High frequency road monitoring using connected vehicles

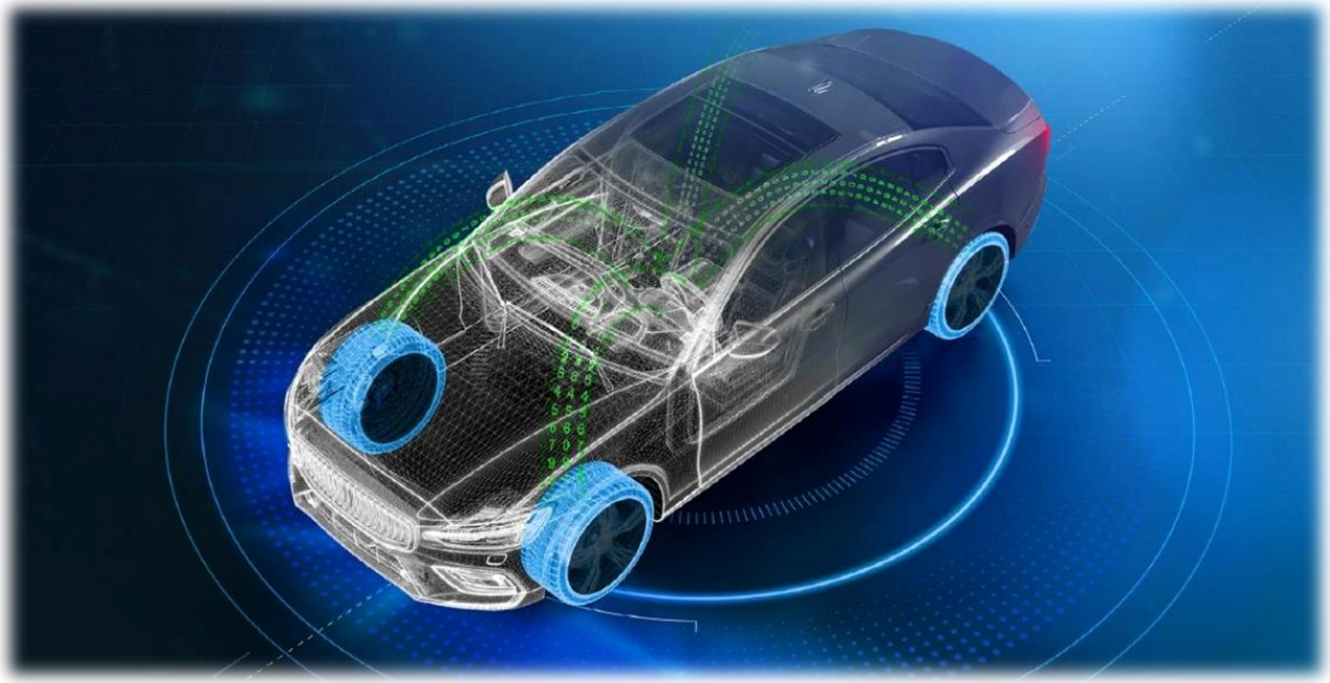
PhD, Matteo Pettinari
Solution Architect @ NIRA
ERPUG, Athens 26-10-23

matteo.pettinari@niradynamics.se

What is NIRA Dynamics?

NIRA Dynamics quick facts

software solutions for next level of mobility



85 million+
vehicles equipped with onboard analytics

2.0 million+
connected vehicles gathering road surface data

NIRA DYNAMICS

What is NIRA Dynamics?

LIVE

Volkswagen Group

ŠKODA

CARIAD

Tire Grip Indicator data

OEM Backend

NIRA

WEATHER DATA

+

NIRA Backend

=

RESULTS
Friction Map & Roughness Map

PRODUCTS

ROAD HEALTH

WINTER ROAD INSIGHTS

ROAD SAFETY

RSA

RSC

Connected products

Driver must approve data sending

Using the unique volume power of the Volkswagen Group with over 2.000.000 vehicles p.a.

Already available in **Europe & North America**

GDPR-compliant anonymized aggregated data

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What makes NIRA unique in the road sector?

1) **Tire – Pavement interaction**

2) **Measures such as International Roughness Index and Grip data**

3) **High Frequency Road Scanning**

"motionless pictures are moving …… a motion picture"
"The Fabelmans" film directed by Steven Spielberg

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THE FABELMANS

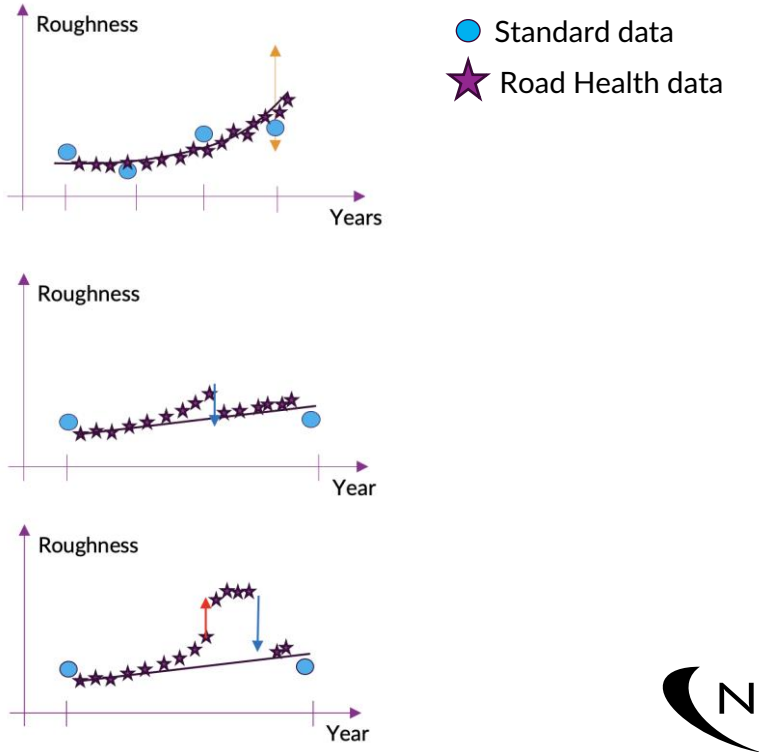
What makes NIRA unique in the road sector?

