



VAISALA
DIGITAL

Wx Horizon

Leveraging observations to drive
improvement in winter road
maintenance

Your job is to make the road safe. Our job is to make yours easier

In the past, road maintenance agencies relied on general forecasts and government requests to make the roads safer during storms. Today, there are many more tools and sources of information.

Do they really make the job easier?

This eBook explains the tools available now that provide the situational awareness you need to understand what's happening on the roads and how to proactively keep them safer.



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Road maintenance: From reactive to proactive

Road maintenance decision making is complex. There are numerous factors to consider, but the top four are:



Just a few decades ago, road maintenance agencies depended on two main sources for weather information: television and radio. If a storm was predicted, most agencies reacted well after the event began and were often notified of deteriorating conditions by law enforcement or a simple alarm. This reactive maintenance method resulted in messy roads, accidents that may have already occurred, and high levels of material used to make the roads safe again.

Winter maintenance agencies demanded better forecasting and weather tools so they could become more proactive and get ahead of weather events.

Decision-making today: enough or too much?

Deciding how and when to maintain winter roads has changed along with technology and become even more complex. There are many tools and information sources to aid in decision making, from radar to consumer-driven forecasting data.

The missing piece: Road weather information. This enables the most proactive maintenance in the face of approaching storms.

The challenge of interpretation

Today's decision makers gather all possible information from multiple sources, then try to interpret the data to make the right decision at the right time. This is a logical approach but is also very time consuming. In addition, every source of information has a slightly different prediction of how weather conditions will evolve during a storm.

So how do you interpret the information?

Forecasts are necessary, but those without specific information to your road network or road weather are not helpful in planning operations.

When evaluating a source of information, you can determine its usefulness by asking:

- Where did it come from?
- When was it created?
- How relevant is it to my decision making?

Example of a 36-hour forecast

How much does this say about road conditions? What is the source of the data, and how long ago was it created?

Now	Next 36 Hours		
	Tonight 	Tomorrow 	Tomorrow Night 
Cloudy 44° F Feels Like: 36°F	Rain/Snow Showers/Wind 32° Low	AM Snow Showers 47° High	Snow Showers Late 30° Low
Past 24-hr Snow: 0 in Past 24-Precip: .93 in (est.)	Snowfall: 0 in No significant snow accumulations Chance of Precip: 60%	Snowfall: 0 in No significant snow accumulations Chance of Snow: 40%	Snowfall: 0 in No significant snow accumulations Chance of Snow: 30%
Wind: From NE at 10mph	Wind: SE at 21mph	Wind: NNE at 12mph	Wind: ESE at 5 mph

Observation + forecast

Combining observations with forecasting to deliver actionable information in first-class visualization drives the best decision-making.

Weather forecasting indicates what is happening in the air. **Road weather forecasting** indicates what is happening on the road surface. There are several steps in the forecasting chain where measurements play a crucial role.



Attached to the balloon is a radiosonde, which relays data from the upper atmosphere to the ground. This data is one of the key measurements of weather forecasting.

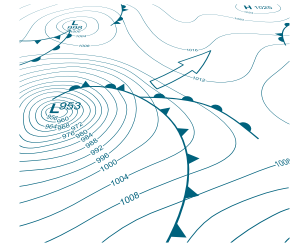
5 steps to build an atmospheric weather forecast



1. **Know the current atmospheric conditions around the world.**
Every nation in the world participates in global cooperation for measurements.



2. **Collect measurements into global weather prediction centers.**
Global weather models are only computed by a few organizations around the world with exceptional computer processing power.



3. **Use high-resolution models to refine global weather models.**
Most governments run a local model for their own regions. Vaisala also runs local models where more data is needed.



4. **Refine raw data.**
Machine learning techniques improve forecasts by learning from past forecast errors, past measurements, and past forecasts.



5. **Run a nowcast model to improve the initial forecast.**
Nowcasting models use the latest weather station, radar, and satellite data to improve short-range forecasts.

How a road weather forecast is created

The road weather model is a physical model of the main processes affecting the road surface. It consists of an energy balance model, a material balance model, and forecast site information.

