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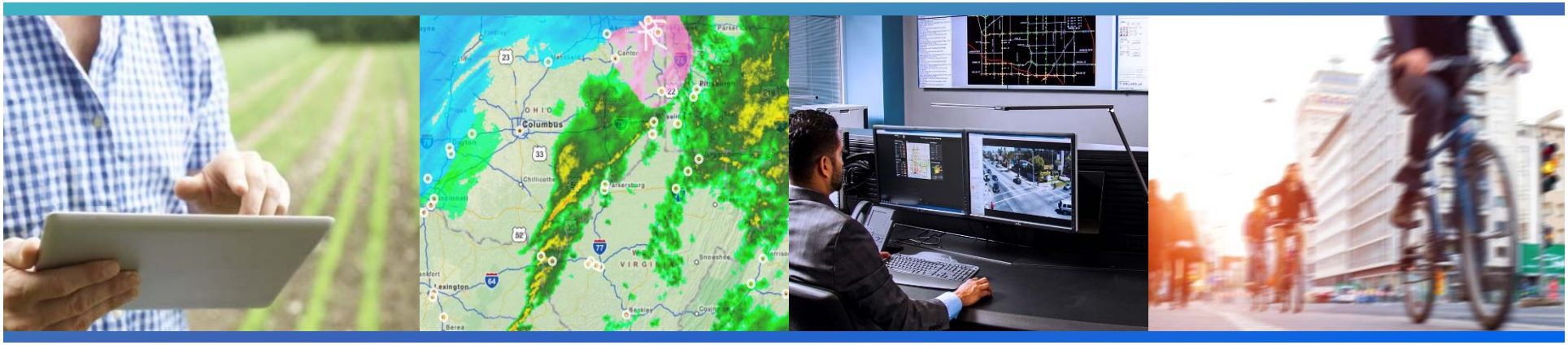

Maintenance Decision Support System (Pooled Fund Study)

Ben Hershey

Michigan Winter Operations Conference

Tuesday October 17th

Overview

- Who is Iteris
- What is MDSS
- What is a Pooled Fund Study
- How does MDSS Work
- MDSS Pavement model
- Impacts of telematics information (AVL/MDC)
- MDSS at Michigan DOT
- Research Topics within MDSS

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Iteris (NASDAQ: ITI) is a public company and a leader in agriculture and transportation informatics since 1999.

The company is comprised of three reporting segments:

- Roadway Sensors
- Transportation Systems
- Ag and Weather Analytics
  - ***ClearAg***: Agronomic Content & Software Analytics
  - ***ClearPath Weather*** Road-Weather Prescriptive Software

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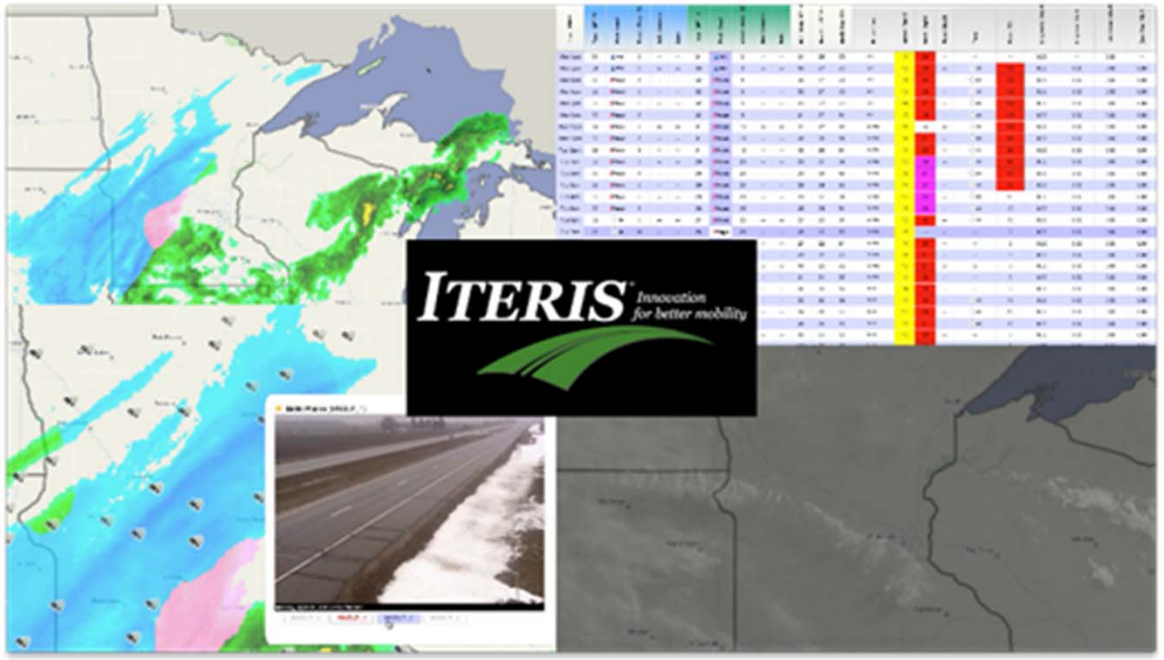
Grand Forks, ND – Office

- Over 19 years of experience of providing weather and pavement forecasting support to state agencies (DOT's)
- Iteris (formerly Meridian), was selected in 2002 as the prime contractor to the Pooled Fund Study Maintenance Decision Support System (PFS – MDSS)
- 24/7 Operational Support for both weather forecasting and 511 services



What is MDSS?

- A Maintenance Decision Support System is anything helping aid the maintenance decision process.
  - Prior Knowledge (Experience)
  - Snow and Ice Guidance Documents
  - RWIS-ESS Observations
  - Fellow operators/supervisors (Communication)
  - “That’s the way we’ve always done it”
  - A computer system that integrates weather, road and maintenance information to provide scientifically driven recommendations

