

MDSS Development & Deployment

Accomplishments of the Pooled Fund Study Maintenance Decision Support System

David L. Huft

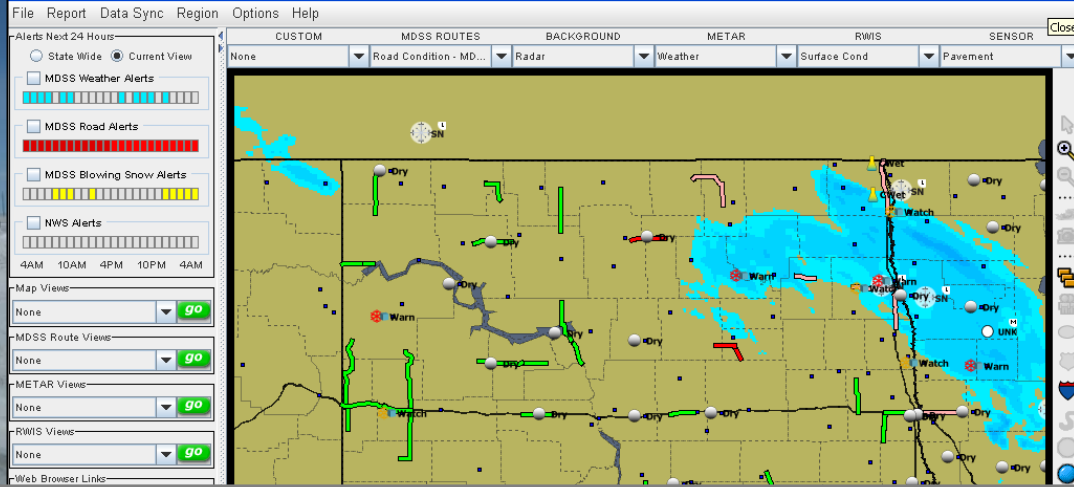
South Dakota Department of Transportation

Leon F. Osborne, Jr.

Meridian Environmental Technology, Inc.

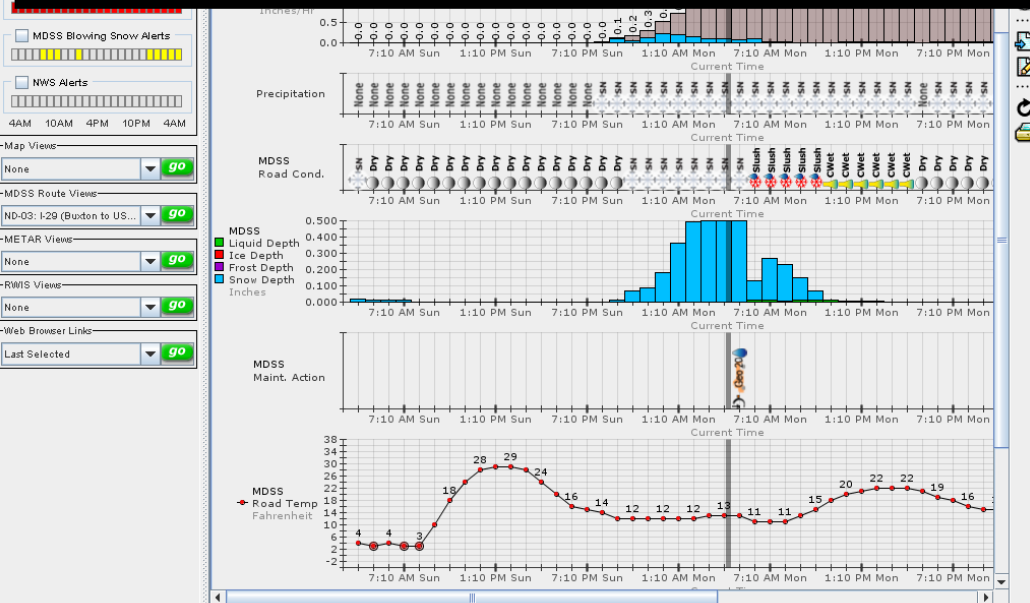
Presented at the MDSS Stakeholders Meeting #10

Reno, NV August 6, 2008



Pooled Fund Study (PFS)

