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Norwegian Public Roads Administration

Workshop: Usage of TSDDs at network level

Experiences from Norway

Photo: Rambøll

Outline

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- The strategy of NPRA (The Norwegian Public Roads Administration) on TSDD measurements
- What has been done and what is planned
- Challenges and lesson learned after the 1. Year of measurements
- Our ideas on how to utilize the data

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The Norwegian Public Roads Administration (NPRA) 2022

The future is just down the road

[We are on the road forward- YouTube]














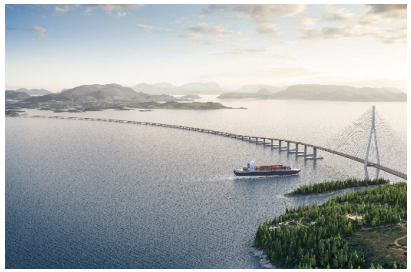

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The NPRA consists of the Directorate of Public Roads and six divisions

Directorate of Public Roads

Road Users and Vehicles

Transport and Society

Construction

Operations and Maintenance

Shared Services

IT

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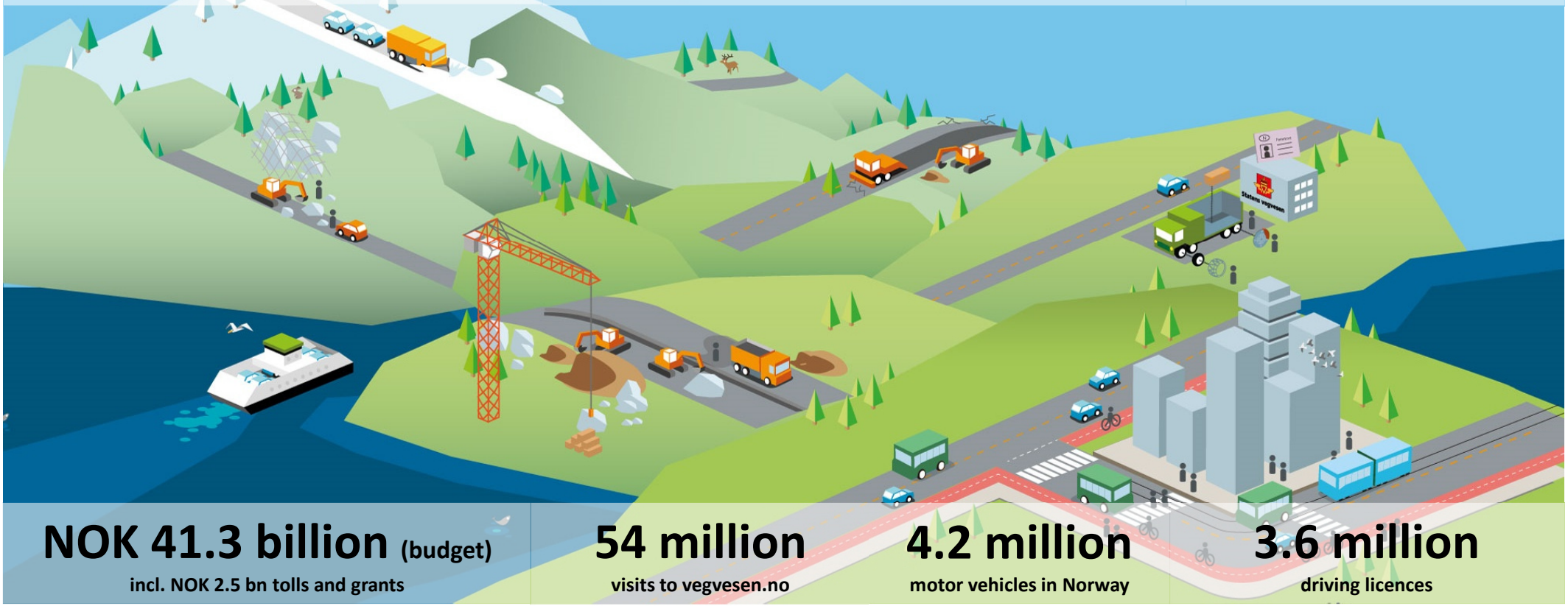
10,500
kilometres of national roads

5,600
Bridges

590
tunnels on European and national roads

72
Driver and Vehicle Licensing Offices

4,750
FTE employees (full-time equivalents)

