

Mobile
observation
platform (also
removes
snow)



Mobile observations in winter decision making

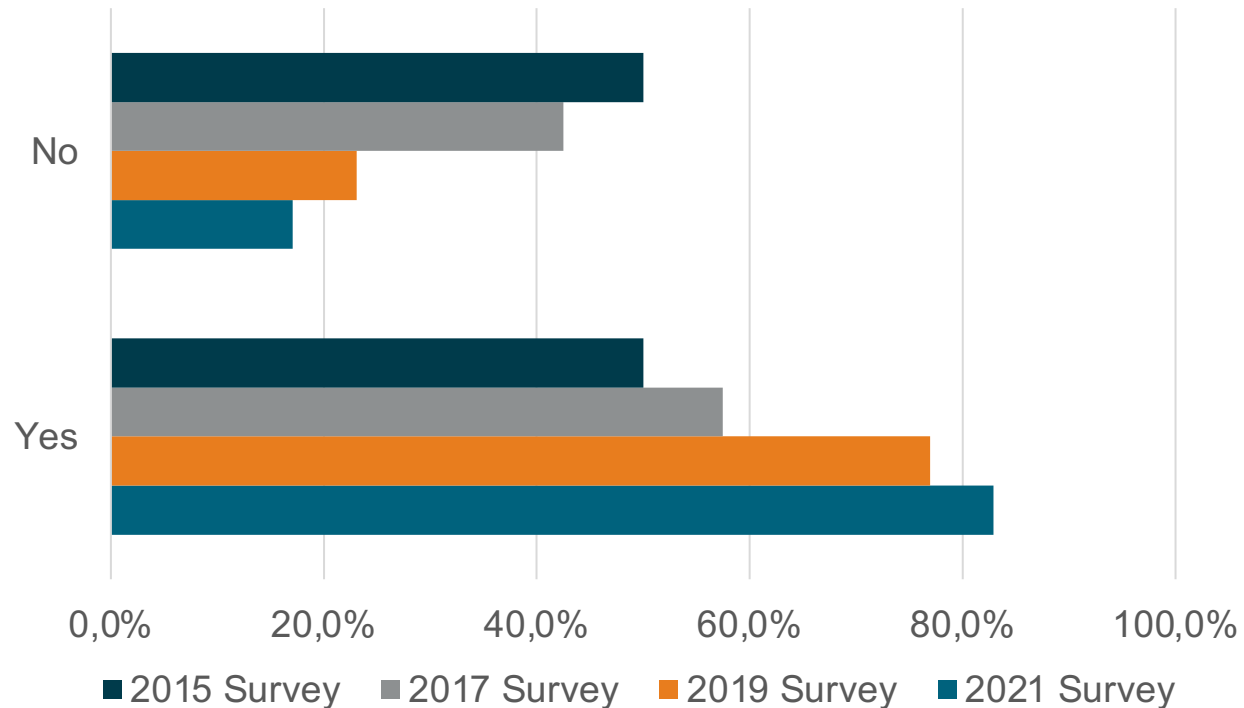


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VAISALA

Percent of agencies collecting real-time field data from maintenance vehicles continues to increase

- Over 80% of U.S. respondents collect real-time data from their fleet
- Type of Data (ordered most to least):
 - Plow status and material usage data
 - Road weather conditions data
 - Atmospheric weather data
 - Images/videos from dashboard cameras