The modelling

The energy balance model predicts the surface temperature. For example: When black asphalt gets warmer under sunlight, the model calculates the rise in temperature.



The material balance model tracks and categorizes the amount and state of water and chemicals on the road surface. For example: When the weather forecast says it is raining, the model adds water to the water category. If the surface temperature then drops below freezing, the model moves material from the water category to the ice category.



Forecast site information processes environmental site factors. For example: Identifying bridges, capturing traffic profiles, determining the impact of shading on the forecast location.



With access to measurements, the road weather model also fine-tunes the forecast for even greater accuracy.

The processes

The road weather model predicts surface temperature and surface condition by taking multiple factors into account, including the following.

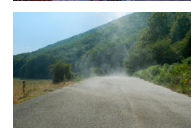
Road surface temperature – Impacted by heating and cooling

- Solar radiation
- Traffic heating / turbulence
- Radiative cooling
- Deicing



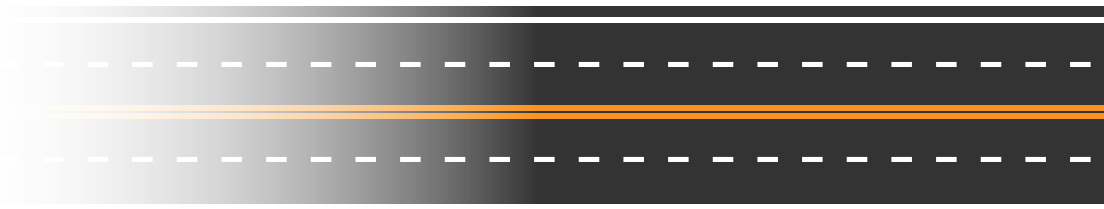
Adding and removing material: water, snow, ice, and chemicals

- Rain
- Snow
- Condensation or frost
- Evaporation or sublimation
- Treatment and snow removal
- Traffic spray



Road weather condition – Interpretation based on road surface temperature + the amount of water, snow, and ice

- Dry
- Moist
- Wet
- Slush
- Snow
- Frost
- Ice
- Black ice



Measurements that improve road weather forecasts

Measurements enable forecast fine tuning. There are two primary measurement types available: Fixed and mobile stations.



Fixed road weather stations (first introduced by Vaisala) are reference grade, continuous sensors which can be used to calibrate other data sources. For example, if biases in third-party mobile data are observed, fixed station data can be used to make corrections by keeping track of the differences when mobile sensors pass the fixed stations.