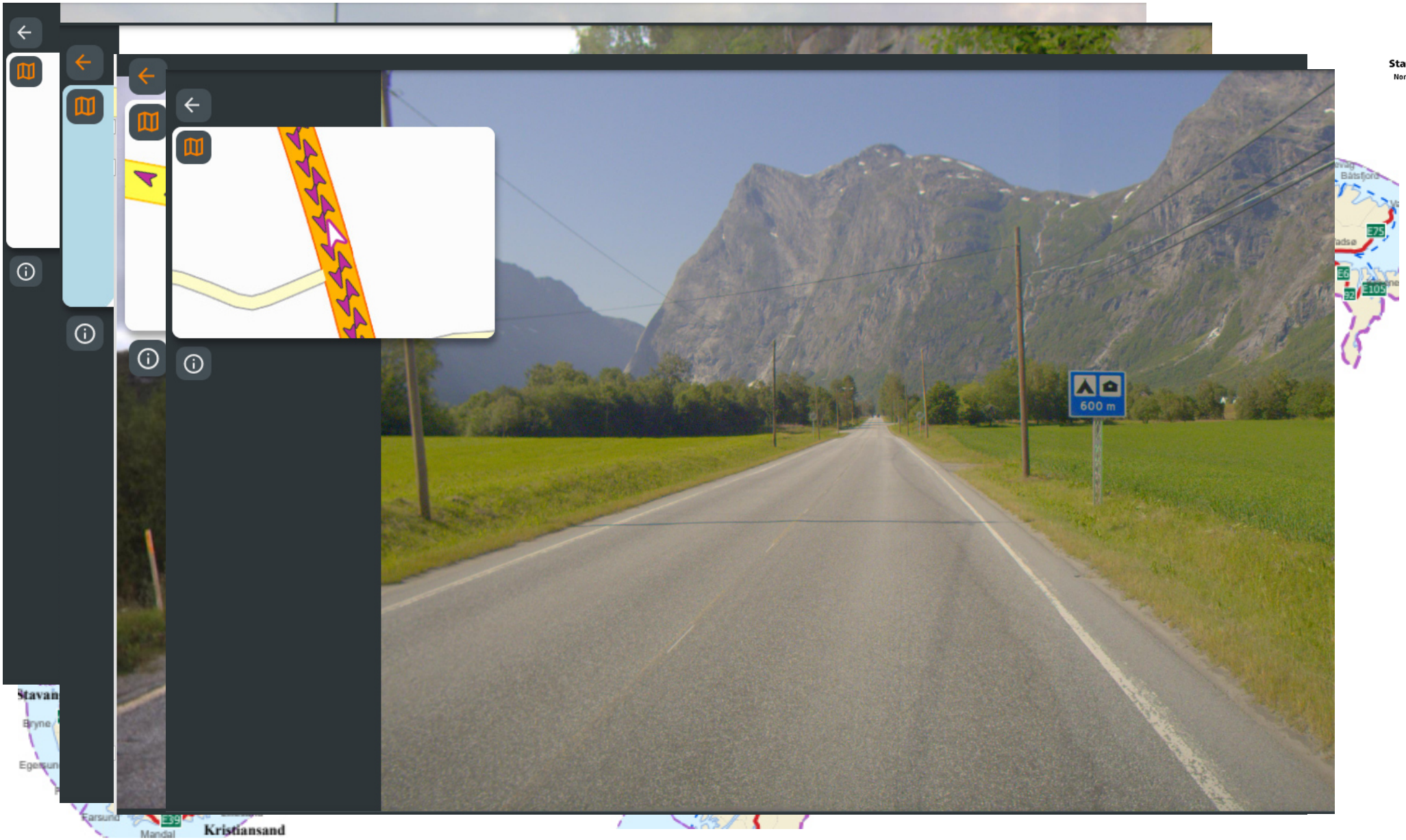


NOK 41.3 billion (budget)
incl. NOK 2.5 bn tolls and grants

54 million
visits to vegvesen.no

4.2 million
motor vehicles in Norway

3.6 million
driving licences



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Goals in the National Transport Plan 2022-2033

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An efficient, safe and environmentally friendly transport system in 2050

More value for money

Efficient use of new techniologies

Contribute to Norway's fulfilment of its climate and environment goals

Vision Zero for road fatalities and serious injuries

Easier everyday mobility and increased competitiveness for business and industry

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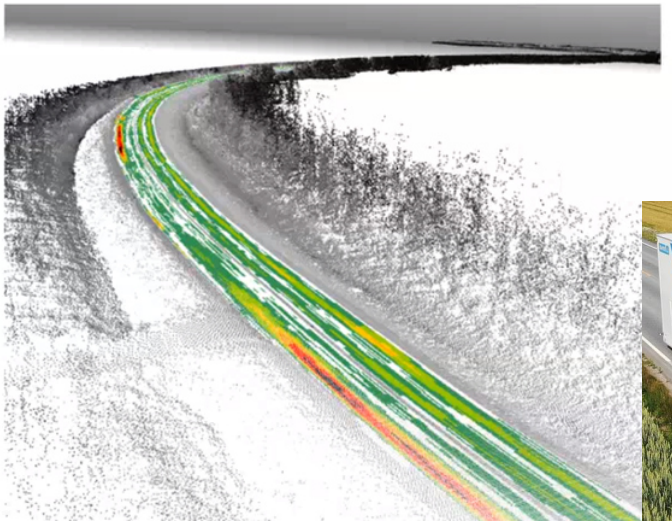
The strategy of NPRA on TSDD measurements – why do we do this?

What is Intelligent Asset Management

ROADEX Network
For better rural roads

1. **Reactive:** measures are taken based mainly on the surface condition monitoring results (=symptoms)

2. Proactive: monitoring is made to detect root causes of the surface condition problems (diagnostics) and measures are taken before damages appear



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Rv. 7 – condition Autumn 2020

