New data sources for efficient winter maintenance

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APSE Bradford, 13th October 2022

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Topics for Discussion

- Expansion of observation networks beyond established roadside weather stations

- New and additional sources of data

- Benefits of expanded observation networks

- How to interpret these increased amounts of data

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Background

- In the UK, Vaisala have over three decades of experience in the supply, operation and maintenance of roadside weather stations (RWIS) for winter maintenance activities

- Vaisala currently provide these services to the majority of strategic highway bodies and local authorities
  - Around 1400 Vaisala reference-grade RWIS are installed across the UK and Ireland

- Our customers have consistently requested additional observations at other points of concern around their networks
  - Has often been a challenge due to factors such as:
    - Cost
    - Infrastructure
    - Power
    - Communication

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Reasons for additional observations

- *Winter Maintenance*
  - Increased visibility at points of concern
  - Forecast / RBF enrichment and verification
  - Short-term / temporary observations during roadworks & schemes
  - Car parks, hospitals, schools
  - Quality assurance of winter maintenance
  - In the future: dynamic spreader rates & routing

- *Active Travel networks*
  - Observations on cycleways and footways

- *Traffic Management*
  - Minimize impact that weather has on traffic
  - Mitigate impact traffic has on environment
    - Warning signs
    - Variable speed limits
    - Air quality measurement for dynamic routing

- *Automotive*
  - Weather conditions for Autonomous Driving
  - Infotainment content
    - Destination weather
    - Road weather warnings
    - Weather impact on driving time

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New sensor options

- Technological advances mean that many of these previous restrictions have now been overcome

- Now possible to deploy high density / low-cost observation networks to supplement and support existing reference-grade RWIS networks

- Vaisala have developed a range of sensors to meet these demands:

  - *Fixed observations*
    - Battery powered, NB-IoT (Narrow Band Internet of Things) sensors
    - Compact air quality sensor that can be installed on existing RWIS or standalone

  - *Mobile observations*
    - Vehicle-mounted road surface temperature / state sensor
    - Vehicle mounted sensors using Computer Vision and Artificial Intelligence for pavement management and winter maintenance applications

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Vaisala GroundCast

- Surface temperature
- Treatment material amount
- Surface dry / not dry

- Temperature at -6 cm / 2.4 inch

- Temperature at -30 cm / 1 feet

Helps to predict road freezing

The data enhances pavement forecasts

Helps you target treatments

Monitor the amount of residual treatment material

30 cm / 1 feet

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GroundCast

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Vaisala TempCast
(Launching winter 2022/23)

Ambient temperature

Dew point
Vaisala HUMICAP®

Surface temperature

⚠ **Helps to predict frost formation**

🛣 **The data enhances pavement forecasts**

⚠ **Helps you target treatments**

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TempCast

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Vaisala Air Quality Transmitter AQT530

- Ideal for supplementary air quality networks

- Measures the most important air pollutants in one compact package
  - Particulates
    - PM_{10}
    - $PM_{2.5}$
  - Gases
    - NO_2
    - NO
    - CO
    - O_3

- Can be added to existing RWIS

- Can be installed standalone as part of compact Beacon weather station

- Complimented by new Hyperlocal Air Quality Forecasting Service
  - Resolution as high as 15m in urban environments, 72hr forecast outlook

