New data sources for efficient winter maintenance and future roadmap

Customer Forum

Michael Wall, Erik Sucksdorff

Birmingham
March 28, 2023

VAISALA

Topics for Discussion

- Directions of travel – in-fill and traffic management applications
- 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

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, but this has often been a challenge due to factors such as:
  - Cost
  - Infrastructure
  - Power
  - Communications

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
    - Warning signs
    - Variable speed limits
  - Mitigate impact traffic has on environment
    - Air quality monitoring and environmental traffic management
- *Automotive*
  - Weather conditions for Autonomous Driving
  - Infotainment content
    - Destination weather
    - Road weather warnings
    - Weather impact on driving time

New sensor options

- Technological advances mean that many of these previous restrictions have now been overcome. It is now possible to:
  - Derive more value from existing RWIS networks for year-round traffic management purposes
  - Deploy high density / low-cost observation networks to supplement and support existing RWIS networks
- Vaisala have developed a range of sensors to meet these demands:
  - *Traffic management*
    - Compact air quality sensor that can be installed on existing RWIS or standalone
    - 3rd party road cameras and traffic counters on RWIS stations
  - *In-fill observations*
    - Battery powered, NB-IoT (Narrow Band Internet of Things) sensors
  - *Mobile observations*
    - Vehicle-mounted road surface temperature / state sensor
    - 3rd party floating car data (FCD)

Road Weather Station - Traffic Management Platform

- A road weather station is not just a winter maintenance appliance. It can support many critical traffic management applications
  - Atmospherics – high winds, poor visibility
  - Road state – slippery roads, aquaplaning
  - Air quality – particles and gases
  - Traffic – counting, speed, occupancy
  - …
- Greater efficiency with shared investments between winter maintenance and traffic management

- New standards to help RWIS share data with vehicles directly over infrastructure-to-vehicle communications

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_2, O_3
- Can be added to existing RWIS
- Can be installed standalone or as part of a Compact Station
  - Can include atmospheric information, including wind speed & direction
- Complimented by new Hyperlocal Air Quality Forecasting Service
  - Resolution as high as 15m in urban environments, 72hr forecast outlook

Vaisala GroundCast

- **Helps to predict road freezing**
- **The data enhances pavement forecasts**
- **Helps you target treatments**
- **Monitor the amount of residual treatment material**