A history of thick asphalt and narrow roads

Photo: Fredrik Moen, NPRA

The strategy of NPRA on TSDD measurements - Goals

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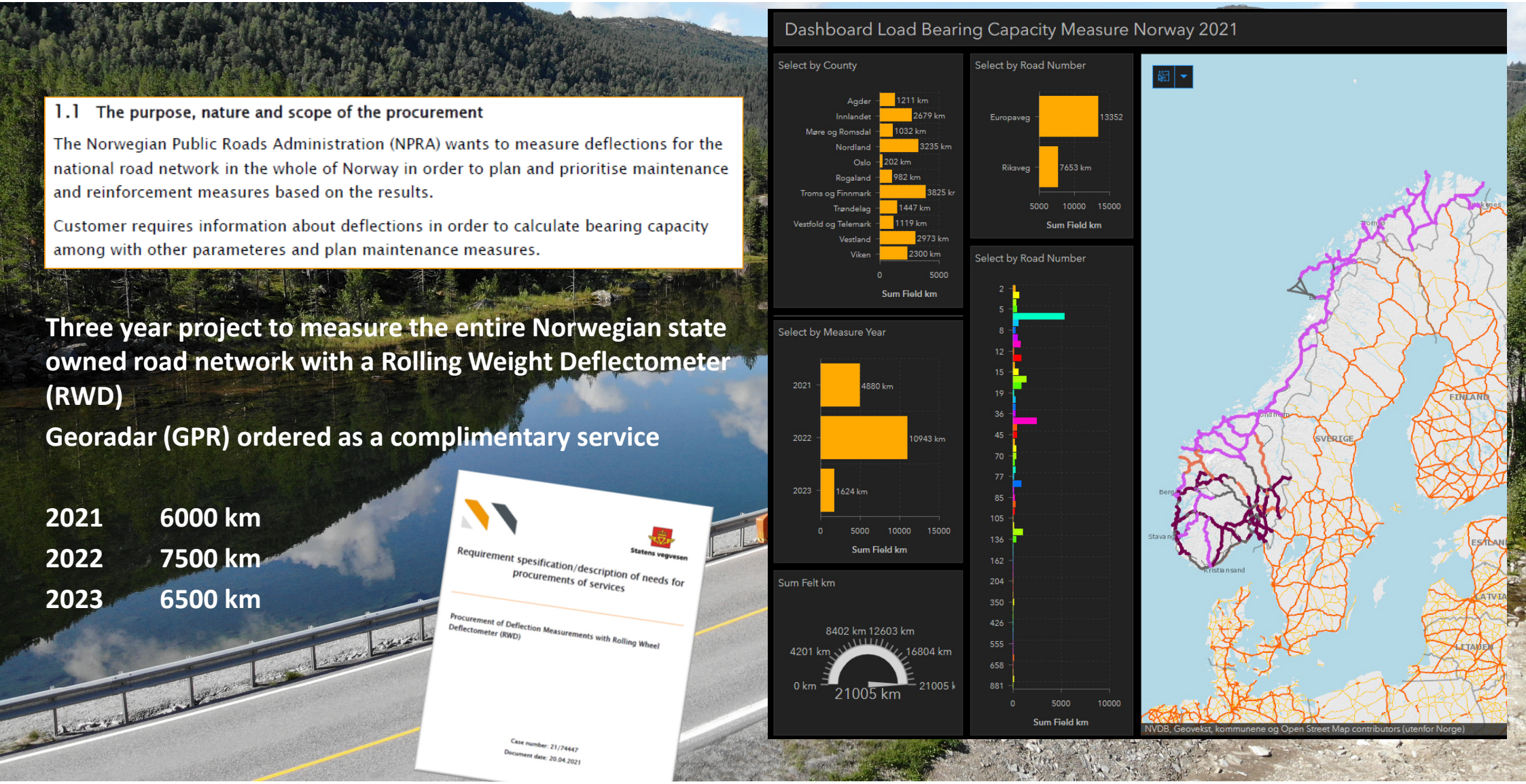
- Get the nessesary knowledge on the structural condition on national roads.
- Get a basis for national priority-lists and systematic work on strenghtening measures.
- Data-driven maintenance planning.
- Moving towards proactive mainteance.
- Get documentation to use in political and budgeting processes.
- Overall asset management in a life cycle perspective.
- Contribute to fulfil the goals in the national transport plan

What has been done and what is planned



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What has been done and what is planned

2021:

- Procurement for TSDD measurements announced in april 2021
- Contract signed with Rambøll 2021-06-24
- Option for GPR included
- Comparative measurements with FWD
- Test measurements 2021-07-23
- Start measurements 2021-08-02
- End measurements 2021-09-13

2022:

- Start measurements 2022-07-01
- Comparative measurements with FWD and GPR
- Low-frequency GPR antenna added

2023:

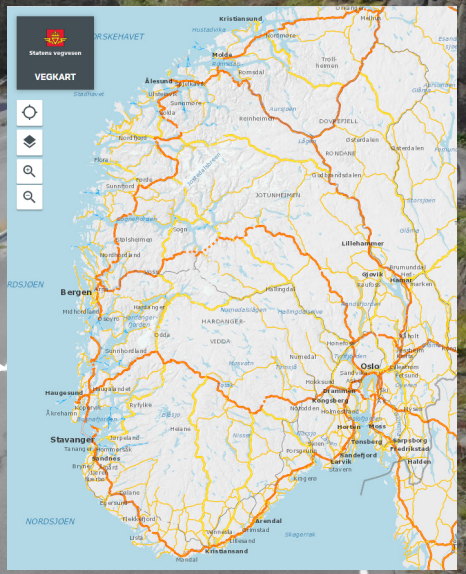
- Optional year to finish measuring the whole road network.

Measurements - delivery

Position + Chainage
FWD equivalent deflections
Structural parameters
Layer thicknesses

NVDB API

ASSET MANAGEMENT DASHBOARD



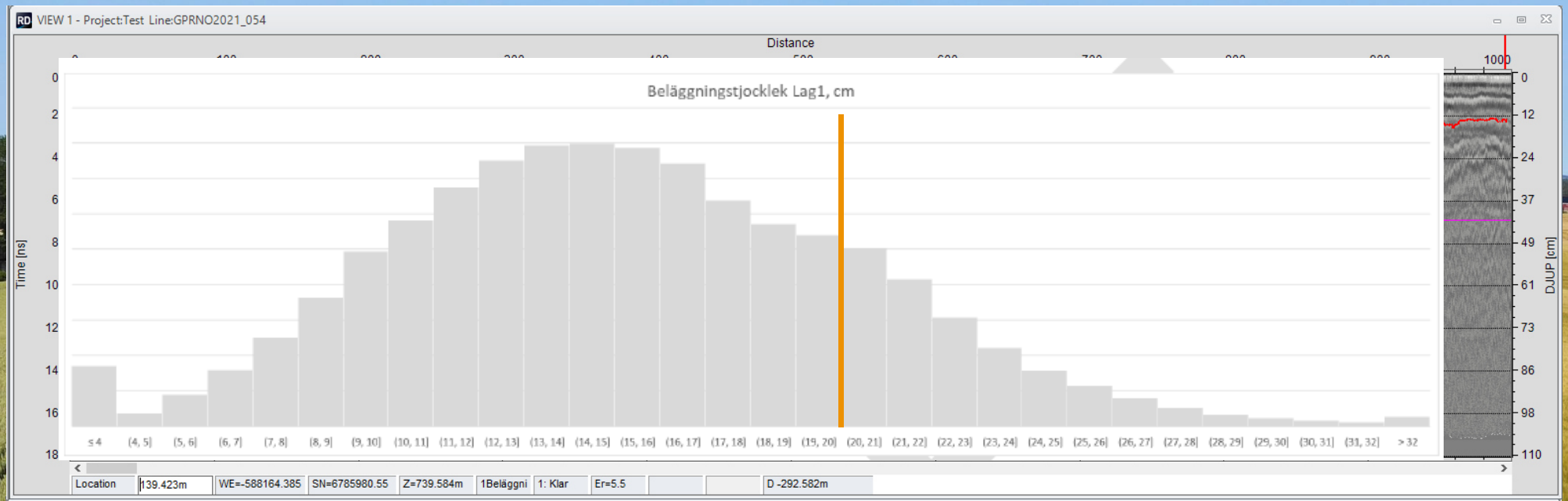
Measurements done in the right whell path in two directions.

