Wx Horizon and Cast Sensing

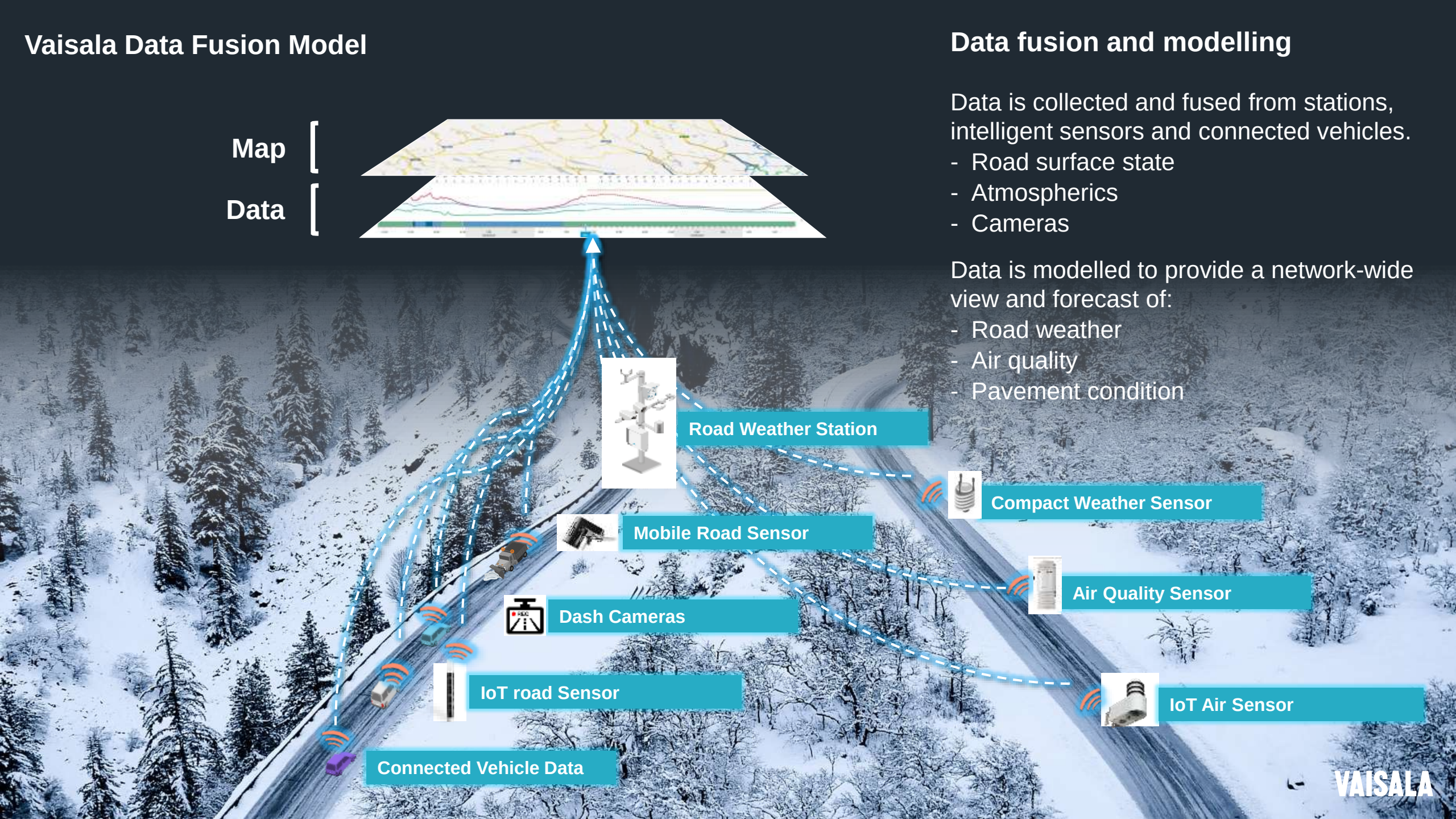
Vaisala Customer Forum

23rd March 2023

Overview

- Reminder of Vaisala road weather data fusion principles
  - To deliver the best assessment of current and future weather across a road network
- Where we are today
  - Wx Horizon with Cast sensing
  - Value of observations to forecasts
  - Use Cases
  - Deep dive into GroundCast
  - Deep dive into TempCast

Vaisala Data Fusion Model



Data fusion and modelling

Data is collected and fused from stations, intelligent sensors and connected vehicles.