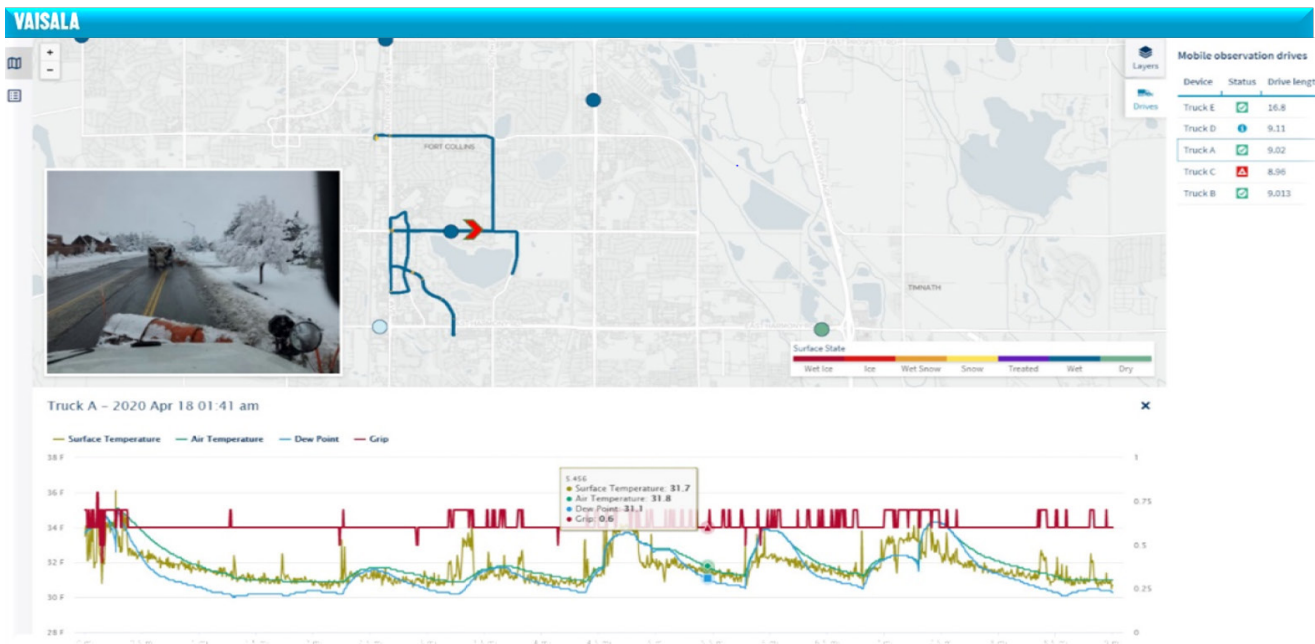


Mobile stations are professional grade intermittent sensors which provide broad network coverage and ease of deployment. This method requires a driver on the road to collect the data, resulting in intermittent coverage. If a verification routine is needed to track forecast quality, however, it is far easier to use the fixed stations.

Enabling better decisions in winter maintenance

Vaisala Wx Horizon is a first-of-its-kind service that helps you stay ahead of weather changes and make accurate decisions on when—and how—to keep your roads safer.

The combination of observations and forecasting that Horizon performs gives a clear and accurate view of current and near-future road weather conditions. This insight helps simplify road maintenance decision making for greater speed, accuracy, and proactive maintenance.

