



Polish Nordic Road Forum 2018

Traffic Speed Deflectometers (TSD) as the most advanced tool for making structural measurements at project level for the whole network

by

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- Profiling of pavements and functional data
- MiniProf – Profiling of train wheels and rails
- TSD – deflection of pavements and structural bearing capacity





Road Maintenance Savings

The ROADEx Network; a collaboration of northern European roads organisations whose aim is to share roads information and research.

Conclusion: When road strengthening can be optimized using road diagnostics to meet a target level the savings can be 15-50% of the project level cost, and the **saving over the lifetime of the rehabilitation can be up to 50%.**

Focus areas:

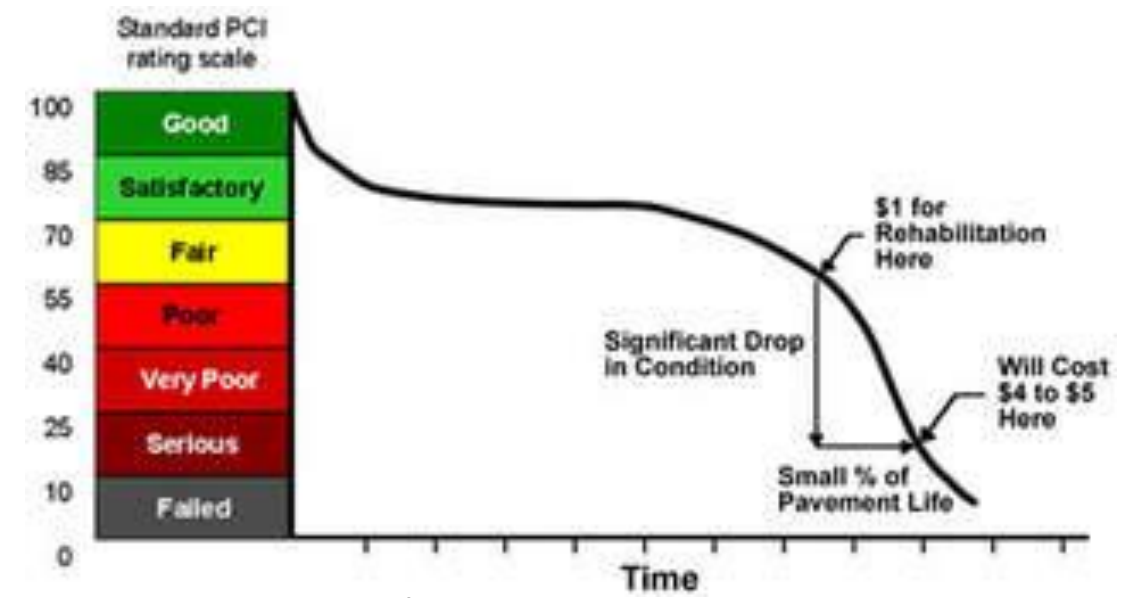
- 1) Focus on repairing the underlying reasons of the road problems, instead of dealing with the symptoms
- 2) Focus on the weakest road section in strengthening measures
- 3) Focus on the correct timing
- 4) Focus on preventive maintenance



Bearing Capacity Measurements



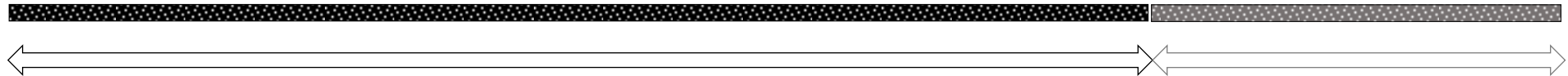
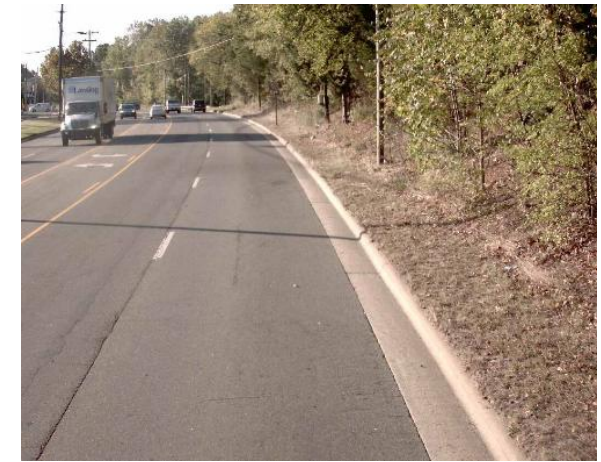
Quality assurance