High Frequency Road Scanning

a) Predictive maintenance

b) Preventive maintenance

c) Corrective maintenance



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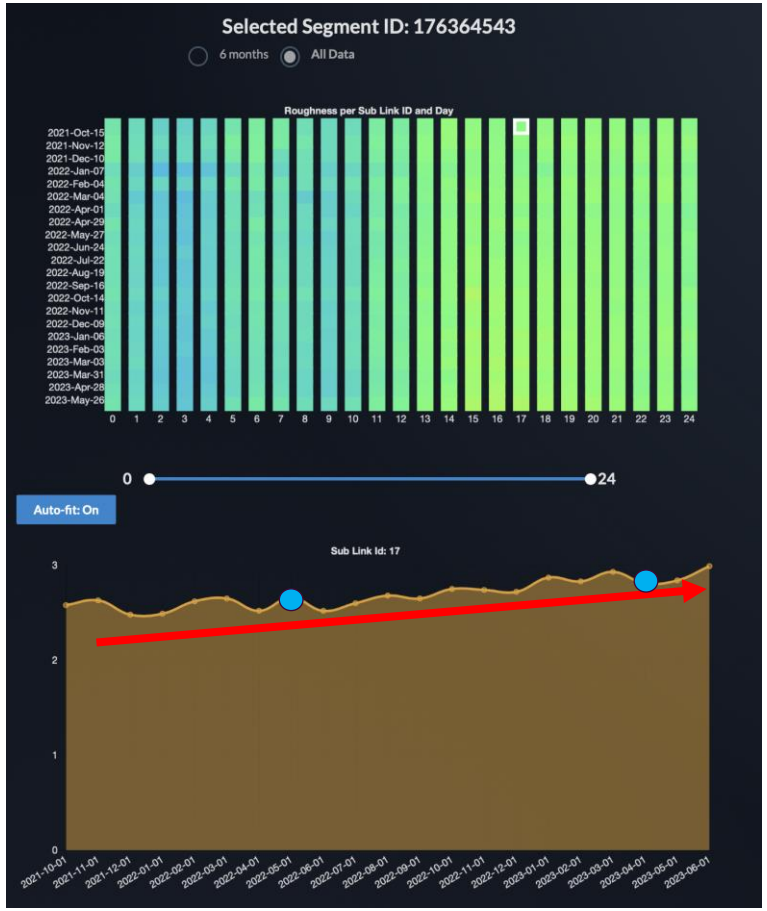
Road Health: Predictive maintenance

DETERIORATION MODELS to estimate remaining lifetime
Integrate Road Health data to standard data

- ***Long term modelling using aggregated data***
- *Deterioration trend extracted from real-time data* ⟶
- *Possibility to **integrate with other data sources***



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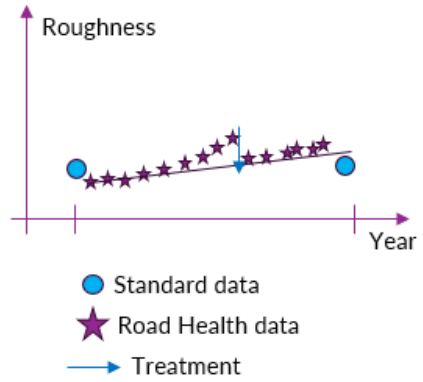
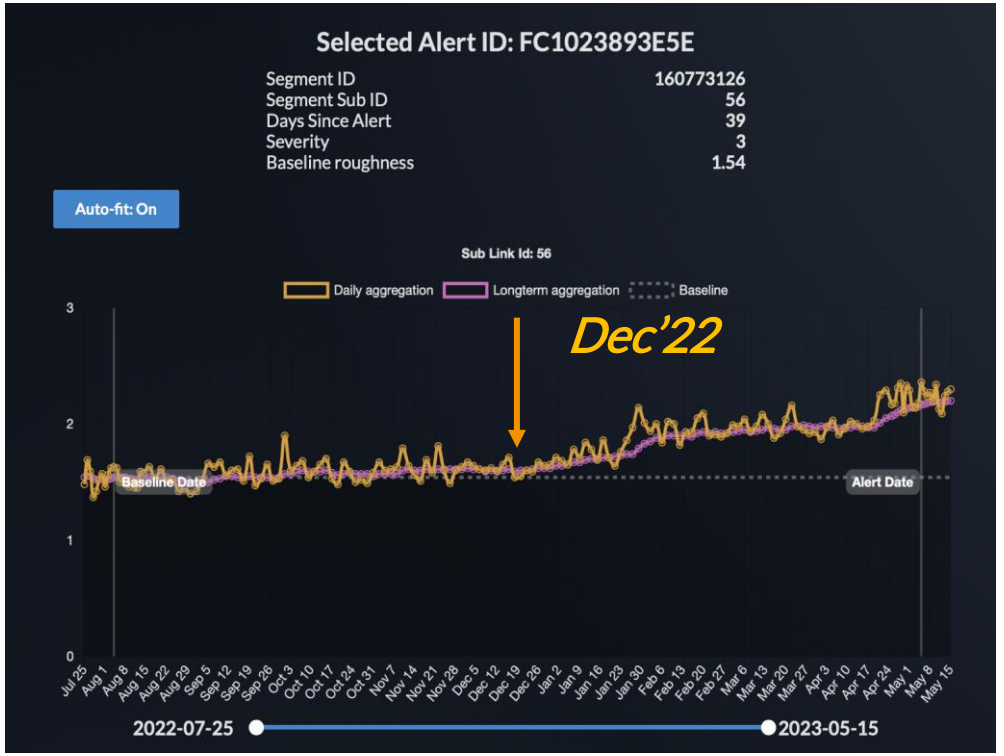
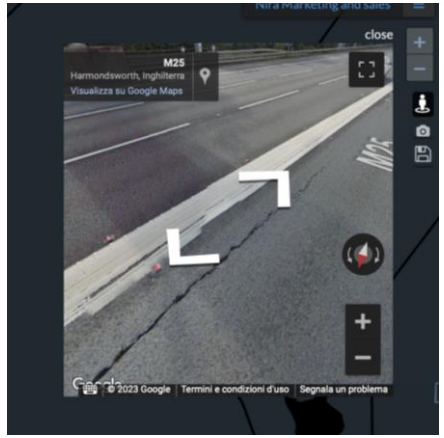
Road Health: Preventive maintenance

includes **routine inspections** to schedule treatments aimed at preventing the occurrence of major issues



- *Significant **change in roughness development***
- *Possible structural problem due to the rate of change*
- *Inspection needed to define repair strategy*





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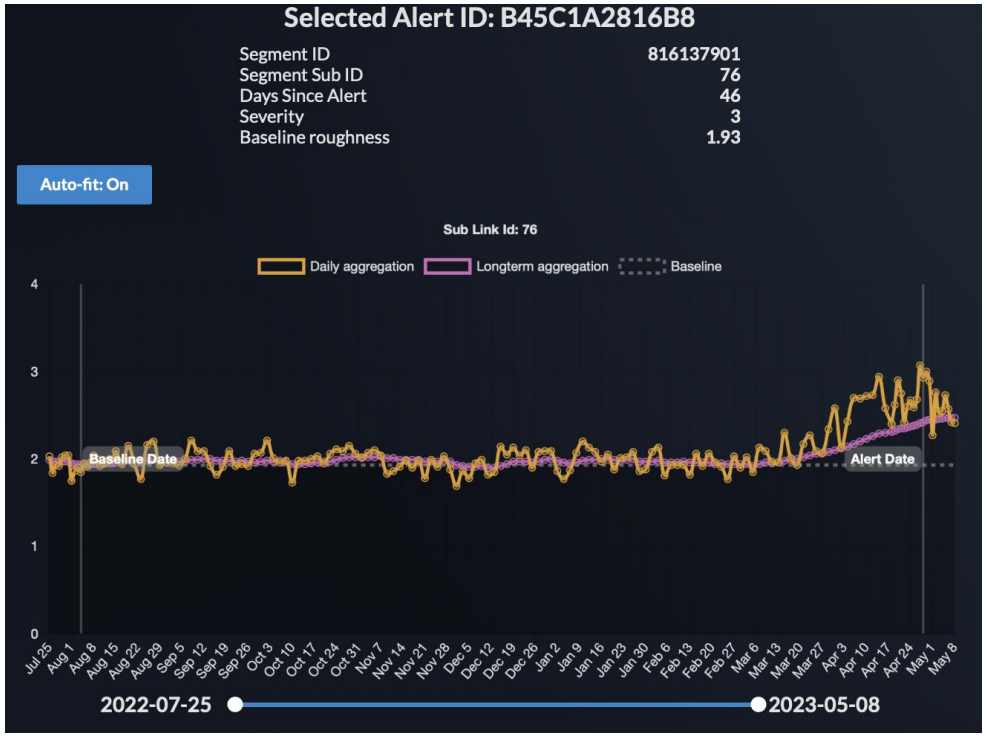
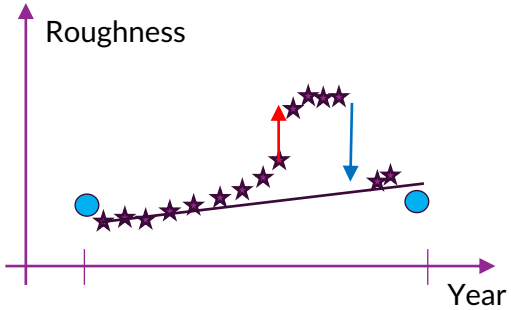
Road Health: Corrective maintenance