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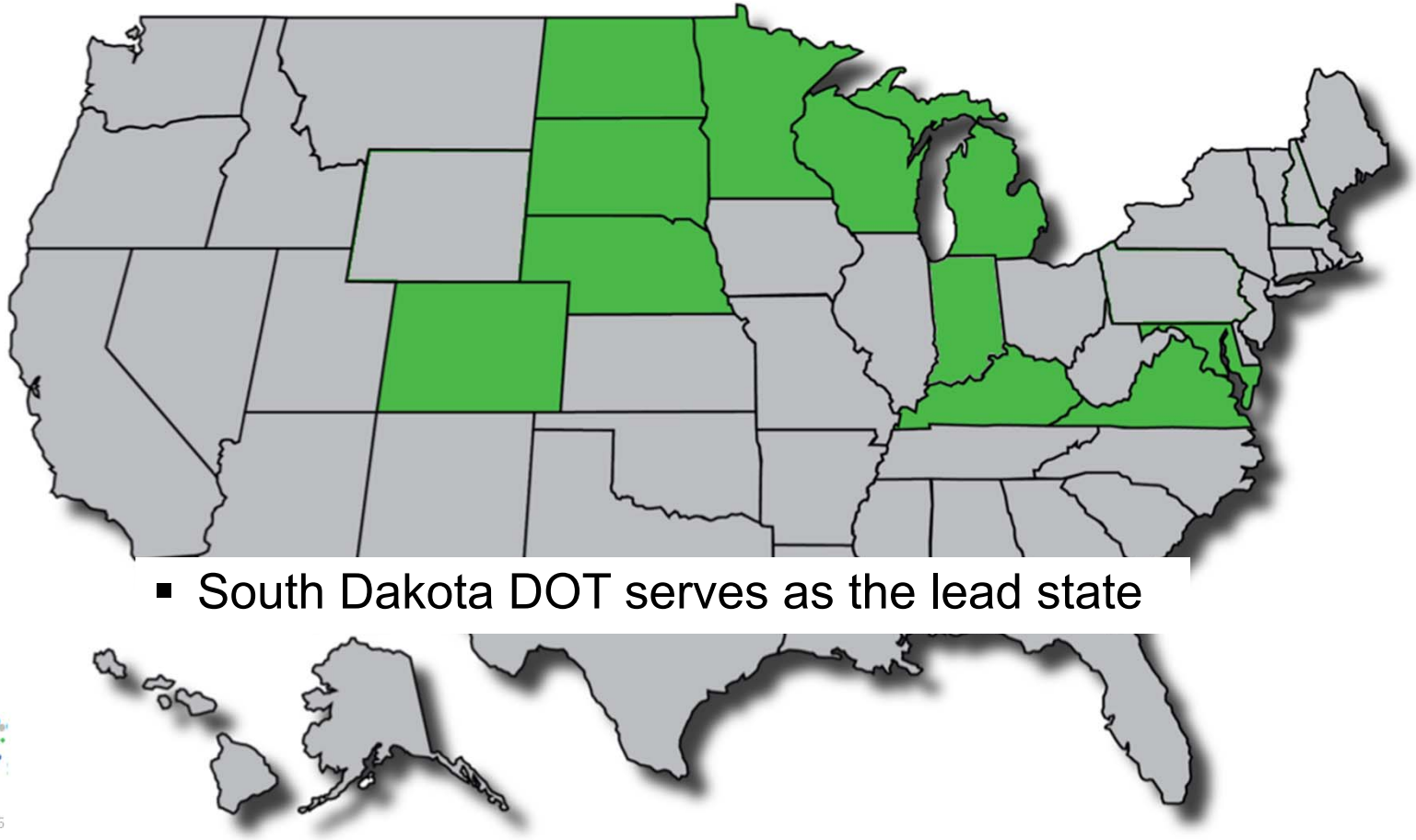
Pooled Fund Studies

- When significant or widespread interest is shown in solving transportation-related problems, research, planning, and technology transfer activities may be jointly funded by several federal, state, regional, and local transportation agencies, academic institutions, foundations, or private firms as a **Pooled Fund Study**.

- There are many different Pooled Fund Studies in existence today

- The Maintenance Decision Support System Pooled Fund Study was started in 2002

MDSS PFS – Current Members



- South Dakota DOT serves as the lead state

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Stakeholder - Definition

- a person with an interest or concern in something, especially a business.

- What does this mean?

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DOT Stakeholder

- Who is a stakeholder of the front line supervisor and area supervisor within a DOT?
  - General Traveling Public
  - EMS – Law Enforcement, Fire, Ambulance
  - Commercial Traffic
  - Schools/Universities
  - Who else?

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DOT Needs & Concerns

- Pre-Storm Planning
  - Crew Scheduling
  - Chemical Applications and Allocations
  - Equipment Allocation
- Nowcasting Information
  - Start Time!!!
  - Precipitation Type
  - Precipitation Amount
  - Other Weather Variables
- Management of Resources During Event
  - Vehicle Location
  - Chemical Usage
  - Dynamic Equipment Allocation
  - Communication with other Agencies
- Post Storm Activities
  - Assessment of Performance
  - Communication with other Agencies
  - Chemical Allocations
  - Budget

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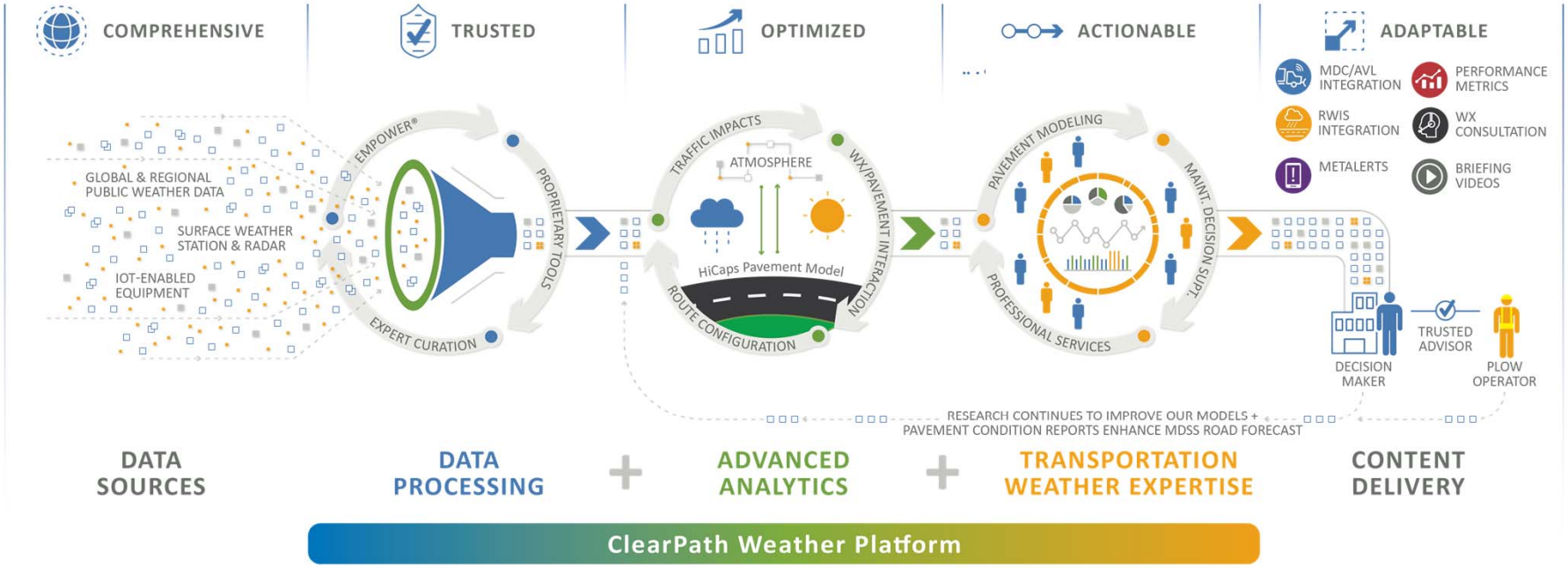
PFS MDSS Approach to Data Integration



