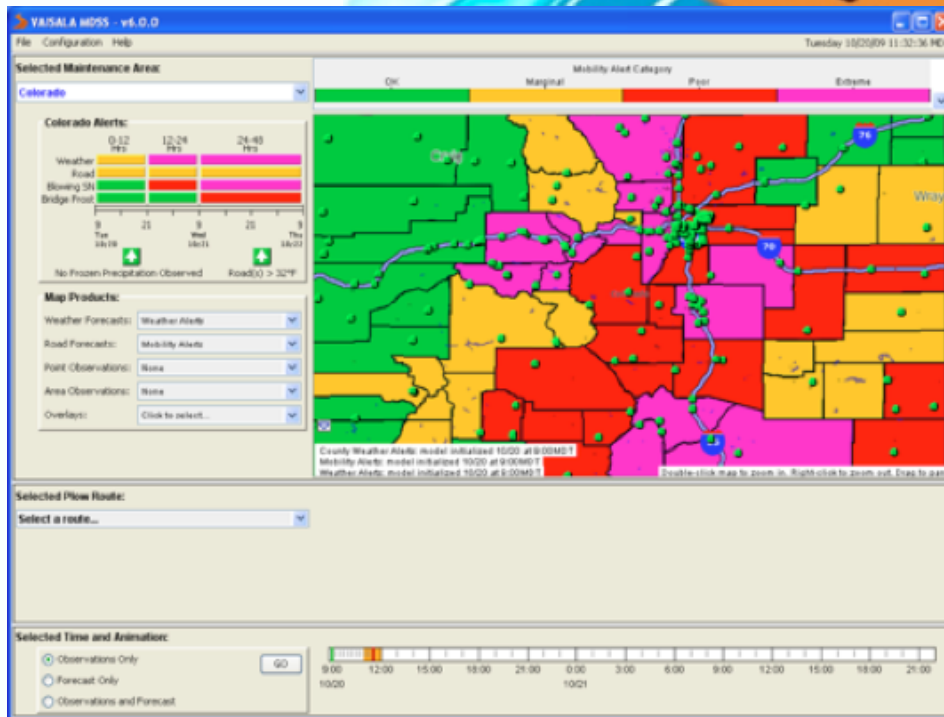
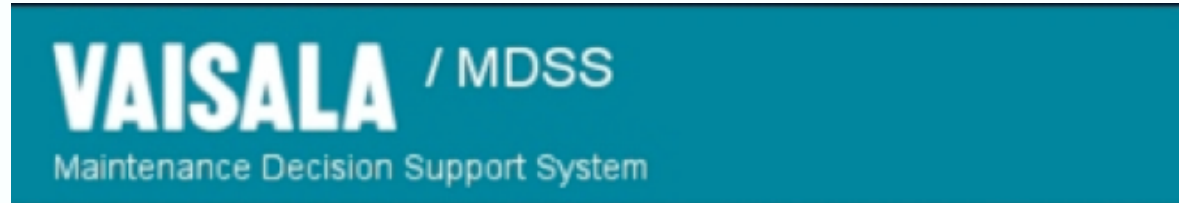
Observations & Forecast Parameters