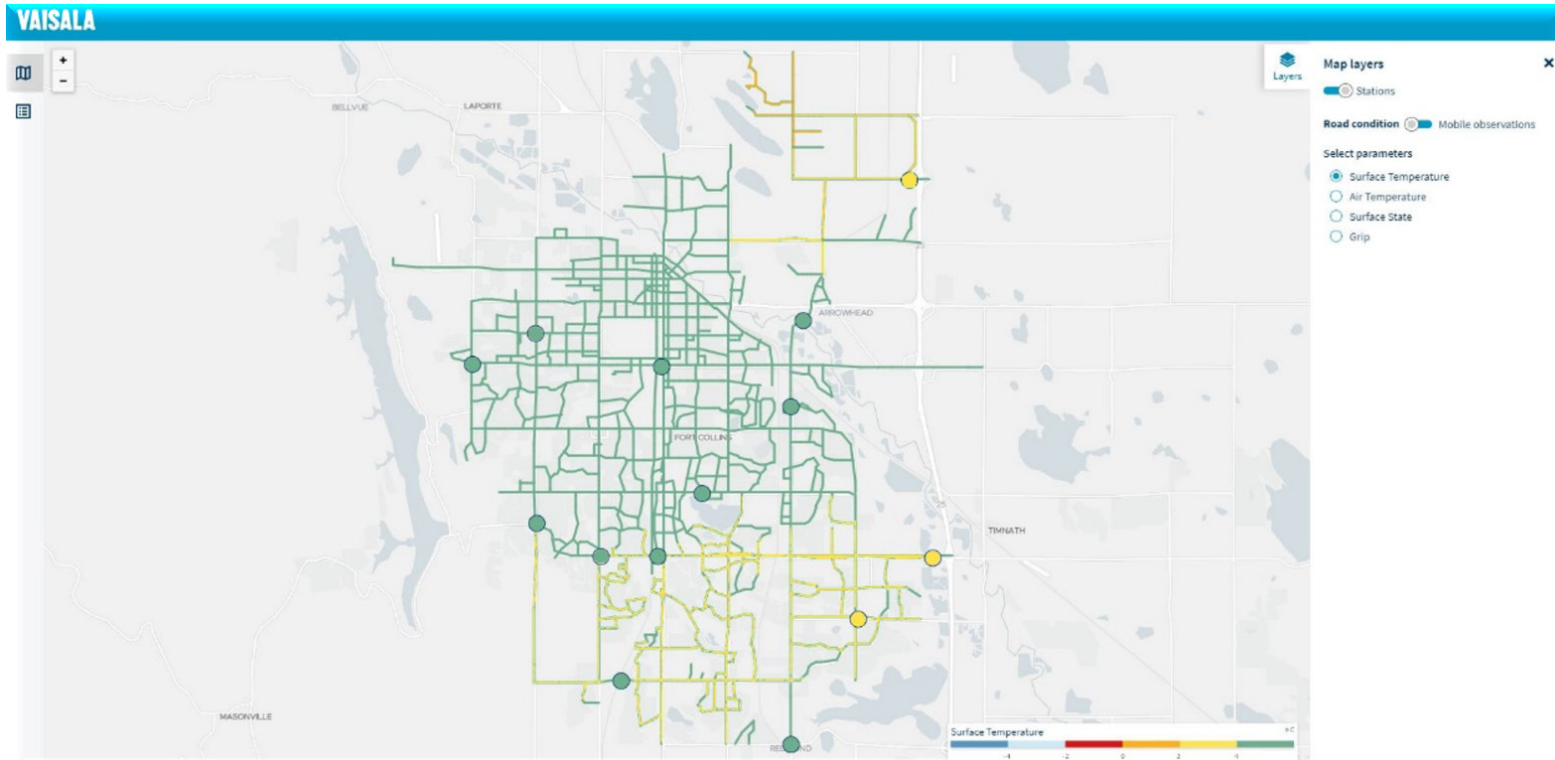


Example: Mobile data visualization

Horizon can incorporate and display data from any mobile device. In this example, the plow is equipped with a Vaisala MD30 sensor to read multiple parameters.

Data from the mobile sensor and fixed weather station is displayed on the map as well as a graph and is refreshed to show the