refers to repairs or maintenance activities performed after a failure or problem has occurred

- *Increase of Roughness related to a surface failure*
- *Inspection to define the repair strategy*
- *Possible to evaluate the entire section*





Standard data
Road Health data
Local damage
Treatment

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Other Applications of High Frequency scans?

- Climate Resilience
- Assessment of Winter Damage
- Safety

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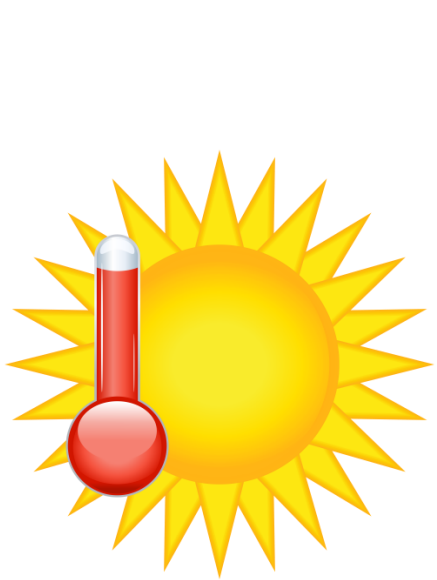
Climate Resilience of Road

Climate Change leading into changes that may manifest as a *rise in temperature and sea level*, as well as *increase the frequency and magnitude of extreme weather events now and in the future**.



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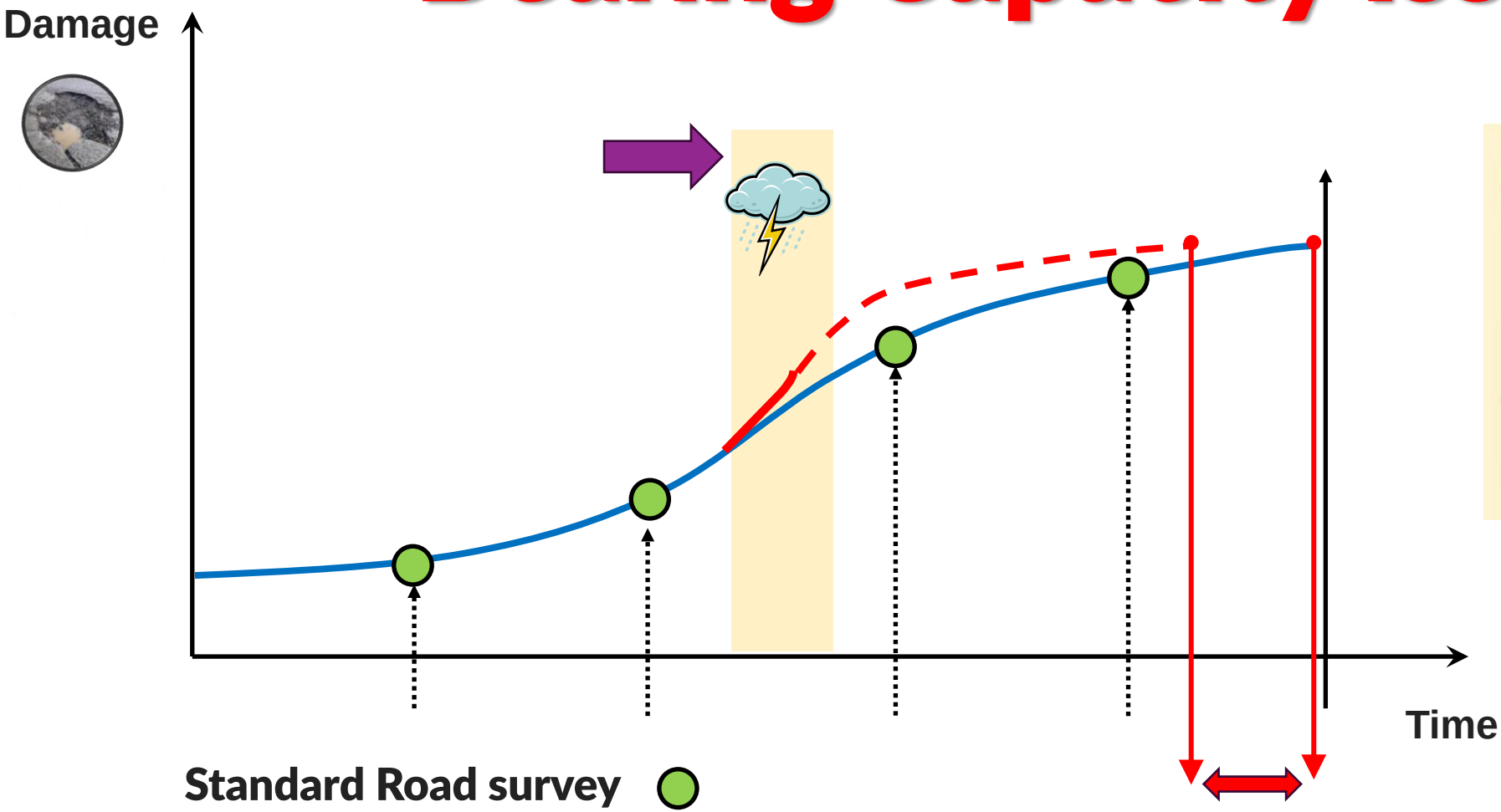
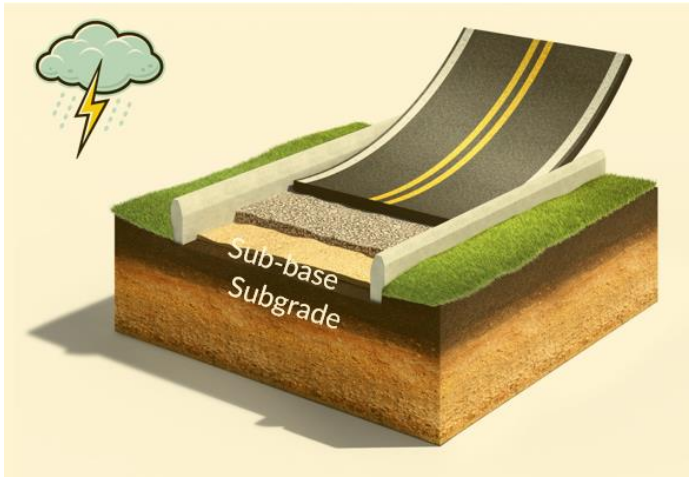
*Federal Highway Administration. FHWA Order 5520. Effective December 15, 2014. https://www.fhwa.dot.gov/legsregs/directives/orders/5520.cfm#par6