Maintenance Decision Support System

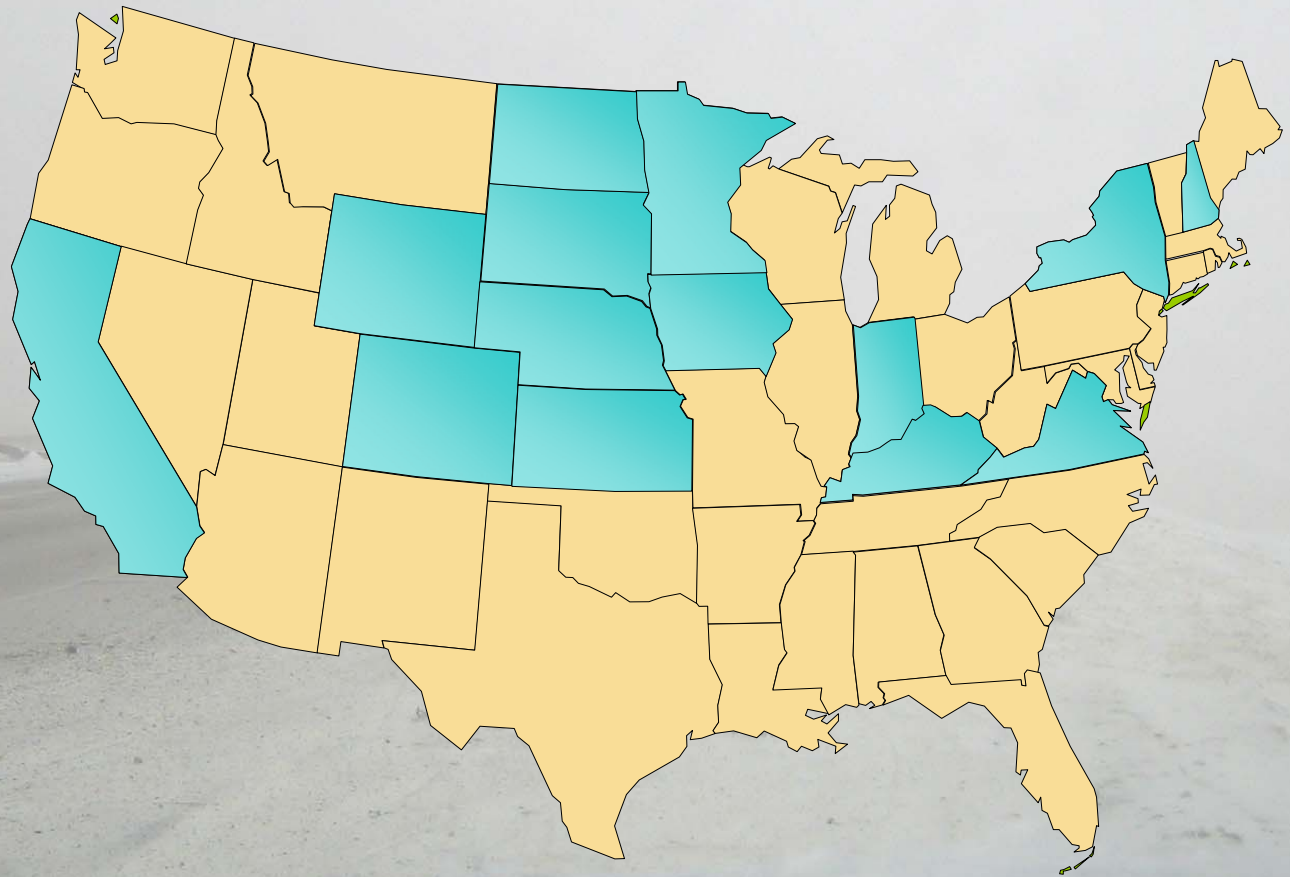


Pooled Fund Study TPF-5(054) Beginnings

- Roots in FHWA-led Surface Transportation Weather Decision Support Requirements (STWDSR)
- 2001: MN, ND, SD, & Meridian discuss Multi-State MDSS alternative to Functional Prototype
- June 2002: SDDOT Research Project Statement for Pooled Fund Study MDSS (IN, MN, ND, SD)
- September 2002: Kickoff meeting identified issues to guide MDSS Development
- November 2002: Contract award to Meridian

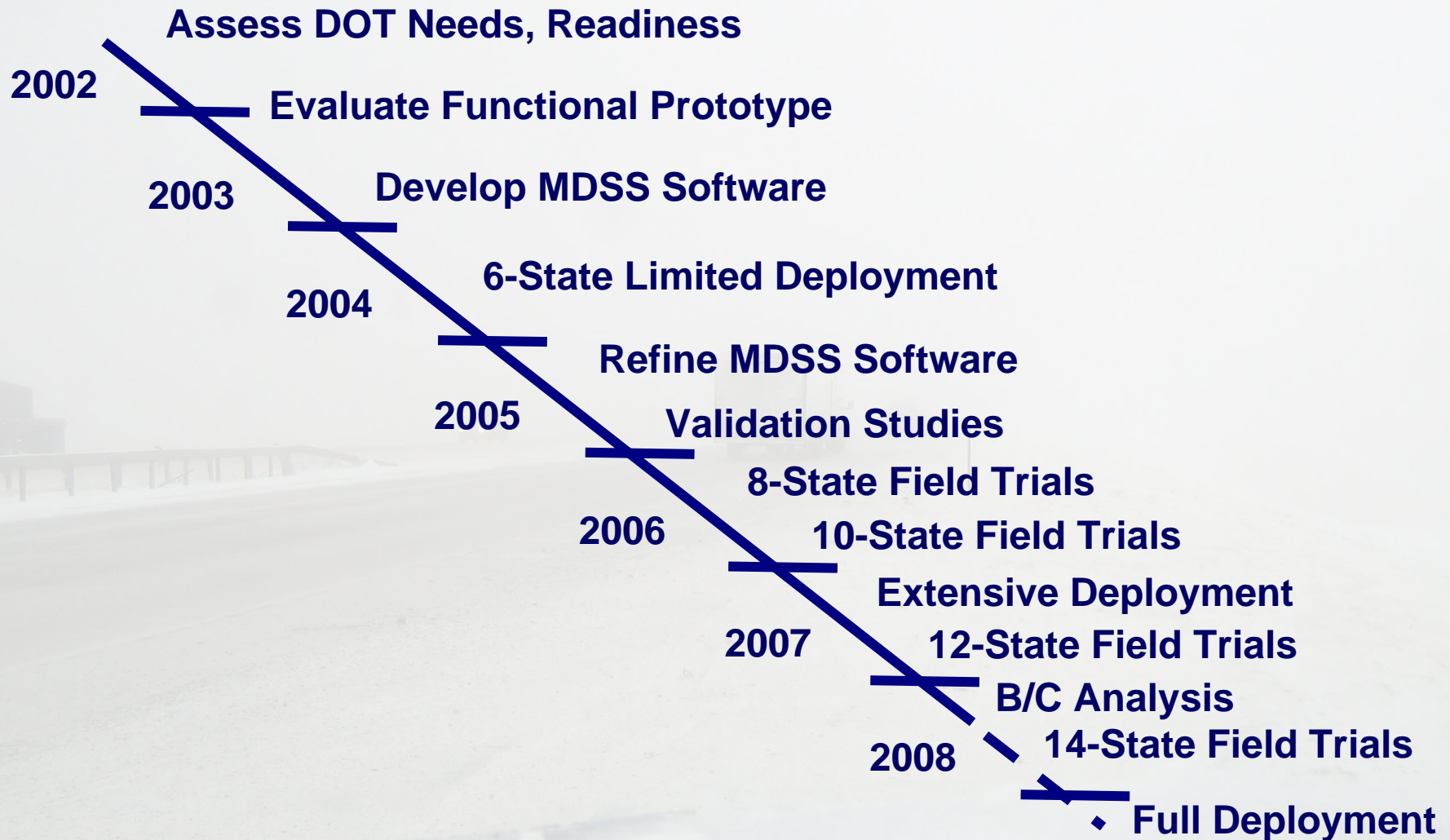
PFS MDSS Growth

**5 states
(2002)**



**14 states
(2008)**

Pooled Fund MDSS Timeline



MDSS Operating Premise

If you know...

- Road characteristics
- Current conditions
- Weather forecast
- Physics & chemistry of snow, ice, chemicals
- Available resources (material, equipment, schedule)

Then you can recommend...