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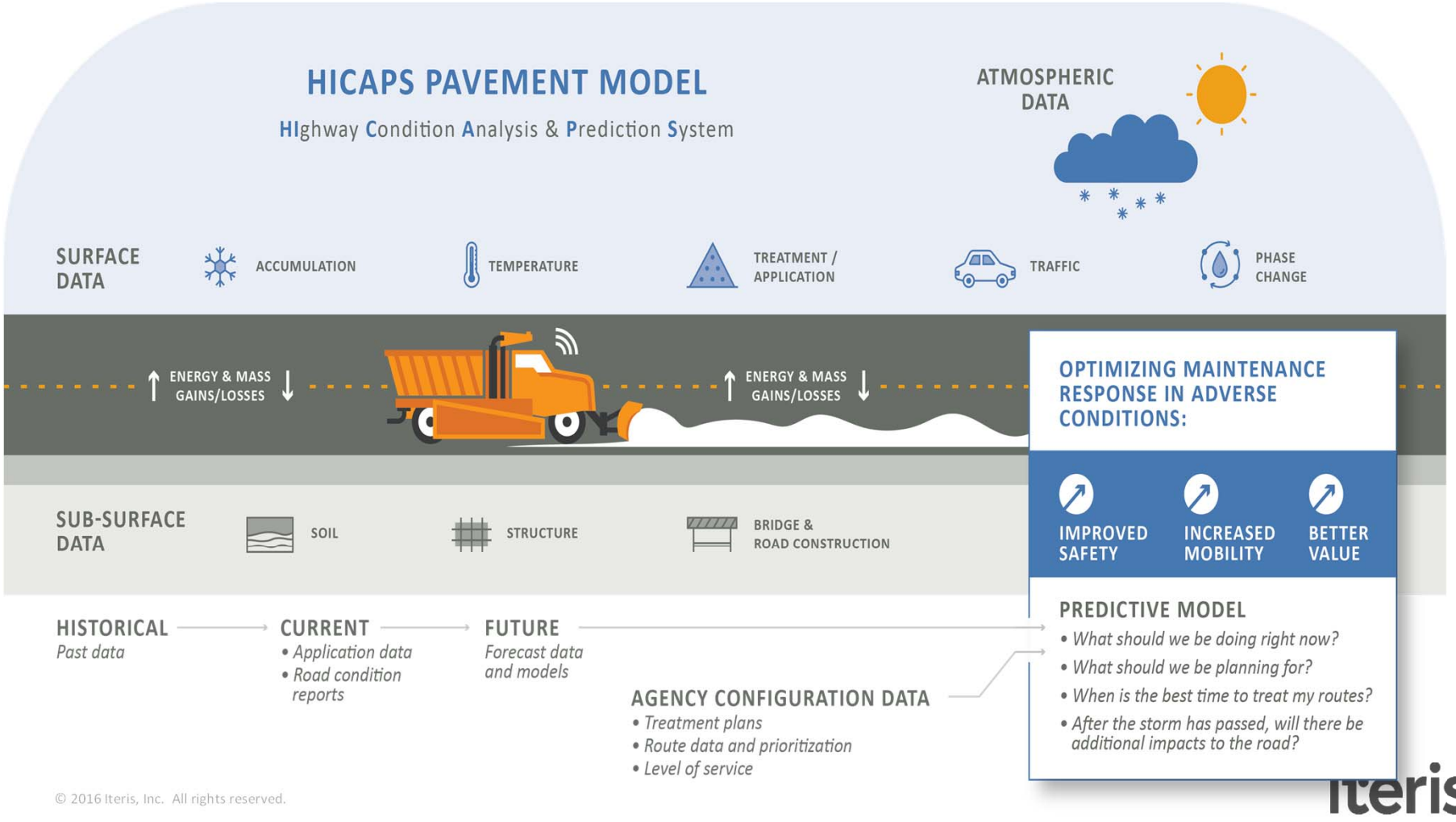
HiCAPS Model



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Transportation Expertise

PAVEMENT MODELING

- Pavement/Bridge Temperature and Condition
- 3D Cross-section
- Sub-pavement Temperature
- Driving/Passing Lane Biases

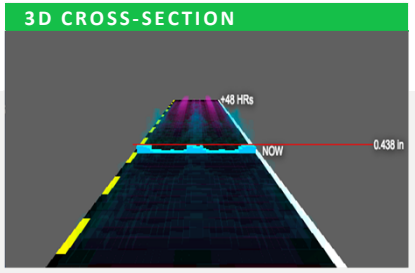
MAINTENANCE DECISION SUPPORT

- Recommended Maintenance Actions
- Schedule Crews
- Reduce Salt/Chemical Usage

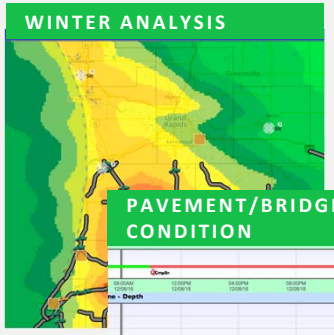
PROFESSIONAL SERVICES

- Interactive Training
- Weather Consultation
- Advanced Alerting
- Winter Analysis

