Using Statistical Weather Data to Support the Winter Maintenance Programme

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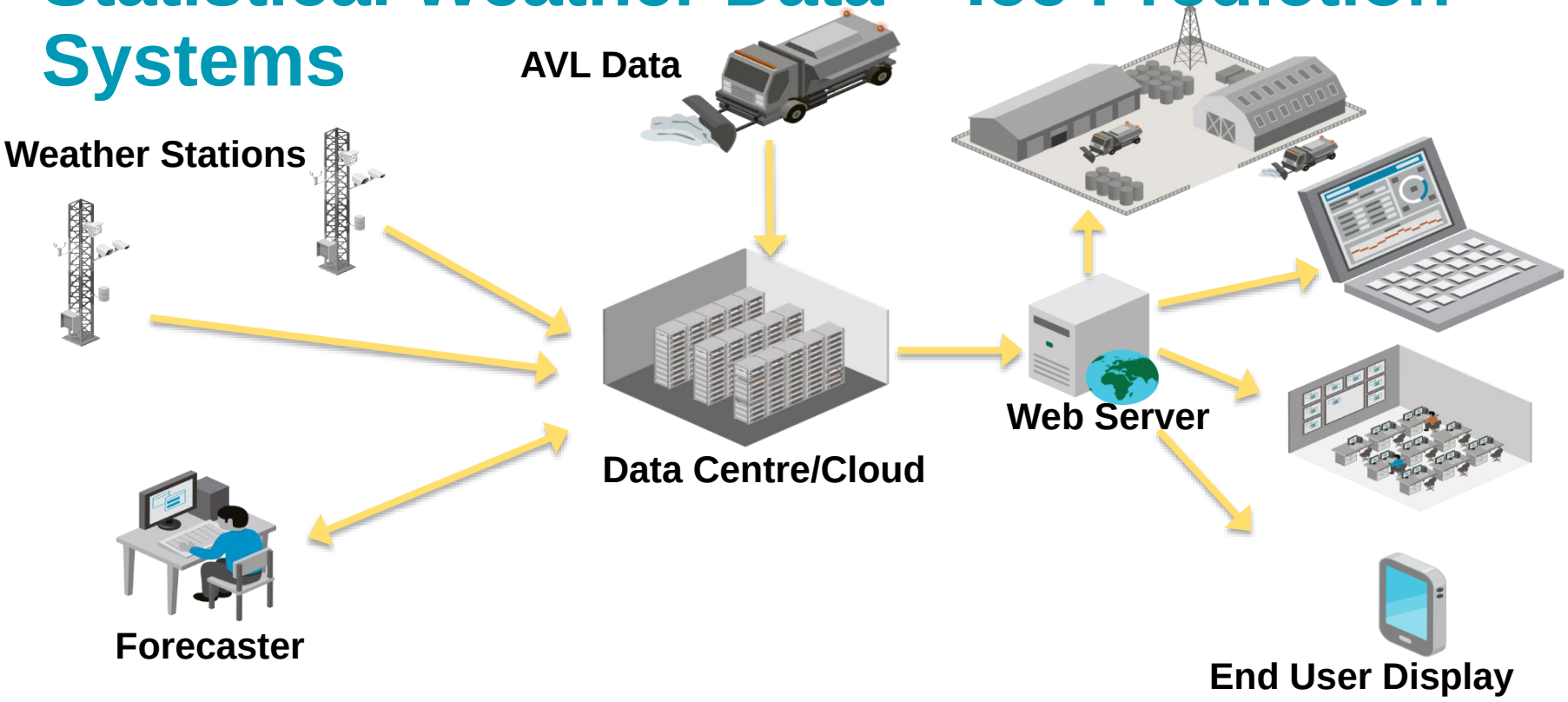
Focus Areas

- Prediction of freezing conditions and their locations
- Creating a risk based framework for winter maintenance
- Rational winter decision making – tools and techniques

Statistical Weather Data – Ice Prediction Systems



Prediction of Freezing Conditions and Their Location

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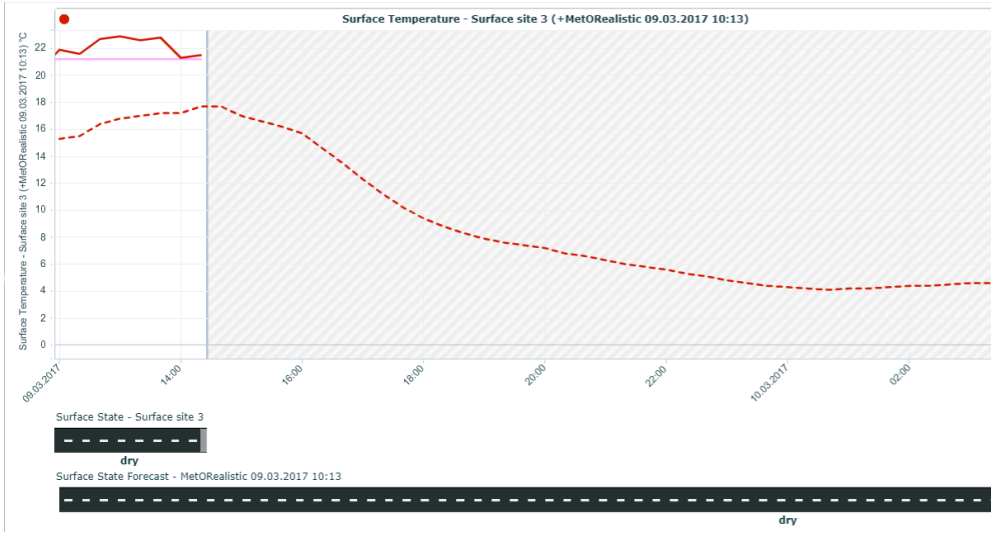
Prediction of Freezing Conditions and Their Location

- Forecast graphs and text.