- Treatment type
- Application rate
- Optimal timing

...and predict

- Future road conditions with or without treatments

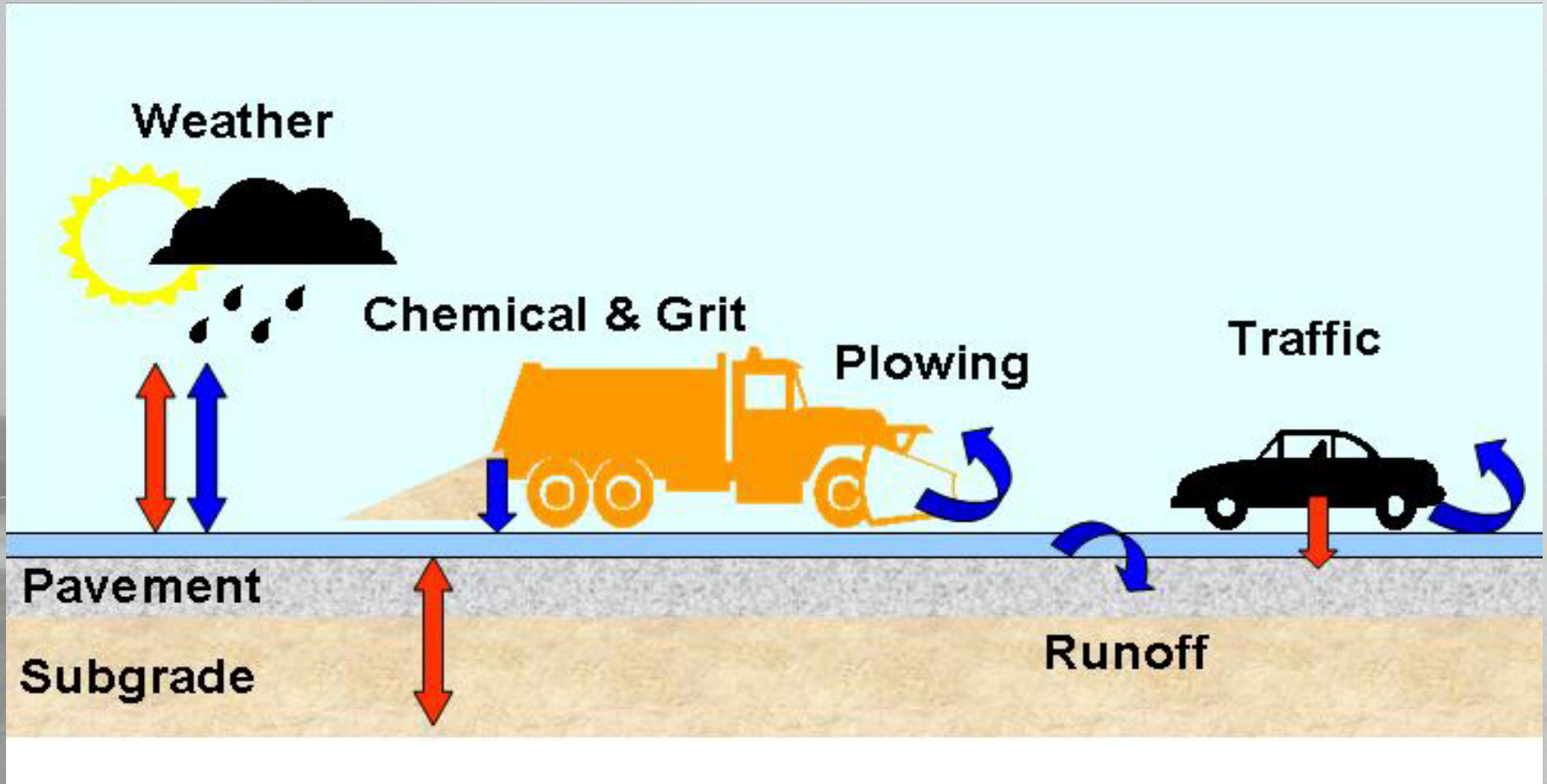
PFS MDSS Objectives

- **Integrate**
 - **Maintenance practices & policies**
 - **Available maintenance resources**
 - **Previously reported maintenance treatments**
 - **Road conditions and predictions**
 - **Weather conditions and forecasts**
- **To Yield**
 - ❖ **Continuously updated maintenance recommendations**
 - ❖ **Mechanisms that enable “What If” decision support**

Concept of Operations

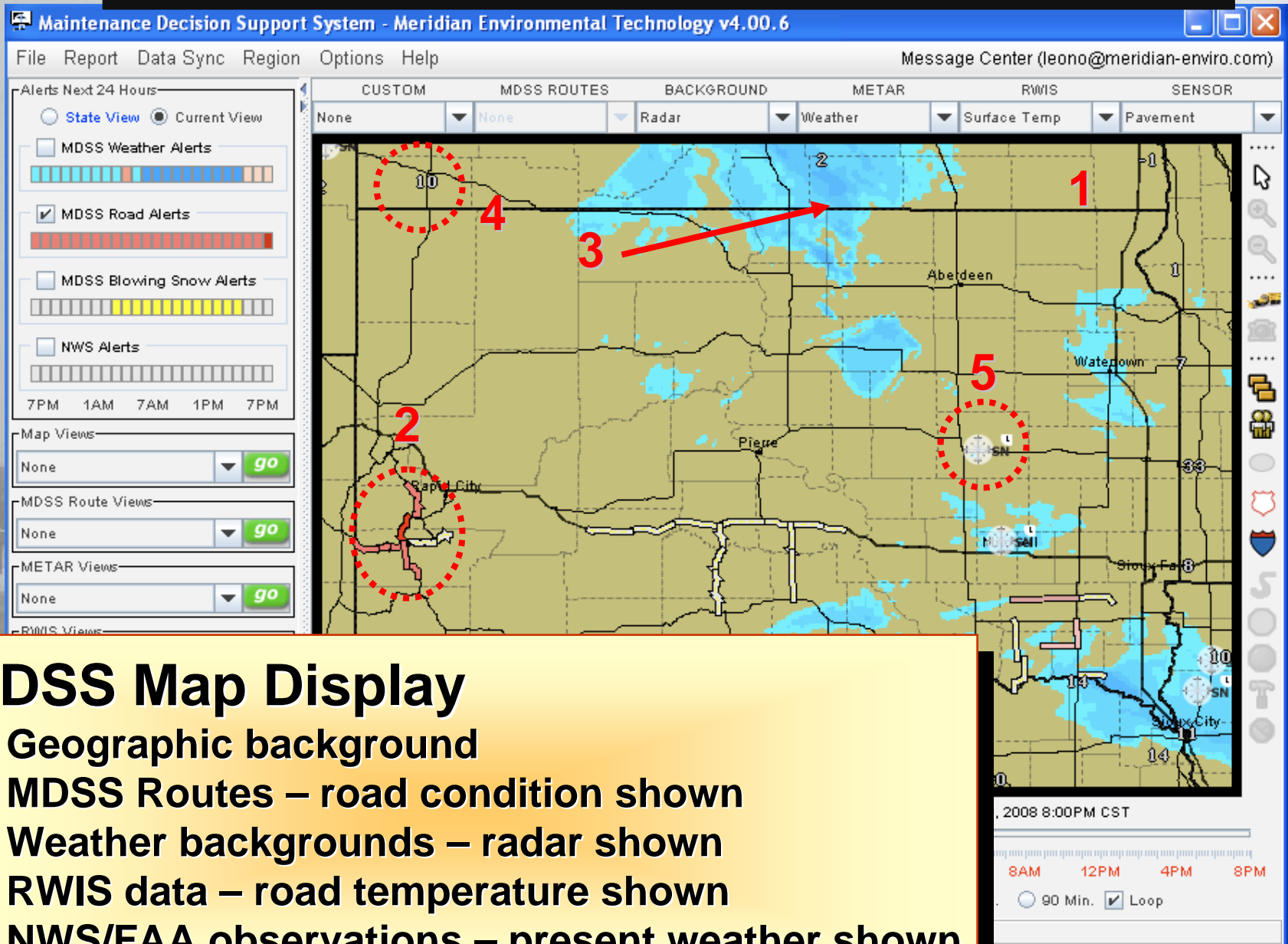
- **Weather creates a dynamic layer on the road surface**
- **The intent of maintenance is to modify or remove this layer in the most effective and efficient manner**
- **The goal is to improve safety and mobility**

MDSS Mass & Energy Model



MDSS modeling requires knowledge of plowing and chemical applications

PFS MDSS Accomplishments



MDSS Map Display

1. Geographic background
2. MDSS Routes – road condition shown
3. Weather backgrounds – radar shown
4. RWIS data – road temperature shown
5. NWS/FAA observations – present weather shown

PFS MDSS Accomplishments

Maintenance Decision Support System - Meridian Environmental Technology v4.00.6

File Report Data Sync Region Options Help Message Center (leono@meridian-enviro.com)