Source: RWMP Performance Measurement Study

Slide courtesy Tony Coventry, FHWA

Equipment placement in vehicle



MD30 sensor behind the bumper



Phone in the cab



Data from single drive

Snapshot from Jan 20, 2022 10:00 AM

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Map

10-day forecast

Station Summary

Image Wall

Settings

Fort Collins
demo001cityoffortcollins
Jan 20, 2022 10:00 AM
Reset

24h 72h

Alerts

User

Mobile observation drives

SHOWING DRIVES BETWEEN

Jan 19, 2022 10:48 PM

Jan 20, 2022 2:31 AM

10:48 PM

2:31 AM

22059

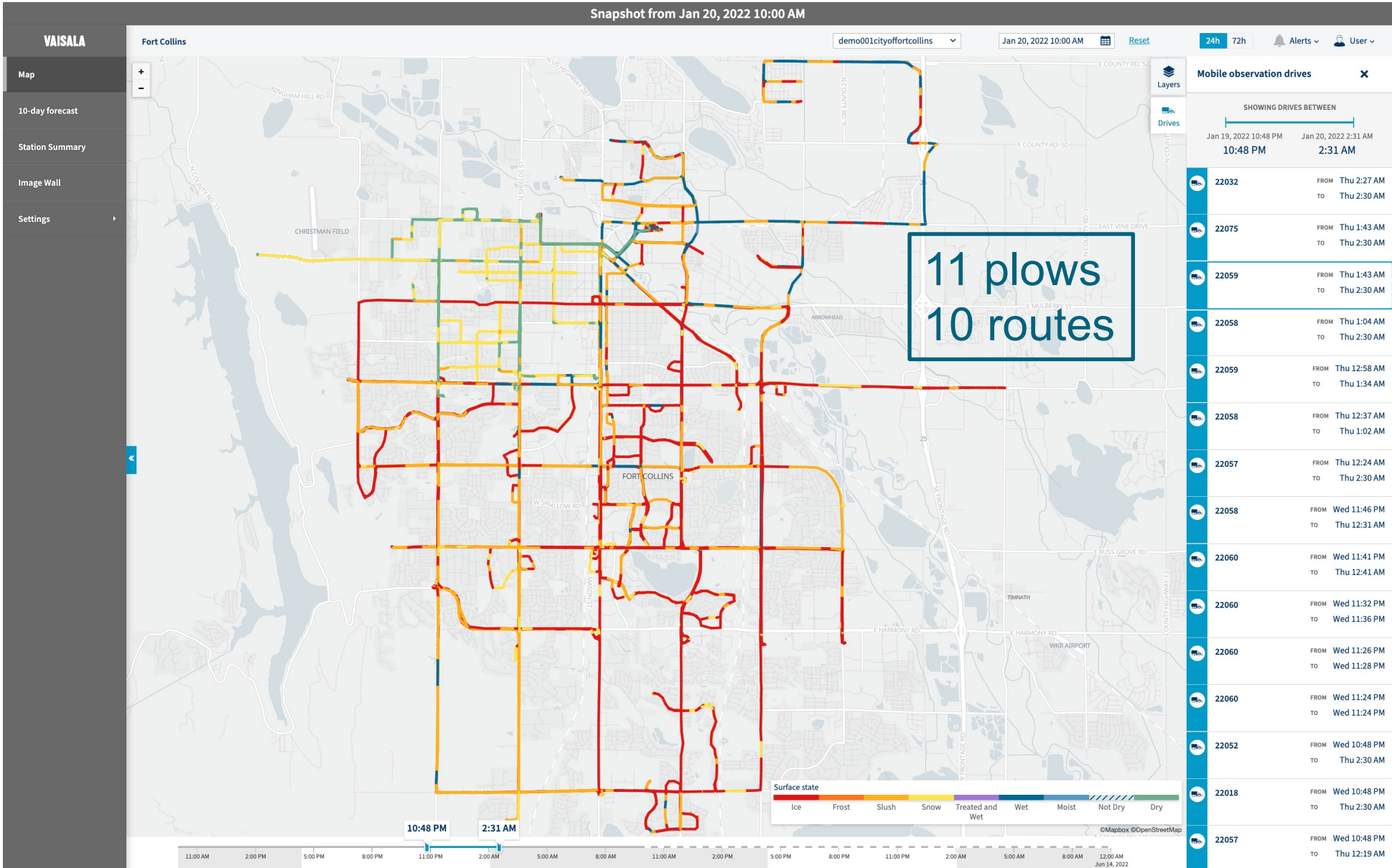
— Surface temperature
 — Air temperature
 — Dew point temperature
 — Grip
 ● Water layer thickness
 ● Snow layer thickness
 ● Ice layer thickness

Layers

Drives

Drive ID	Start	End
22032	Thu 2:27 AM	Thu 2:30 AM
22075	Thu 1:43 AM	Thu 2:30 AM
22059	Thu 1:43 AM	Thu 2:30 AM
22058	Thu 1:04 AM	Thu 2:30 AM
22059	Thu 12:58 AM	Thu 1:34 AM
22058	Thu 12:37 AM	Thu 1:02 AM
22057	Thu 12:24 AM	Thu 2:30 AM
22058	Wed 11:46 PM	Thu 12:31 AM
22060	Wed 11:41 PM	Thu 12:41 AM
22060	Wed 11:32 PM	Wed 11:36 PM
22060	Wed 11:26 PM	Wed 11:28 PM
22060	Wed 11:24 PM	Wed 11:24 PM
22052	Wed 10:48 PM	Thu 2:30 AM
22018	Wed 10:48 PM	Thu 2:30 AM
22057	Wed 10:48 PM	Thu 12:19 AM