Met Office OpenRoad

OpenRoad Forecaster:
Dave Elliott

Met Office 24 Hour Domain Forecast for	
Issued At 15:32 UTC, Wed 08 Mar 2017	Valid 18:00 UTC, Wed 08 to 12:00 UTC, Thu 09 Mar 2017

Weather Summary

There is no change to the general outlook for tonight.
This evening will start dry with clear spells. Later this evening and overnight it will become cloudier with patchy fog on high ground. Thursday morning will then be dry with the cloud breaking to allow some sunny spells. Road temperatures will hold above freezing.

Snow Summary

Nil.

Domain	Min RST	Min Air	Snowfall	Ice	Hoar Frost	Rain	Strong Wind	Fog
	PS 3.0	PS 4.5	N/H	N/H	N/H	N/H	Y/L	Y/L 0100-0200
	PS 4.5	PS 5.0	N/H	N/H	N/H	N/H	N/L	N/H
	PS 4.5	PS 6.5	N/H	N/H	N/H	N/H	N/H	N/H
	PS 5.0	PS 6.0	N/H	N/H	N/H	N/H	N/H	N/H
	PS 6.0	PS 7.0	N/H	N/H	N/H	N/H	N/H	N/H

6 Hr Winds dir sp (gust) mph	18-00	00-06	06-12
	WSW 15 (30)	WSW 18 (34)	WNW 22 (46)
	WSW 11 (26)	WSW 13 (32)	WNW 17 (41)
	SW 07 (22)	SW 07 (28)	W 14 (35)
	SW 06 (20)	WSW 09 (28)	WNW 14 (37)
	SW 06 (18)	SW 09 (26)	W 12 (33)

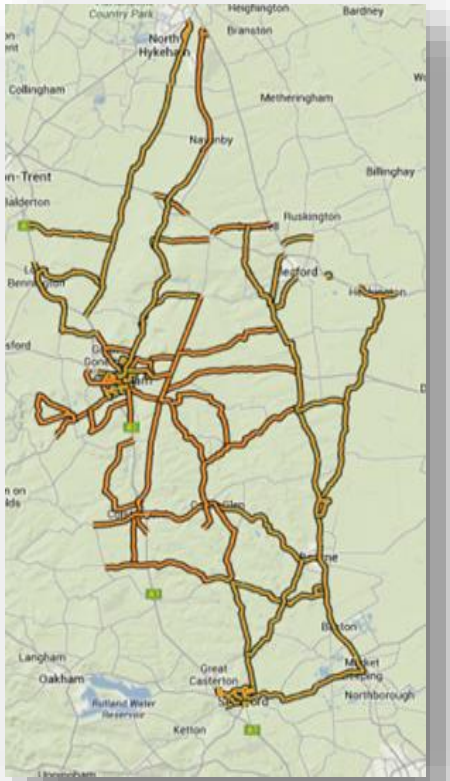
Readiness Colour Coding	
GREEN	Road surface temperatures are expected to remain above freezing with no ice/hoar frost/snow accumulations. Confidence HIGH.
AMBER	Road surface temperatures are expected to fall close to or below freezing. Confidence is LOW regarding ice and/or hoar frost and/or snow accumulations.
RED	Road surface temperatures are expected to fall to or below freezing with ice and/or hoar frost and/or snow accumulations likely. Confidence HIGH.

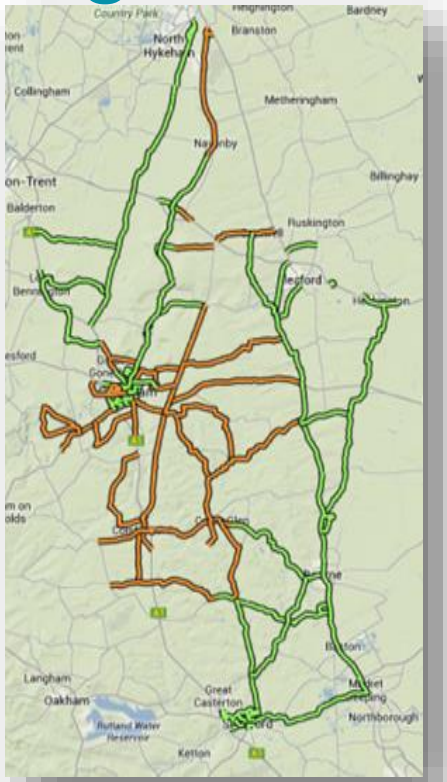
Parameter	Threshold
Rain	>=2mm per hour
Strong Wind	>=45mph gusts
Fog	Visibility < 200 metres