Maintenance planning

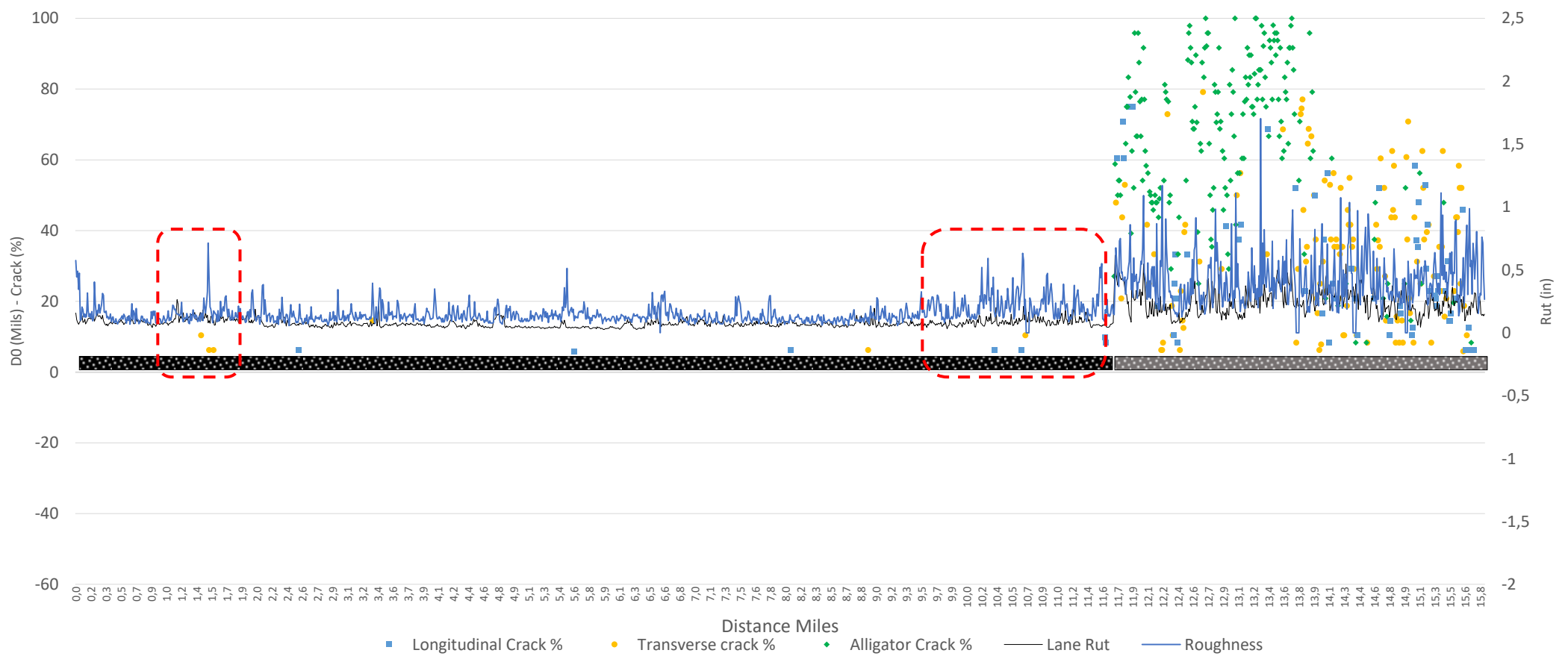


Example - recent reseal

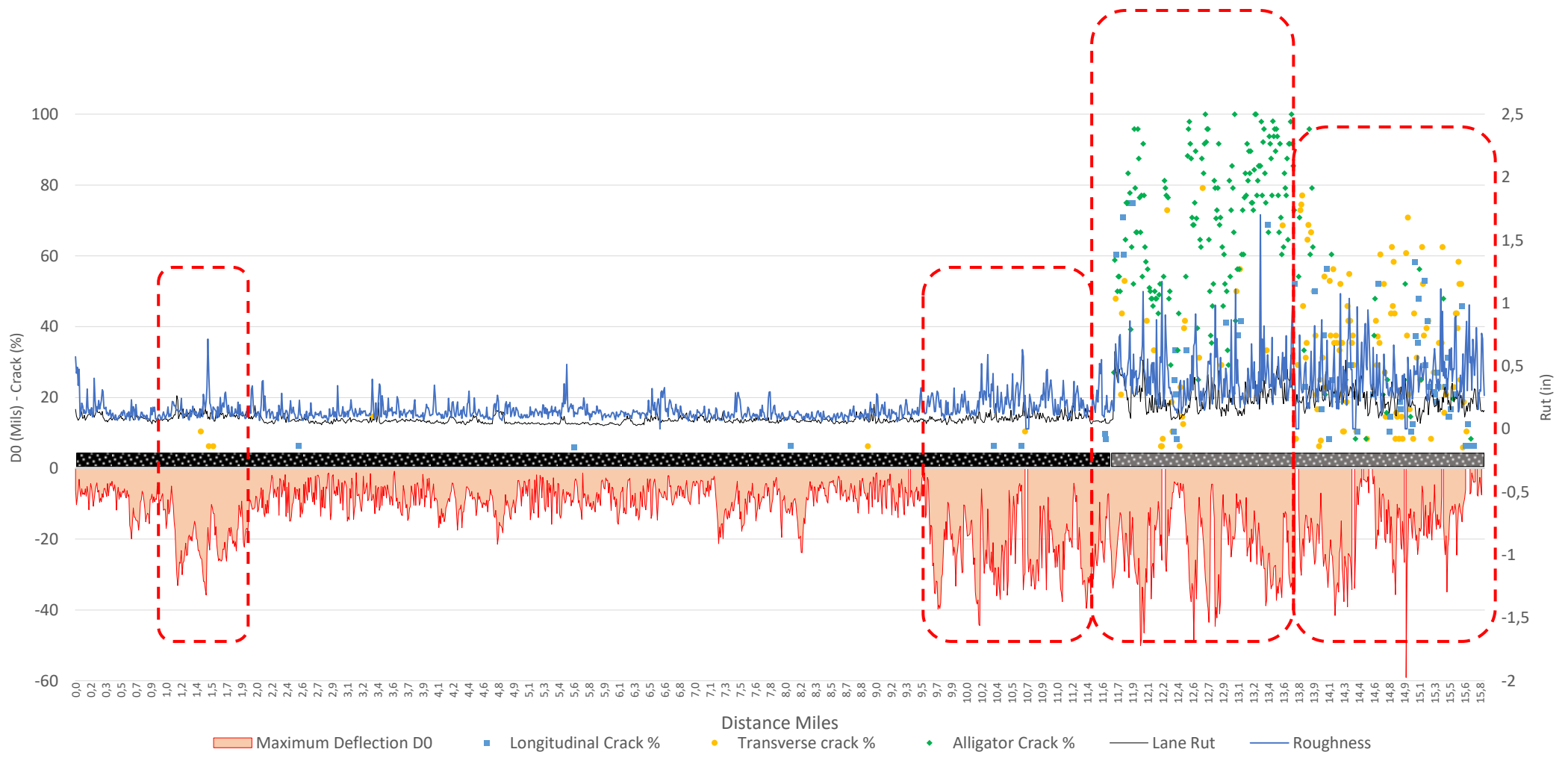


Resealed

Surface characteristics



Strength





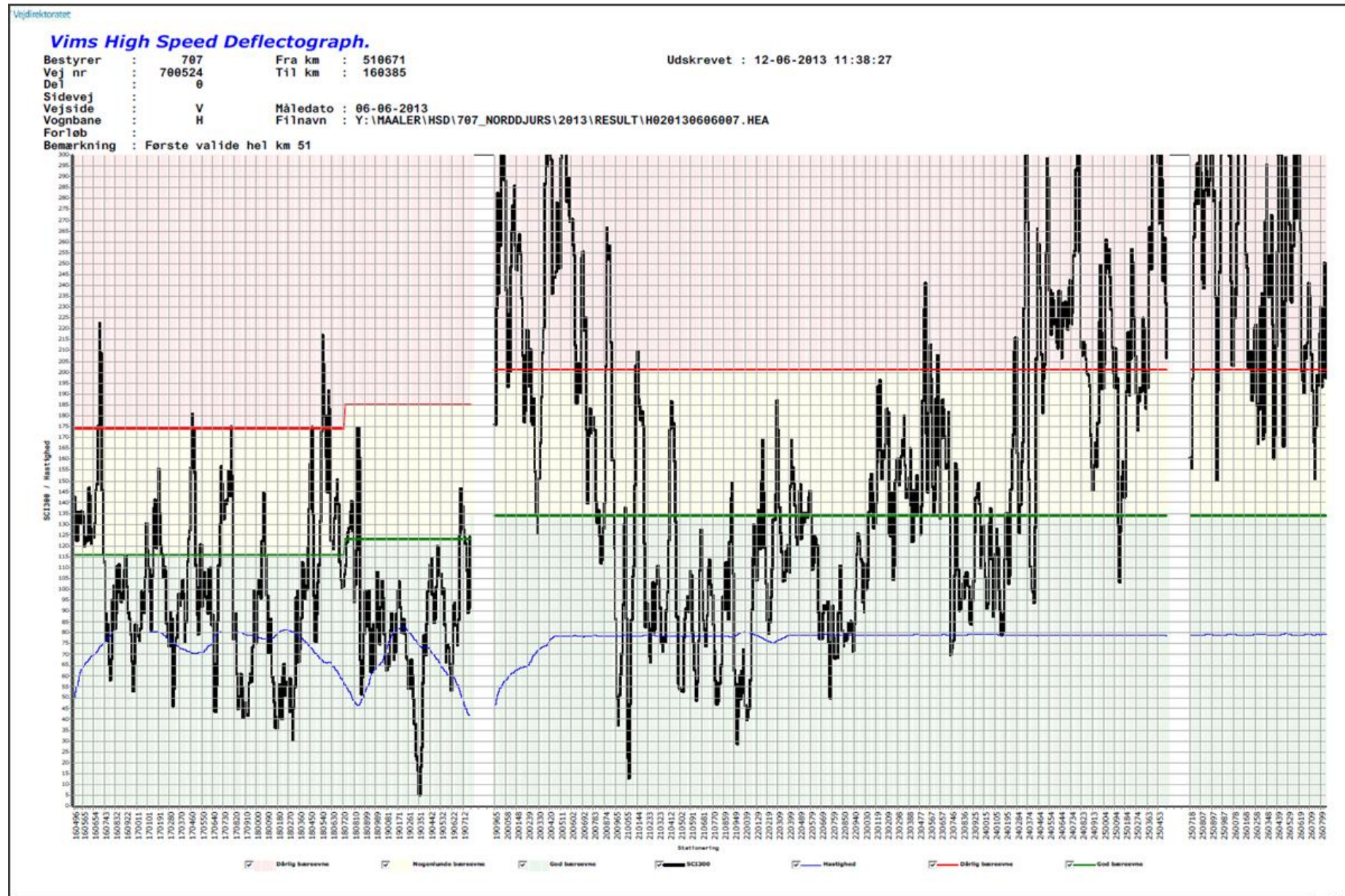
The State Road Network

Min. 1/6 of motorways every year
(total of approx. 1.500 km (940 miles))

1/3 of remaining roads every year
(total of approx. 2.100 km (1.300))