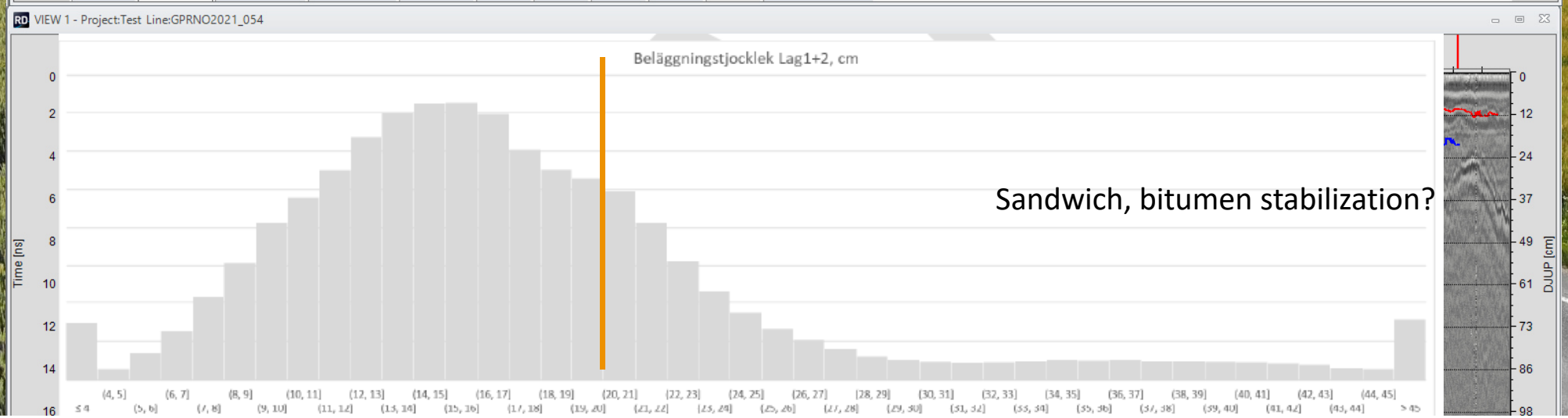
Results normalized to data points covering 10m of road.

Some pictures and experience from measurements in 2021 (Photos: Rambøll)

RAPTOR - GPR

NB: No support from drill cores





Sandwich, bitumen stabilization?

Calculating parameters

- **Bearing capacity in tonnes:***

$$B_{asfalt} = 11 \cdot \left(\frac{E_{dim}}{200}\right)^{0,6} \cdot \left(\frac{50}{\text{ÅDT}_T}\right)^{0,072}$$

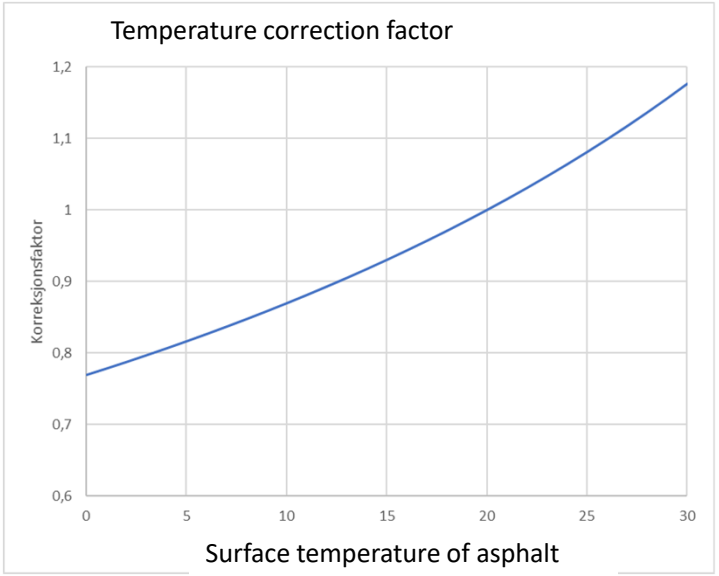
$$E_{dim} = \frac{110 \cdot p}{\sqrt{d_0 \cdot (d_0 - d_{20})}} \text{ [MPa]}$$