- Road surface state
- Atmospherics
- Cameras

Data is modelled to provide a network-wide view and forecast of:

- Road weather
- Air quality
- Pavement condition

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Vaisala Data Fusion Model

Map

Data

Intelligence

Automotive

- Autonomous driving
- Assisted driving
- Navigation

Traffic Management

- Warning signs
- Variable speed limits
- Adaptive traffic lights

Winter Maintenance

- Decision support
- Alerting/notifications
- Recommendation

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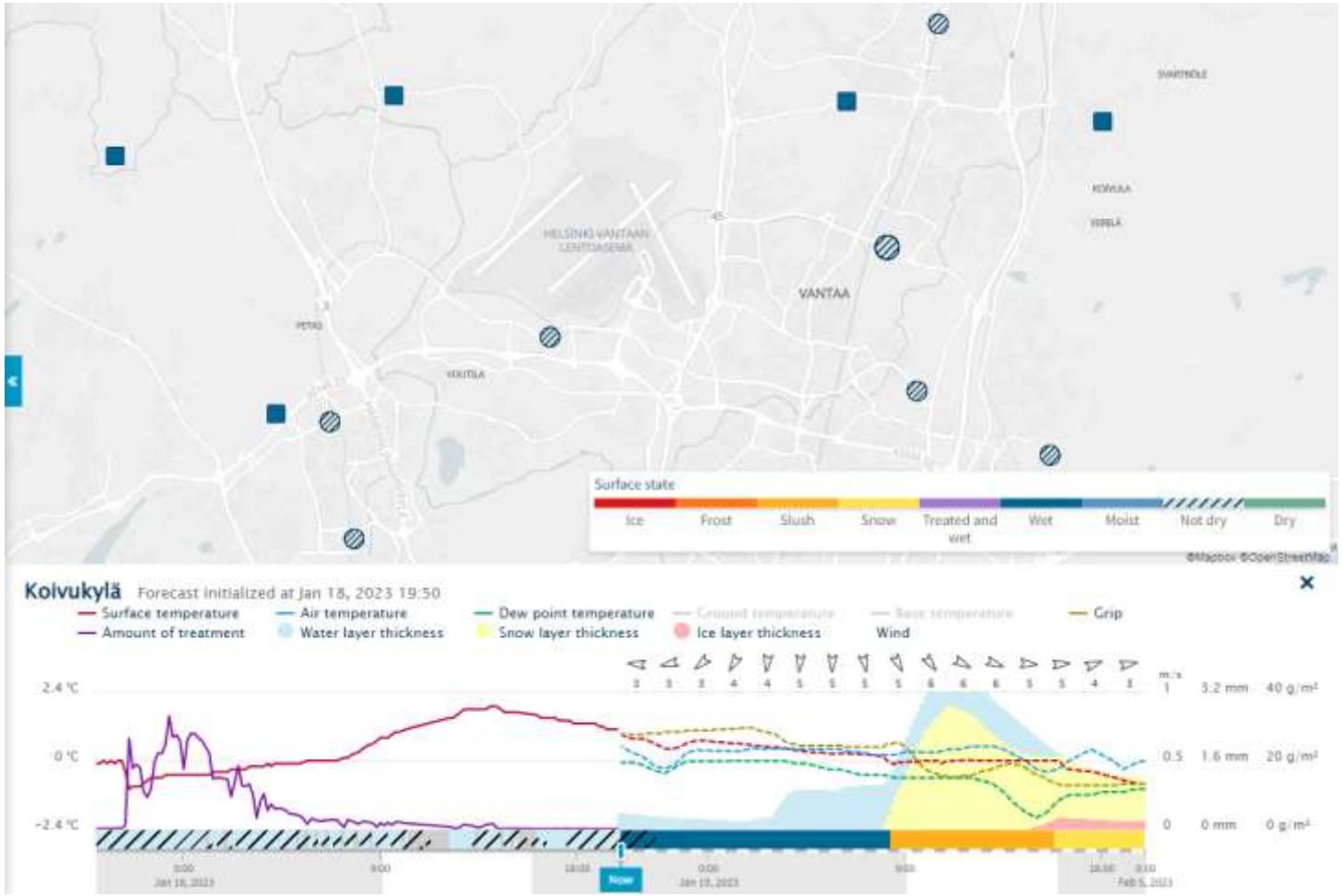
With knowledge about the **road surface** condition, winter treatment of mobility and safety improves