CUSTOM MDSS ROUTES BACKGROUND METAR RWIS SENSOR

None None Radar Weather Surface Temp Pavement

Alerts Next 24 Hours

- State View Current View
- MDSS Weather Alerts
- MDSS Road Alerts
- MDSS Blowing Snow Alerts
- NWS Alerts

7PM 1AM 7AM 1PM 7PM

Map Views: None go

MDSS Route Views: None go

METAR Views: None go

RWIS Views: None go

Web Browser Links: Last Selected go

Total (Recv): 16.35 MB
Server (Recv): 16.35 MB
Peers (Recv): ---
Peers (Sent): ---
Files Sync'd: 4479/6523 (69%)
Peer Count: ---

MDSS Alert System

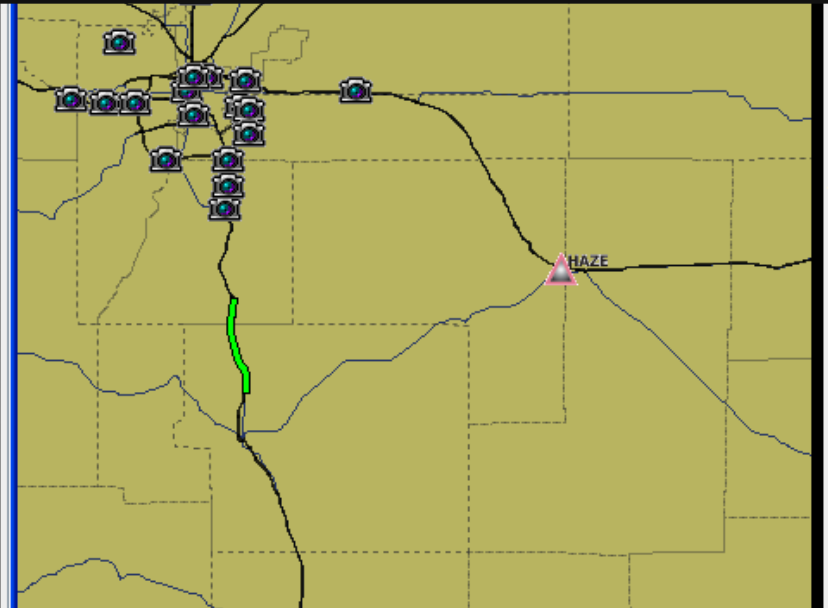
- Weather alerts
- Road condition alerts
- Blowing snow alerts
- National Weather Service watches and warnings

Current Time: Sun Feb 10, 2008 8:00PM CST Selected Time: Sun Feb 10, 2008 8:00PM CST

8PM 12AM 4AM 8AM 12PM 4PM 8PM 12AM 4AM 8AM 12PM 4PM 8PM

Meridian Environmental Technology

PFS MDSS Accomplishments



Current Time: Wed Jan 18, 2006 8:30AM MST

8AM 12PM 4PM 8PM 12AM 4AM 8AM

1 Hour 10 Min. Loop

MDSS
incorporates camera
images as a
support resource

PFS MDSS map is a link to more detailed pavement and weather info

File

Alerts Next 24 Hours

State View Current View

MDSS Weather Alerts

MDSS Road Alerts

MDSS Blowing Snow Alerts

NWS Alerts

7PM 1AM 7AM 1PM 7PM

Map Views

None

MDSS Route Views

None

METAR Views

None

RWIS Views

None

Web Browser Links

Last Selected

Total (Recv): 16.35 MB
Server (Recv): 16.35 MB
Peers (Recv): ---
Peers (Sent): ---
Files Sync'd: 4479/6523 (69%)
Peer Count: ---

CUSTOM MDSS ROUTES BACKGROUND METAR RWIS SENSOR

None None Radar Weather Surface Temp Pavement

Current Time: Sun Feb 10, 2008 8:00PM CST Selected Time: Sun Feb 10, 2008 8:00PM CST

8PM 12AM 4AM 8AM 12PM 4PM 8PM 12AM 4AM 8AM 12PM 4PM 8PM

▶ || ■ ◀▶ ● 10 Min. ○ 20 Min. ○ 30 Min. ○ 60 Min. ○ 90 Min. Loop

Meridian Environmental Technology

Alerts Next 24 Hours

State Wide Current View

MDSS Weather Alerts

MDSS Road Alerts

MDSS Blowing Snow Alerts

NWS Alerts

7PM 1AM 7AM 1PM 7PM

Map Views

Colorado

MDSS Route Views

CO-01: I-25 (USAF Acade...

METAR Views

CO-01: I-25 (USAF Academy to Greenfield Exit)

Cheyenne (Cheyenne Air...

RWIS Views

None

Web Browser Links

Last Selected

Custom Refresh

None / Alternative MDSS (Recommended) Standard

Tue 11:50AM	61	Damp	0	0.00	61	Damp	0	0.00	SSW 4	4	RA	0.00	Tue 11:50AM
Tue 10:50AM	54	Damp	0	0.00	54	Damp	0	0.00	↑ S 6	4	MX	0.00	Tue 10:50AM
Tue 09:50AM	47	Damp	0	0.00	47	Damp	0	0.00	↑ S 5	4	SN	0.00	Tue 09:50AM
Tue 08:50AM	41	Damp	0	0.00	41	Damp	0	0.00	↖ SE 2	0	None	0.00	Tue 08:50AM
Tue 07:50AM	36	Damp	0	0.00	36	Damp	0	0.00	↓ NNE 5	8	SN	0.01	Tue 07:50AM
Tue 06:50AM	36	Wet	0	0.00	36	Wet	0	0.00	↖ NE 5	0	SN	0.04	Tue 06:50AM
Tue 05:50AM	36	Wet	0	0.00	36	Wet	0	0.00					
Tue 04:50AM	36	Wet	0	0.00	36	Wet	0	0.00					
Tue 03:50AM	36	Wet	0	0.00	36	Wet	0	0.00					
Tue 02:50AM	36	Wet	0	0.00	36	Wet	0	0.00					
Tue 01:50AM	35	Wet	0	0.00	36	Wet	0	0.00					
Tue 12:50AM	35	Wet	0	0.00	35	Wet	0	0.00					
Mon 11:50PM	34	Wet	0	0.00	34	Wet	0	0.00					
Mon 10:50PM	33	Wet	0	0.00	33	Wet	0	0.00					
Mon 09:50PM	33	Wet	0	0.00	33	Wet	0	0.00					
Mon 08:50PM	32	Wet	0	0.00	32	Wet	0	0.00					
Mon 07:50PM	32	Slush	31	MgCl ₂ 40	0.18	32	Slush	31					
Mon 06:50PM	32	Slush	26	MgCl ₂ 35	0.12	32	Slush	26					
Mon 04:50PM	34	Wet	0	0.00	34	Wet	0	0.00					
Mon 03:50PM	37	Wet	0	0.00	37	Wet	0	0.00					
Mon 02:50PM	39	Wet	0	0.00	39	Wet	0	0.00					
Mon 01:50PM	40	Wet	0	0.00	40	Wet	0	0.00					
Mon 12:50PM	37	Wet	0	MgCl ₂ 35	0.00	37	Wet	0					
Mon 11:50AM	36	Wet	10	MgCl ₂ 35	0.03	36	Wet	10					
Mon 10:50AM	36	Wet	0	0.00	36	Wet	0	0.00					
Mon 09:50AM	34	Wet	17	MgCl ₂ 35	0.09	34	Wet	17					
Mon 08:50AM	33	Slush	52	0.44	33	Slush	52	0.44					
Mon 07:50AM	32	Slush	46	MgCl ₂ 35	0.33	32	Slush	46					
Mon 06:50AM	33	Slush	52	mix 400	0.45	33	Slush	52					
Mon 05:50AM	33	Slush	54	0.48	33	Slush	54	0.48					
Mon 04:50AM	33	Slush	41	0.29	33	Slush	41	0.29					
Mon 03:50AM	32	Wet	3	MgCl ₂ 16	0.01	32	Wet	3	MgCl ₂ 16	0.01	NW 16	0.50	Mon 03:50AM
Mon 02:50AM	32	Wet	3	0	0.01	32	Wet	3	0	0.01	NW 17	0.50	Mon 02:50AM
Mon 01:50AM	32	Slush	52	0.47	32	Slush	52	0.47	NW 16	0.47	SN	0.67	Mon 01:50AM
Mon 12:50AM	32	Slush	38	0.27	32	Slush	38	0.27	NW 16	0.27	SN	0.47	Mon 12:50AM
Sun 11:50PM	32	Slush	42	0.32	32	Slush	42	0.32	NW 14	0.32	SN	0.92	Sun 11:50PM
Sun 10:50PM	33	Wet	0	0.00	33	Wet	0	0.00	NNW 15	0.00	SN	0.58	Sun 10:50PM
Sun 09:50PM	37	Wet	0	0.00	37	Wet	0	0.00	NNW 18	0.00	SN	0.33	Sun 09:50PM
Sun 08:50PM	39	Wet	0	0.00	39	Wet	0	0.00	NNW 18	0.00	SN	0.15	Sun 08:50PM
Sun 07:50PM	44	Wet	0	0.00	44	Wet	0	0.00	NNW 15	0.00	RA	0.00	Sun 07:50PM