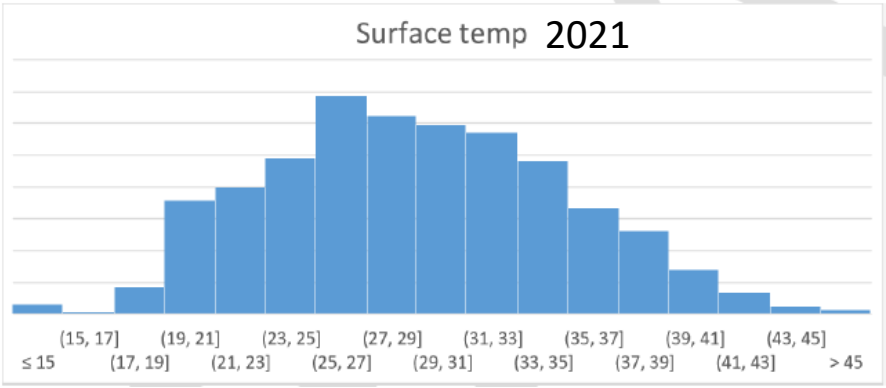
- **Simple temperature correction for bearing capacity:**

$$B_{Temp.korr.} = \frac{B}{1,3 - 0,015 \times T}$$

- **SCI (D0-D200)**
- **BCI (D900-D1200)**
- **Other paramters**

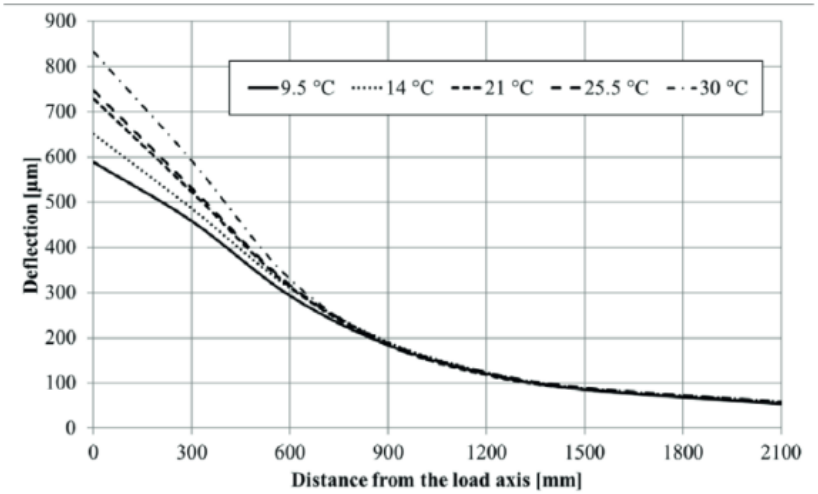
* The largest axel load a road can carry over a period of time (dimensioning period) witout the road condition falling under a defined axeptable limit (normal maintenance included).





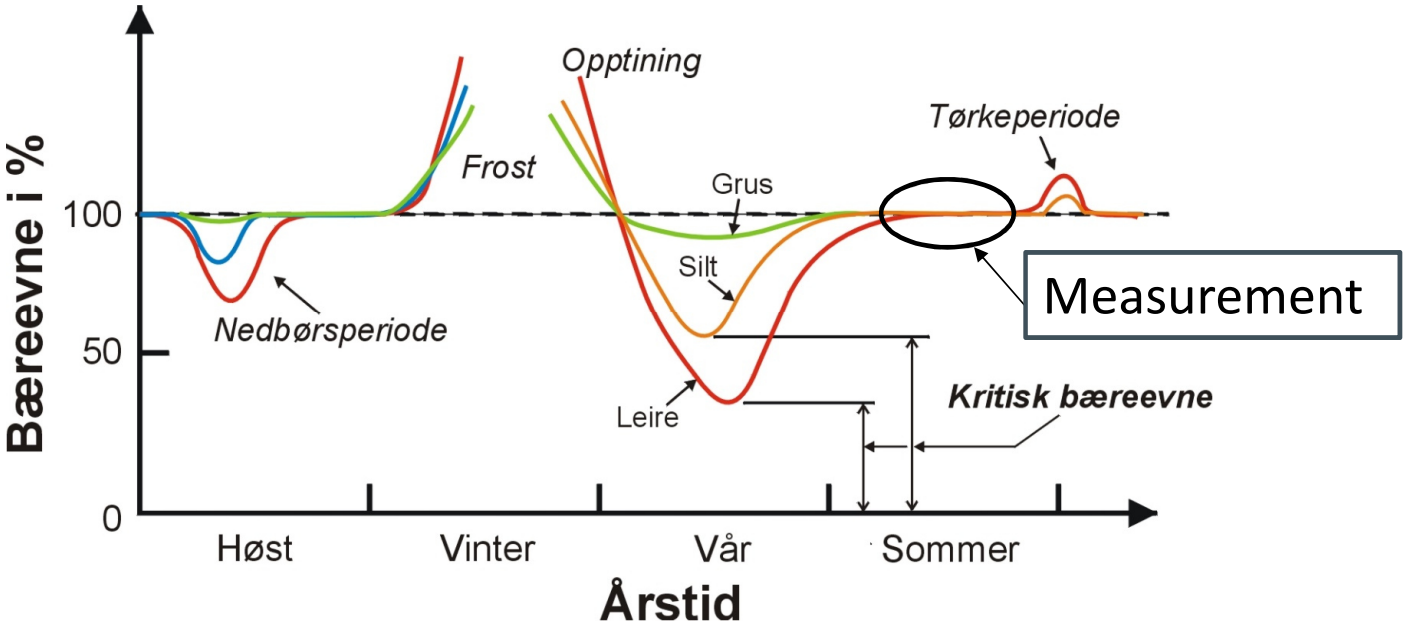
Temperature correction

- Want to use a more accurate temperature correction model.
- Master's degree (NTNU), spring 2021.
- Options:
  - Correct E-modules used to calculate deflections from Raptor measurements
  - Correct calculated deflections
- Challenge: How to obtain in-depth data on the pavement temperature.
- Not concluded yet