Route Based Forecasting

All domain treated

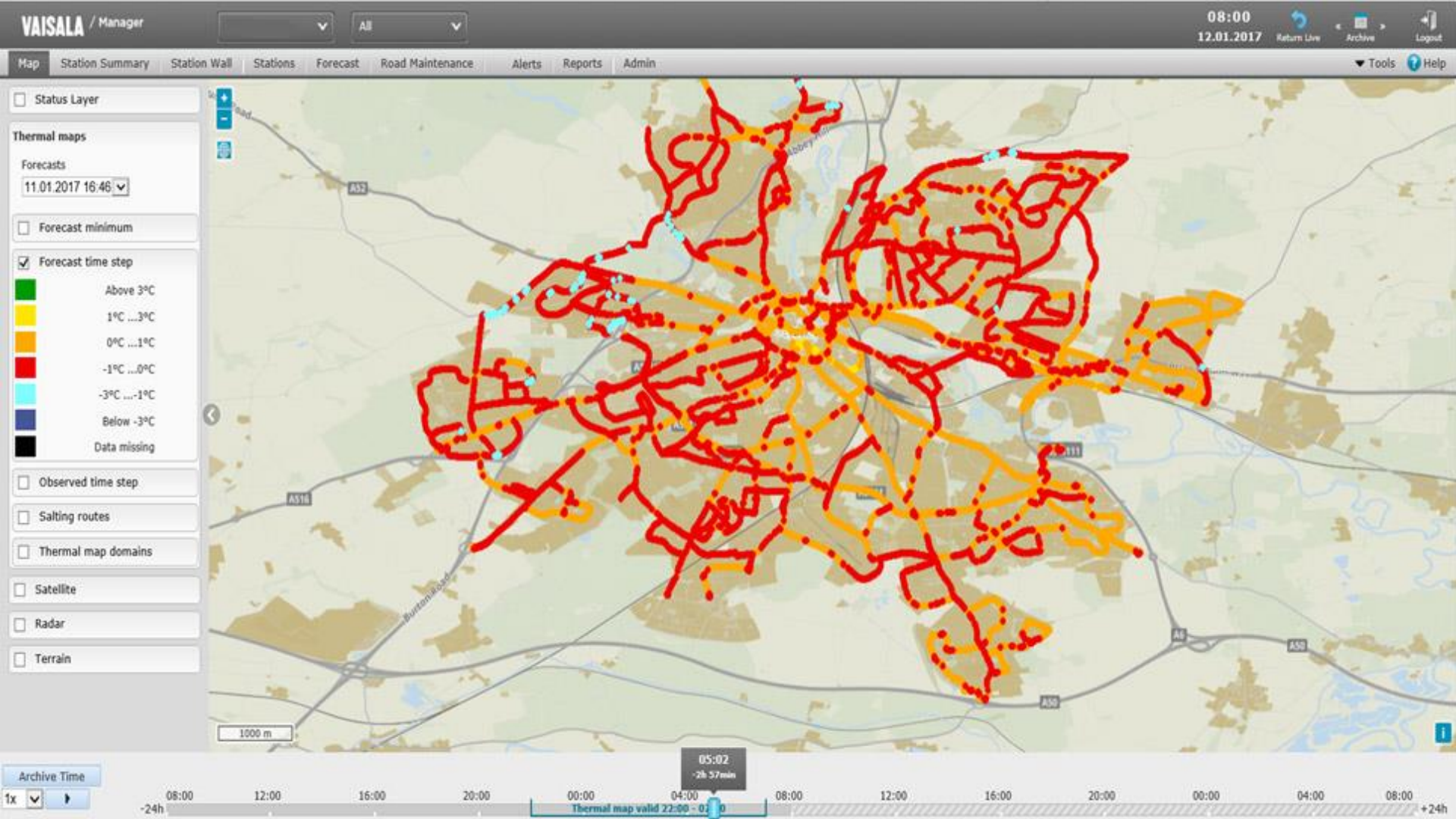
Domain colour state

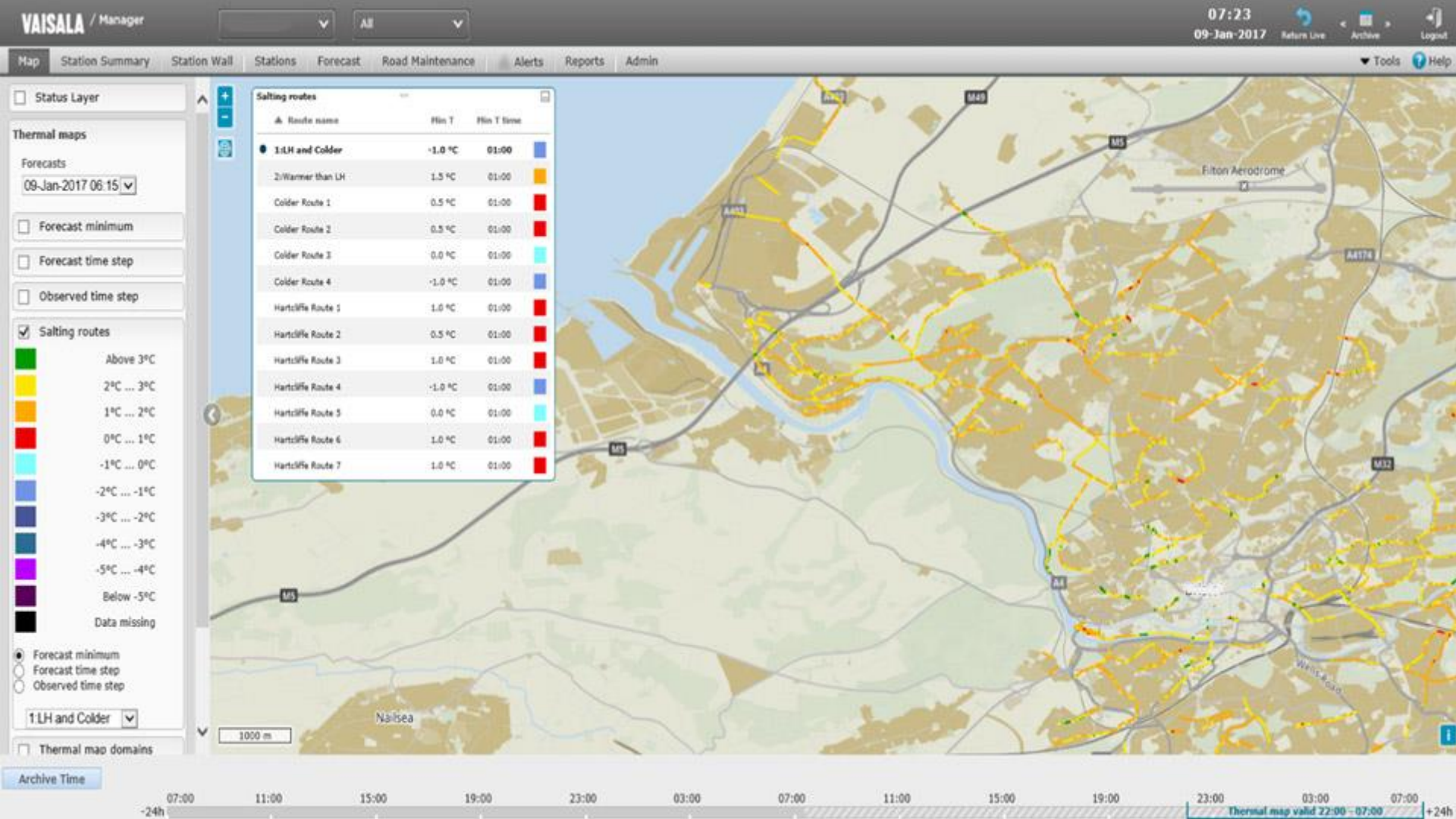




Not all the routes need treating

Individual route colour state


VAISALA / Manager
All
08:00
12.01.2017
Return Live
Archive
Logout
Map
Station Summary
Station Wall
Stations
Forecast
Road Maintenance
Alerts
Reports
Admin
Tools
Help
Status Layer
Thermal maps
Forecasts
11.01.2017 16:46
Forecast minimum
Forecast time step
Above 3°C
1°C ...3°C
0°C ...1°C
-1°C ...0°C
-3°C ...-1°C
Below -3°C
Data missing
Observed time step
Salting routes
Thermal map domains
Satellite
Radar
Terrain
A52
A516
A38
A50
1000 m
Archive Time
1x
05:02
-2h 57min
08:00
12:00
16:00
20:00
00:00
04:00
08:00
12:00
16:00
20:00
00:00
04:00
08:00
-24h
Thermal map valid 22:00 - 02:00
+24h