PFS MDSS

integrates maintenance actions reported from manual and automated sources

- Maintenance actions
- Road conditions
- Weather conditions
- Pavement temperatures

Hwy 37 (Hwy 50 to Hwy 18) SD-07-1

Date Time	Road Temp	Road Cond	% Ice	Maint Action	Road Ice Depth	Road Liq Depth	Road Snow Depth	Air Temp	Dew Pt	Precip Prob	Precip Type	Liq Rate	Snw Rate	Date Time
Sat 08:50PM	17	Slush	45		0.004	0.005	0.00	9	6	0	None	0.000	0.00	Sat 08:50PM
Sat 07:50PM	17	Slush	44		0.004	0.005	0.00	10	8	0	None	0.000	0.00	Sat 07:50PM
Sat 06:50PM	17	Slush	43		0.004	0.005	0.00	11	9	0	None	0.000	0.00	Sat 06:50PM
Sat 05:50PM	18	Slush	42		0.005	0.006	0.00	13	10	0	None	0.000	0.00	Sat 05:50PM
Sat 04:50PM	19	Slush	40		0.005	0.007	0.00	14	11	0	None	0.000	0.00	Sat 04:50PM
Sat 03:50PM	22	Wet	8		0.000	0.009	0.01							
Sat 02:50PM	24	Wet	10		0.000	0.011	0.02							
Sat 01:50PM	25	Slush	21		0.000	0.012	0.06							
Sat 12:50PM	25	Slush	40		0.001	0.012	0.15							
Sat 11:50AM	24	Slush	56		0.001	0.011	0.26							
Sat 10:50AM	23	Slush	61		0.001	0.011	0.34							
Sat 09:50AM	22	Slush	67		0.001	0.010	0.40							
Sat 08:50AM	21	Slush	73		0.001	0.009	0.46							
Sat 07:50AM	20	Slush	73		0.001	0.009	0.49							
Sat 06:50AM	20	Slush	74		0.001	0.009	0.52							
Sat 05:50AM	21	Slush	73		0.001	0.010	0.52							
Sat 04:50AM	20	Slush	71		0.001	0.010	0.48							
Sat 03:50AM	20	Slush	73		0.001	0.010	0.52							
Sat 02:50AM	20	Slush	74		0.001	0.010	0.55							
Sat 01:50AM	19	Slush	76		0.000	0.010	0.60							
Sat 12:50AM	19	Slush	77		0.000	0.010	0.64							
Fri 11:50PM	19	Slush	76		0.000	0.010	0.65							
Fri 10:50PM	19	Slush	75		0.000	0.010	0.63							
Fri 09:50PM	18	Slush	75		0.000	0.010	0.61							
Fri 08:50PM	18	Slush	74		0.000	0.010	0.55							
Fri 07:50PM	18	Slush	70		0.000	0.010	0.46							
Fri 06:50PM	17	Slush	67		0.000	0.010	0.40							
Fri 05:50PM	17	Slush	61		0.000	0.010	0.32							
Fri 04:50PM	17	Slush	50		0.000	0.011	0.21							
Fri 03:50PM	17	Slush	74	mix 2400	0.000	0.002	0.09							
Fri 02:50PM	18	Slush	65		0.000	0.002	0.07							
Fri 01:50PM	18	Slush	67		0.000	0.002	0.09							
Fri 12:50PM	18	Slush	67		0.000	0.002	0.08							
Fri 11:50AM	17	Wet	0	mix 601	0.000	0.001	0.00							
Fri 10:50AM	16	SN	96		0.001	0.000	0.02							
Fri 09:50AM	17	Ice	93		0.001	0.000	0.00	9	5	30	SN	0.000	0.20	Fri 09:50AM
Fri 08:50AM	15	SN	96		0.001	0.000	0.02	7	4		SN	0.000	0.09	Fri 08:50AM
Fri 07:50AM	15	Ice	95		0.001	0.000	0.01	6	2		SN	0.000	0.02	Fri 07:50AM
Fri 06:50AM	14	Ice	95		0.001	0.000	0.01	5	0		None	0.000	0.00	Fri 06:50AM

PFS MDSS generates maintenance recommendations showing

- Road temperature
- Road condition
- Percent ice
- Maintenance actions
- Depth of ice
- Depth of liquid
- Depth of snow

PFS MDSS Graphic Route Display

Forecasted Weather Conditions

Message Center (leono@meridian-enviro.com)
 None / Alternative MDSS (Recommended) Standard