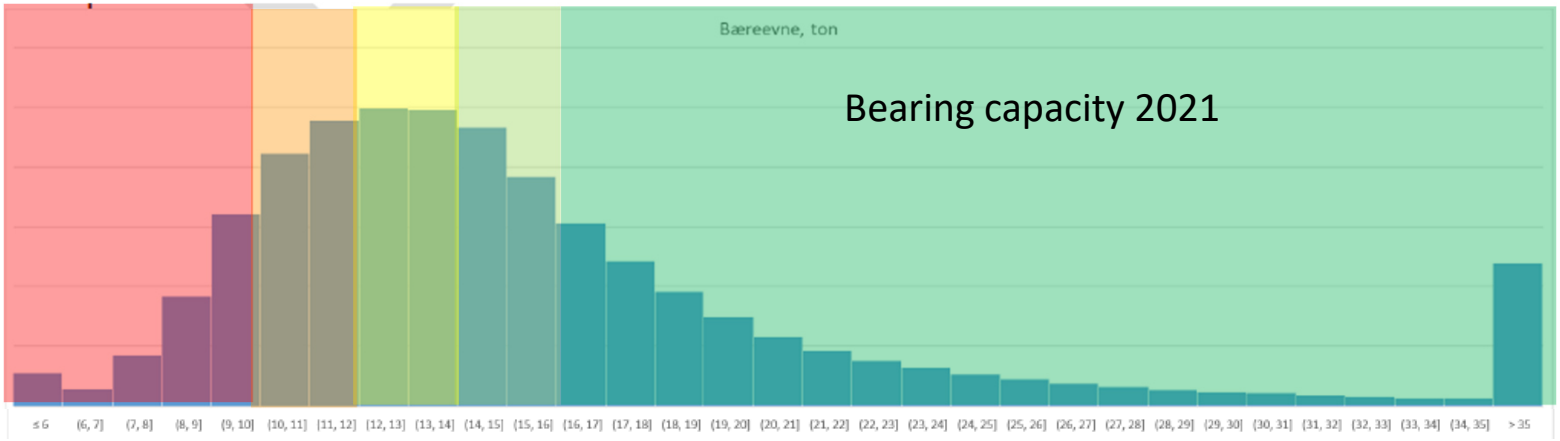
Figur 5 Nedbøyning fra fallodd som funksjon av avstand fra lastsenter for forskjellige temperaturer (Březina, Machel og Zavřel, 2022)

Bearing capacity over the year

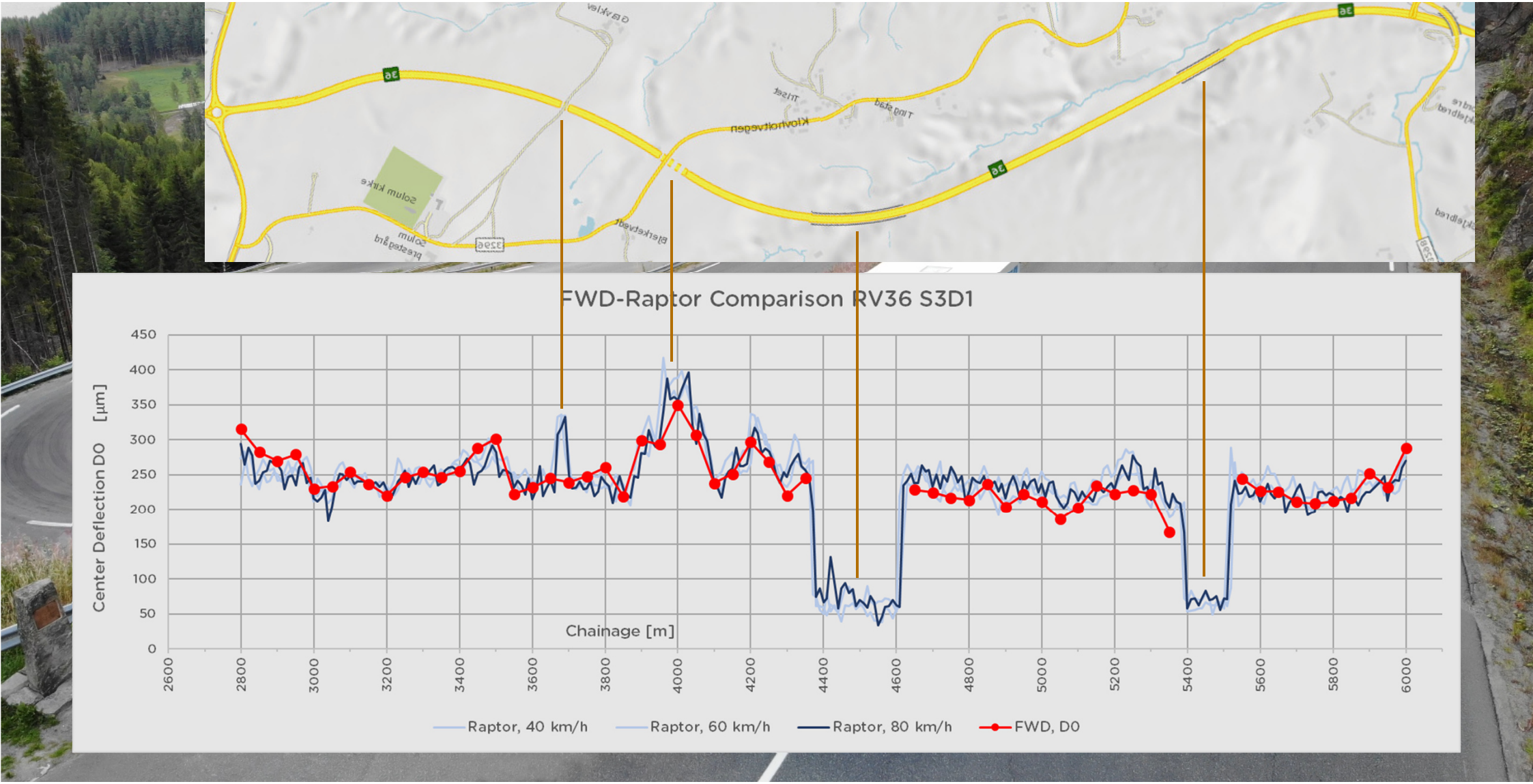


Bearing capacity (tonnes)*	Classification
> 16	Good
14-16	Fair
12-14	Warning
10-12	Bad
< 10	Very bad