3D CROSS-SECTION

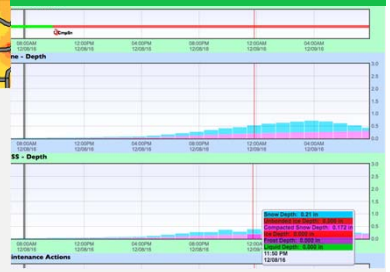


WINTER ANALYSIS



Example Outputs

PAVEMENT/BRIDGE CONDITION



RETURN TO PLATFORM OVERVIEW

DATA SOURCES — COMPREHENSIVE

DATA PROCESSING — TRUSTED

\+ ADVANCED ANALYTICS — OPTIMIZED

\+ TRANSPORTATION WEATHER EXPERTISE — ACTIONABLE

CONTENT DELIVERY — ADAPTABLE

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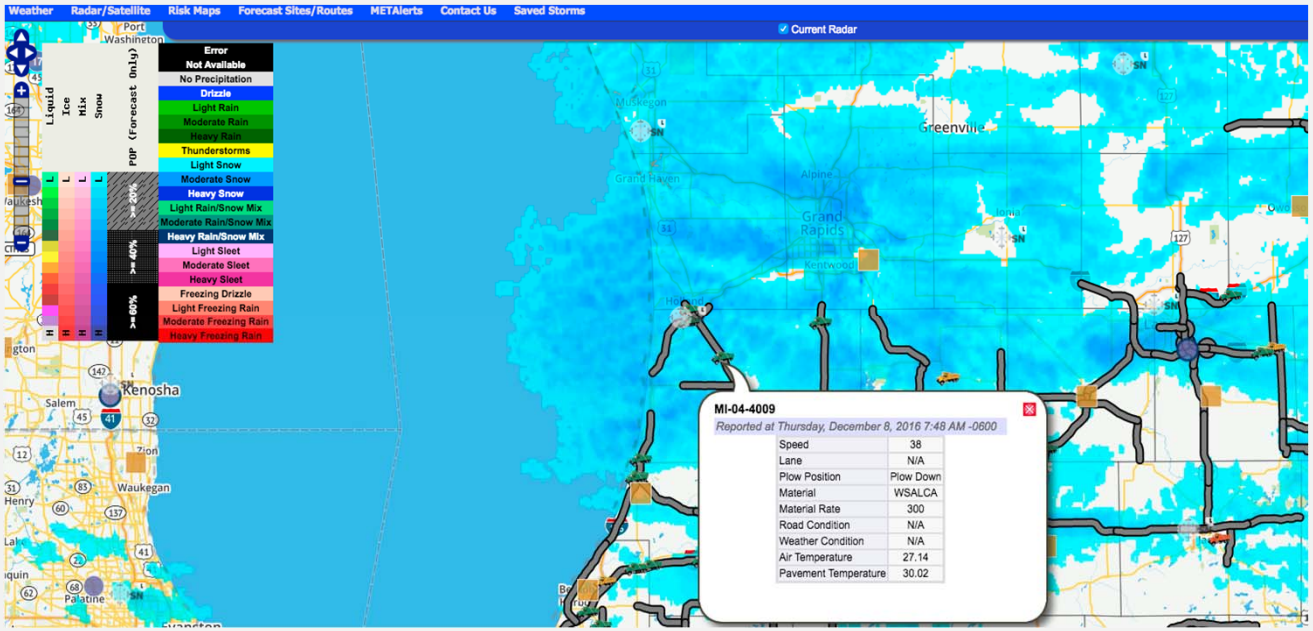
MDC/AVL Integration

(Mobile Data Collection / Automated Vehicle Location)

Integrate MDC/AVL data for real time truck location, reports, and camera images.

Weather and pavement condition reports enhance MDSS road forecast.



DATA SOURCES — COMPREHENSIVE

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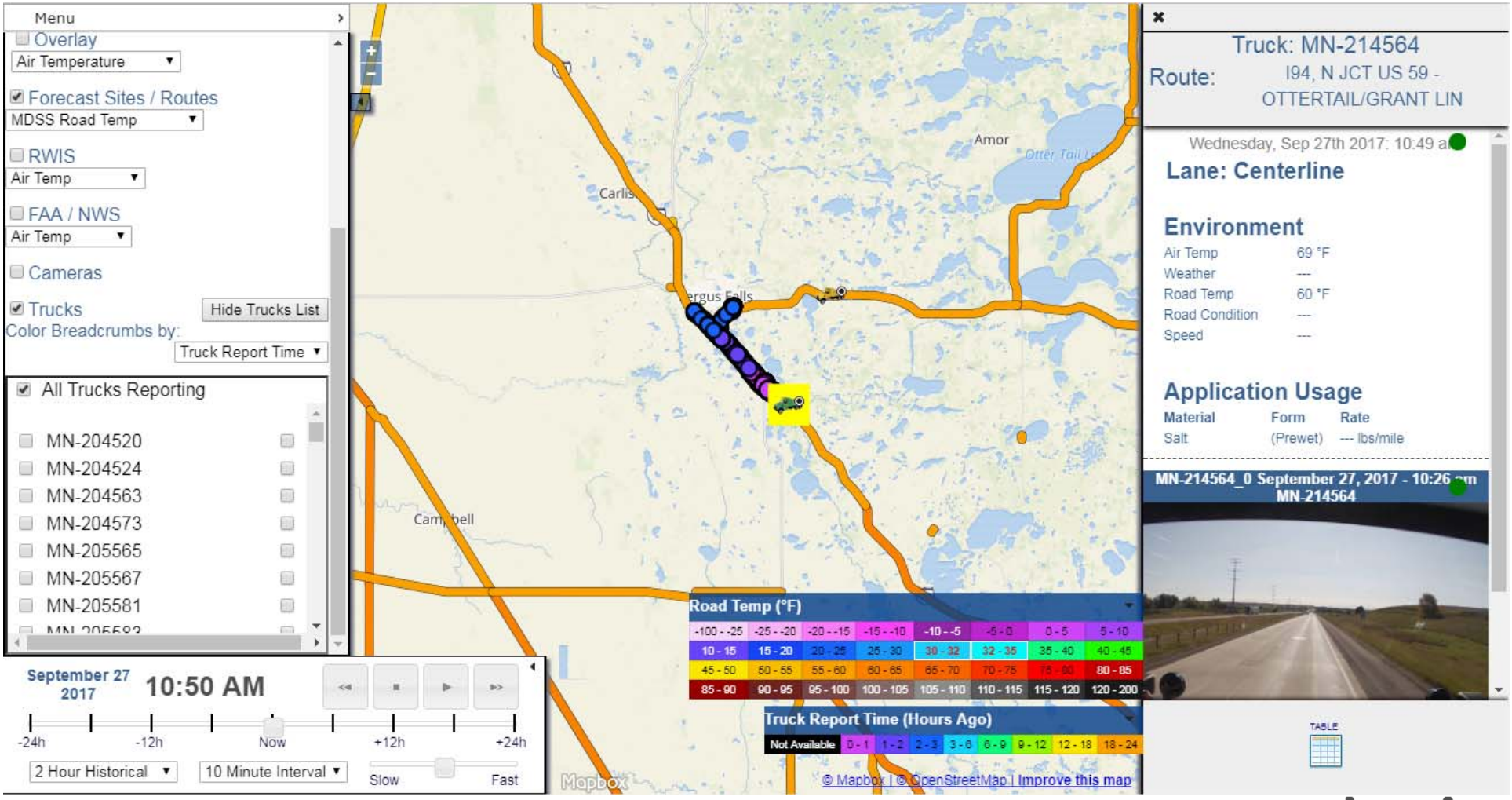