Climate Resilience of Road (POC)

Bearing Capacity Issue





High water content in
Subgrade and Sub-base

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Climate Resilience of Road

Floods in Emilia Romagna (Italy) 2023

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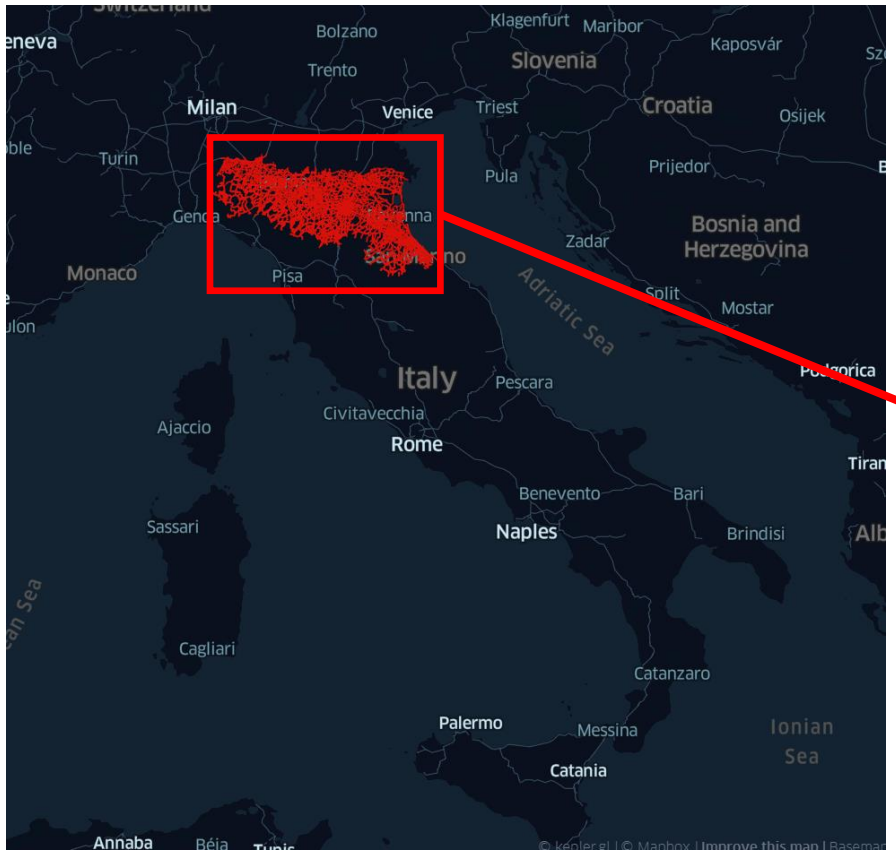
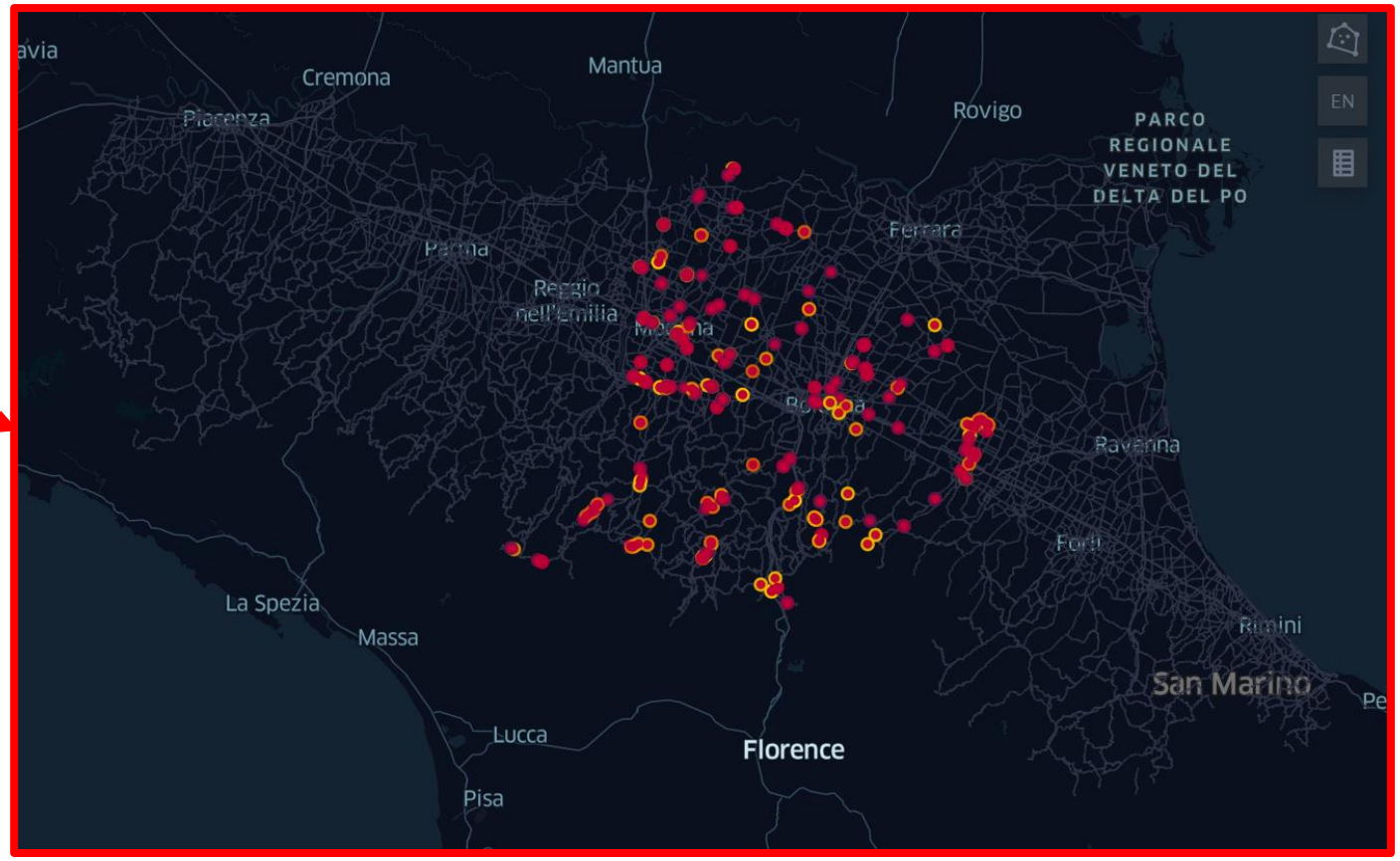
Climate Resilience of Road (POC)