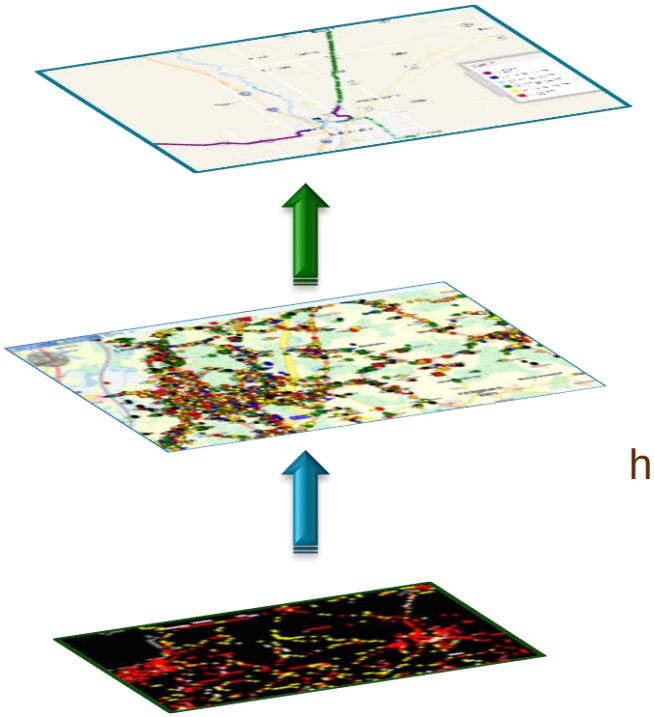

VAISALA / Manager
All
07:23
09-Jan-2017
Return Live
Archive
Logout
Map
Station Summary
Station Wall
Stations
Forecast
Road Maintenance
Alerts
Reports
Admin
Tools
Help
Status Layer
Thermal maps
Forecasts
09-Jan-2017 06:15
Forecast minimum
Forecast time step
Observed time step
Salting routes
Above 3°C
2°C ... 3°C
1°C ... 2°C
0°C ... 1°C
-1°C ... 0°C
-2°C ... -1°C
-3°C ... -2°C
-4°C ... -3°C
-5°C ... -4°C
Below -5°C
Data missing
Forecast minimum
Forecast time step
Observed time step
1:LH and Colder
Thermal map domains
Salting routes
Route name
Min T
Min T time
1:LH and Colder -1.0 °C 01:00
2:Warmer than LH 1.5 °C 01:00
Colder Route 1 0.5 °C 01:00
Colder Route 2 0.5 °C 01:00
Colder Route 3 0.0 °C 01:00
Colder Route 4 -1.0 °C 01:00
Hartcliffe Route 1 1.0 °C 01:00
Hartcliffe Route 2 0.5 °C 01:00
Hartcliffe Route 3 1.0 °C 01:00
Hartcliffe Route 4 -1.0 °C 01:00
Hartcliffe Route 5 0.0 °C 01:00
Hartcliffe Route 6 1.0 °C 01:00
Hartcliffe Route 7 1.0 °C 01:00
M49
M5
Filton Aerodrome
A4174
M32
A38
Nailsea
1000 m
Archive Time
07:00
11:00
15:00
19:00
23:00
03:00
07:00
11:00
15:00
19:00
23:00
03:00
07:00
-24h
Thermal map valid 22:00 - 07:00
+24h

Hazard Based Treatment Map

Hazard-Based Treatment Routes

Other Data, e.g. Accident Statistics

Road Temperature Map Layer



Observational Intelligence/ Impact Intervention

Intelligence Engine
From weather hazards to impacts on operations

Weather Observation Repository

Creating a Risk Based Framework for Winter Maintenance

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New Well-managed Highway Infrastructure Code of Practice

- *"A risk based approach should be adopted for all aspects of highway infrastructure maintenance, including setting levels of service, inspections, responses, resilience, priorities and programmes."*

How Can Risk be Applied to Winter Service?

- Compliance with Codes of Practice
- Operationally
  - Treatment times
  - Decision making
  - Route coverage
- Determining policy
  - "*Authorities should develop local service levels for Winter Service which define the Overall Winter Period, the Core Winter Period, the level of resilience and treatment networks……should be based on a risk assessment to define the scope of the service.* "