* Temperature corrected summer bearing capacity



FWD-Raptor comparison



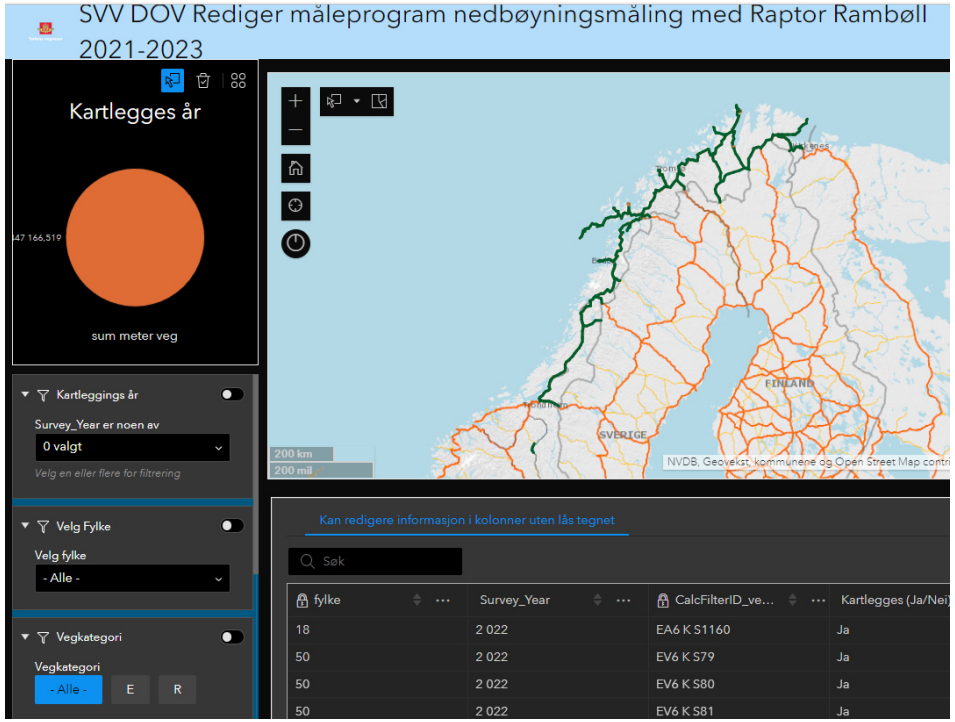
Challenges and lesson learned after the 1. Year of measurements

- A learing process for both the customer and the supplier.
- Measurement program must be established and quality controlled well before measurements starts

- Problems linking data to road network (NVDB API).
- Positioning in tunnels.

- The importance of temperature correction when comparing the whole road network.
- Allowable asphalt surface temperatur when measuring.
  - No limit in 2021.
  - 35 °C as limit in 2022.

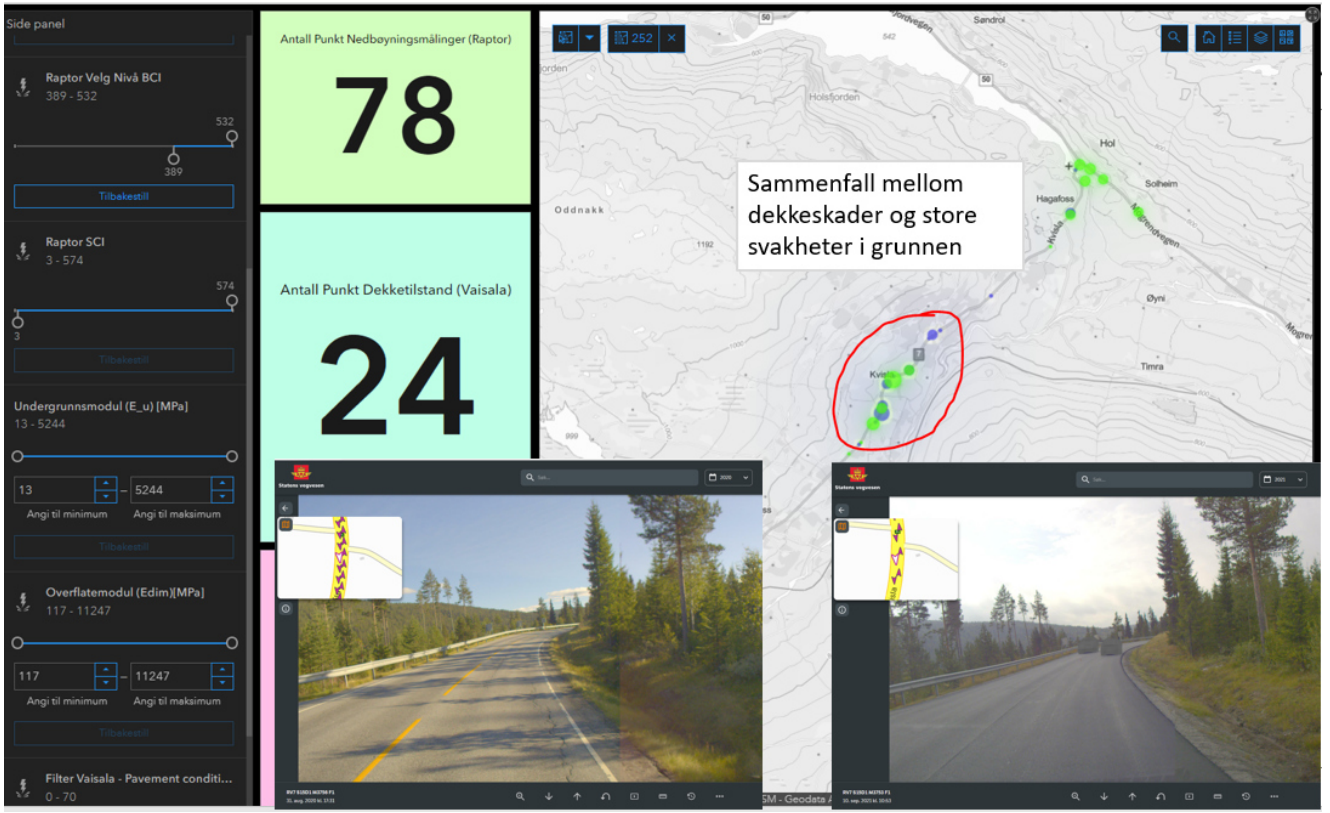
- Comparative measurements with FWD important.
- No support from drill cores makes GPR interpretation somewhat uncertain, but hard to obtain in network level.