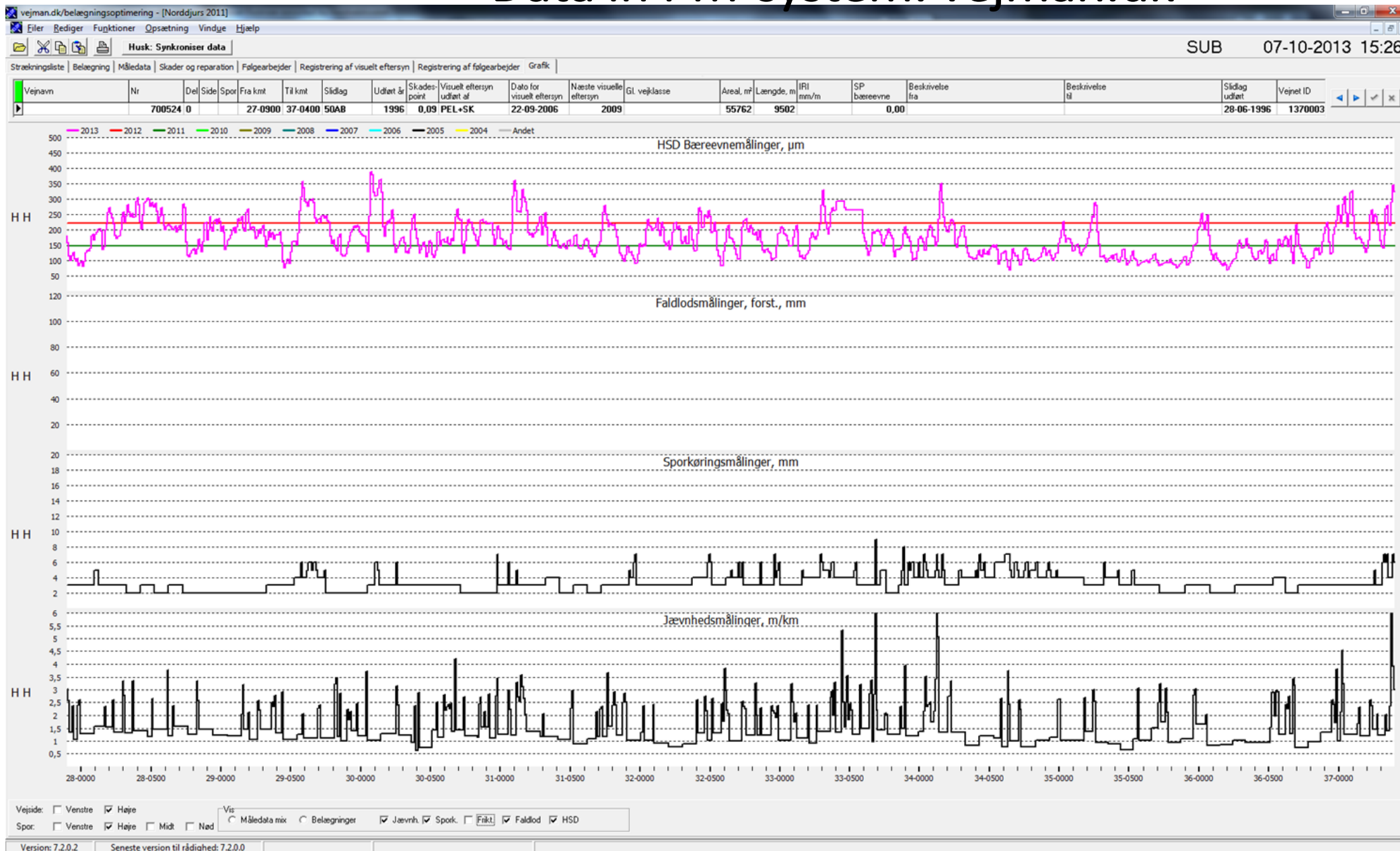


SCI - 300

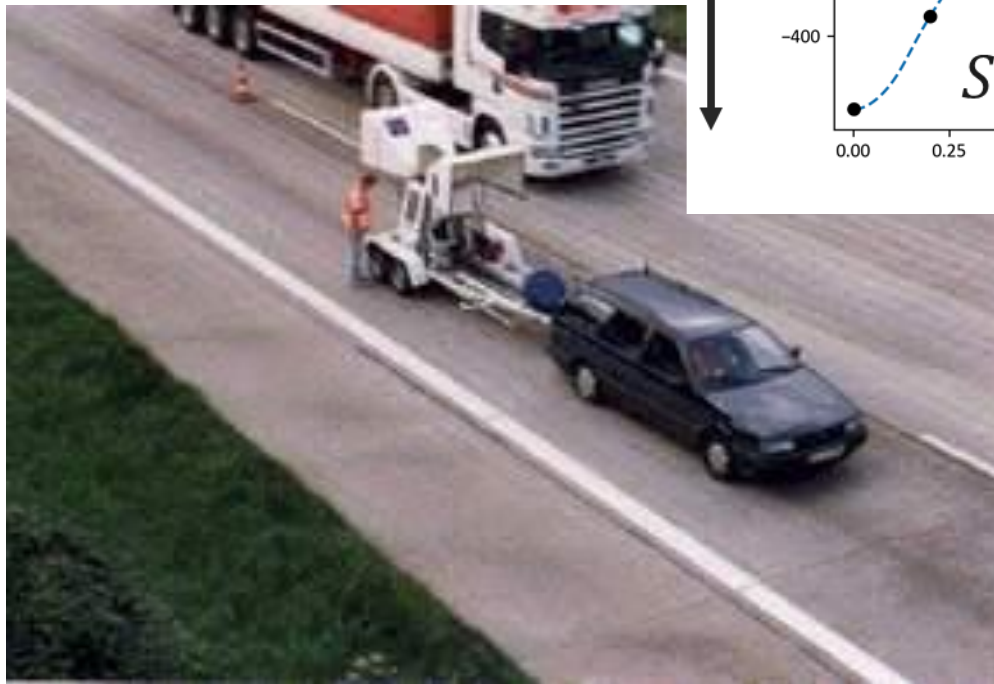
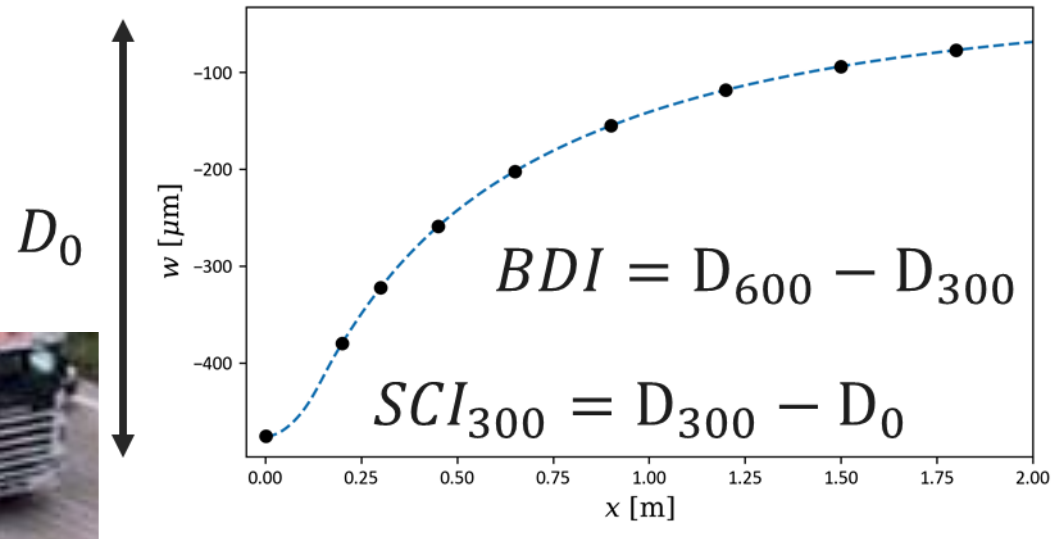




Data in PM-system: vejman.dk



Bearing Capacity Measurements

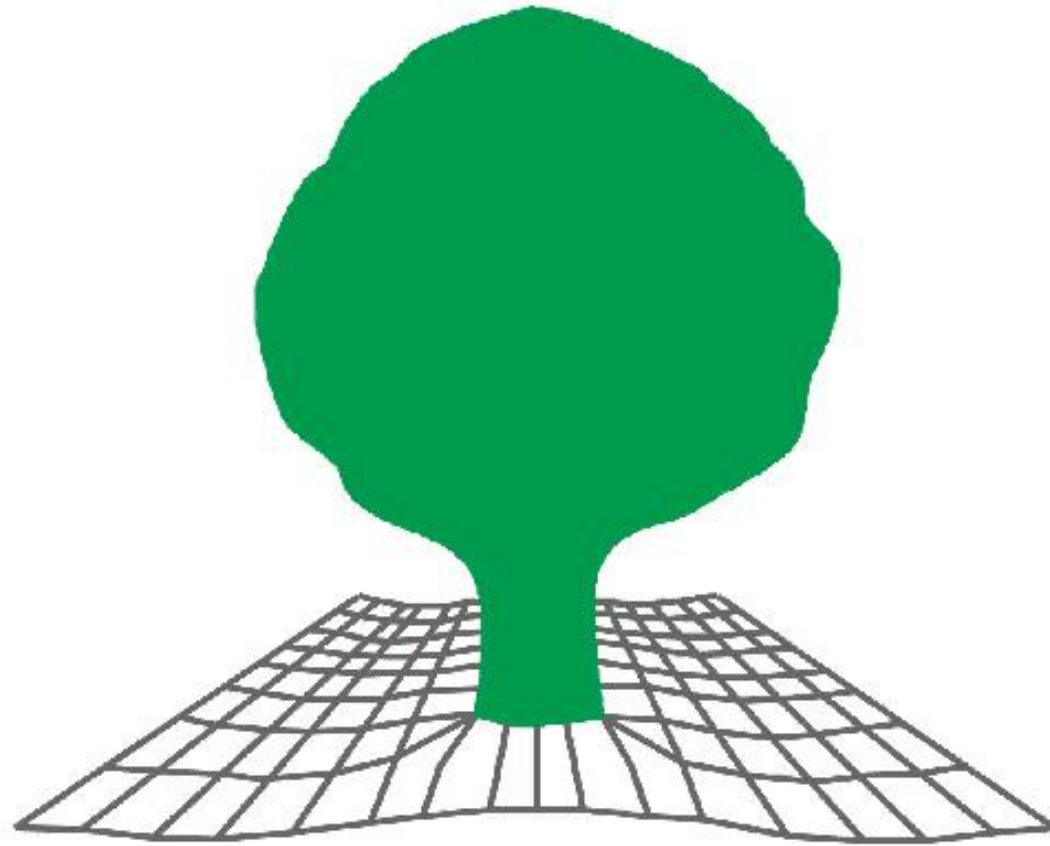


Falling Weight Deflectometer, FWD



Traffic Speed Deflectometer, TSD

- Measures at traffic speed 5 km/h – 80 km/h
- Uses laser Doppler vibrometers to measure pavement response