Data from concurrent drives



Benefits for Operators

- Current Road Data
 - Level of Grip,
 - Surface Temperature
 - Air Temperature
 - Pavement Surface State, Snow and Ice Layer Thickness
- No need to radio in data
- Better decisions on application rates



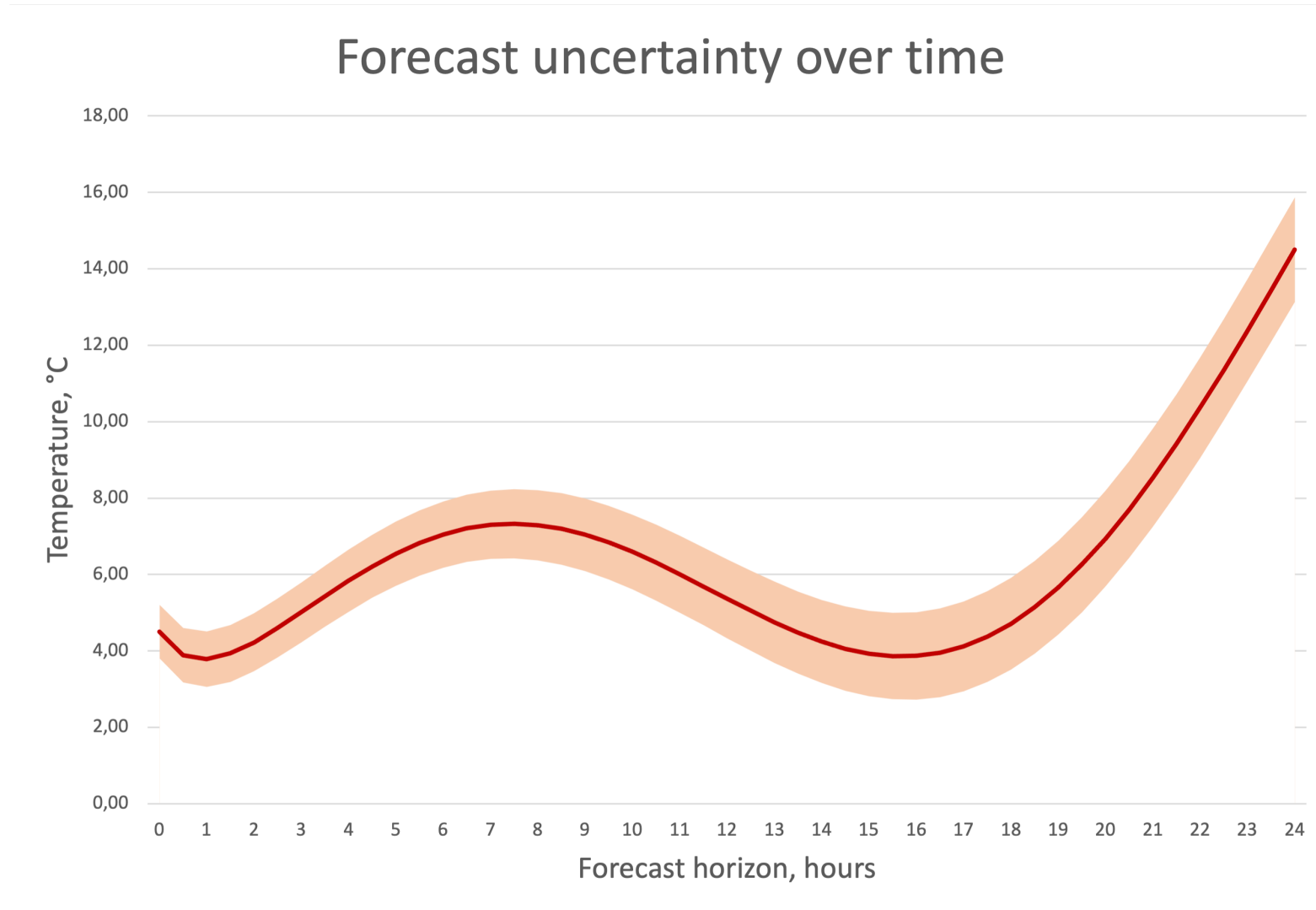
Benefits for Supervisors

- Near real-time grip displayed on map
- Check Each Route on Map
- Plows utilized more efficiently
- Verification of citizen claims
- Differences between routes easy to see