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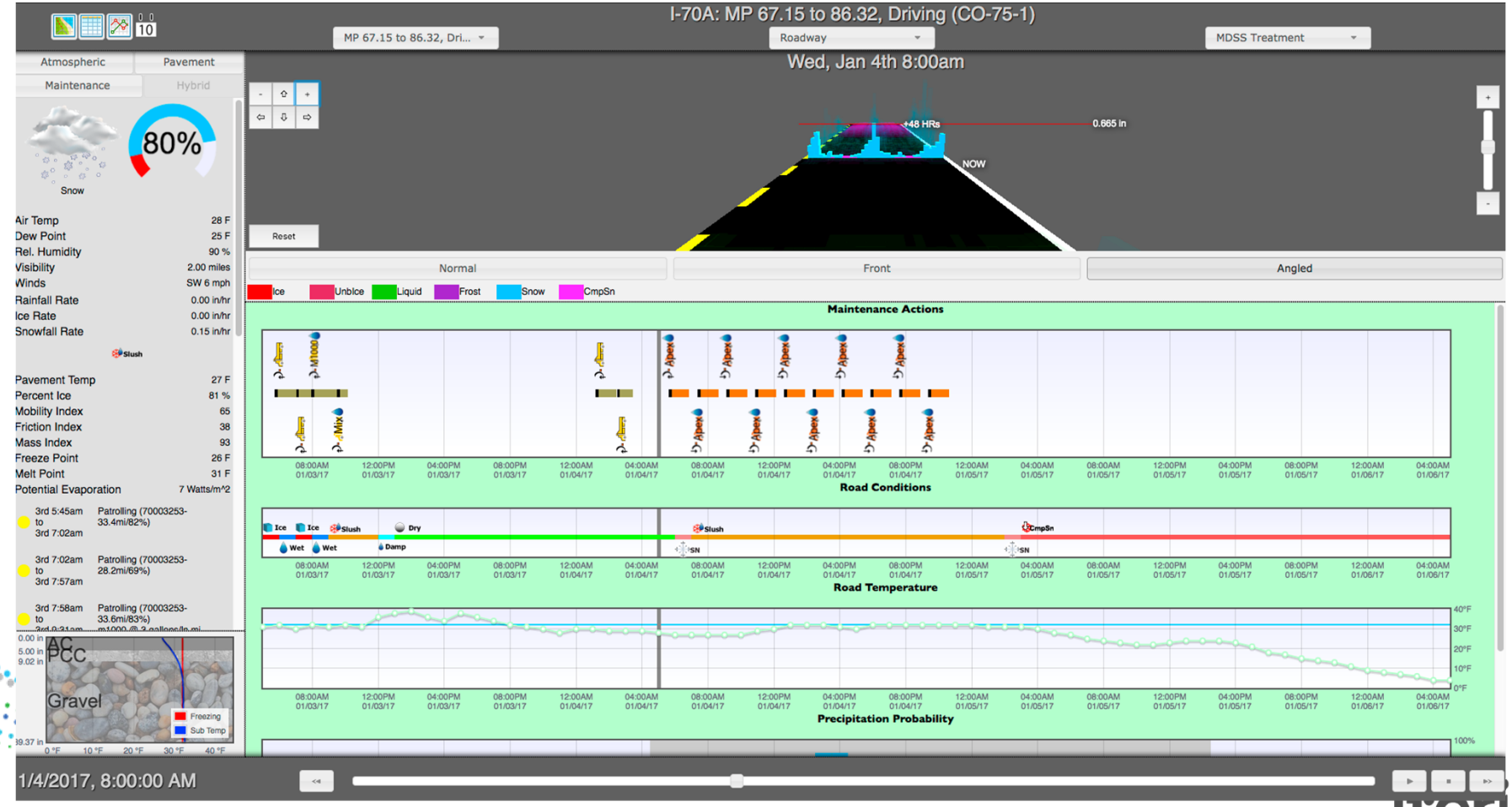
Heads-up Display of Road Weather Information

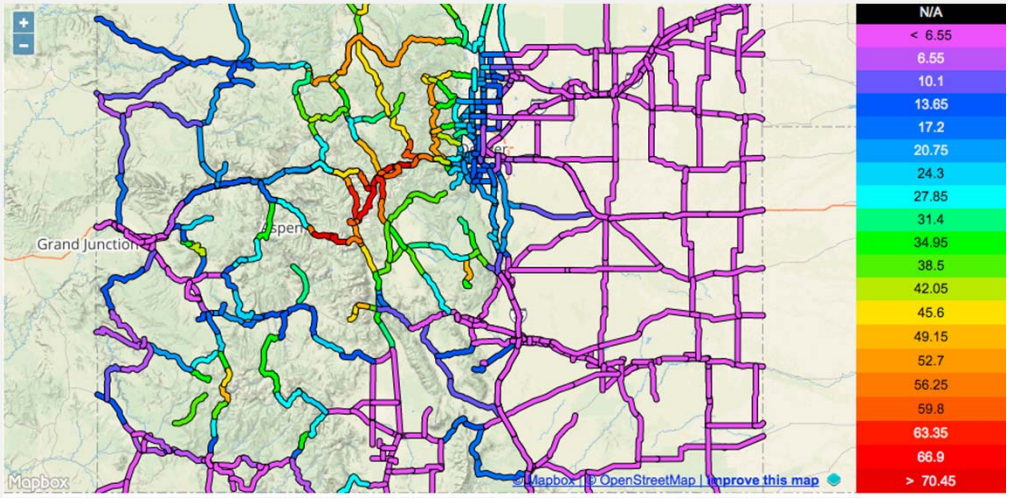


Performance Metrics

Weekly, monthly or seasonal reports on weather analysis and truck data.

Choose from 20 weather variables, 23 maintenance variables and 12 condition variables.

View reports in a map or table-view with the ability to print and export data.