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

- Temperature at -6 cm / 2.4 inch

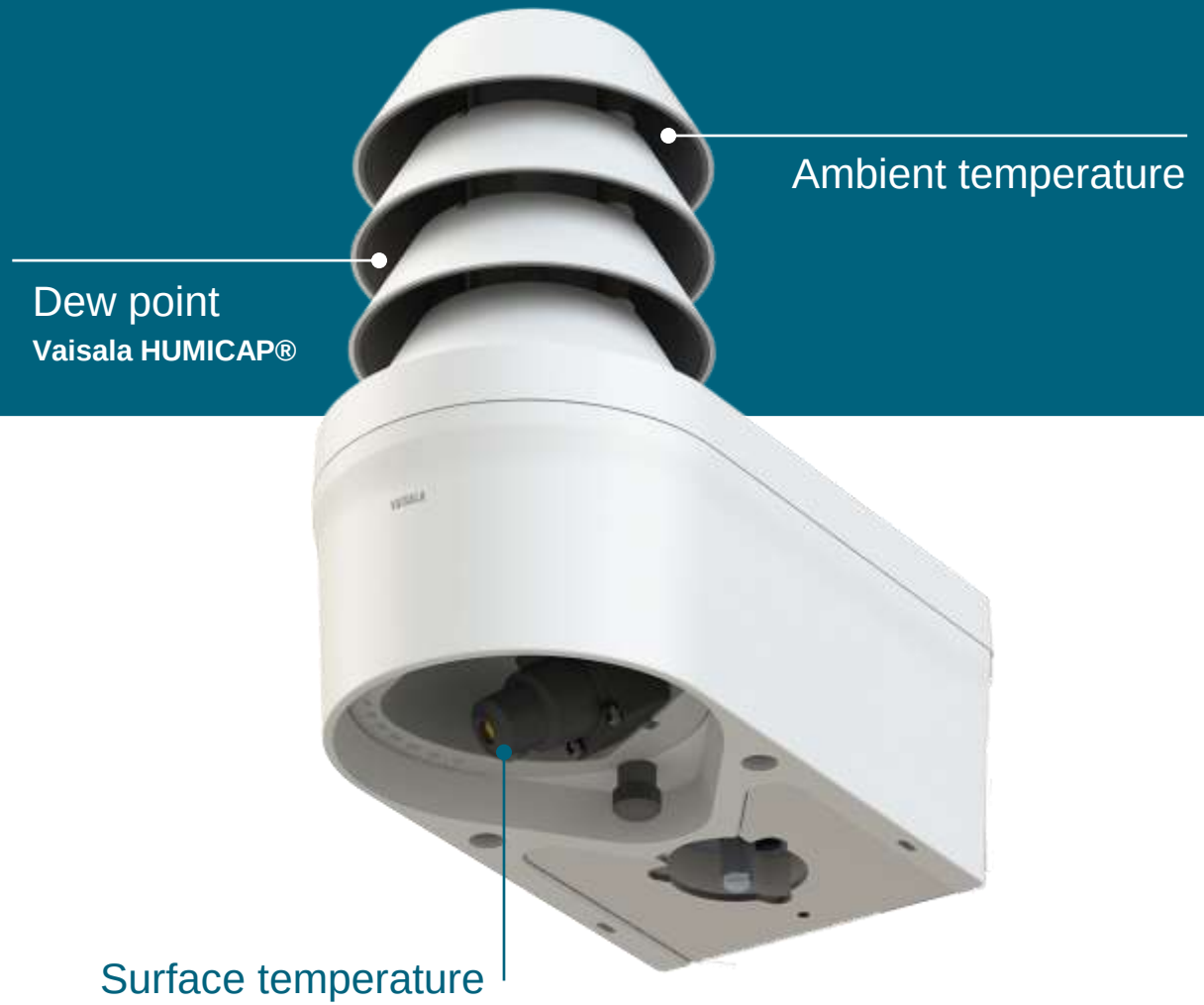
- Temperature at -30 cm / 1 feet

VAISALA

GroundCast

VAISALA

Vaisala TempCast



- Helps to predict frost formation
- The data enhances pavement forecasts
- Helps you target treatments

VAISALA

TempCast

VAISALA

IoT infill sensor application areas

- **Vaisala IoT Data Solutions are ideal for:**
  - In-fill measurement points on road networks (part of hybrid network with RWIS)
  - Supporting Route Based Forecasting
    - To enhance accuracy of route forecasts
    - 2019 Met Office study suggests that having data improves forecast accuracy by at least 1C
      - Recent Vaisala Science study supports this finding
  - Cycleways / Footways
    - Eg Dundee City and South Gloucestershire
      - Mix of GroundCast and TempCast
  - Elevated sections
    - 5 IoT sensors are currently being installed on Mancunian Way in centre of Manchester
  - Car parks
    - Just sold qty 5 TempCast for this application
  - Park & Rides
  - Pedestrian areas
  - Smart Cities

VAISALA

Vaisala Mobile Detector MD30

Application areas

- Network data for locating RWS/IoT sensors
- Patrol car /gritter data for better decision making
- Quality assurance of gritting – e.g. ice hunting
- Dynamic spreader control – manual/automated
- Thermal mapping – self-service mode