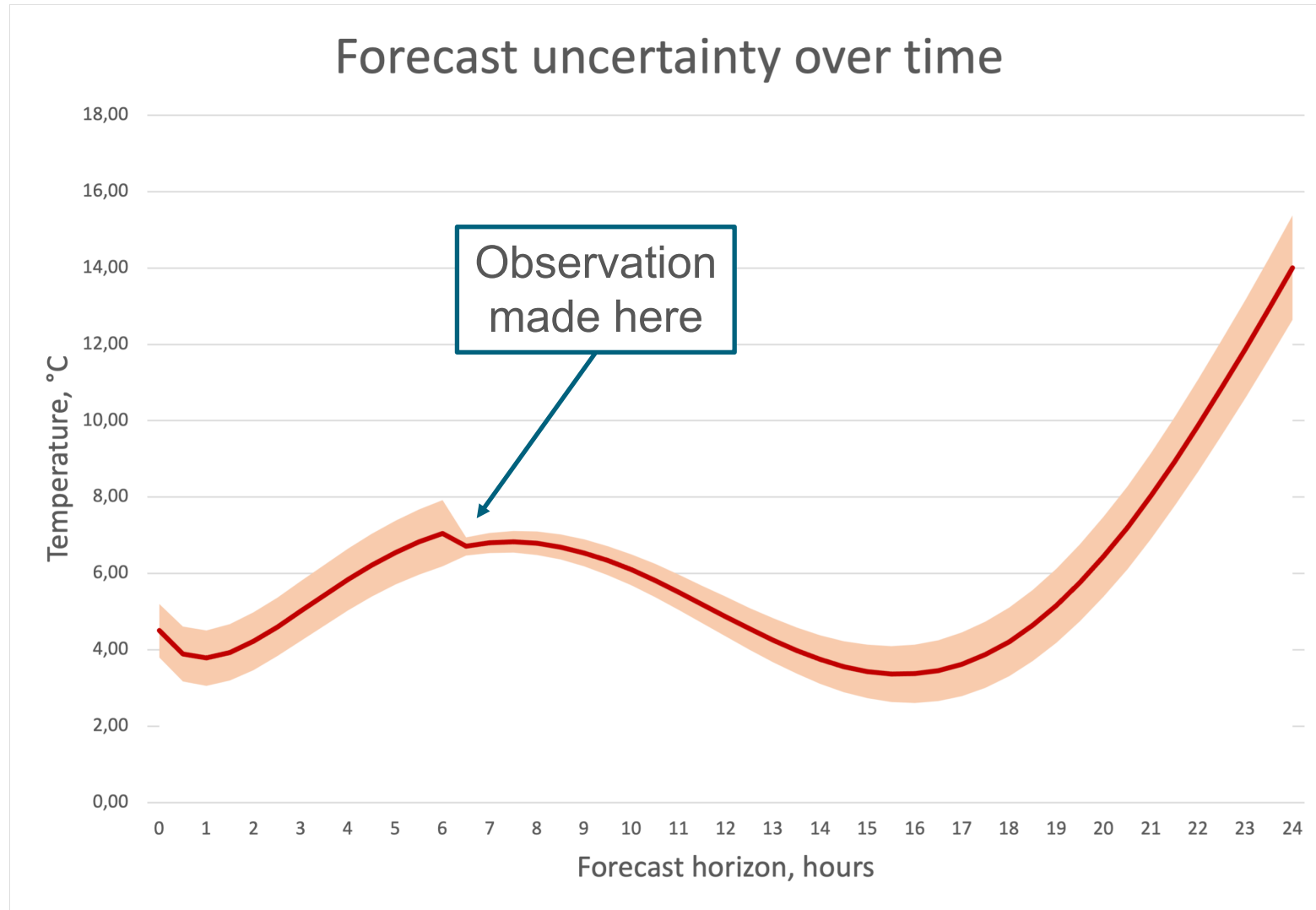
List courtesy of Larry Schneider, City of Fort Collins

Forecast uncertainty with no local observations



- In the absence of observations, forecast error is large but grows slowly over time

Forecast uncertainty with local observations



- Remainder of forecast is affected
- Uncertainty reduced to near obs uncertainty but slowly returns to original levels