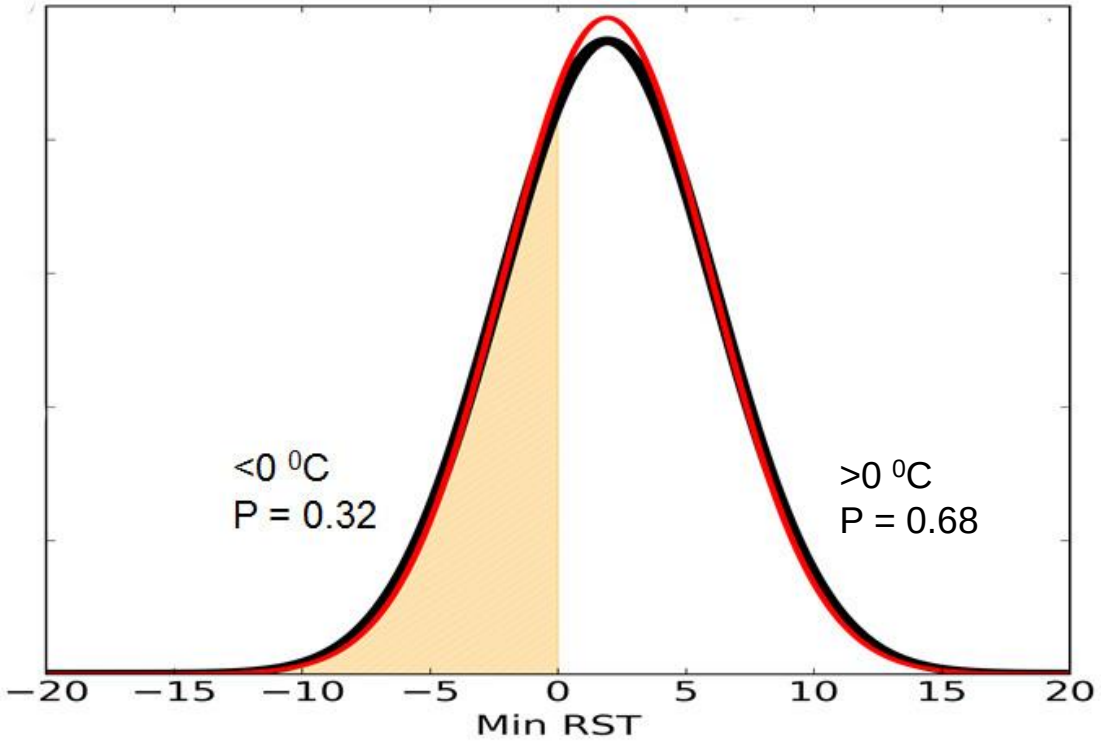
Case Study - Doncaster MBC

Weather Station Data : 2000-2016

Oct 1st to Mar 31st (180 nights) x nights

Analysis RST <= 0.0 ºC

Hazard Likelihood



16 Year Sensor Data

16 Year Sensor Data plus 130 year climate data

<0ºC

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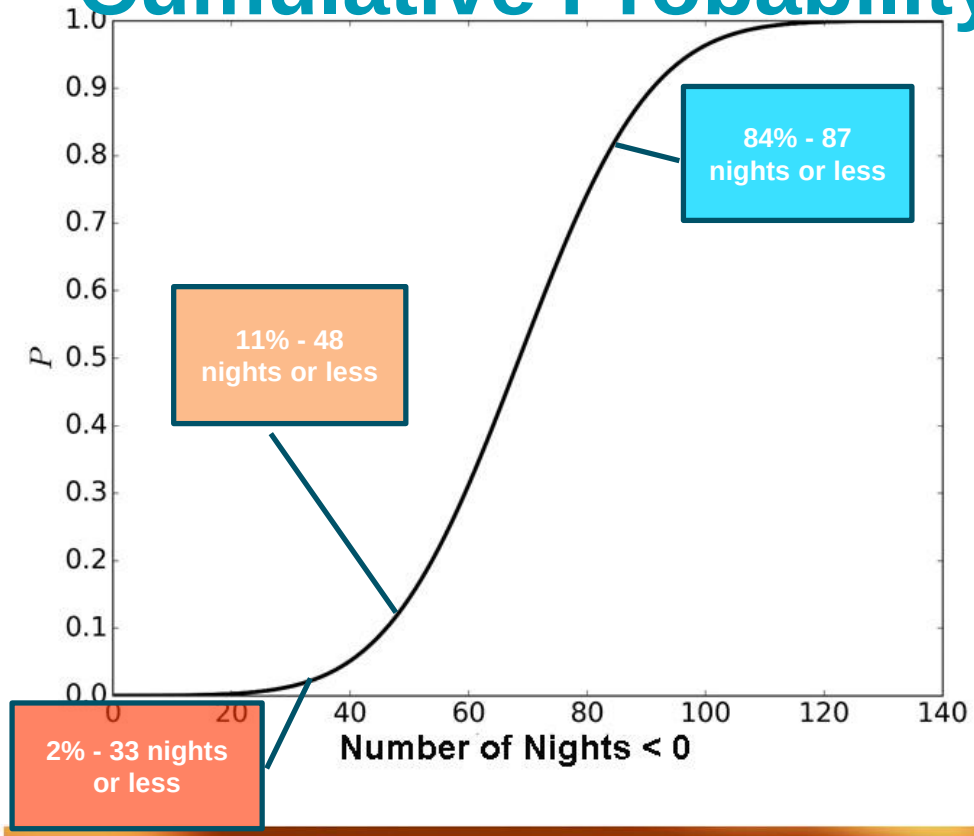
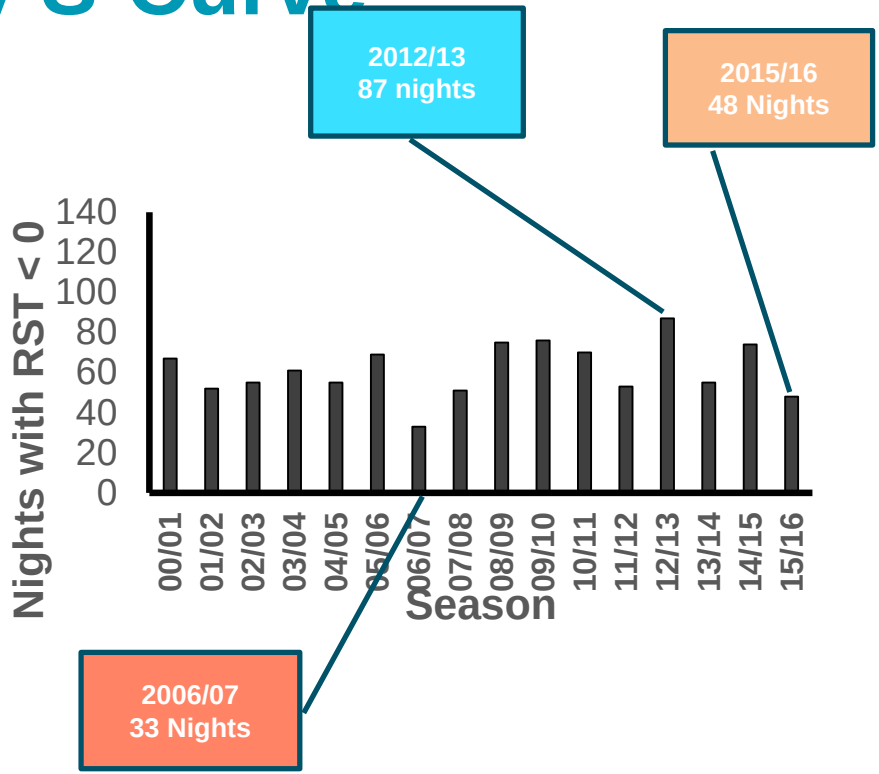
Risk Appetite

Risk Appetite - Our attitude towards the amount of risk that we are prepared to accept in trying to achieve our strategic and other objectives.