VAISALA

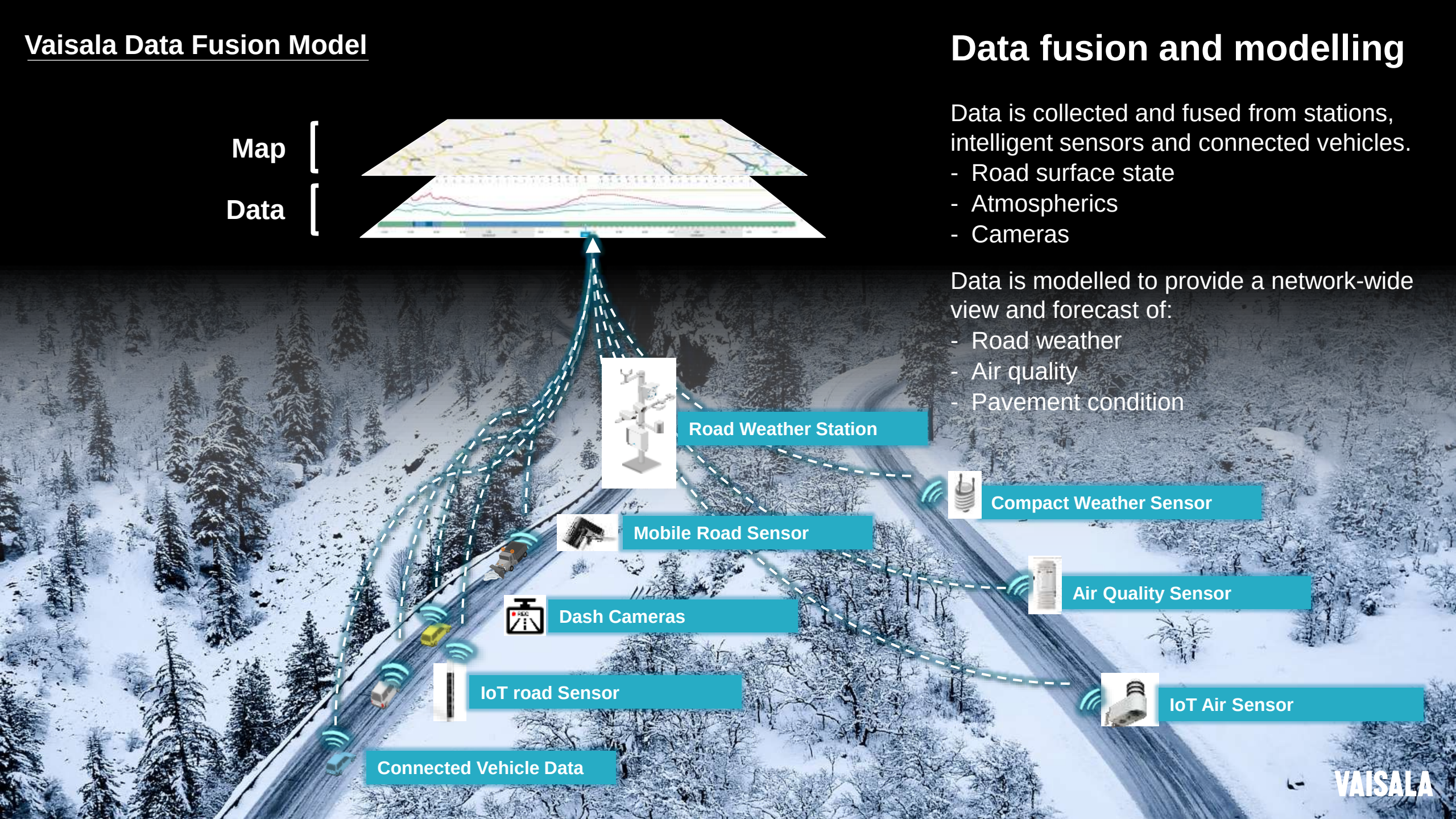
Floating car data and connected vehicles

- 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, BMW, Mercedes-Benz, VW, Hyundai and TomTom
  - Estimate that up to 20m vehicles are using Vaisala weather data globally
- Data from connected vehicles can also be fed back into the Vaisala road weather model
  - Provides live situational awareness on precipitation (windscreen wipers), surface condition (braking times) etc
  - Research ongoing

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)
  - 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

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

VAISALA

Vaisala Data Fusion Model

Map

Data

Intelligence

Intelligence

We turn rich data into intelligence so that our clients make informed decisions

- Automotive
- Traffic management
- Winter maintenance
- Pavement management

Automotive

- Autonomous driving
- Assisted driving
- Navigation

Traffic Management

- Warning signs
- Variable speed limits
- Adaptive traffic lights

Winter Maintenance

- Decision support
- Alerting/notifications
- Recommendation

VAISALA

Benefits of denser road weather observations

Denser observations

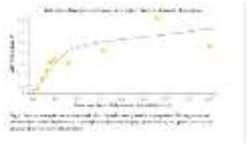
RWS200

GroundCast
TempCast

MD30

WX Horizon

Impacts over time



Situational awareness
- IoT on whole network
- Real-time mobile data

Forecast
- Verification to learn
- Improvement 1.0 C 6 hrs

Impacts on operations

Selective treatment
- Only cold routes
- 20% savings

Improved timing
- Proactive treatment
- 4 x efficiency gain

Dynamic spreading
- Only where needed
- 30% savings

Impacts on sustainability

Environmental impact
- Salt savings
- CO2 cuts

Ensuring accessibility
- Active travel
- Autonomous driving

- Pilot projects suggest that recent advances in road weather technologies can improve winter maintenance decision making by 20-30%
- Especially on marginal nights, which account for 50-70% of all the treatments

VAISALA

Where are we today?

- IoT sensors have been rolled out & ramped up over the last winter
  - GroundCast and TempCast have been successfully deployed in around 10 local authorities across the UK
- Mobile Detector MD30 available now
- Air Quality Transmitter AQT530 / Compact Station available now
- Wx Horizon available now in selected markets
  - For new customers, Wx Horizon Pro is the default software choice
  - For those customers currently using Vaisala's Navigator or Manager software, further developments on sensor fusion is on-going to ensure a good user experience
  - Full sensor fusion capabilities envisaged in 2024
    - Transition of Navigator users likely in time for 2024/25 season

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 RWIS, IoT sensors 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 will turn data from these various sources into actionable intelligence

VAISALA