Hours of Snowfall

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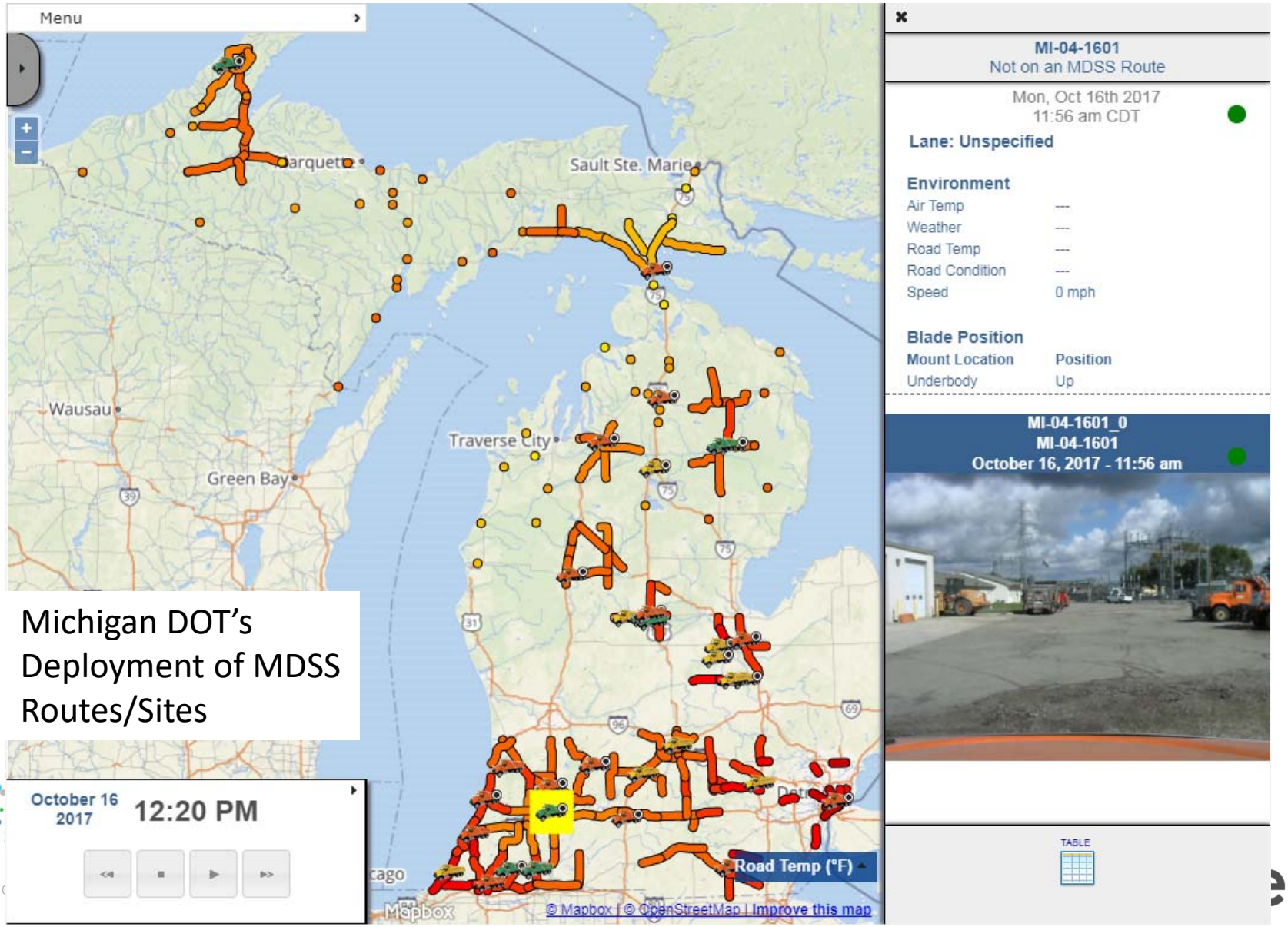
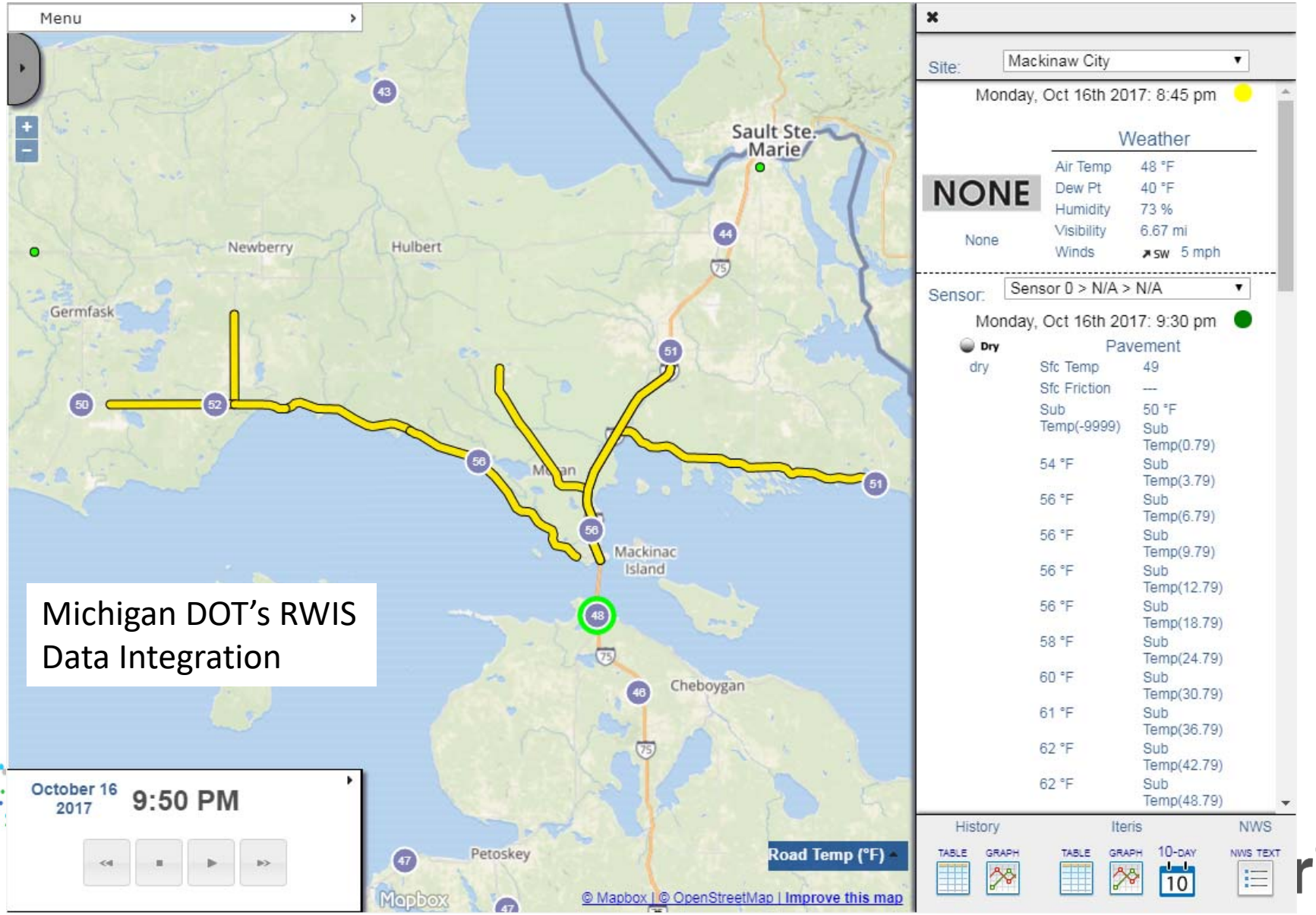
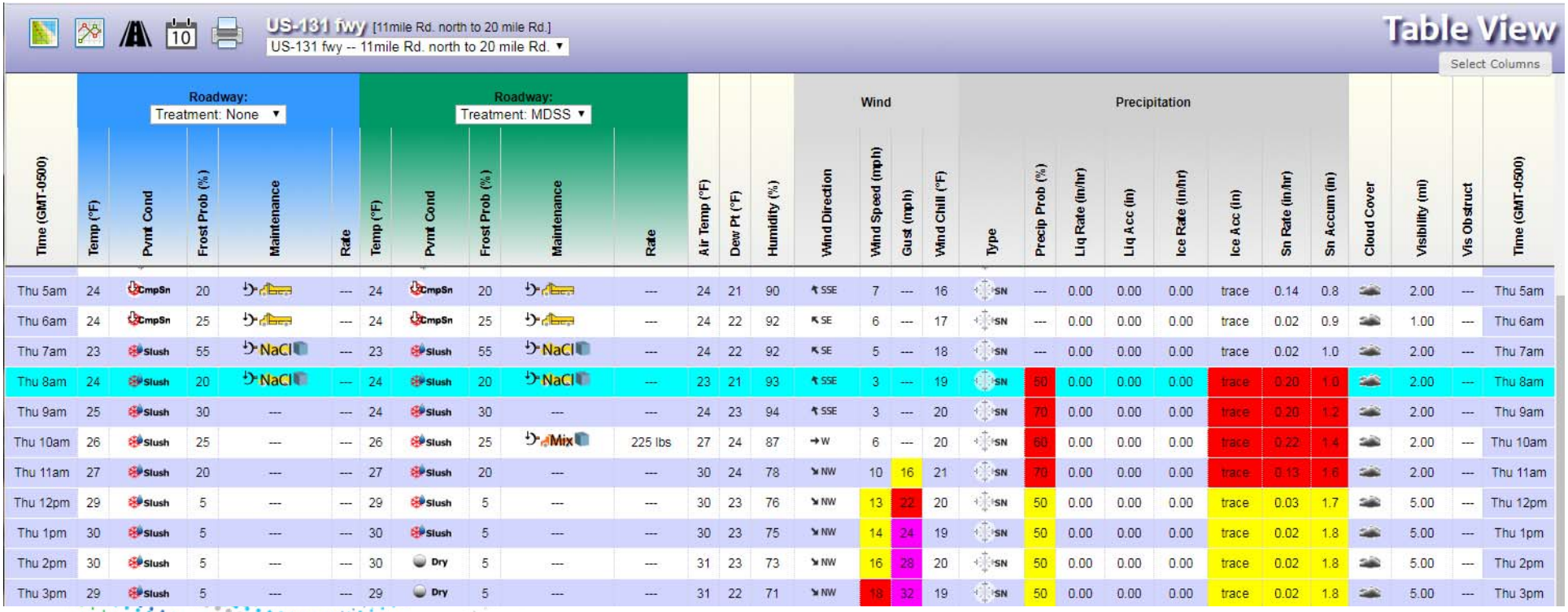