MDSS Road Alerts
 MDSS Blowing Snow Alerts
 NWS Alerts

8PM 2AM 8AM 2PM 8PM

Map Views: None

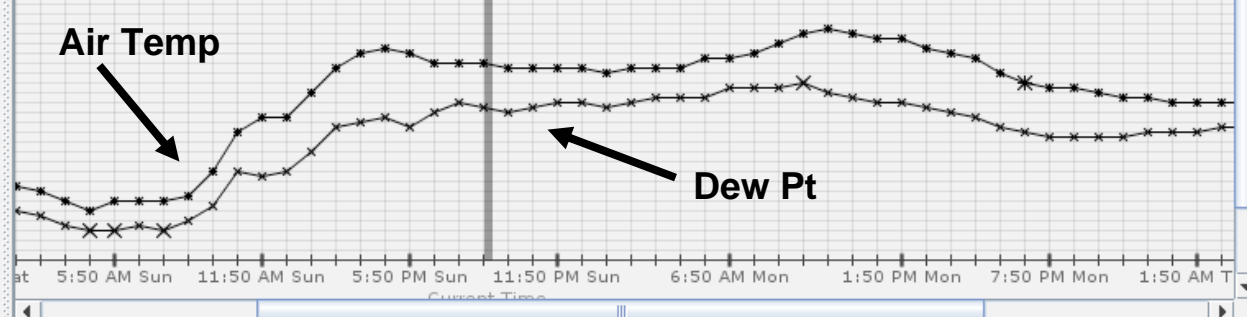
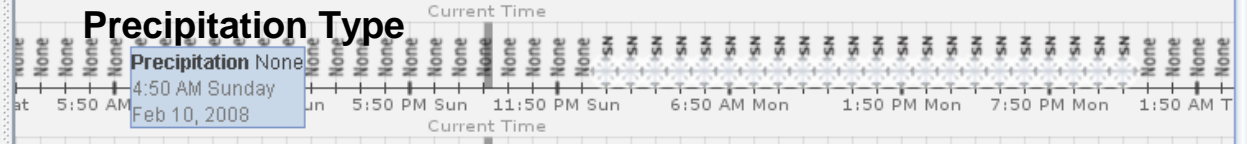
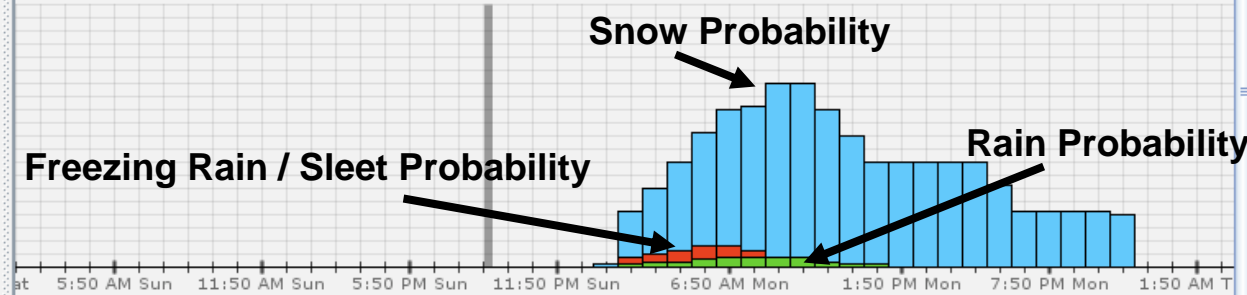
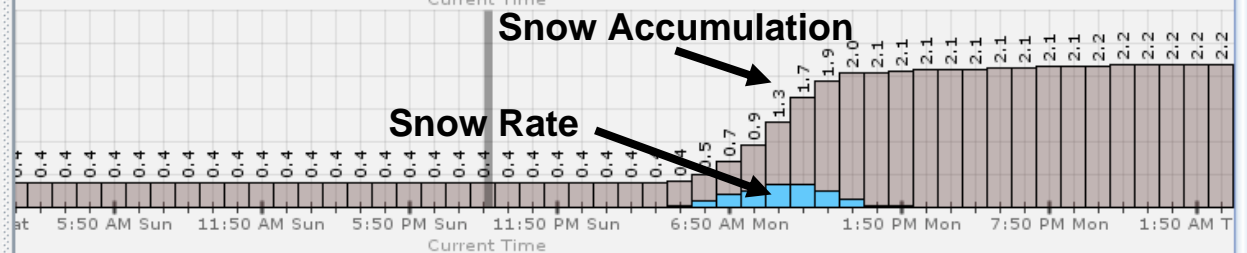
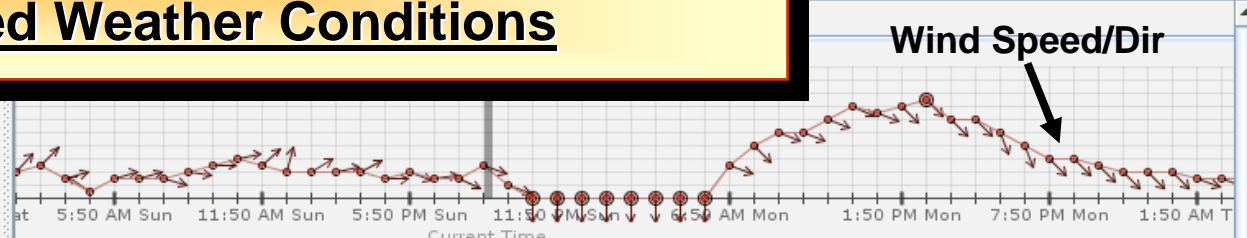
MDSS Route Views: US 385: Custer to Wind C...

METAR Views: None

RWIS Views: None

Web Browser Links: Last Selected

Total (Recv): 30.12 MB
 Server (Recv): 30.12 MB
 Peers (Recv): ---
 Peers (Sent): ---
 Files Sync'd: 4060/6517 (62%)
 Peer Count: ---



Alerts Next 24 Hours

State View Current View

MDSS Weather Alerts

MDSS Road Alerts

MDSS Blowing Snow Alerts

NWS Alerts

8PM 2AM 8AM 2PM 8PM

Map Views

None

MDSS Route Views

US 385: Custer to Wind C...