past two hours. Each drive is color-coded to identify the surface temperature and surface state measured at each road segment.

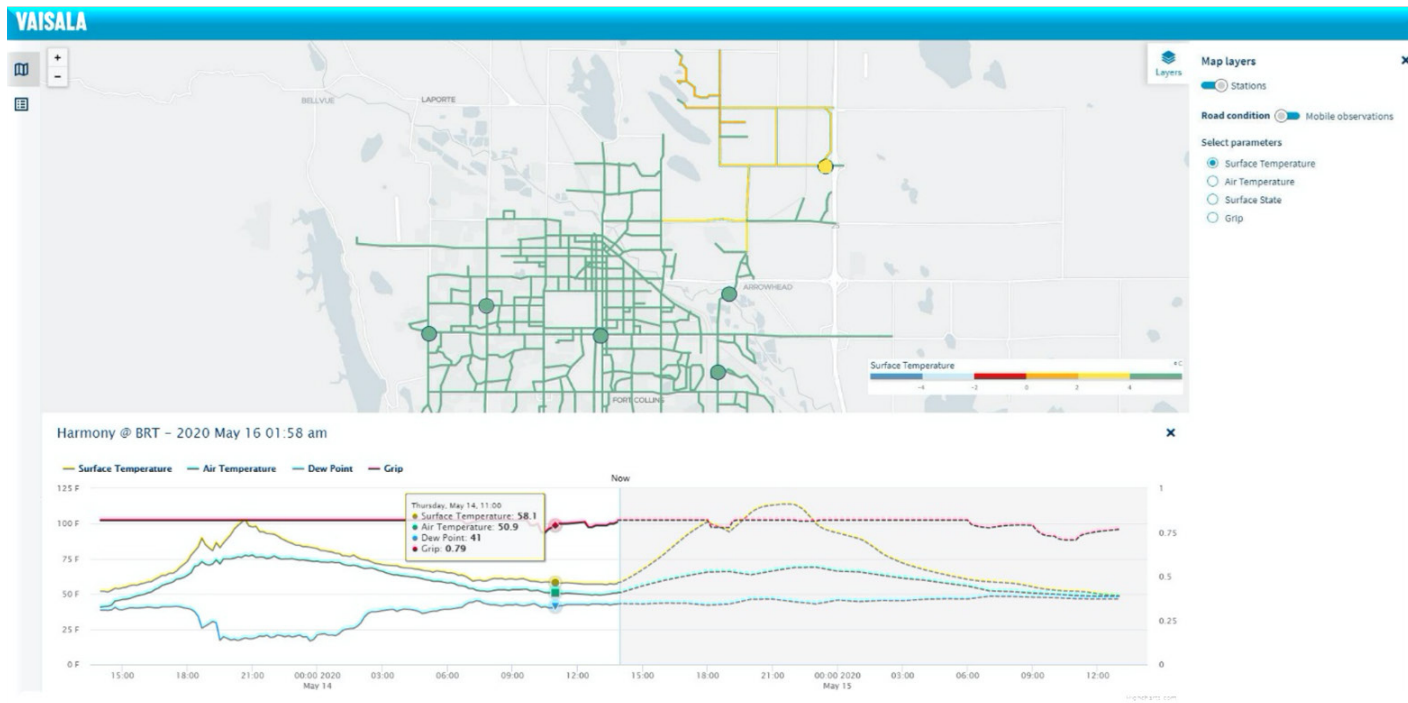
Where images have been collected by the in-vehicle camera, you can click on any road segment along the drive to select the image recorded, and also select an individual drive or multiple vehicles.