- Reliance on atmospheric weather forecasts, particularly off road networks
- Widespread siting of reference-grade road weather stations
- Roads far from depots, lacking “eyes on the road”
- No data points in-between measurements

Wx Horizon with Cast sensors

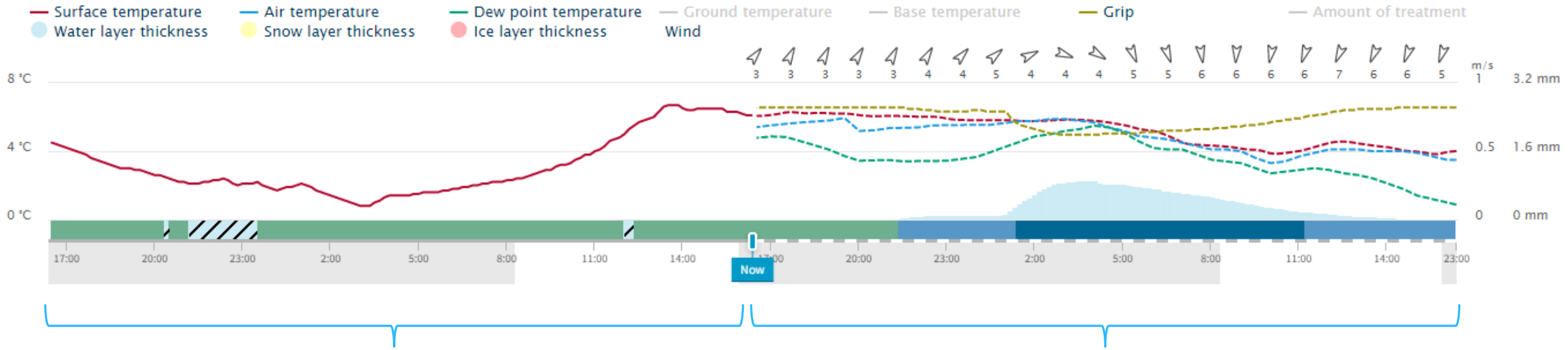


- Observations integrated with point forecasts
- Sensor data used to initialize the next forecast
- Forecast model self-learns local patterns over time
- 72hr road weather forecasts
- Forecast includes non-measured parameters eg grip, layer thickness, dew point

Why do observations matter?

- Road weather forecasts deliver better information than randomly generated forecasts
- 2022/23 research in both hemispheres determined how observations might further improve forecast skill
- Combined influence of observations from a fully equipped road weather station result in more accurate forecasts
- **Road surface temperature** and state measurements add the greatest value
- For the first 30 mins of a forecast at a particular location and time, 1C forecast error without observation could be reduced on average to 0.3C when observations are included
- New data every 10 mins enables updated forecasts to capitalize on near-term improvement from observations.

Forecasts improved with sensor data



Measured parameters

Observation enhanced forecast

Bridges and elevated sections

Short distances Unexpected conditions Hidden hazard

- Different, shallow construction compared with adjacent roads
- Heat loss from both above & below the surface
- Beware the start of winter!