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ENGINEERING**

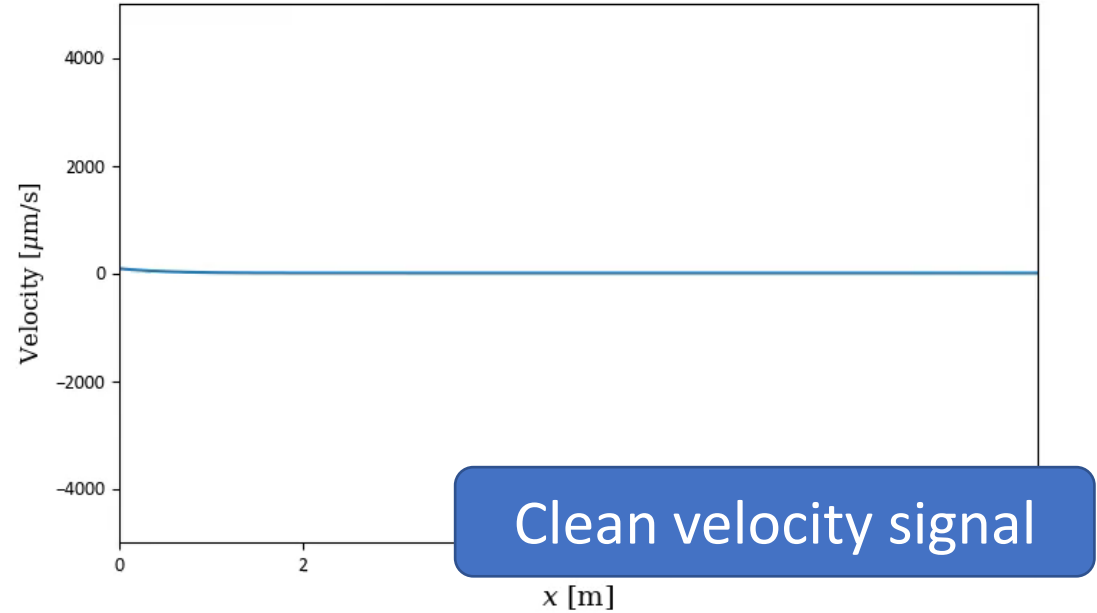
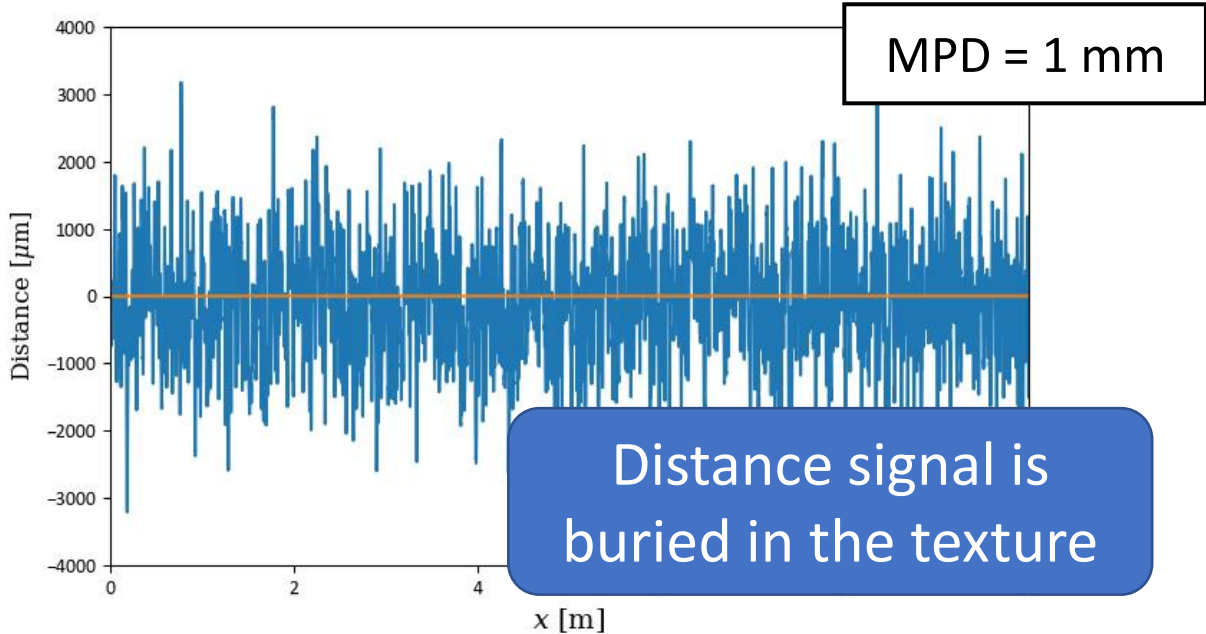
Why measure velocity instead of distance ?

Velocity is insensitive to surface texture!