METAR Views

None

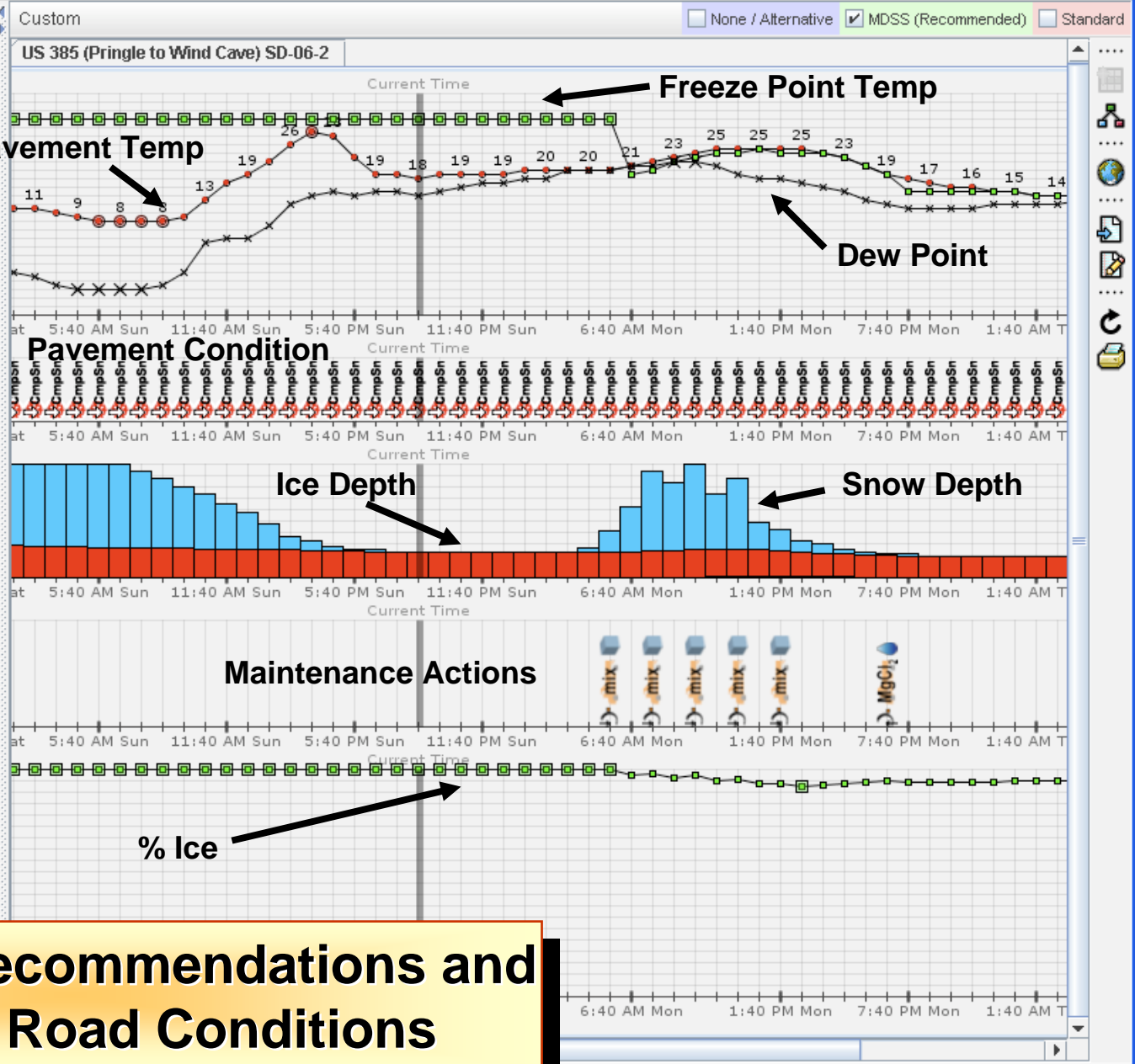
RWIS Views

None

Web Browser Links

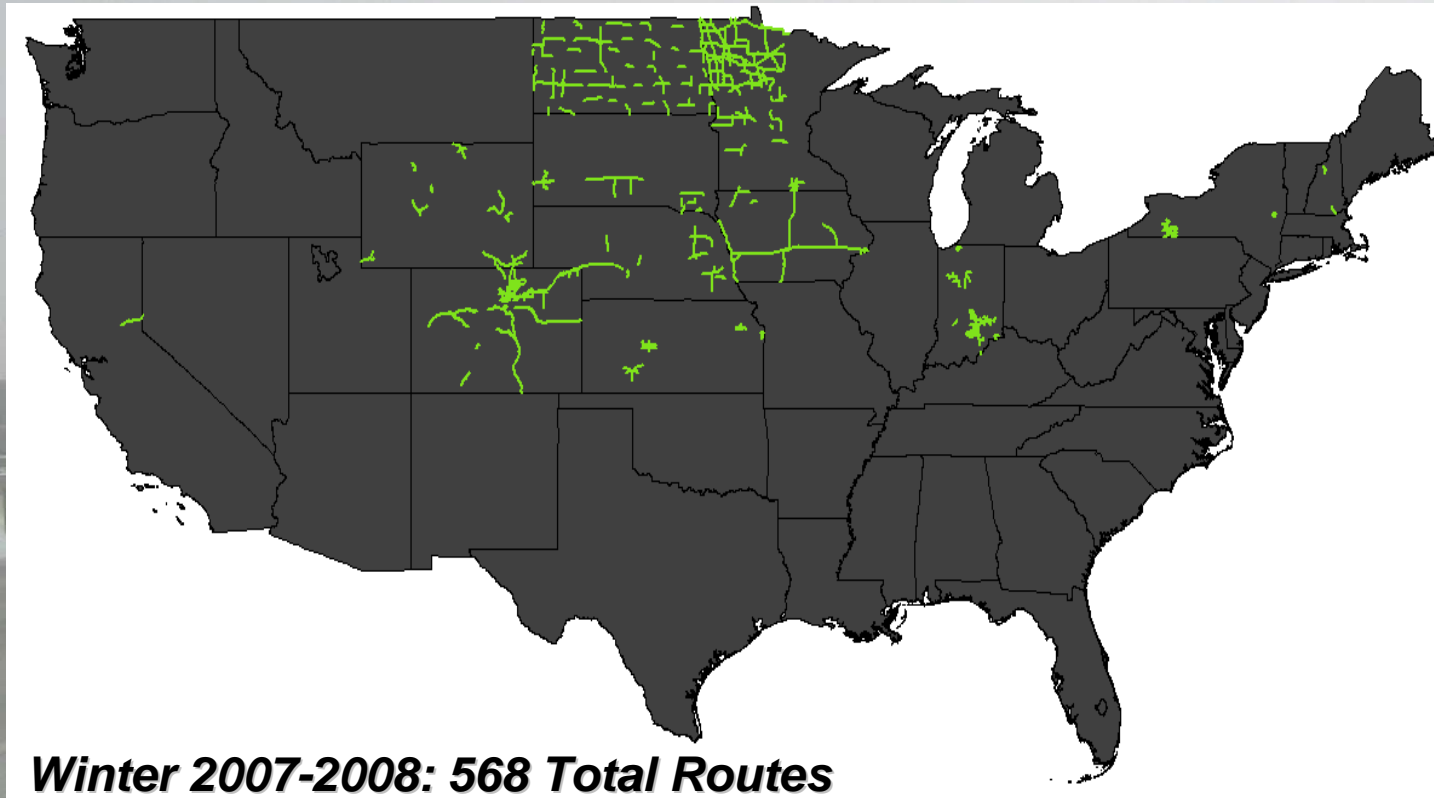
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Peers (Sent): ---
Files Sync'd: 4089/6511 (63%)
Peer Count: ---



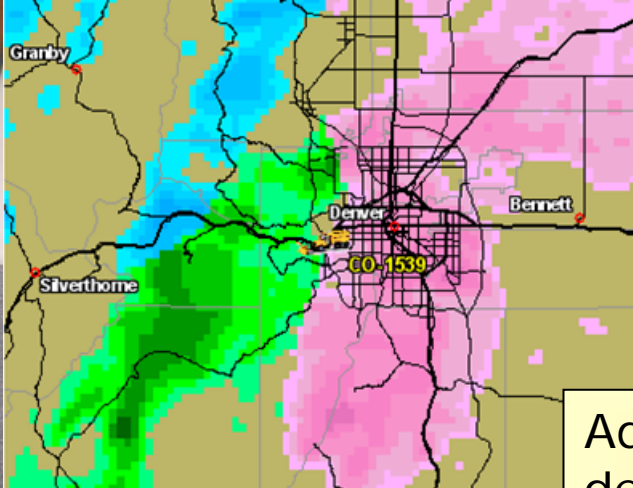
Maintenance Recommendations and Forecasted Road Conditions

MDSS Routes Supported: 2007-2008



CA	6
CO	89
IN	50
IA	67
KS	18
KY	NEW
MN	142
NE	28
NH	4
NY	19
ND	77
SD	24
VA	19
WY	25

In-Vehicle MDC/AVL MDSS



Recommended Actions:

Start Time	Practice	Rate
For I-70A, MP 258.72-265.73, Passing:		
Wed 02:16 MDT	Ice Slicer	100lbs
For I-70A, MP 265.73-269.01, Driving:		
Wed 02:16 MDT	Ice Slicer	100lbs
For I-70A, MP 265.73-269.01, Middle:		
Wed 02:16 MDT	Ice Slicer	100lbs
For I-70A, MP 265.73-269.01, Passing:		
Wed 02:16 MDT	Ice Slicer	100lbs

Forecast:

Time	Wind speed (miles/hour)	Wind Direction	Precip Type	Precip Prob (%)	Snow Rate (in/hour)	Cloud Cover (%)
Tue 14:00 MDT	2	NNE	RA	70	-	100
Tue 15:00 MDT	2	NNE	RA	90	-	100
Tue 16:00 MDT	2	NNE	RA	90	-	100
Tue 17:00 MDT	2	NNE	RA	80	100	100

Advanced method for determining real-time maintenance actions. Two way data flow maximizes value of MDC/AVL systems



SDDOT Maintenance Decision Support System 12/01/06 10:50:20
MAIN MENU

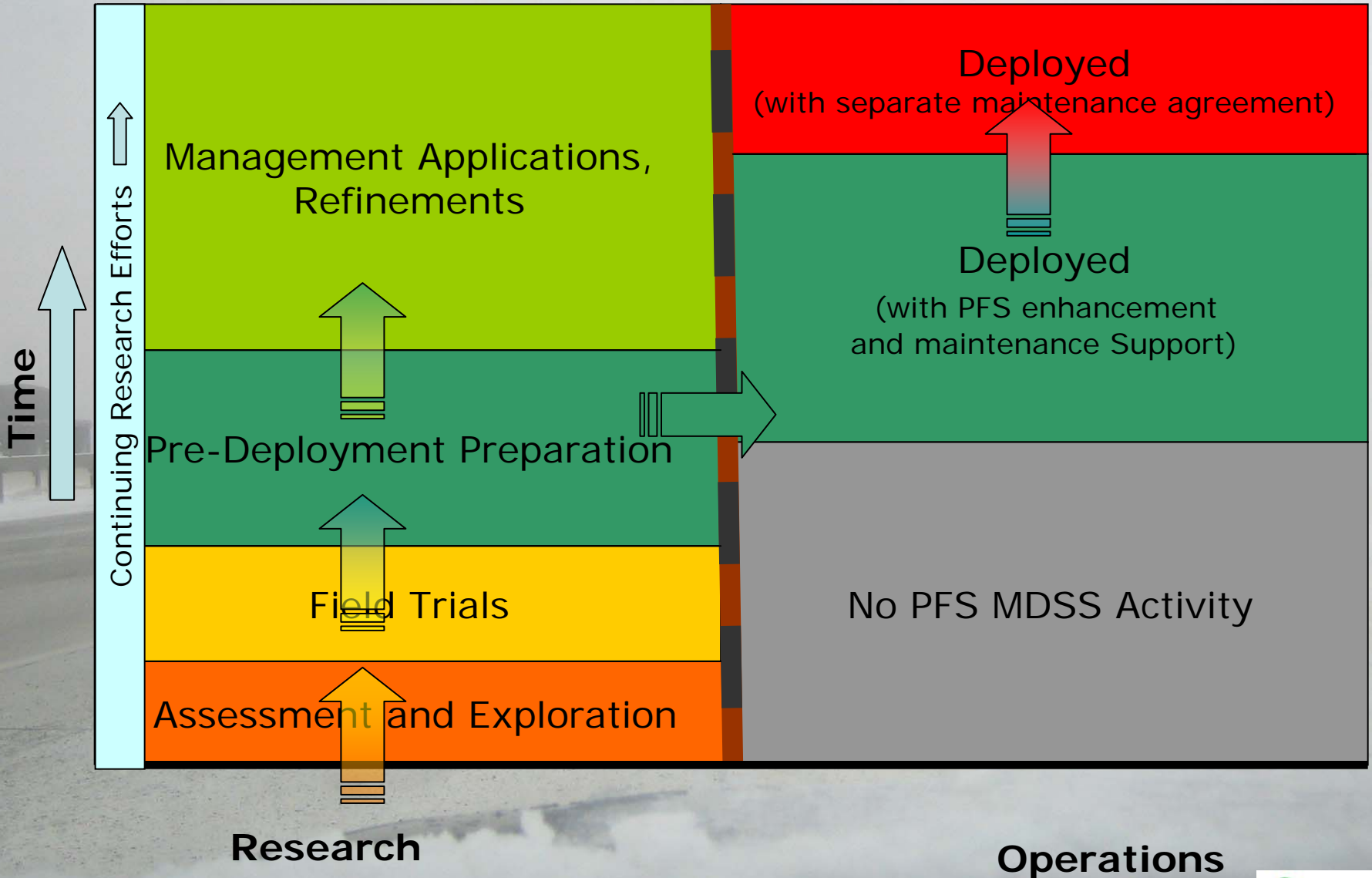
<p>DEMO</p> <p>TRUCK</p> <p>FRONT: ↑</p> <p>↑ WINGS ↓</p> <p>UNDERBODY: ↑</p>	<p>80% / 20% Sand/NaCl</p> <p>Rate: 700 lb/mi</p> <p>MATERIAL</p> <p>30% Other</p> <p>Rate: OFF</p>	<p>DIRECTION: EAST</p> <p>Treat: Turn Left Mid Right</p> <p>Plow: Turn Left Mid Right</p> <p>HIGHWAY</p> <p>Speed: 0 mph</p> <p>GPS: 90.000001°N 180.000001°E</p>
<p>Moderate Rain <1/4 Mile</p> <p>WEATHER</p> <p>64.4°F</p>	<p>Drifted Snow</p> <p>ROAD</p> <p>59°F</p>	<p>Communication Available</p> <p>MDSS</p>

MDC/AVL MDSS Use

- PFS states at varying levels of MDC/AVL implementation
- 366 total MDC/AVL units used 2007/2008
- Significant expansion expected 2008/2009

CA	N/A	NE	IWAPI(8)
CO	IWAPI (152)	NH	N/A
IN	IWAPI(12) Purdue U(8)	NY	AmeriTrak(37)
IA	N/A	ND	Location Tech (27)
KS	IWAPI(25)	SD	Intelligent Devices (4) → (104)
KY	N/A	VA	N/A
MN	IWAPI(70)/SEI	WY	IWAPI(23)

PF MDSS Transition to Deployment



Summary of Achievements

- GIS display of weather, pavement, route conditions
- Display of vehicle location and treatment history
- Display of video imagery
- Enhancement of alert system
- Site specific pavement condition modeling
- Integration of actual maintenance into pavement condition model
- Incorporation of standard maintenance practices where MDC/AVL data is not available
- Integration of traffic into pavement condition model

Summary of Achievements

- Introduction of innovative treatment recommendations based on performance and cost considerations
- Creation of in-vehicle display of weather conditions and route recommendations
- Modular, open architecture design
- Development of interface specifications
- Storm playback for training & analysis
- Support for Benefit/Cost analysis

For More Information

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