Parking lots

Low traffic Low speeds Microclimate

- Parking is a major industry
  - Park n Ride
  - Shopping malls
  - Supermarkets
- Microclimate by design
  - Shading from buildings & vegetation
  - Low traffic speeds
- Insurers recommend property owners use certified snow removal contractors
- Hyper-local surface weather data difficult to obtain

Cities

Heavy traffic

Low speeds

Large variations in road weather

- Need to maintain mobility
  - Treatments and snow removal
- Critical spots are typically known
  - Hills and inclines
  - Intersections
  - Bus stops
- Suitable sensor locations are hard to find

Non-urban roads

Low traffic | High speeds | Long distances

- Long distances to monitor and clear
- Priorities and resourcing
  - Keep routes open
  - Need to ensure driver safety
    - Winter or variable speed limits
    - Snow chains or winter tires
    - Close the road until cleared
- Hazardous spots due to topography and shading

Cycleways and sidewalks

- Sustainable commuting is becoming more important
  - Requires the right infrastructure
  - Requires extremely diligent winter maintenance practices

- Different thermal properties compared to roads
  - Usually cools down before streets

GroundCast sensors in cycle path between Bristol and Bath, UK

Wx Horizon with Cast sensors

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Vaisala Cast sensors

Proven Vaisala performance in wireless IoT sensor package
Sensors coupled with sensor-improved point forecasts

Wx Horizon & RoadDSS

Surface temp accuracy **± 0.2 ºC** (same than RWS)

Surface temp accuracy **± 0.5 … 1.0 ºC**
Air temp accuracy **± 0.2 ºC** (same than RWS)

Dense hybrid network

Infill sensor to cover critical blind spots

Potential Cast Sensor RWS

Multi-lane highway

Airport area

Getting started

No observations or only from nearest state highways

Cast sensor variants

With typical use cases

GroundCast

“Data from anywhere”

- Cold spots without any infra
- Multilane measurements
- Residual salt per route

GroundCast

+

TempCast

“Best performance”

- Critical frost risk locations
- Infill station between any RWS
- Residual salt per route

TempCast with surface temperature

“Fully remote”

- Bridges (no drilling)
- Areas without salt treatment
- Any additional location

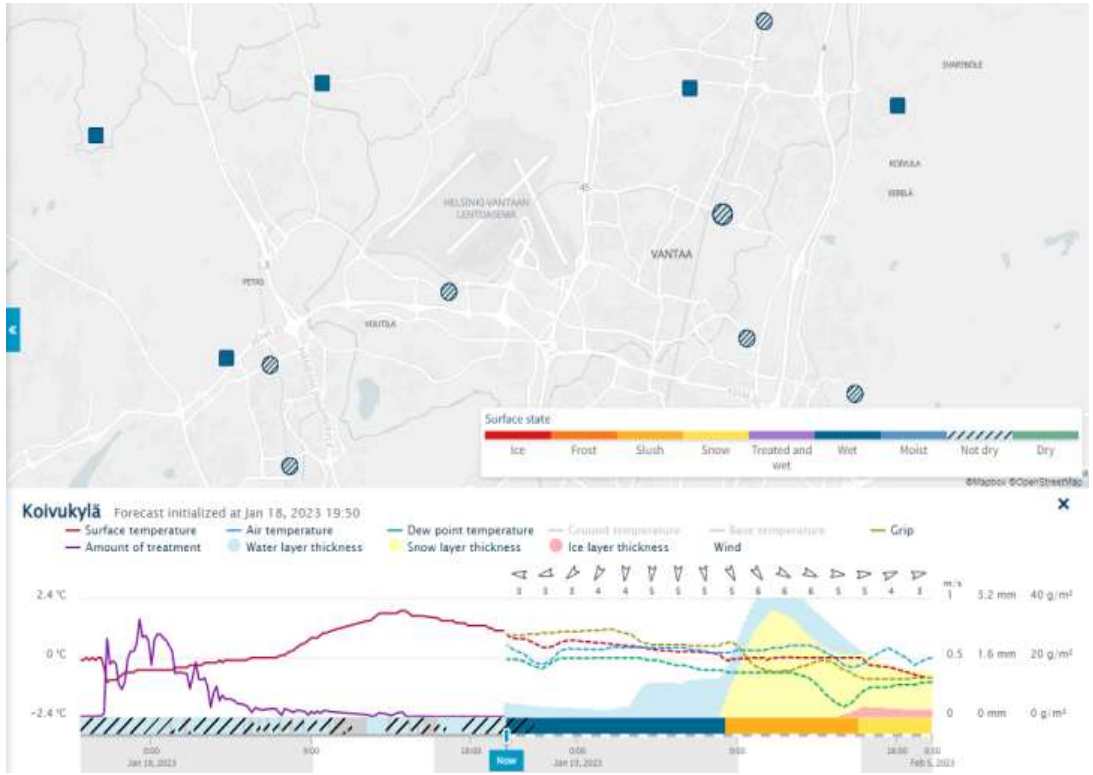
Data available in both Wx Horizon and RoadDSS