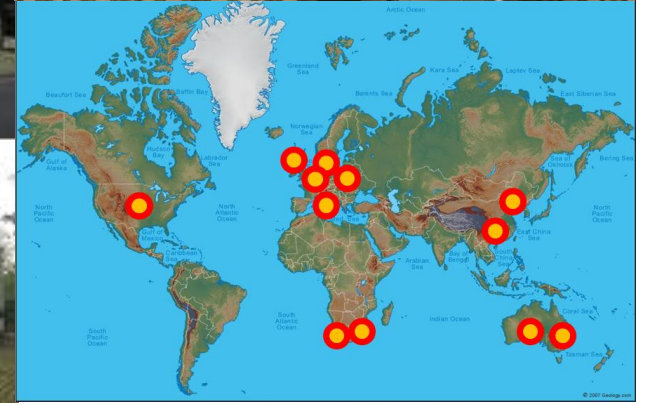


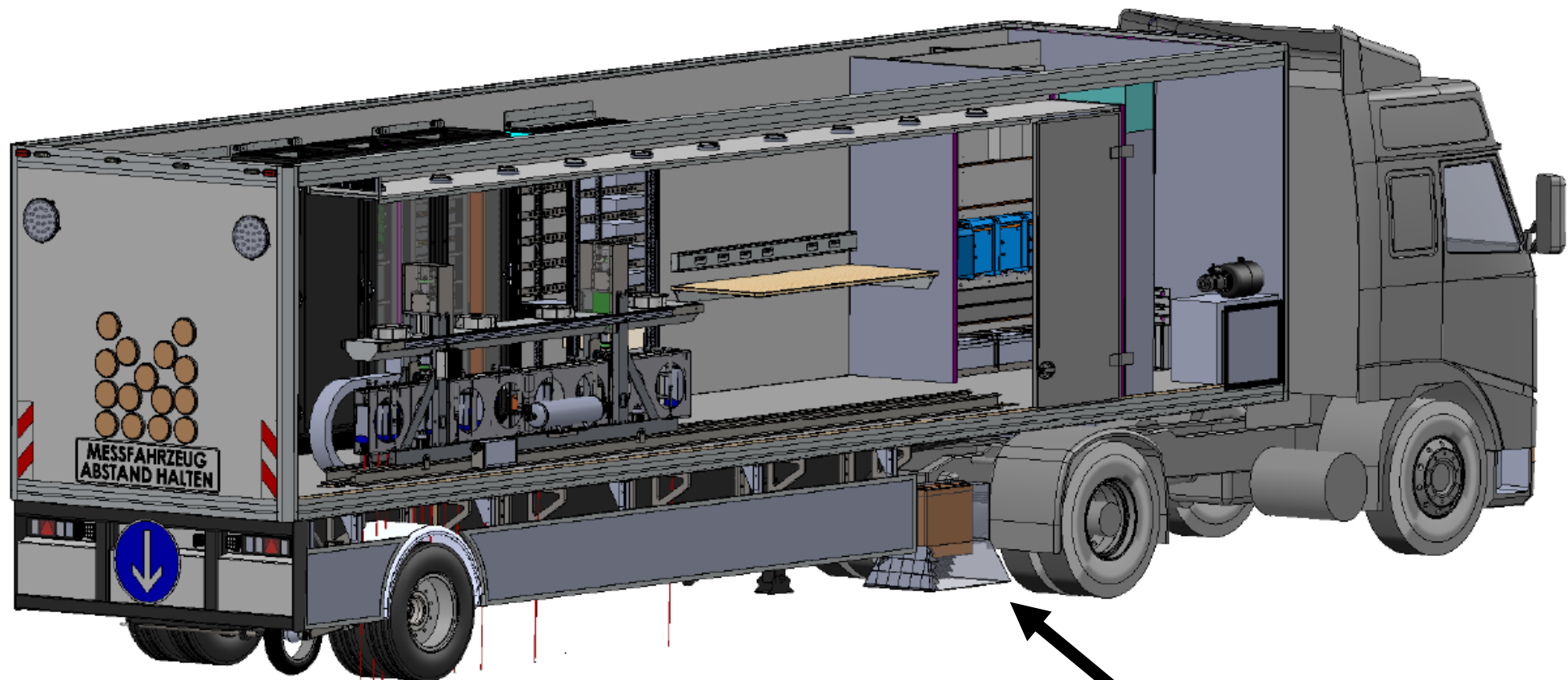
Height measurement

Velocity measurement



13 operating TSDs





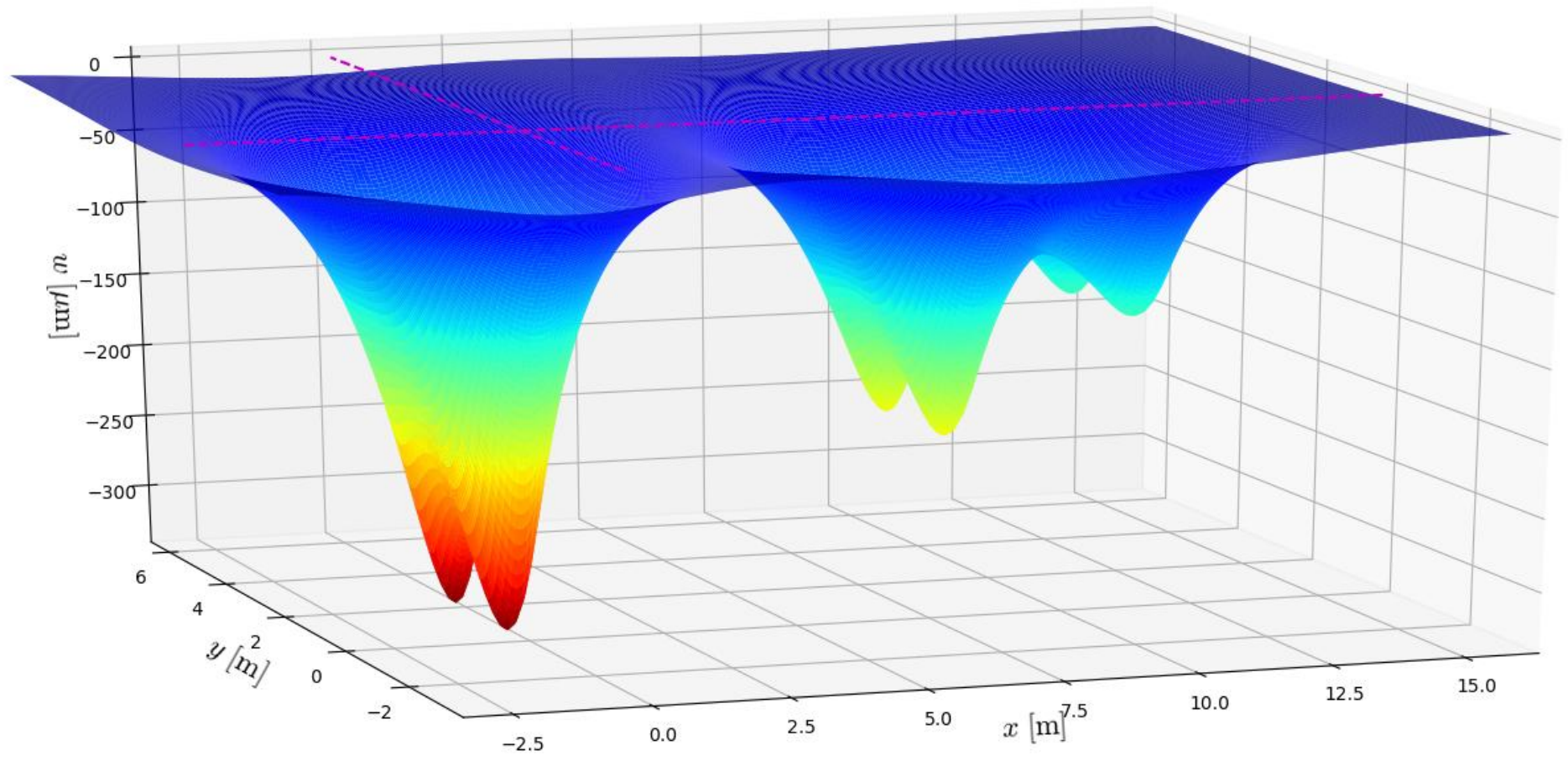
Measurements behind load

Ground Penetrating Radar (GPR)