Bearing Capacity Issue

Studying the IRI DEVELOPMENT RATIO

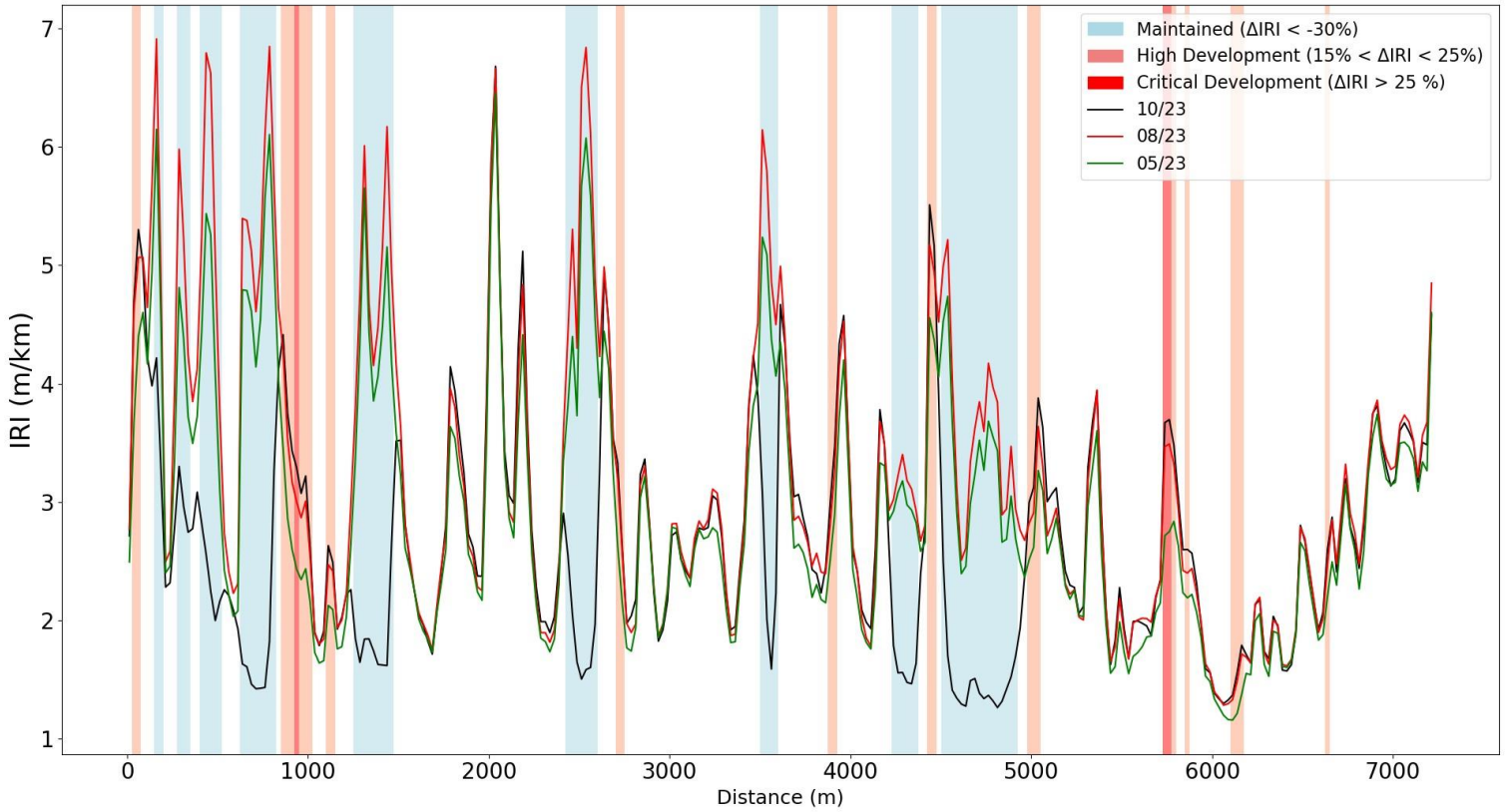
Short-term development and Long-term development

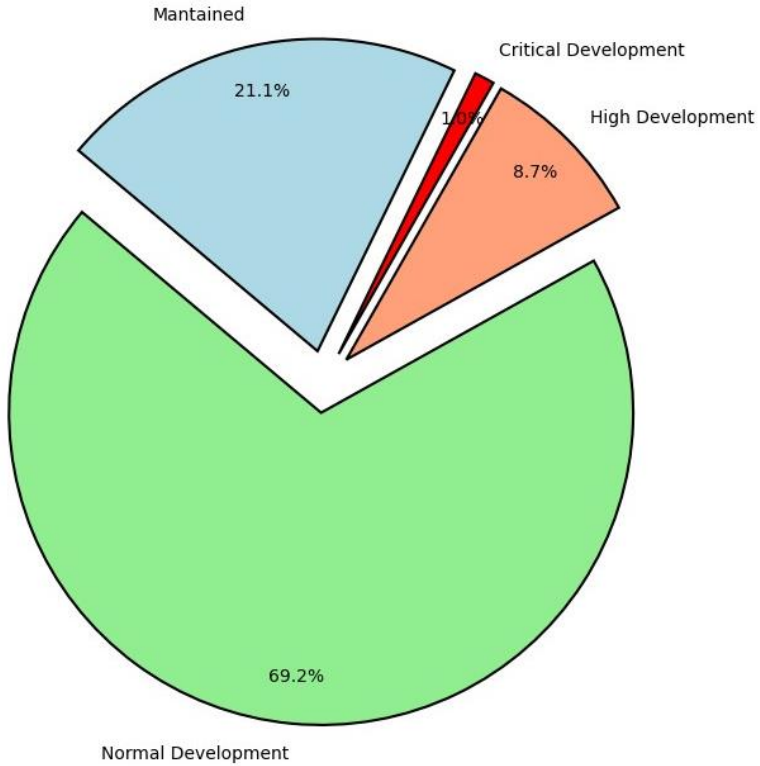




Climate Resilience of Road (POC)
Bearing Capacity Issue

Studying the DEVELOPMENT RATIO – example IRI 05/23, 08/23 and 10/23





Short-term development and Long-term development

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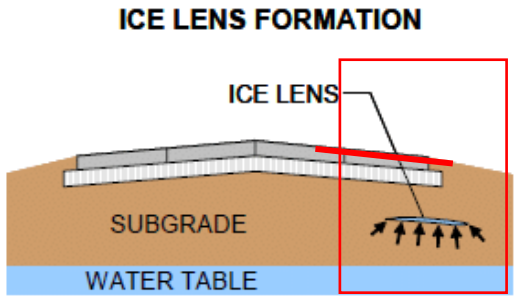
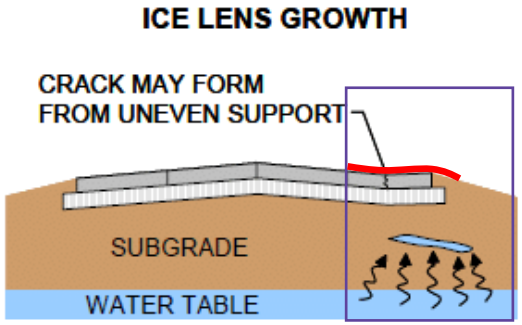
Assessment of Winter Damage (POC)