9/23/09

New Jersey's Science & Technology University

New Deployments

Vaisala – Denver and E470



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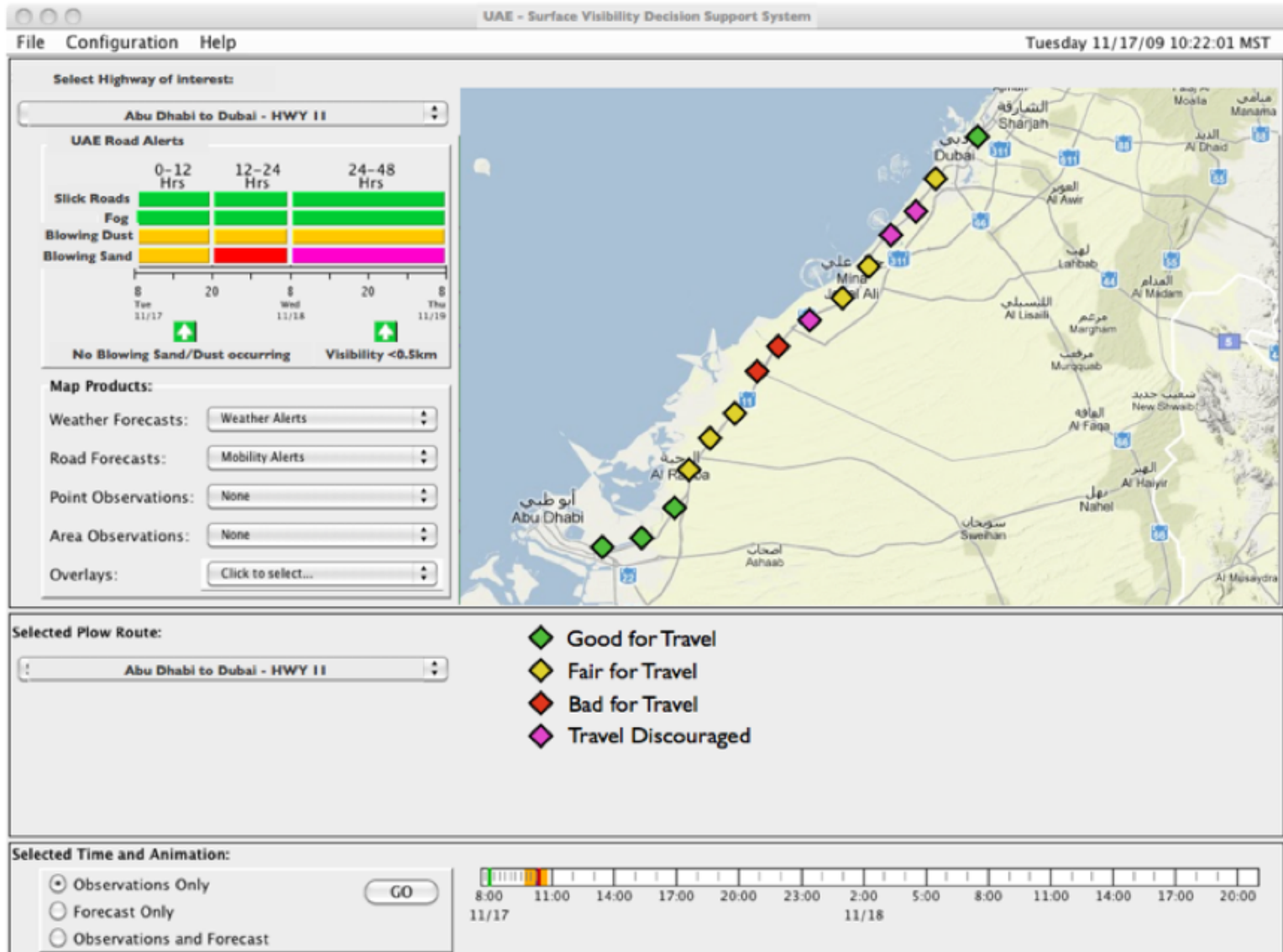
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Future Applications

Maintenance and Operations Decision Support System (MODSS)

- *Clarus* regional demonstration
- Non-winter weather system
- Provide support for maintenance activities such as:
 - weed spraying
 - lane striping
 - pothole repair
 - mowing
 - other weather impacted activities

Future Applications



MDSS Information

NCAR Maintenance Decision Support System | RAL

You are here: NCAR • RAL • Maintenance Decision Support System (MDSS)

Maintenance Decision Support System

Controlling snow and ice buildup on roadways during winter weather events presents several challenges for winter maintenance personnel. Among these challenges is the need to make effective winter maintenance decisions (treatment types, timing, rates, and locations), as these decisions have a considerable impact on roadway safety and efficiency. Additionally, poor decisions can have adverse economic and environmental consequences. In an effort to mitigate the challenges associated with winter maintenance decisions, the Federal Highway Administration (FHWA) Office of Transportation Operations (HOTO) initiated a program in 2001 aimed at developing a winter road Maintenance Decision Support System (MDSS).

The MDSS project goal is to develop a prototype capability that:

- Capitalizes on existing road and weather data sources,
- Augments data sources where they are weak or where improved accuracy could significantly improve the decision-making task,
- Fuses data to make an open, integrated and understandable presentation of current environmental and road conditions,

Latest News & Events

15th World Congress on ITS
November 16-20, 2008
New York City, NY
[see details](#)

88th Annual Transportation Research Board Annual Meeting
January 11-15, 2009
Washington, DC
[see details](#)

89th Annual American Meteorological Society Annual Meeting
January 11-15, 2009
Phoenix, AZ
[see details](#)

Sixth stakeholder meeting for the Clarus Initiative Coordinating Committee (ICC)
August 4-5, 2008
Silver Legacy Resort, Reno, Nevada
contact: Andy Stern | astern@nobis.org | 703-610-1754 or Paul Pisano | paul.pisano@dot.gov | 202-366-1301

Maintenance Decision Support System (MDSS) Stakeholder Meeting
August 6-7, 2008
Silver Legacy Resort, Reno, Nevada
contact: Andy Stern | astern@nobis.org | 703-610-1754 or Paul Pisano | paul.pisano@dot.gov | 202-366-1301

http://www.rap.ucar.edu/projects/rdwx_mdss

Mike Chapman - mchapman@ucar.edu

Sheldon Drobot - drobot@ucar.edu