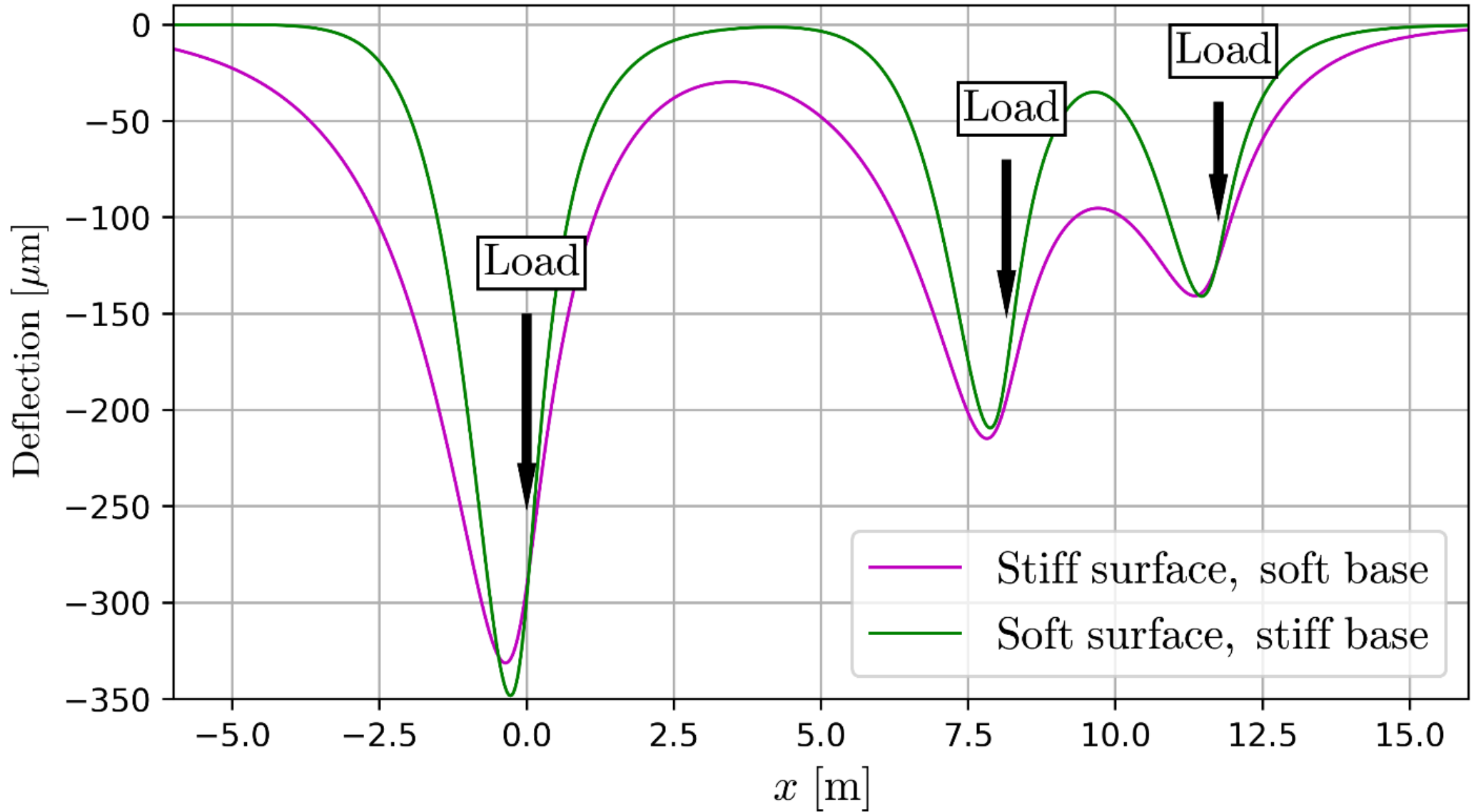


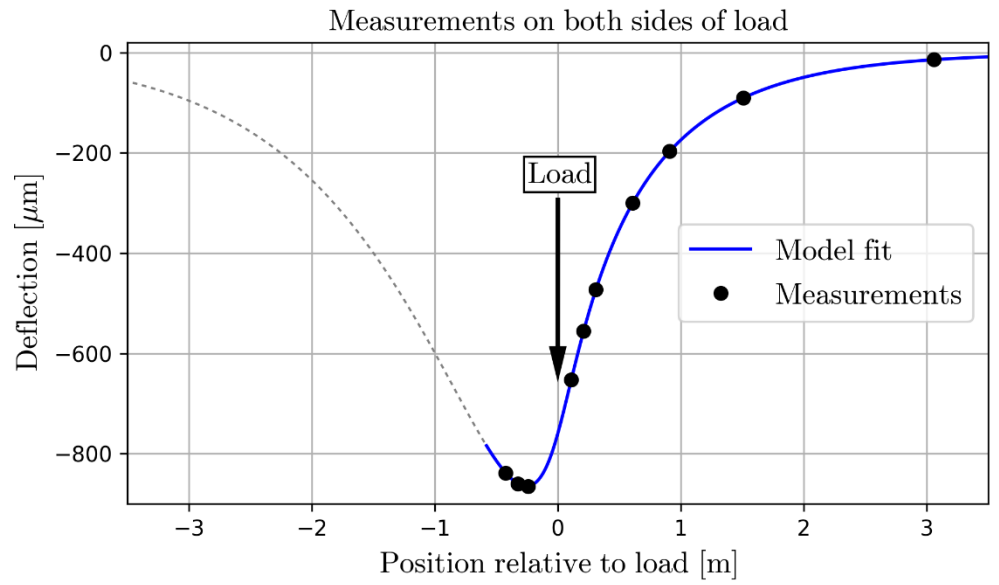
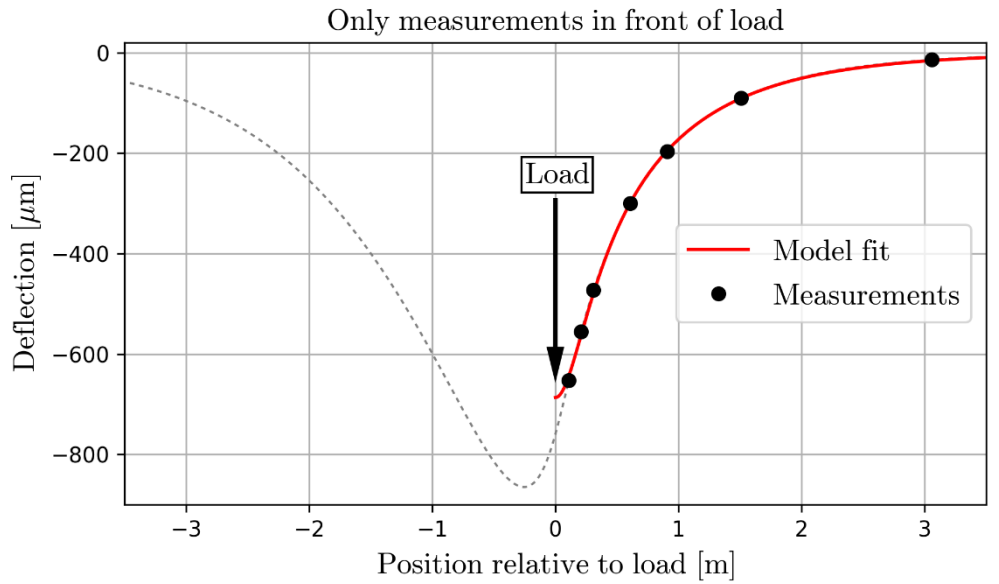
TSD "footprint"





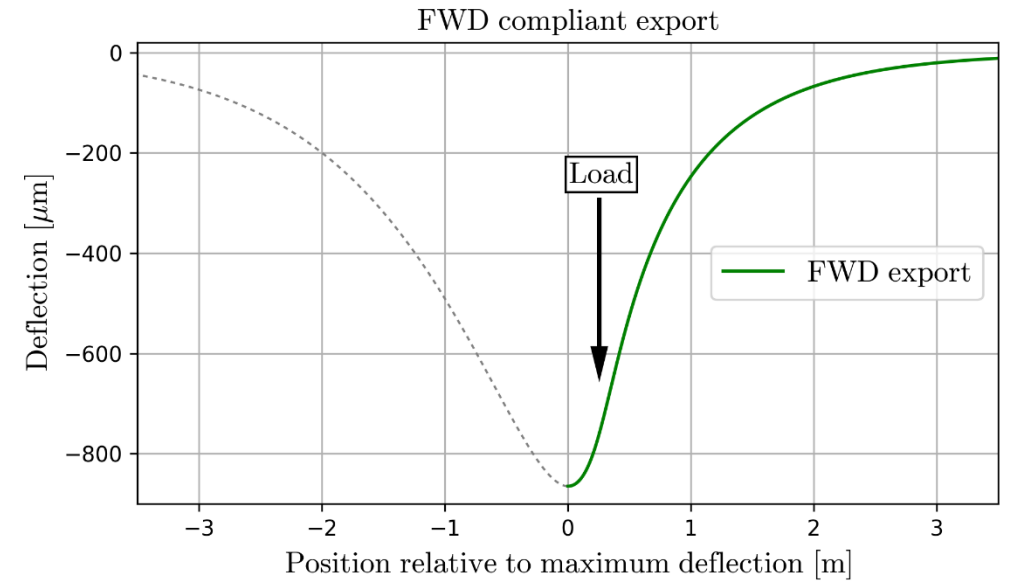
Deflection along driving direction



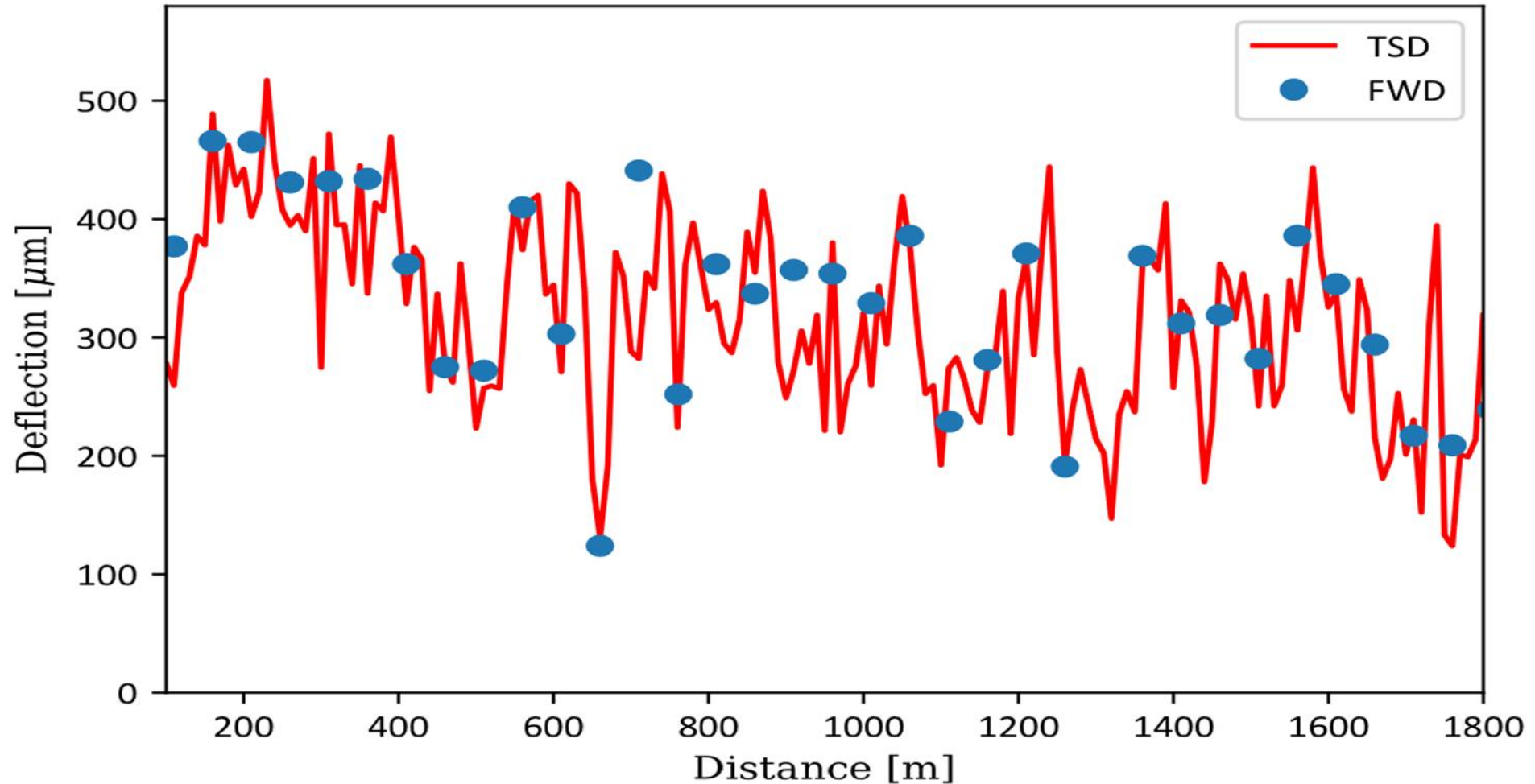


Measuring both leading and trailing deflection facilitates:

- Asymmetrical assesment of deflection bowl
- Compliance with usual back-calculation
- Evaluation of damping properties
- Speed normalization



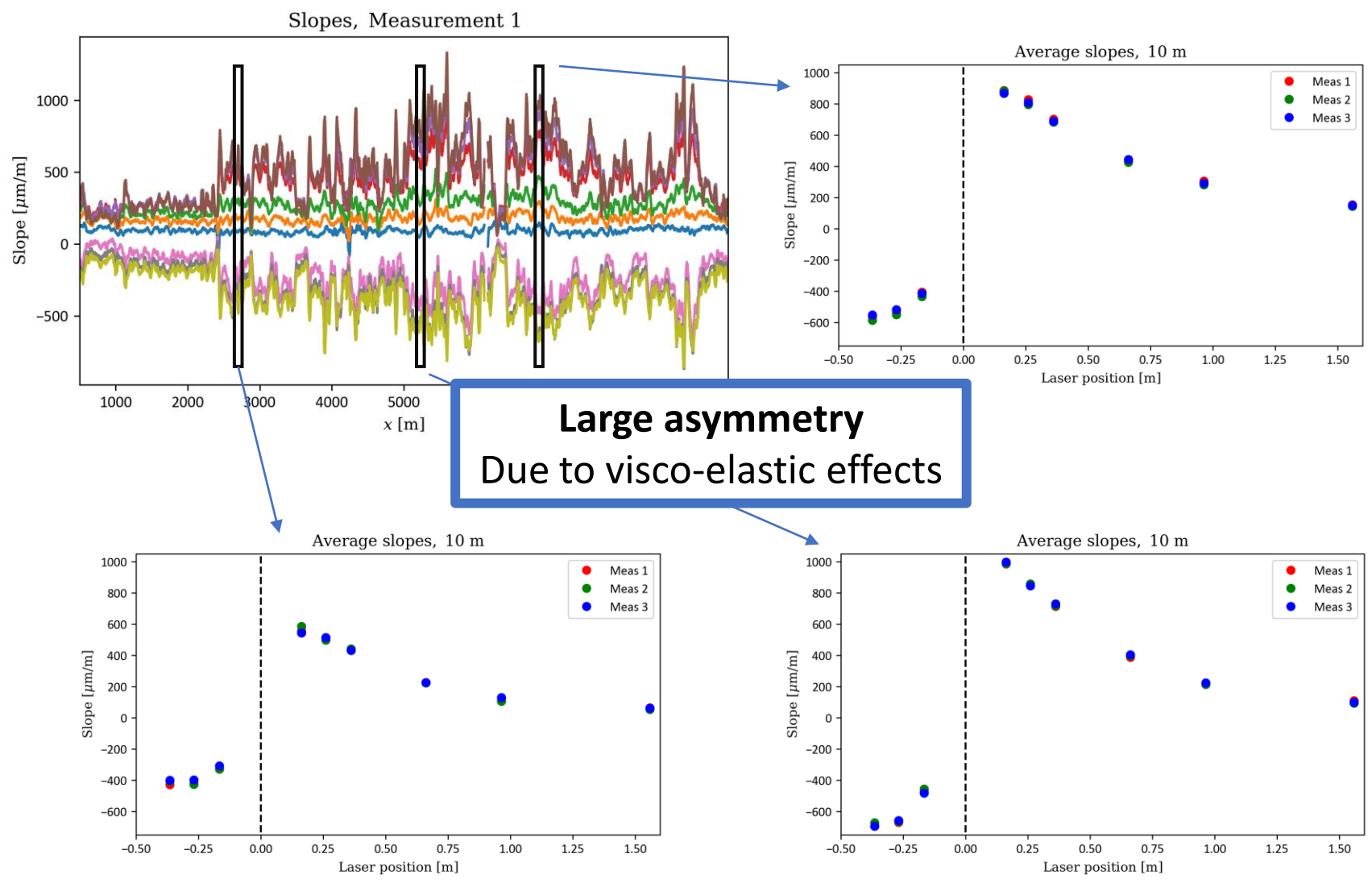
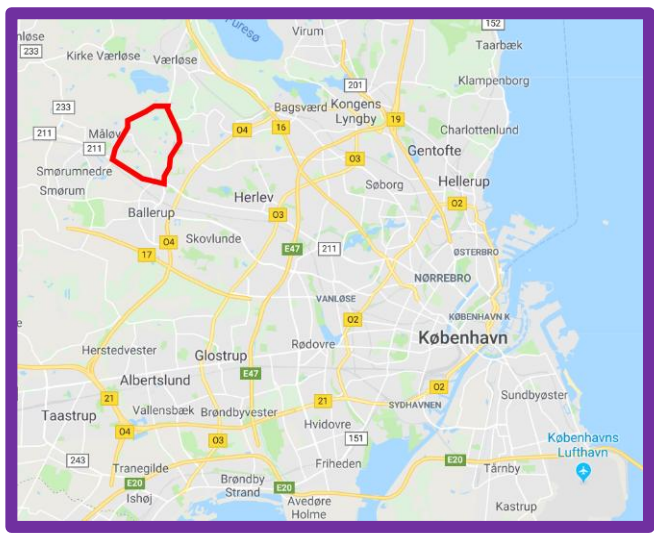
TRAFFIC SPEED DEFLECTOMETER <-> FALLING WEIGHT DEFLECTOMETER



Measured November 14 and 15, 2017. Temp. app. 10°C. Highway E47 on Lolland, Denmark
 Measured with TSD 7, with 10 lasers in right wheel centre line between twin-tires
 (three lasers behind rear axle to show deepest deflection point behind the wheel)

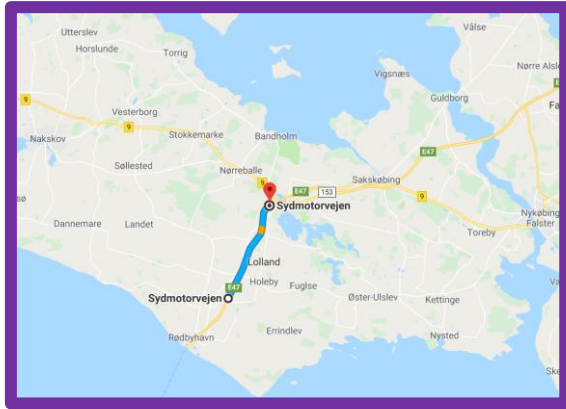
Time dependence: measurement examples

Road near Copenhagen.
Three runs.