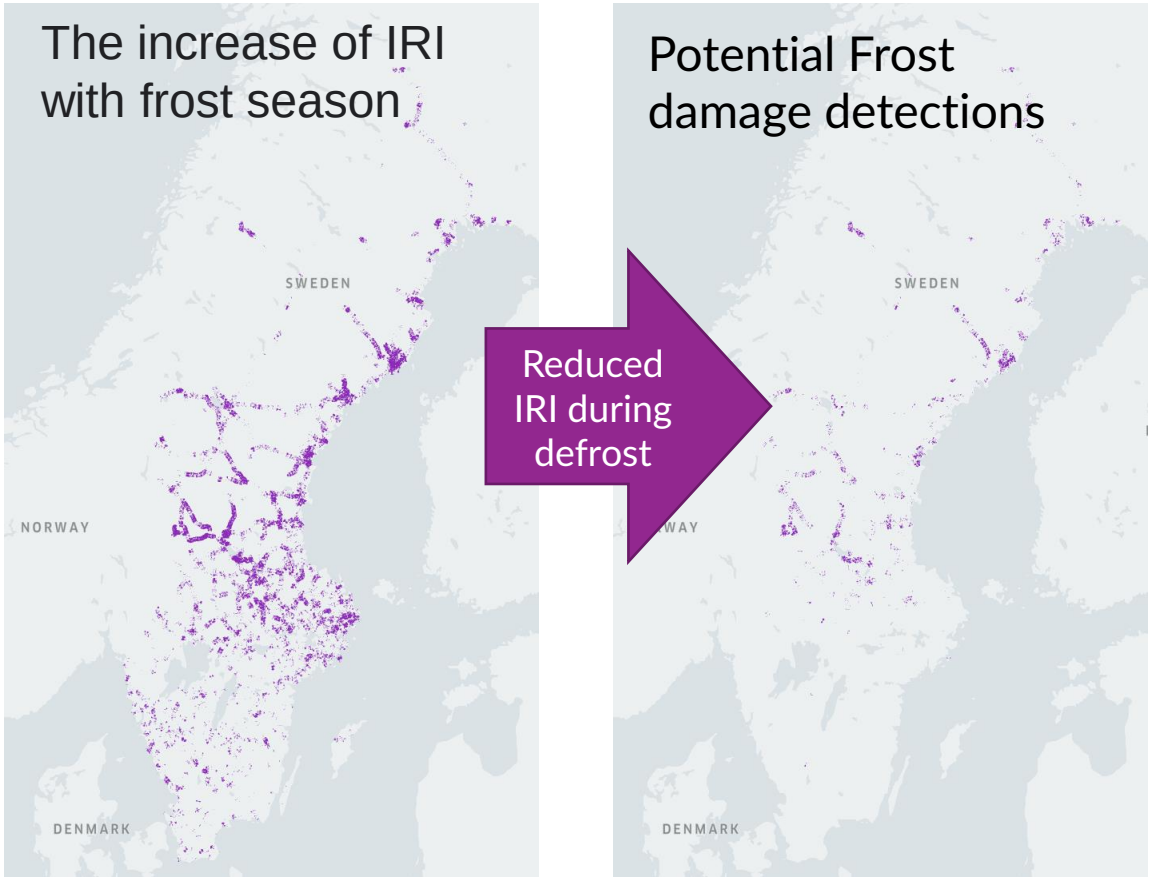
Physical: frost heave damages

Freezing and Thawing cycles





Ice lens formation and frost heaving [2]. | Download Scientific Diagram (researchgate.net)



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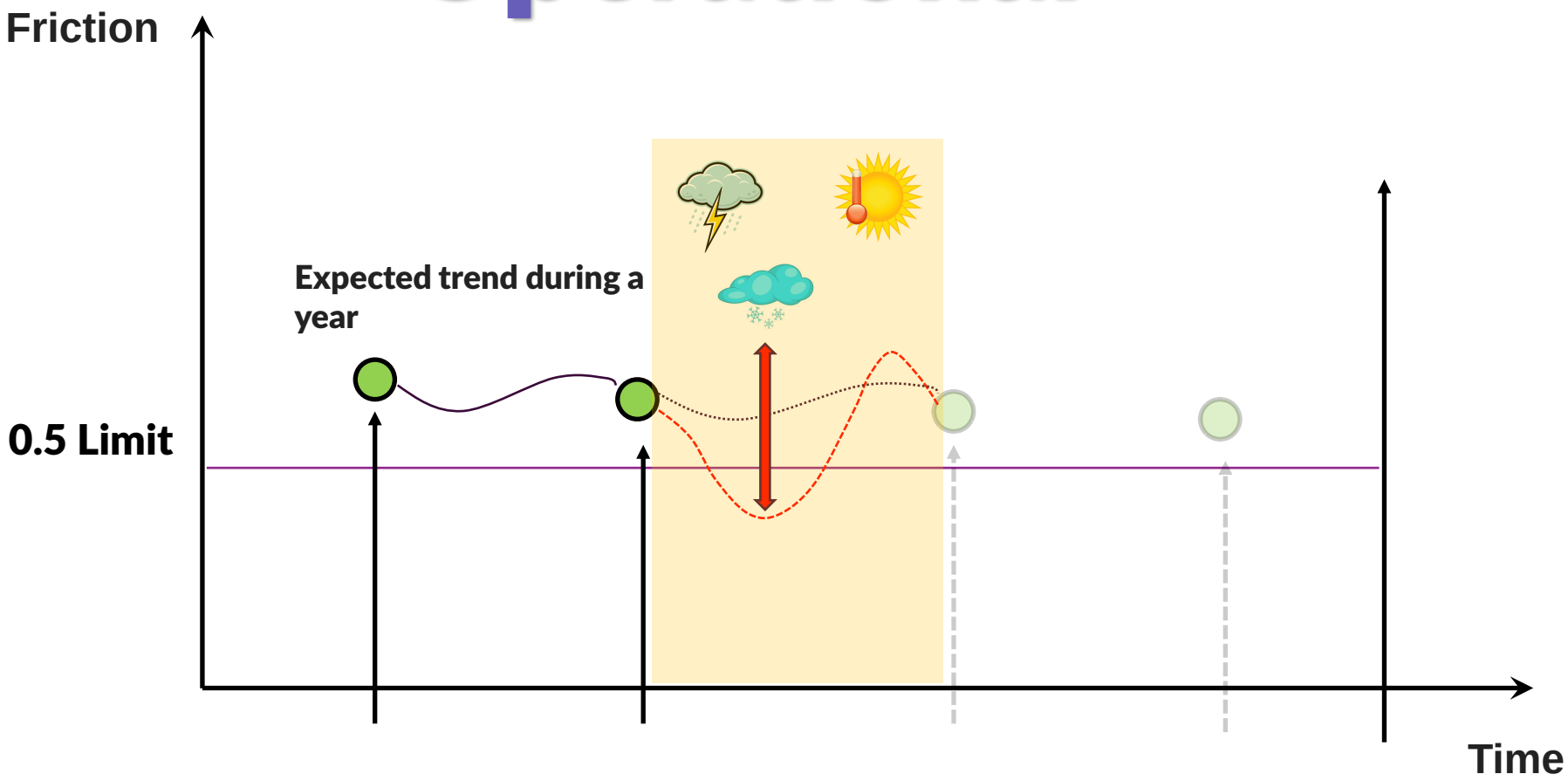
Safety: Grip data Operational



Friction survey ● - *normally measured in summer*
(start, yearly or 3rd year)