Michigan DOT's Deployment of MDSS Routes/Sites



Michigan DOT's RWIS Data Integration

Data Integration and Recommendation



US-131 fwy [11mile Rd. north to 20 mile Rd.]

US-131 fwy -- 11mile Rd. north to 20 mile Rd.

Table View

Select Columns

Time (GMT-0500)	Roadway: Treatment: None					Roadway: Treatment: MDSS					Air Temp (°F)	Dew Pt (°F)	Humidity (%)	Wind				Precipitation								Cloud Cover	Visibility (mi)	Vis Obstruct	Time (GMT-0500)
	Temp (°F)	Pvmt Cond	Frost Prob (%)	Maintenance	Rate	Temp (°F)	Pvmt Cond	Frost Prob (%)	Maintenance	Rate				Wind Direction	Wind Speed (mph)	Gust (mph)	Wind Chill (°F)	Type	Precip Prob (%)	Liq Rate (in/hr)	Liq Acc (in)	Ice Rate (in/hr)	Ice Acc (in)	Sn Rate (in/hr)	Sn Accum (in)				
Thu 5am	24	CmpSn	20		---	24	CmpSn	20		---	24	21	90	SSE	7	---	16	SN	---	0.00	0.00	0.00	trace	0.14	0.8		2.00	---	Thu 5am
Thu 6am	24	CmpSn	25		---	24	CmpSn	25		---	24	22	92	SE	6	---	17	SN	---	0.00	0.00	0.00	trace	0.02	0.9		1.00	---	Thu 6am
Thu 7am	23	Slush	55	NaCl	---	23	Slush	55	NaCl	---	24	22	92	SE	5	---	18	SN	---	0.00	0.00	0.00	trace	0.02	1.0		2.00	---	Thu 7am
Thu 8am	24	Slush	20	NaCl	---	24	Slush	20	NaCl	---	23	21	93	SSE	3	---	19	SN	60	0.00	0.00	0.00	trace	0.20	1.0		2.00	---	Thu 8am
Thu 9am	25	Slush	30	---	---	24	Slush	30	---	---	24	23	94	SSE	3	---	20	SN	70	0.00	0.00	0.00	trace	0.20	1.2		2.00	---	Thu 9am
Thu 10am	26	Slush	25	---	---	26	Slush	25	Mix	225 lbs	27	24	87	W	6	---	20	SN	60	0.00	0.00	0.00	trace	0.22	1.4		2.00	---	Thu 10am
Thu 11am	27	Slush	20	---	---	27	Slush	20	---	---	30	24	78	NW	10	16	21	SN	70	0.00	0.00	0.00	trace	0.13	1.6		2.00	---	Thu 11am
Thu 12pm	29	Slush	5	---	---	29	Slush	5	---	---	30	23	76	NW	13	22	20	SN	50	0.00	0.00	0.00	trace	0.03	1.7		5.00	---	Thu 12pm
Thu 1pm	30	Slush	5	---	---	30	Slush	5	---	---	30	23	75	NW	14	24	19	SN	50	0.00	0.00	0.00	trace	0.02	1.8		5.00	---	Thu 1pm
Thu 2pm	30	Slush	5	---	---	30	Dry	5	---	---	31	23	73	NW	16	28	20	SN	50	0.00	0.00	0.00	trace	0.02	1.8		5.00	---	Thu 2pm
Thu 3pm	29	Slush	5	---	---	29	Dry	5	---	---	31	22	71	NW	18	32	19	SN	50	0.00	0.00	0.00	trace	0.02	1.8		5.00	---	Thu 3pm