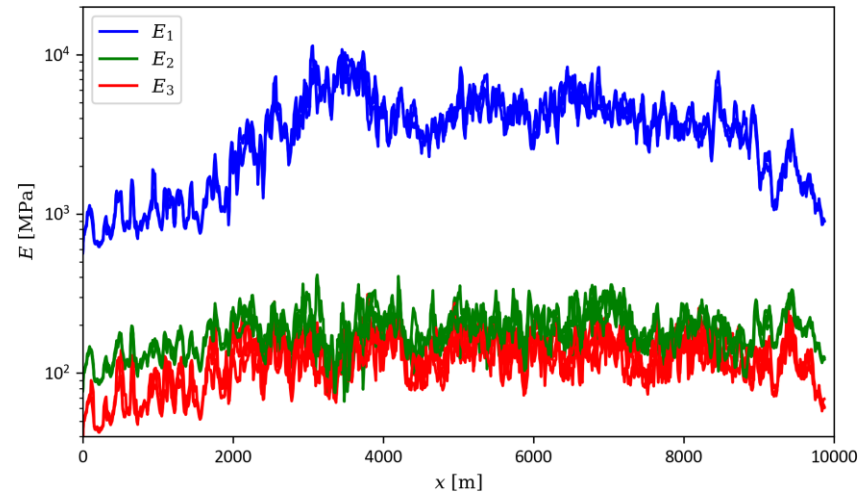


Slope based back-calculation: Example

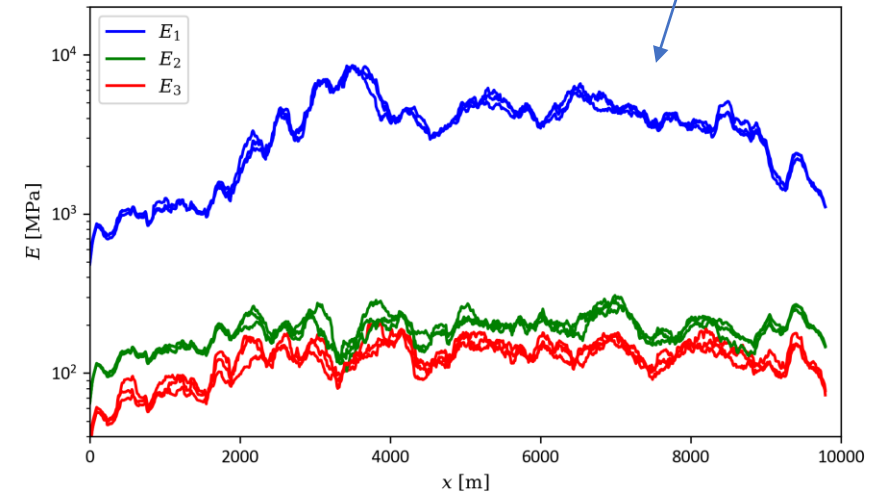
Highway in the south of Denmark.
Three runs.



Back-calculation: Good repeatability



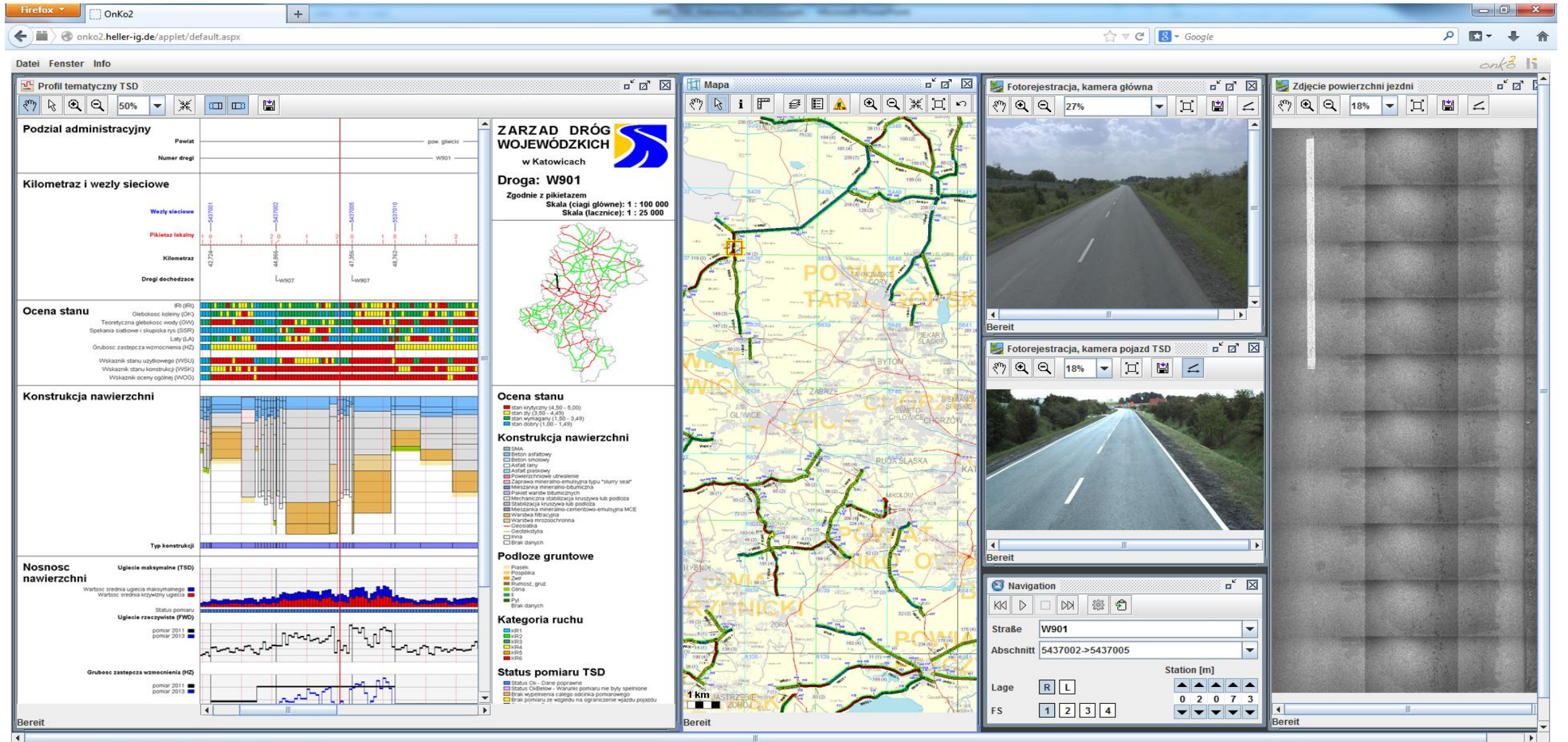
200 m moving average
FWD results



Results are:

- Reasonable ✓
- Repeatable ✓
- Agrees with FWD (✓)

INTERACTIVE DATA VISUALIZATION



Profil tematyczny TSD

Podział administracyjny

Powiat: _____ pow. główny: _____
 Numer drogi: _____ W901

Kilometraż i węzły sieciowe

Węzły sieciowe
 Pikietaż lokalny
 Kilometraż
 Drogi dochodzące

Ocena stanu

IRI (IRI)
 Głębokość kolony (GH)
 Teoretyczna głębokość wody (DW)
 Słupki siatkowe i skłapika rys (SSR)
 Łaty (LA)
 Grubość zastępcza wzmocnienia (HZ)
 Wskaźnik stanu użytkowego (WUSU)
 Wskaźnik stanu konstrukcyjnego (WWSK)
 Wskaźnik oceny ogólnej (WOC)

Konstrukcja nawierzchni

Typ konstrukcji

Nosność nawierzchni

Ugięcie maksymalne (TSD)
 Wartość średnia ugięcia maksymalnego
 Wartość średnia krytycznego ugięcia
 Status pomiaru
 Ugięcie rzeczywiste (FWD)
 pomiar 2011
 pomiar 2013
 Grubość zastępcza wzmocnienia (PD)
 pomiar 2011
 pomiar 2013

ZARZĄD DRÓG WOJEWÓDZKICH
 w Katowicach
Droga: W901
 Zgodnie z pikietażem
 Skala (ciągi główne): 1 : 100 000
 Skala (lacznice): 1 : 25 000

Ocena stanu

- stan krytyczny (4,50 - 5,00)
- stan zły (3,50 - 4,49)
- stan wymagany (1,50 - 3,49)
- stan dobry (1,00 - 1,49)

Konstrukcja nawierzchni

- Beton
- Beton asfaltowy
- Beton sztalowy
- Asfalt twardy
- Asfalt podbitowy
- Asfalt podbitowy
- Powierzchniowe utwardzenie
- Warstwa mineralno-amylna typu "sturdy seal"
- Mieszanka mineralno-obuczkowa
- Pakiet warstw obuczkowych
- Mechaniczna stabilizacja kruszywa lub podłoża
- Stabilizacja kruszywa lub podłoża
- Mieszanka mineralno-cementowo-amylna MCE
- Warstwa filtracyjna
- Warstwa przeciwróżniowa
- Geotekstylia
- Geotekstylia
- inna
- Brak danych

Podłoże gruntowe

- Popielka
- Żwir
- Żwir, piasek
- Żwir, piasek, gruz
- Głina
- Głina
- inny
- Brak danych

Kategoria ruchu

- IR1
- IR2
- IR3
- IR4
- IR5
- IR6

Status pomiaru TSD

- Status OK - dane poprawne
- Status OKBelow - Warunki pomiaru nie były spełnione
- Brak wypełnienia całego odcinka pomiarowego
- Brak pomiaru ze względu na ograniczenie wjazdu pojazdu

Mapa

Fotorejestracja, kamera główna

27%

Zdjęcie powierzchni jezdni

18%

Fotorejestracja, kamera pojazd TSD

18%

Navigation

Straße: **W901**

Abschnitt: **5437002->5437005**

Station [m]

Lage: R L

FS: 1 2 3 4

0 2 0 7 3



Thank you for your attention