Example: Observation-driven impact assessment

The road network view provides a visualization of the current impact of the weather, generated by observations from fixed weather stations on a map and a network-wide assessment. The various colors indicate different, clickable parameters.

The network assessment is driven by atmospheric modeling combined with the latest observations from many sources including radar, satellite, fixed weather stations, and mobile sensors. This gives the winter maintenance decision maker complete situational awareness and the ability to react immediately to the current situation.



Example: Future impact on the road network

Real-time data is vital, but to plan for a storm the decision maker needs to be able to see how an event will impact the road network.

This example displays the current conditions and illustrates how the weather will impact the network over the next 24 hours.

Viewing capabilities:

- A time slider to show how, when, and where the weather will impact the network over the next 24 hours
- RWIS stations and data, the network, or both
- Forecast information on a map or radar
- Network selection; Graph view of how a specific part of the network will behave in the near future

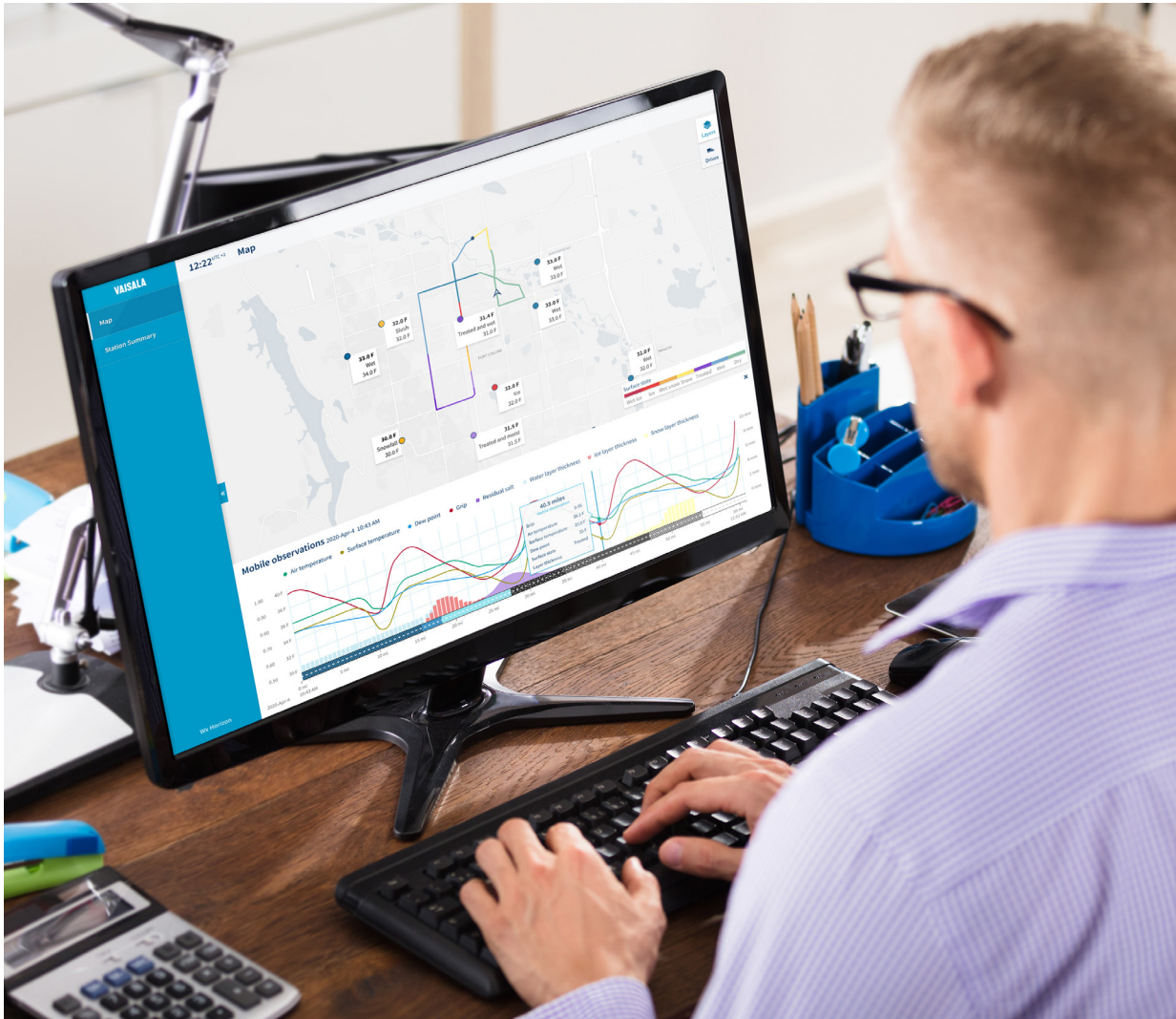
The network will change colors based on impact at future time intervals. You can also see how the

weather will impact the system in the next 24 hours.

Weather can change unexpectedly: User-specified system alerts can notify decision makers of changes to the weather and road network impact. Continual updates provide real-time data and up-to-the minute forecasts.

This information enables data-driven decisions for response and treatment actions.

Vaisala Wx Horizon



Key Benefits

Maintain safer roads

Provides all the information you need— current conditions, precipitation levels, and near-term forecast data—to decide when and where to deploy your fleet.

Simplify and save time

Analyzes and visualizes data from fixed RWIS/ESS, IoT and mobile sensors both from Vaisala and other manufacturers in one interface. Selects and combines relevant parameters from all sensors to provide meaningful information for decision-making.

Improve sustainable operations

Helps managers prioritize treatments, optimize salt and liquid usage, and plan plow resources efficiently to minimize the use of resources that can negatively impact the environment.

Drive efficient treatment practices

Helps organizations save time and money by optimizing winter maintenance resources.

Improve your mobile integration

Uses mobile observations to continuously improve road network forecast, based on research with users of the Vaisala Mobile Detector MD30.

Provide consistent level of service

Removes the inconsistency inherent in decision-making that relies on interpretation of different data sets.

With 80 years of weather measurement expertise, organizations around the world count on Vaisala solutions to help keep their operations safe, effective, and sustainable.

Vaisala brings deep understanding of the challenges faced by winter maintenance decision makers to provide dependable support, training, and project management based on best practices.

Learn more about how to drive improvement in your road maintenance strategies.

[Vaisala.com/wxhorizon](https://vaisala.com/wxhorizon)

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