Cumulative Probability S-Curve





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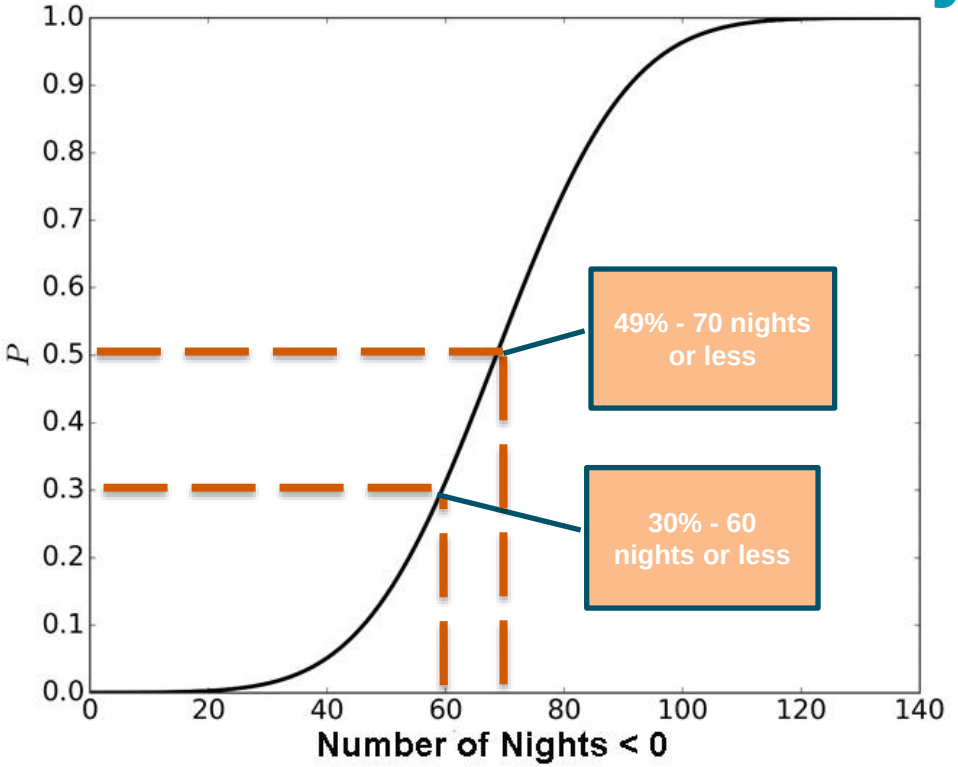
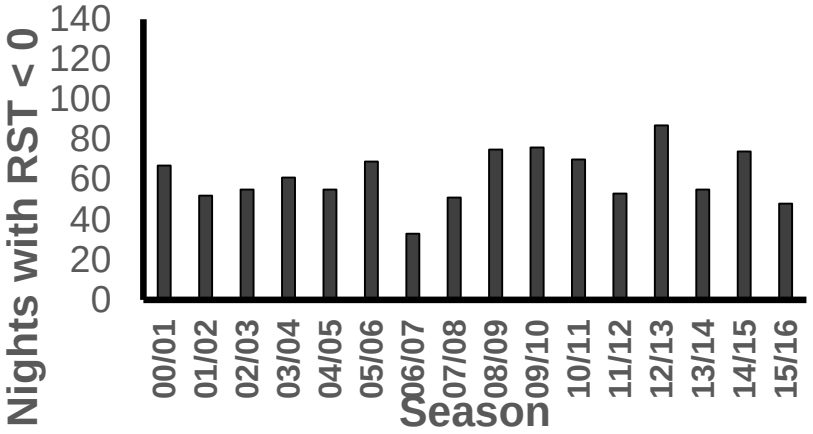
Cumulative Probability S-Curve





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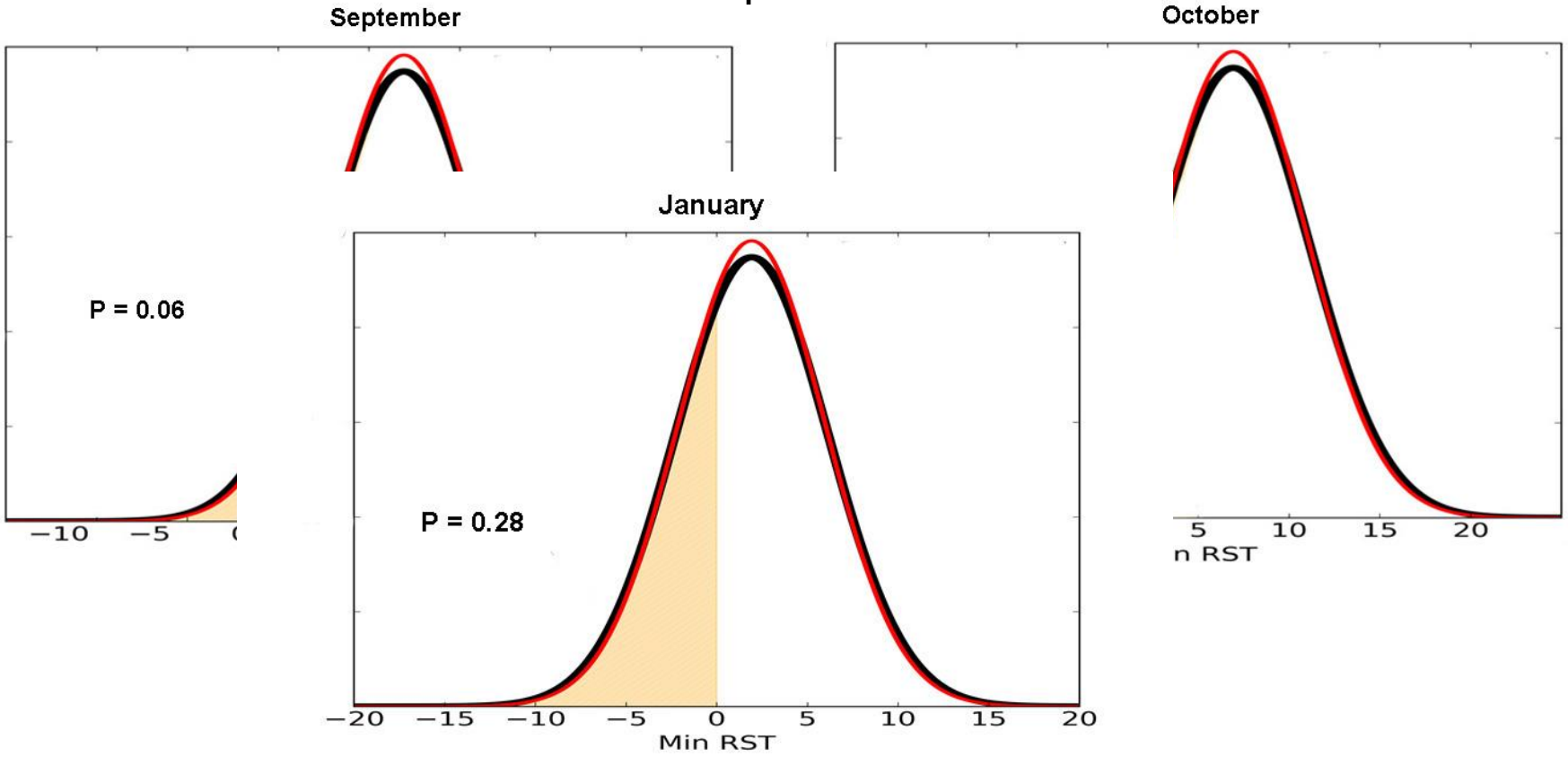
Further Areas of Investigation – Monthly S and Distribution Curves