Vaisala Mobile Detector MD30

Road temperature

Air temp, humidity, dew point

Grip, state, layer thickness
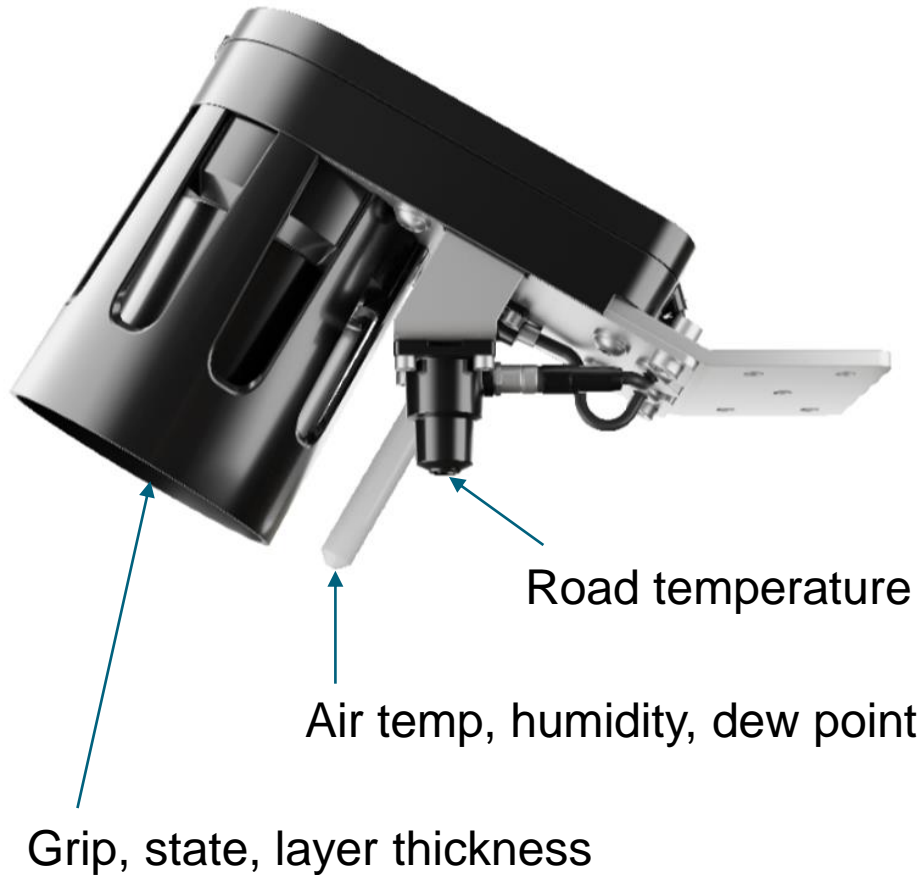
Application areas
- Snow plows & spreaders
- Patrol & inspection vehicles
- Other fleet
    - Taxi
    - Bus
    - Postal
        - Observations collected 24/7

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RoadAI modern road analysis

Smartphone simplicity

AI-based insights

4x faster, ½ the cost of previous methods

Objective, decisive actions and planning

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Continuous pavement condition tracking and analysis

- Objective insights improve decision-making and broader strategy

- All defect types captured

- Support your winter maintenance decisions

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Connected vehicles

- Vehicles behave differently under different weather conditions and if these are taken into consideration operations can be made more efficient

- Over recent years, vehicle manufacturers have increasingly looked towards Vaisala to supply weather data for:
  - Infotainment purposes
  - Notifications and support for safe driving (navigation)
  - Driver assistance and automated driving developments

- Today, Vaisala supplies its road weather model data to organisations such as Hyundai, BMW, Mercedes-Benz, VW and TomTom
  - Estimate that up to 20m vehicles are using Vaisala weather data globally

- Data from these connected vehicles also feeds back into the Vaisala road weather model
  - Live situational awareness on precipitation (windscreen wipers), surface condition (braking times) etc
  - Research ongoing

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Data fusion – Vaisala WX Horizon

- One of the key challenges of receiving all of these additional observations is how to interpret and make sense of everything

- Data fusion is the key

- Data is collected from multiple sources
  - Traditional (reference-grade RWIS)
  - New (NB-IoT sensors, mobile sensors, AQ sensors, RoadAI)
  - 3rd party – eg connected vehicles

- In Vaisala's WX Horizon software, data is fused and turned into actionable intelligence so that informed decisions can be made