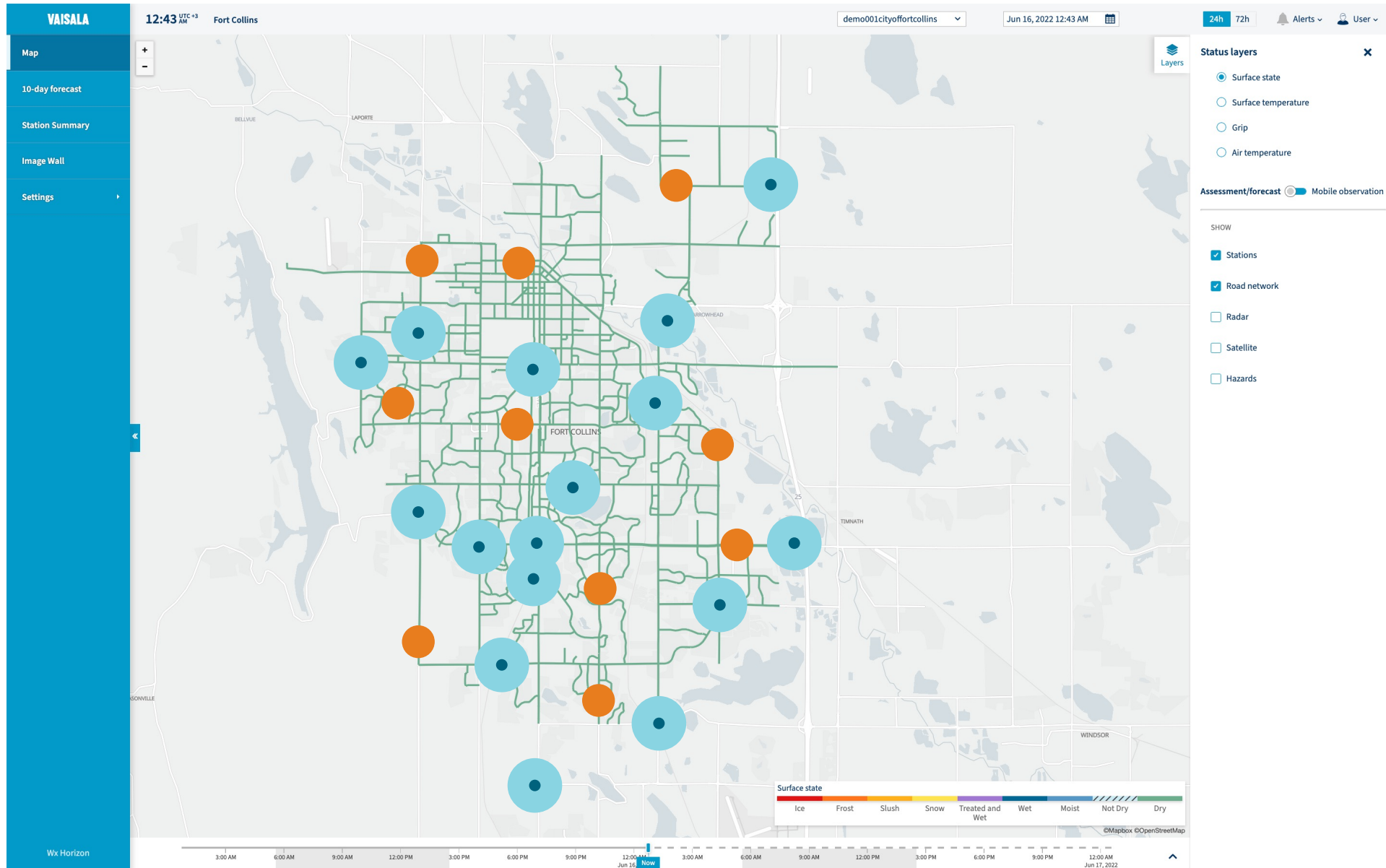
Methodology

- 10 road segments chosen for analysis
 - Far from RWIS stations
 - On regular plow routes
 - Spread across the city
 - Each segment 200m in length
- Forecast system has ingested both surface temperature and moisture data from mobile sensors for the past two winters
- Initial reduction forecast error estimated by evaluating the adjustment made when no observations taken in previous 24 hours
- Persistence of forecast improvement estimated by evaluating the adjustment made when new observations taken within the subsequent 24 hours