Observations and forecasts over UI and API

Wx Horizon

Sensor observations

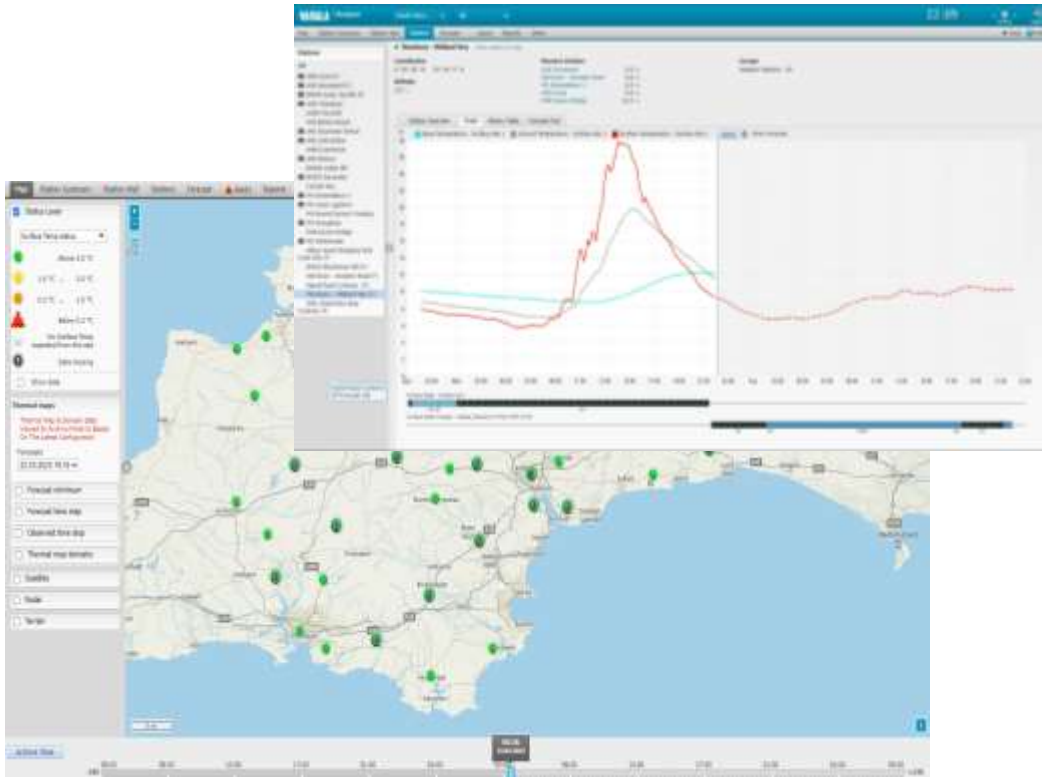
+ improved point forecasts (for multiple parameters)



RoadDSS

Sensor observations

+ improved point forecasts (for measured parameters)