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Vaisala Data Fusion Model

Map
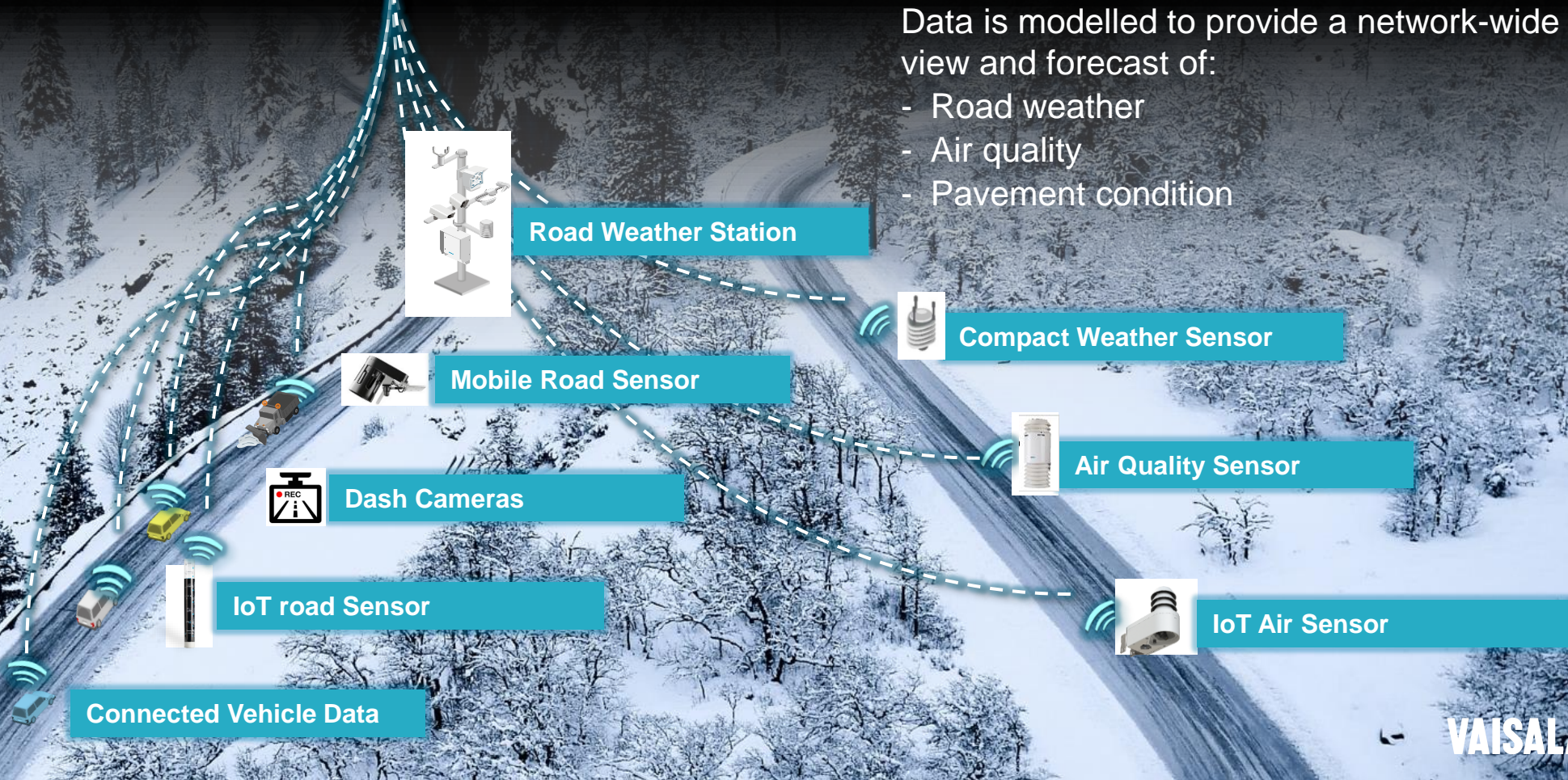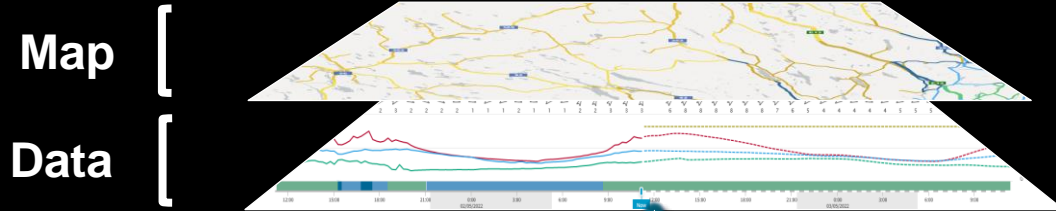
Data

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

Road Weather Station

Compact Weather Sensor

Mobile Road Sensor

Air Quality Sensor

Dash Cameras

IoT road Sensor

IoT Air Sensor

Connected Vehicle Data

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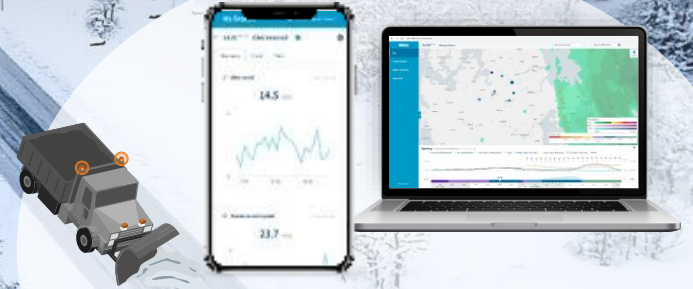
Where are we today?

- IoT sensors are being rolled out & ramped up over the coming winter
    - GroundCast available now
    - TempCast available during winter 22/23
    - Other IoT sensors under development

- Mobile Detector MD30 available now

- Air Quality Transmitter AQT530 / Beacon compact weather station available now

- RoadAI available now

- WXHorizon available now in selected markets
    - For new customers, WX Horizon is the default software choice
    - For those customers currently using Vaisala's Navigator or Manager software, further developments are needed to incorporate existing features and functionality
        - Transition of Navigator users likely in time for 2023/24 season

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Summary

- Changing operational needs, Climate Change and new forms of mobility require more and more weather data
    - Winter Maintenance
    - Active Travel networks
    - Traffic Management
    - Automotive

- New kinds of observations are possible through a variety of fixed and mobile sensors

- Data fusion is the key to ingesting all of this new data and providing a meaningful output

- Vaisala's WX Horizon software is able to turn data from these various sources into actionable intelligence

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