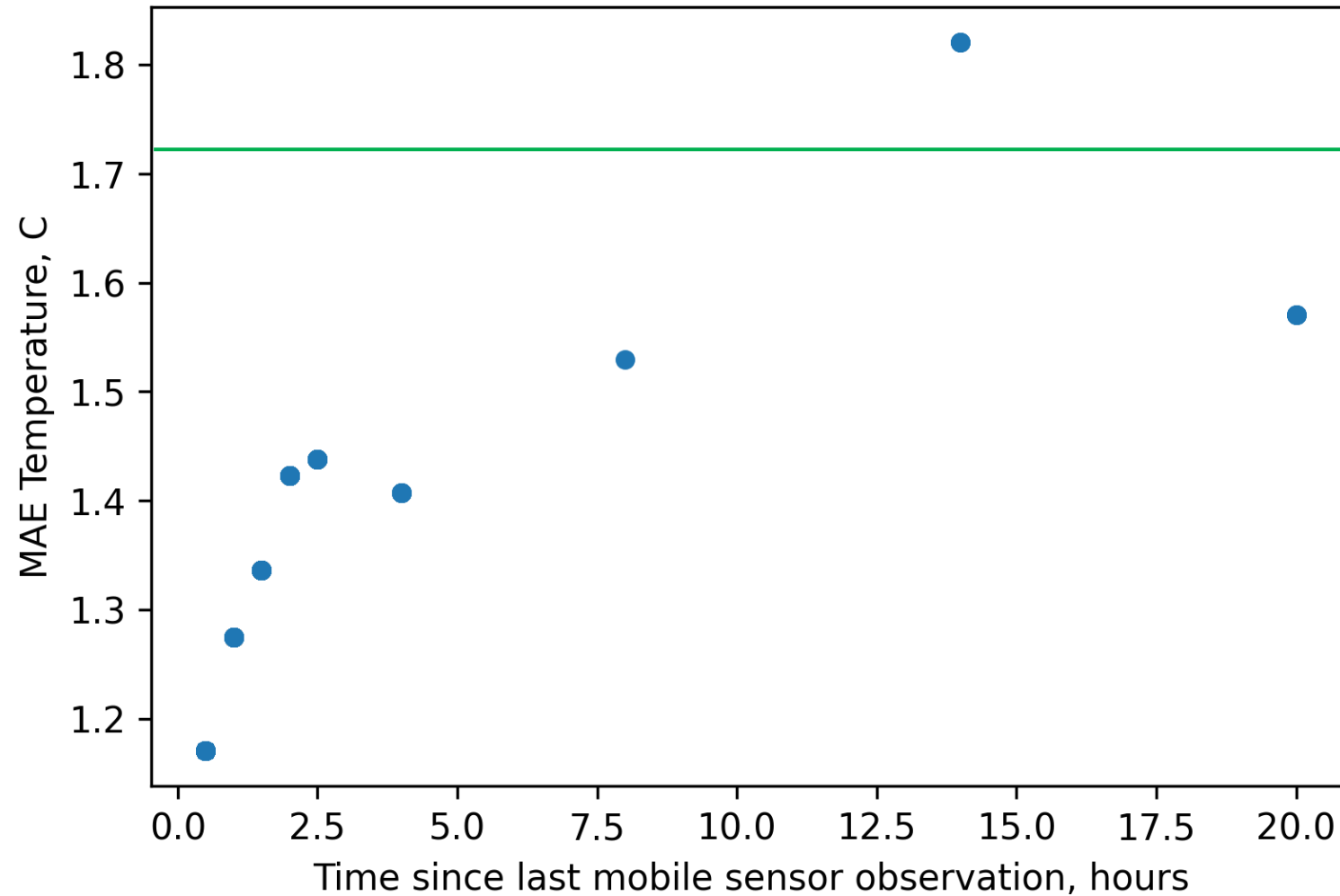
Selection of road segments

Existing RWS

Test segments

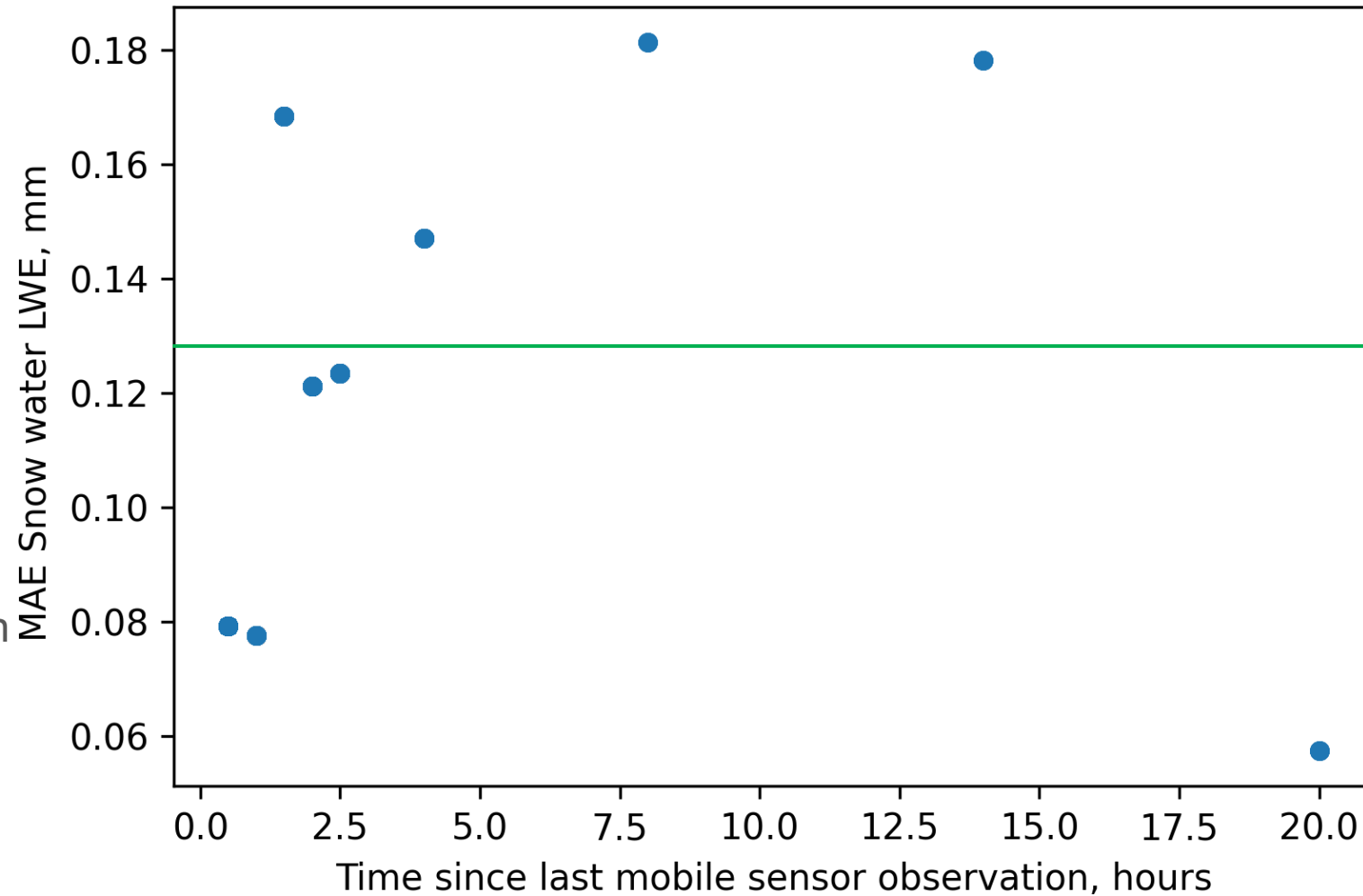


Results (surface temperature)



Green bar shows mean initial reduction in error from first obs after gap of at least 24 hours

Results (snow liquid water equivalent)



Green bar shows mean initial reduction in error from first obs after gap of at least 24 hours

Binary classification of snow on road

	Observed Snow	No observed snow
Forecast Snow	318	115
No Forecast Snow	107	257

- Confusion matrix for measurements with no recent observations
- Snow was observed more than 50% of the time!
- Highlights the benefits and perils of mounting remote sensors only on plows
- F1 Score of 0.74 shows raw model is skillful but can be improved with observations

Conclusions

- Temperature and moisture observations from mobile sensing devices show a positive impact on forecasts in this limited study
- For surface temperature, reduction of forecast error persists for 6-12 hours, but is most pronounced in the first couple hours after an observation
- For snow (and liquid and ice), there is an initial reduction in forecast error after observations are ingested, but it is difficult to quantify
- More data needed! Mounting on service vehicles, transit, etc would be good.

Thank you

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