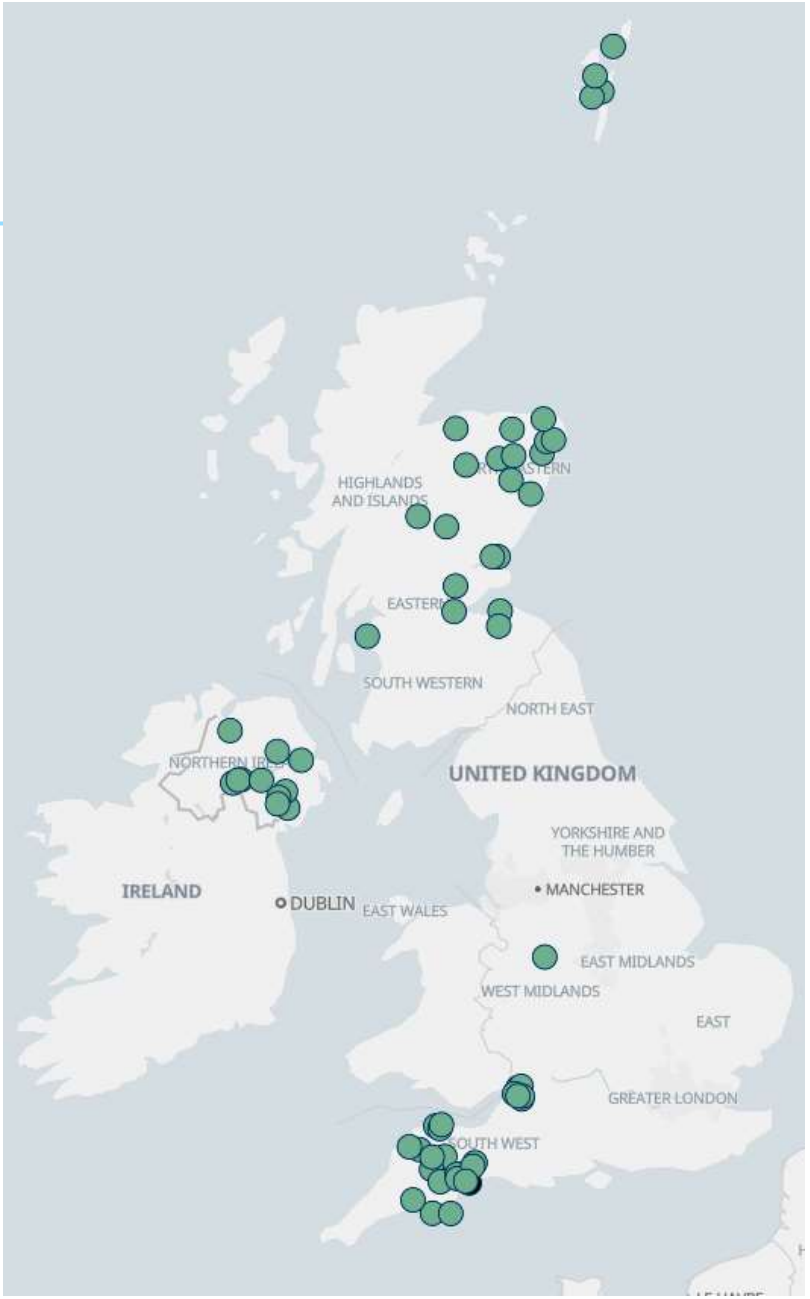
Cast sensors in UK & Ireland

Installed since 2021

Michael Wall • 1st
Weather Sales Manager (Ground Transportation) at Vaisala Ltd
5d • Edited •

Another successful installation of the new #Vaisala #GroundCast sensor, this time in #Staffordshire. The installation is supporting the councils #wintermaintenance team by providing real-time surface condition and temperature observations whilst their #RWS200 weather station has been temporarily removed during construction works.