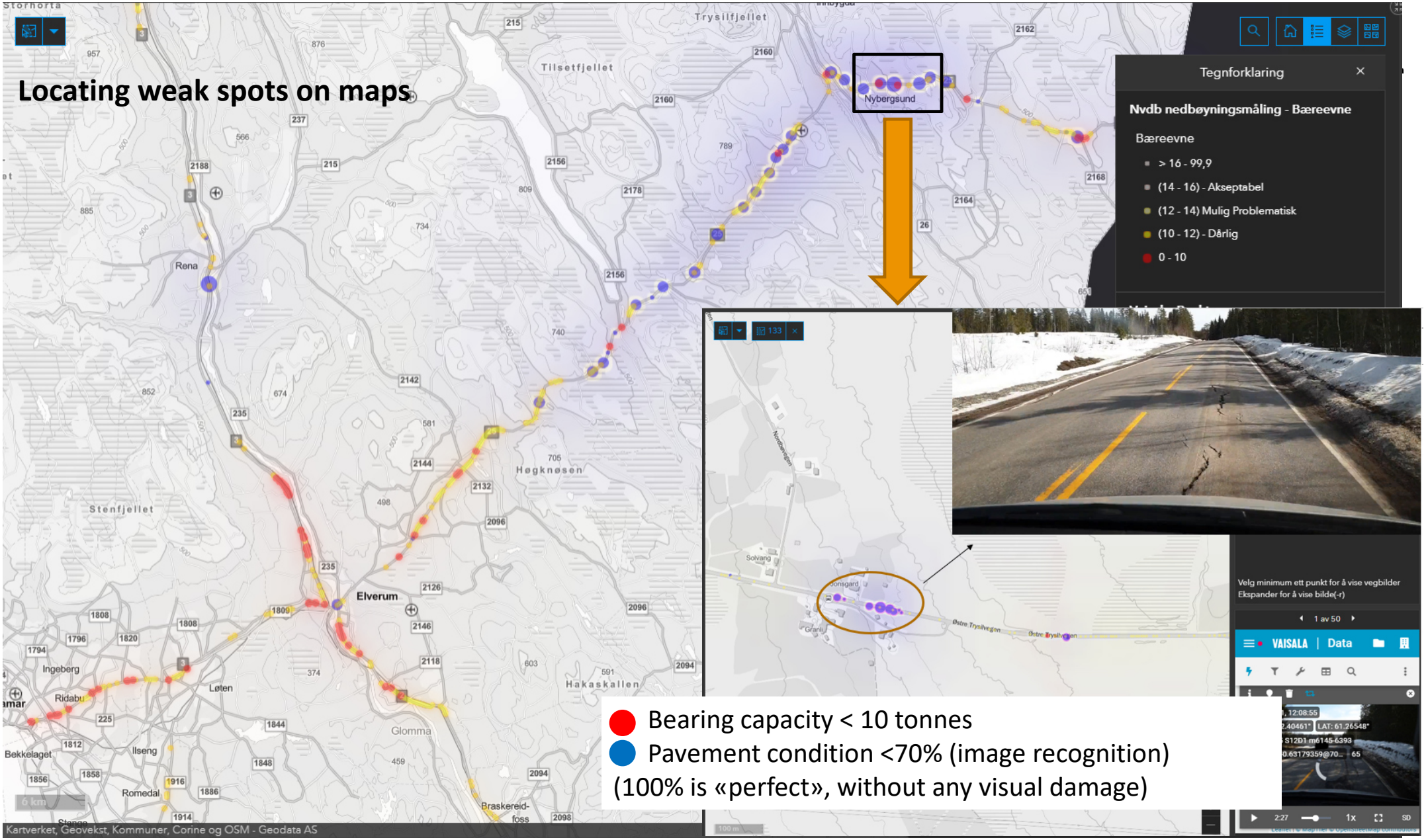
Our ideas on how to utilize the data

- Screening-tool
- Locating week spots for further investigation

- Using mainly Bearing capacity, SCI, BCI
- Combining with other data
  - Rutting, IRI
  - Pavement damages
  - Drainage
- Making thematic maps



Locating weak spots on maps



- Bearing capacity < 10 tonnes
- Pavement condition <70% (image recognition)

(100% is «perfect», without any visual damage)

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Combining bearing capacity and rutting-data

Bearing capacity	Rut developement	
	Good	Bad
Good	No problems, follow ordinary paving programme	Problems in the asphalt or BC in sping thaw, investigate cause, improve drainage
Bad	Potential future problem, investigate cause and preform pro-active maintenance to avoid consequential damage.	Bigger problems, strengthening might be necessary, investigate cause and plan measures

Conclusions

Structural data is the missing, but very important part of a modern PMS system

RWD/TSDD´s produce useable data at high capacity, especially when combined with GPR and other road condition data.

The importance of temperature correction

Pitfalls: Measurement program, positioning, linking of data to road network

How to present and utilize data in the best way?

There is a need of education in the use of TSDD data.

Thank you for your attention!