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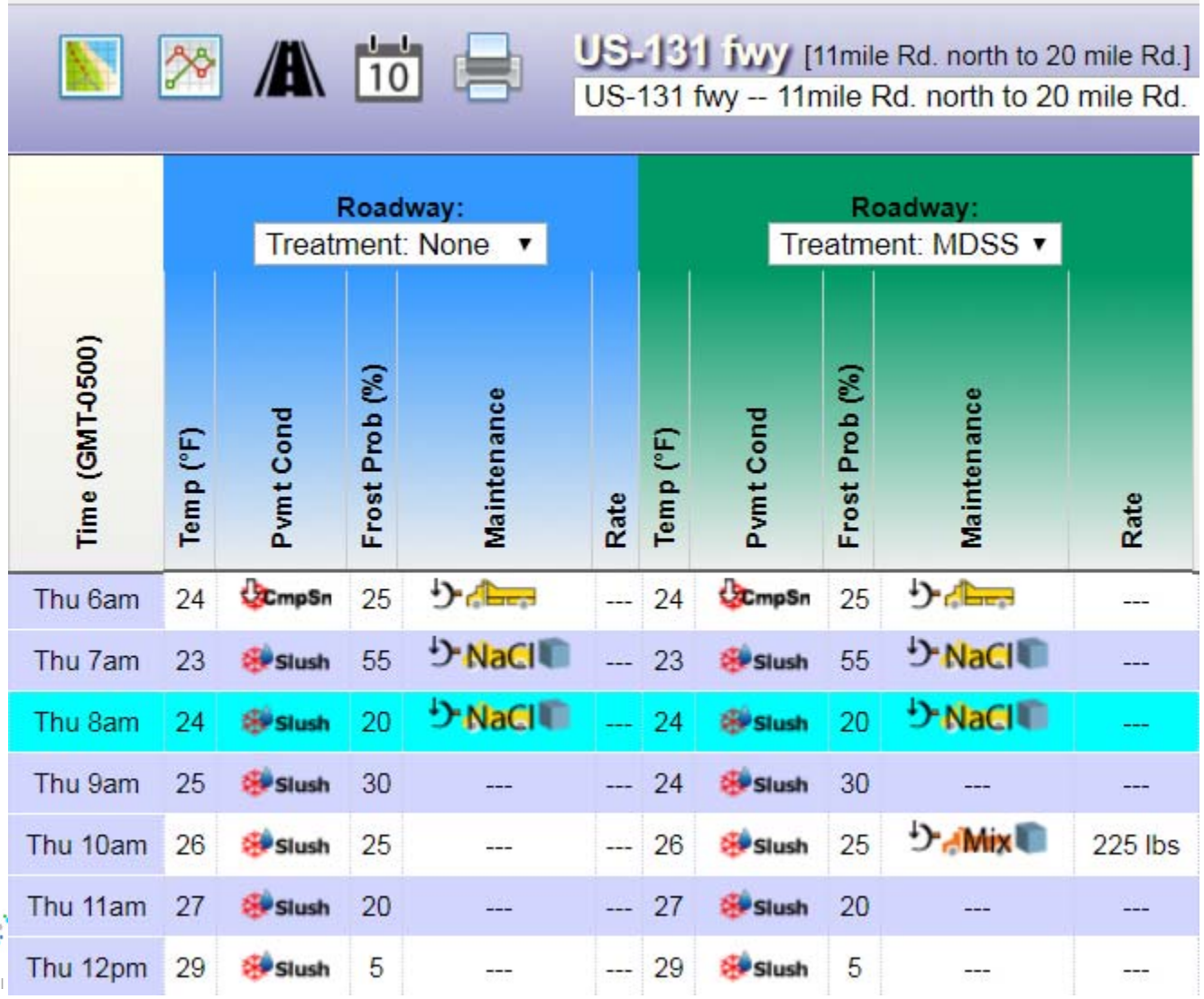

			Wind				Precipitation											
Air Temp (°F)	Dew Pt (°F)	Humidity (%)	Wind Direction	Wind Speed (mph)	Gust (mph)	Wind Chill (°F)	Type	Precip Prob (%)	Liq Rate (in/hr)	Liq Acc (in)	Ice Rate (in/hr)	Ice Acc (in)	Sn Rate (in/hr)	Sn Accum (in)	Cloud Cover	Visibility (mi)	Vis Obstruct	Time (GMT-0500)
24	22	92	SE	6	---	17	SN	---	0.00	0.00	0.00	trace	0.02	0.9		1.00	---	Thu 6am
24	22	92	SE	5	---	18	SN	---	0.00	0.00	0.00	trace	0.02	1.0		2.00	---	Thu 7am
23	21	93	SSE	3	---	19	SN	50	0.00	0.00	0.00	trace	0.20	1.0		2.00	---	Thu 8am
24	23	94	SSE	3	---	20	SN	70	0.00	0.00	0.00	trace	0.20	1.2		2.00	---	Thu 9am
27	24	87	W	6	---	20	SN	60	0.00	0.00	0.00	trace	0.22	1.4		2.00	---	Thu 10am
30	24	78	NW	10	16	21	SN	70	0.00	0.00	0.00	trace	0.13	1.6		2.00	---	Thu 11am
30	23	76	NW	13	22	20	SN	50	0.00	0.00	0.00	trace	0.03	1.7		5.00	---	Thu 12pm
30	23	75	NW	14	24	19	SN	50	0.00	0.00	0.00	trace	0.02	1.8		5.00	---	Thu 1pm
31	23	73	NW	16	28	20	SN	50	0.00	0.00	0.00	trace	0.02	1.8		5.00	---	Thu 2pm
31	22	71	NW	18	32	19	SN	50	0.00	0.00	0.00	trace	0.02	1.8		5.00	---	Thu 3pm

Future R & D Activities for PFS MDSS Project

- Improve MDSS Mobile Apps
- Improving Usability of Maintenance-Centric Winter Severity Data
- Integration of Mobile Data into MDSS Databases
- Incorporating Real-Time Traffic Data into MDSS

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Ben Hershey – VP of Weather Services Operations

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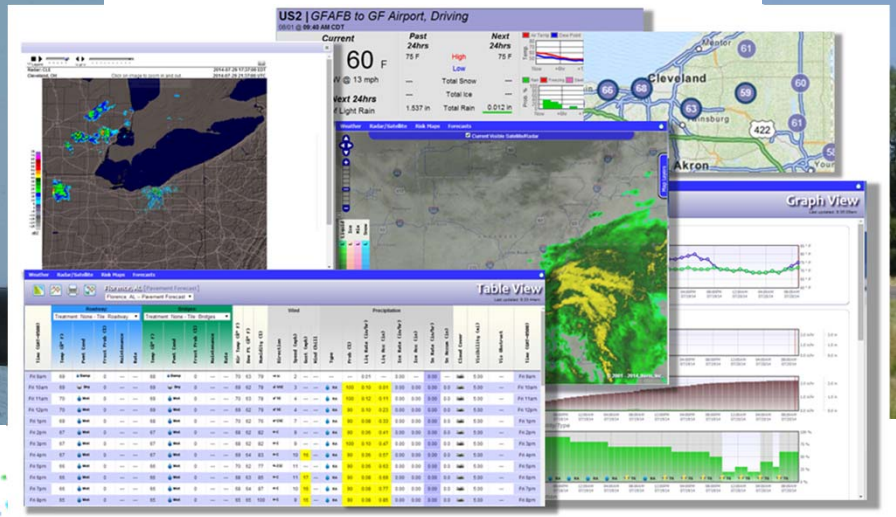
- www.webmdss.com or www.clearpathweather.com



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