https://lnkd.in/em45J_DA



GroundCast installation & replacement

Sensor installation

1. Activate

2. Drill

3. Apply

4. Seal

5. Clean

6. Done

Sensor replacement

1. Attach

2. Screw

3. Lift

4. Done

TempCast installation & replacement

Sensor installation

1. Activate

2. Attach

3. Place

4. Lock

5. Aim

6. Done

Sensor replacement

1. Reach

2. Lock

3. Lift

4. Unlock → Done

Ensuring sensor quality at Vaisala R&D lab

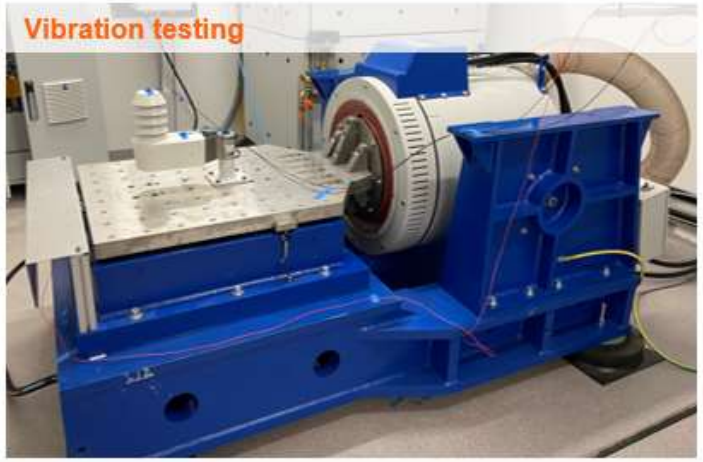
Examples of environmental tests performed for Cast sensors against IEC / EN standards

TempCast

IP rating / dust testing

Heat and cold chamber testing

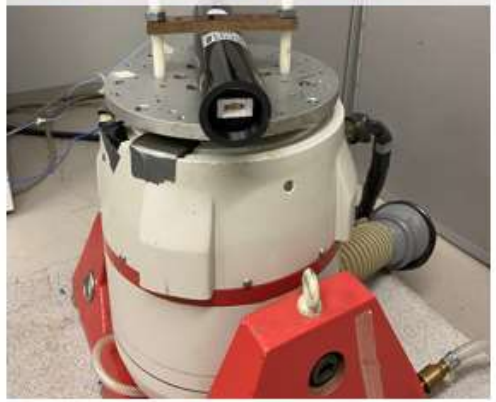
Vibration testing



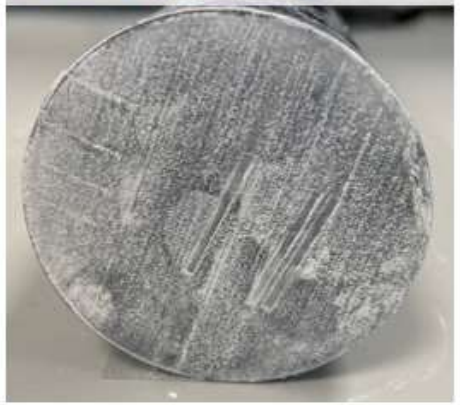
IP rating / water spray testing

GroundCast

Vibration testing - Horizontal



IP rating / dust testing



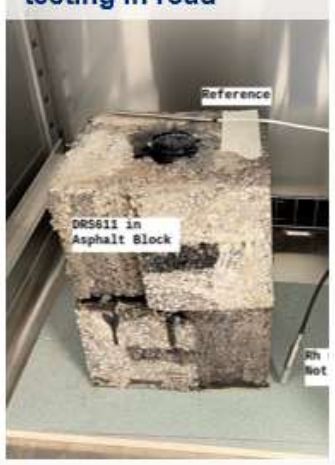
IP rating / water immersion testing

IP68: Water immersion tested under the following conditions:

- Immersion depth: 20 m (65 ft)
- Immersion time: 140 hours

Vibration testing - Vertical

Temperature gradient testing in road



Ensuring sensor quality at product manager's extra testing

After Vaisala R&D testing, the real test was Finnish sauna and kids' playground… ☺











Thank you!