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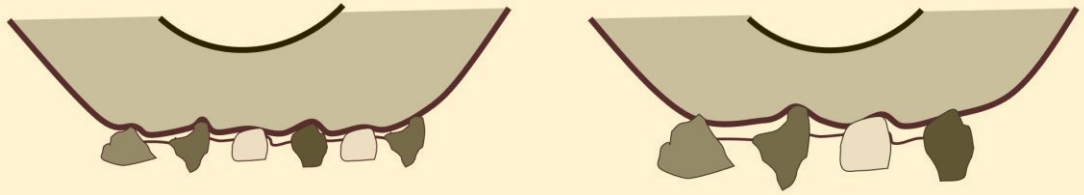
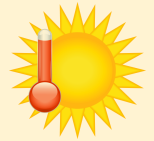
Background about texture and friction

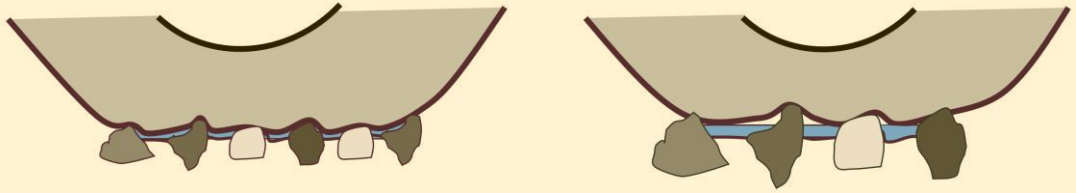
Operational: friction

DRY – low difference between the two surfaces

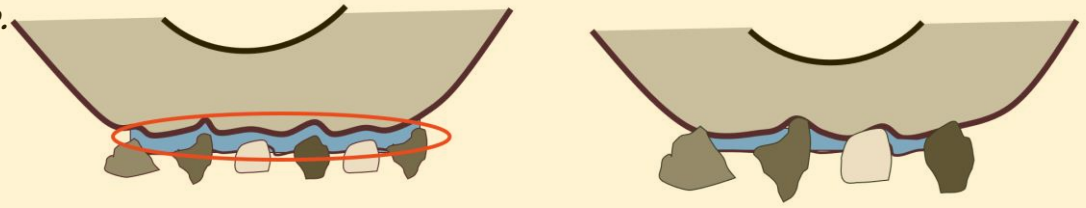




LOW RAIN INTESITY – *Tire-pavement contact not affected*. Both pavements are expected to show the same grip



HIGH RAIN INTESITY – *Tire-pavement contact significantly affected if pavement has poor drainage.*



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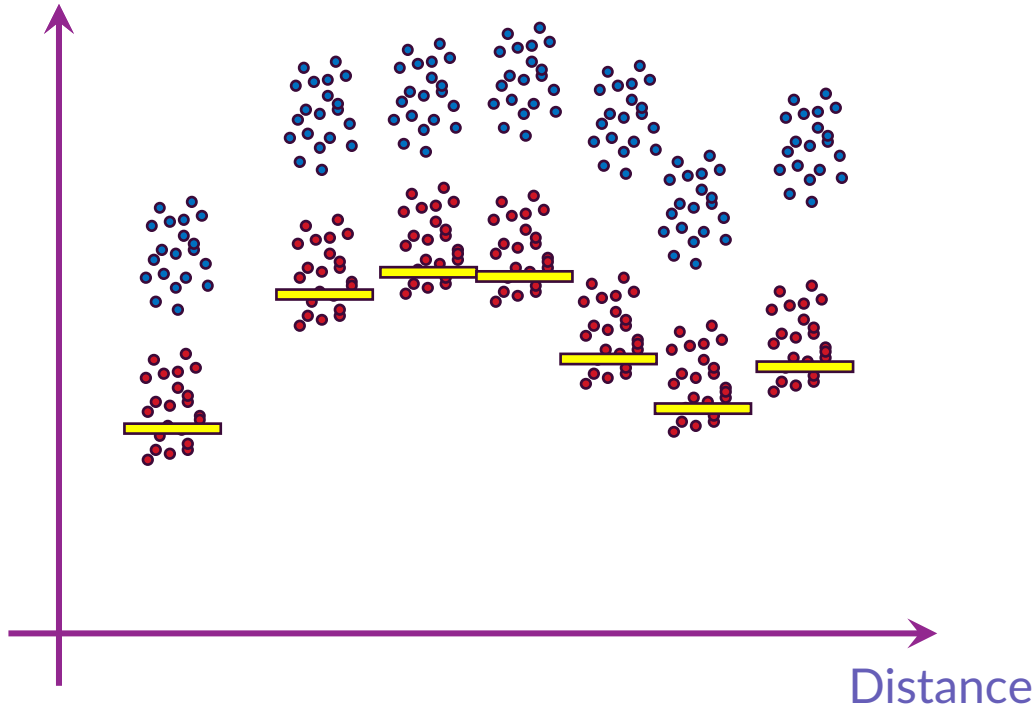
NIRA Dynamics Grip data (POC)
Operational: friction

How can we interpret these data when looking at the road surface

- Upper Level – Max grip
- Lower Level – Min grip
- Lower Level – 10%Q-Min grip

10%Q-Min grip
Over a WEEK
considering the weather in Denmark, might be raining



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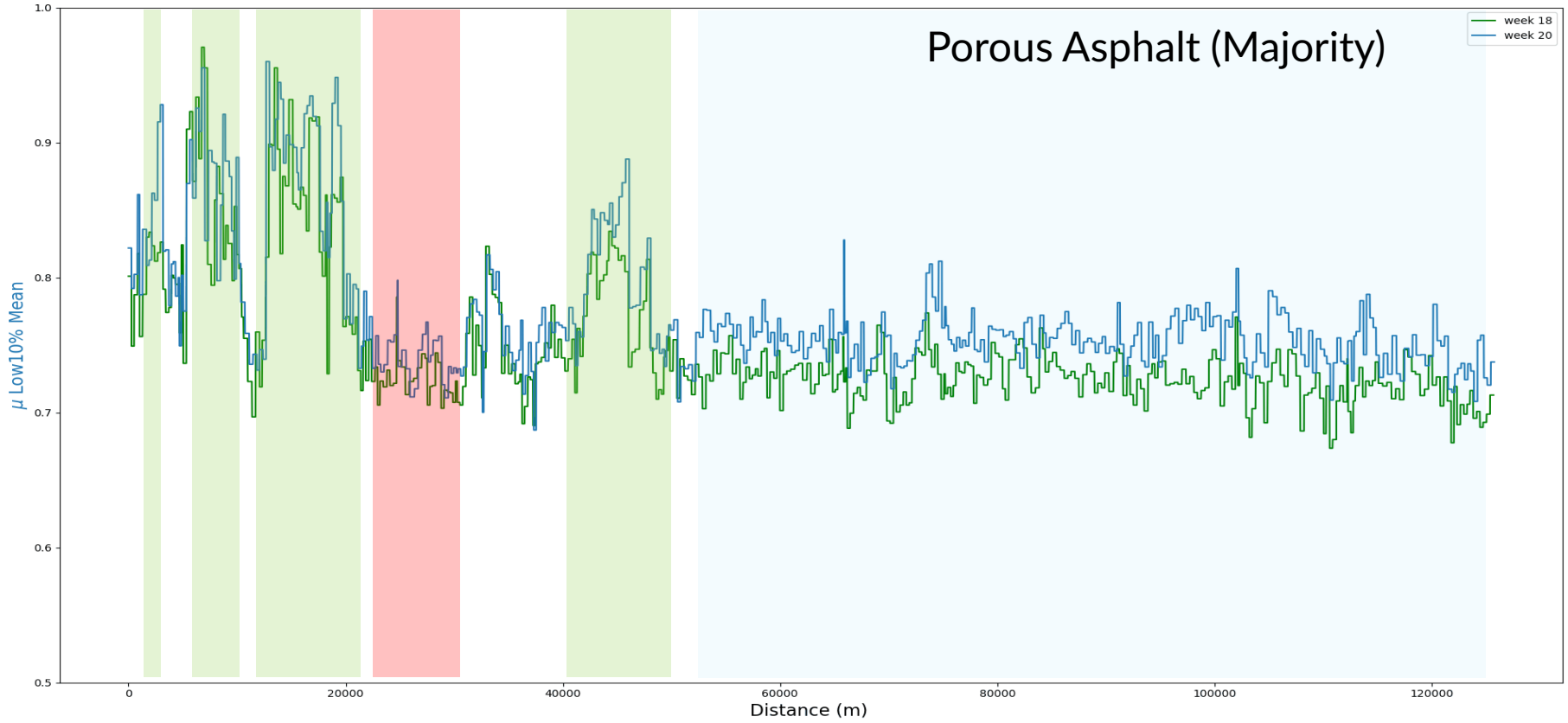
NIRA Dynamics Grip data (POC)
Operational: friction