	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.
Marginal (during which severe conditions are unlikely)	■						■
Low (during which severe conditions could arise)		■				■	
High (during which severe conditions might normally be expected)			■	■	■		

Concept Data



Rational Winter Decision Making – Tools and Techniques

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Law – Highways Act

- "In particular, a highway authority is under a duty to ensure, so far as is reasonably practicable, safe passage along the highway is not endangered by snow or ice."
- If a highway authority can prove that it took '... *such care as in all the circumstances was reasonably required …'* then it can avoid liability

Tools & Data


VAISALA / Manager
Station Summary
Morley Road
Station Overview
Graph
A65 Settle
A1 Coniscliffe
A66 Elton
A1 Catterick
Station Summ
Station Name
B1363 Stillington
A61 Carlton Miniot
A65 Settle (F)
A683 Greta Bridge
A172 Carlton
A19 Riccall (F)
B1253 North Grim
A67 Yarm
A64 Staxton (F)
A684 Leyburn (F)
A1237 South Wes
B6265 Grassingto
A59 Blubberhouse
A1036 North East
Great Stainton
A169 Fylingdales
A6034 Silsden
A658 Harrogate B
A64 Whinmoor
A1 Rainton
B1257 Chop Gate
A64 Malton (F)
A66 North Bitts
A1043 Nunthorpe
A1(T) Barnsdale Bar
A1 Catterick
A19 Osmotherly
Current Time
Archive Time
14:12
Map
Station Summary
Station Wall
Stations
Forecast
Road Maintenance
Alerts
Reports
Live Cameras
Admin
14:08
24.03.2017
-24h
+24h

Measuring Performance

Winter Performance Index Legend (Basic scale)	
0.0	Successfully treated
0.00 - 0.30	Significantly accelerated grip recovery
0.31 - 0.49	Some success at grip recovery
0.50 - 0.69	Very little success at deicing
0.70 -	Limited maintenance or no deicer success
	Observation data / parameter missing or temp is below threshold

Station	Date	Time Range	Event	Duration (hours)	Max Wind Speed (m/s)	Max Ice Layer (mm)	Max Snow Layer (mm)	Max Water Layer (mm)	Min Surface Temp (°C)	Severity Index	Precip. (hours)	Precip. Total (mm)	Performance Index	Mobility Index
	26.12.2014	17:00 - 21:40	GRIP<.6	4.67	6.10	0.10	0.88	3.23	-0.40	26.47			0.18	
	26.12.2014	21:40 - 01:40	TREATED	4.00	2.40	0.10	0.06	2.26	-0.40	17.22			0	
	27.12.2014	01:40 - 02:40	GRIP<.6	1.00	2.50	0.00	0.00	2.85	-0.20	17.92	1.67	0.87	0.06	63%
	27.12.2014	02:40 - 10:40	TREATED	8.00	3.00	0.12	0.01	3.85	-1.80	20.99			0	
	27.12.2014	10:40 - 12:00	GRIP<.6	1.33	2.00	0.00	0.00	2.81	-2.20	17.98			0.07	

Techniques

- Know your network
- Understand and use relevant data
- Cultivate your sources
- Timely & flexible
- Target treatments where needed
- Review and learn

Future Trends – Big Data

- *'This will represent a dramatic, potentially paradigm-changing increase in data. Coverage will expand, such that essentially every important location and time period is covered.'*
- *'There will also be a dramatic expansion of the kinds of data that will be available, such as real-time data on braking, acceleration and lane-changing behavior of vehicles on a given stretch of freeway.'*

Big Data's Implications for Transportation Operations
An Exploration www.its.dot.gov/index.htm
White Paper – December 19, 2014 FHWA-JPO-14-157

Future Trends

- More data – Mobile sensors, IOT, vehicle data, traffic flows, accident statistics
- Data sharing/Open data, drivers much more informed
- Need for more 24 hr monitoring
- Increasing targeted treatments
  - Region – Domain – Route – Partial Route
  - Dynamic routing?
- Computer assistance/machine learning/autonomous gritters

Thank you

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