High Grip surfaces – when the radius of a turn is smaller than what allowed

High Sensitivity – changes more during the year

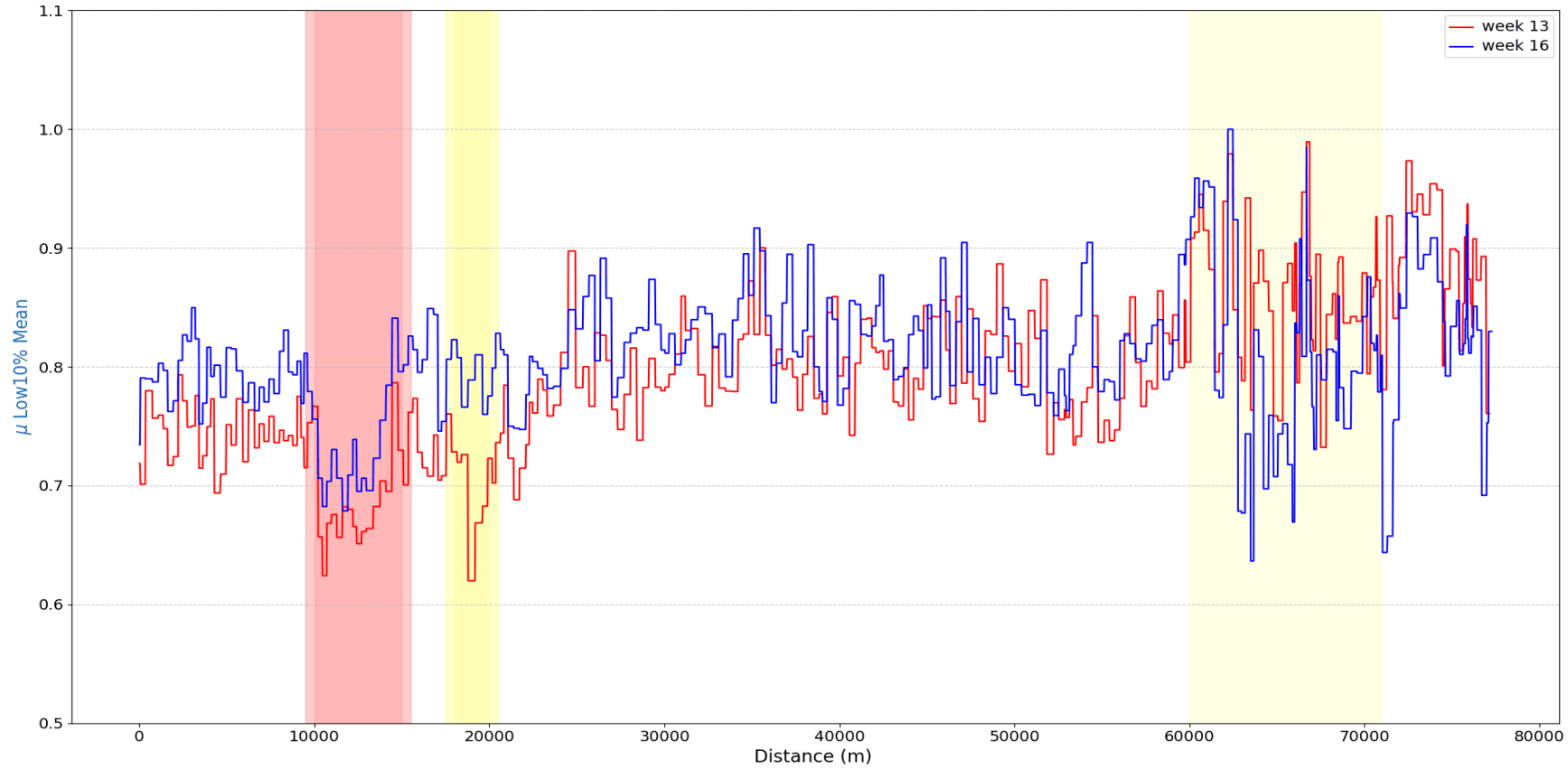


NIRA Dynamics Grip data (POC)

Operational: friction

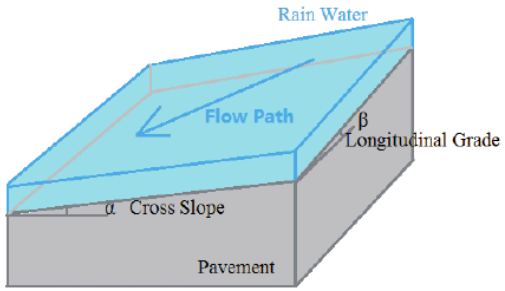
New SMA (known) – low friction at the beginning

New SMA (probably)– Initial low friction and drastic change

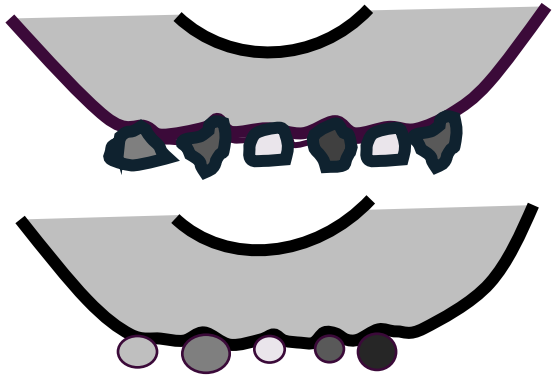


NIRA Dynamics Grip data (POC)
Operational: friction

1. **Surface drainage** capability: ***texture and Crossfall slope***
2. **Identify road mixtures** which perform better over the year
3. Verify **grip on weekly basis on critical locations**



Crossfall slope



Texture & Materials

Critical locations

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Conclusions

- NIRA Dynamics data bring **high resolution time domain** as an additional feature in the data.
- **Predictive, preventive, and corrective** maintenance can be addressed using NIRA Dynamics data, including:
  - surface defects such as cracking,
  - frost heave events
  - damages due to extreme weather events/precipitations
  - skid resistance deficiency
- **Climate resilience of road section (safety, physically)**
- Friction data can be used to define **recommended driving speeds**.
- And much more has to come!

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