



# Digitizing Bike Lanes for Bike PMS



# XenomatiX

Riding the Path to Safety

# Bike lane inspection – Political Context

- x Shift to sustainable transportation is priority for government and road authorities:
  - tax incentives for sustainable mobility, incl. biking
  - efforts for comfort & safety
  - extra incentive for healthcare budget
- x Results
  - more bikes on the 'road'
  - new types of bikes (also for cargo)
  - need for wider and more comfortable bike lanes

Need for :

- more, safer and better quality bike lanes and
- **dedicated bike lane inspection solutions**



Project Map Insert Analysis View Edit Imagery Share Vector Tile Layer

Clipboard Navigate Layer Selection Inquiry Labeling Offline

Tools: Cut, Copy, Paste, Copy Path, Explore, Bookmarks, Go To XY, Basemap, Add Data, Select, Select By Attributes, Select By Location, Clear, Measure, Locate, Infographics, Coordinate Conversion, Pause, Lock, View Unplaced, Convert, Download Map, Sync, Remove

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Map X Catalog

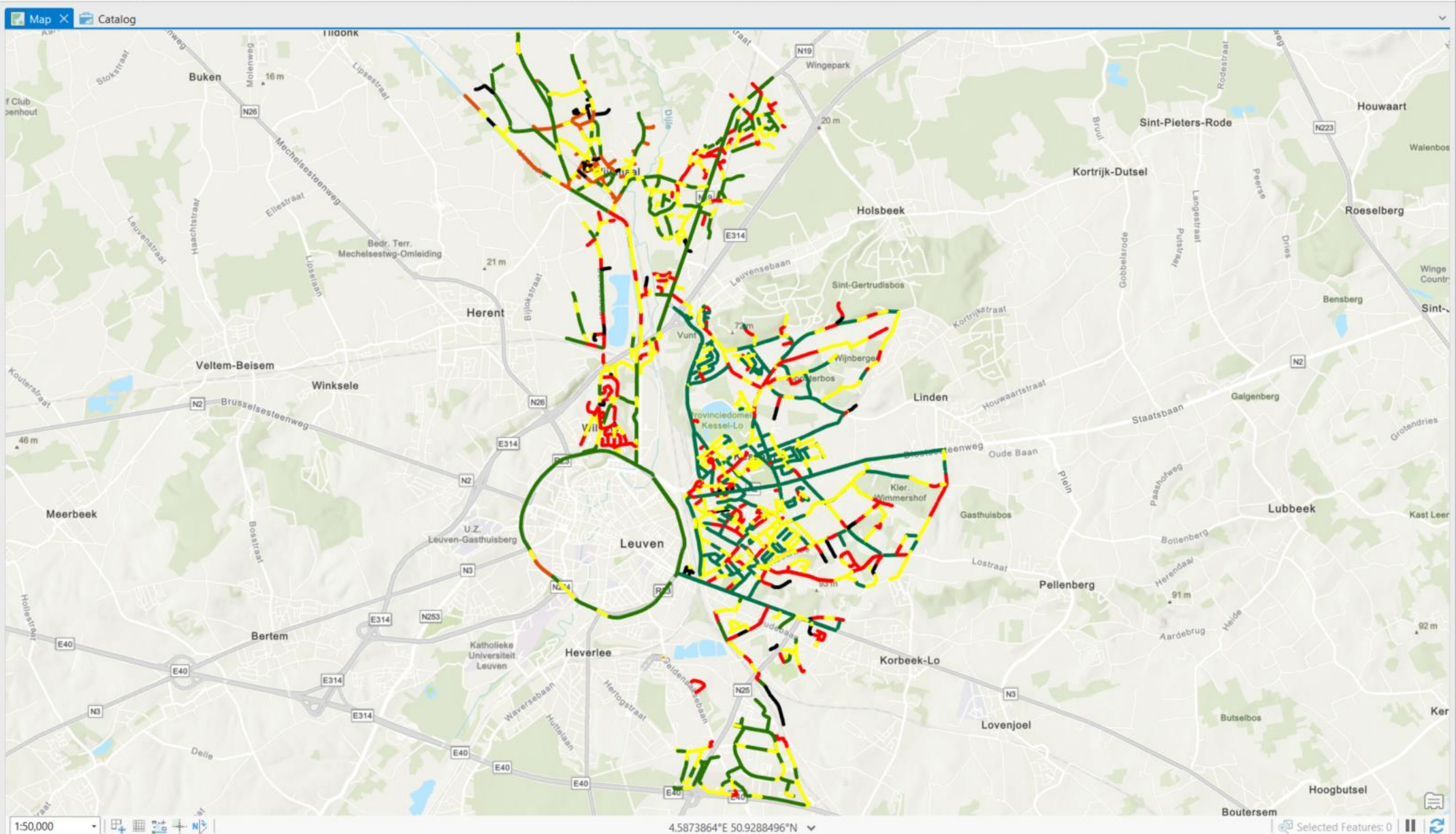
Search

**Drawing Order**

- road\_score\_corrected  
Global Ind
  - 0.883000
  - 0.883001 - 0.887000
  - 0.887001 - 0.892000
  - 0.892001 - 0.897000
  - 0.897001 - 0.900000
- sample  
Global Ind
  - 0.883000
  - 0.883001 - 0.888104
  - 0.888105 - 0.892000
  - 0.892001 - 0.897000
  - 0.897001 - 0.900000
- World Street Map\_869D88BD-944E-4E56-83
- digital\_road000000000.las
- IRI160  
worst iri
  - 1.000000 - 4.000000
  - 4.000001 - 6.000000
  - 6.000001 - 10.000000
  - 10.000001 - 30.000000
- IRI\_320\_ArcGIS  
average\_2
  - 0.483586 - 4.000000
  - 4.000001 - 6.000000
  - 6.000001 - 10.000000
  - 10.000001 - 30.000000
- Rutting\_Stones.las
- 20221215\_Lindensestraat 1.las
- 20221215\_Heuvelstraat.las
- 20221028\_Jan Vandeveldealaan.las

Data percentage: 0

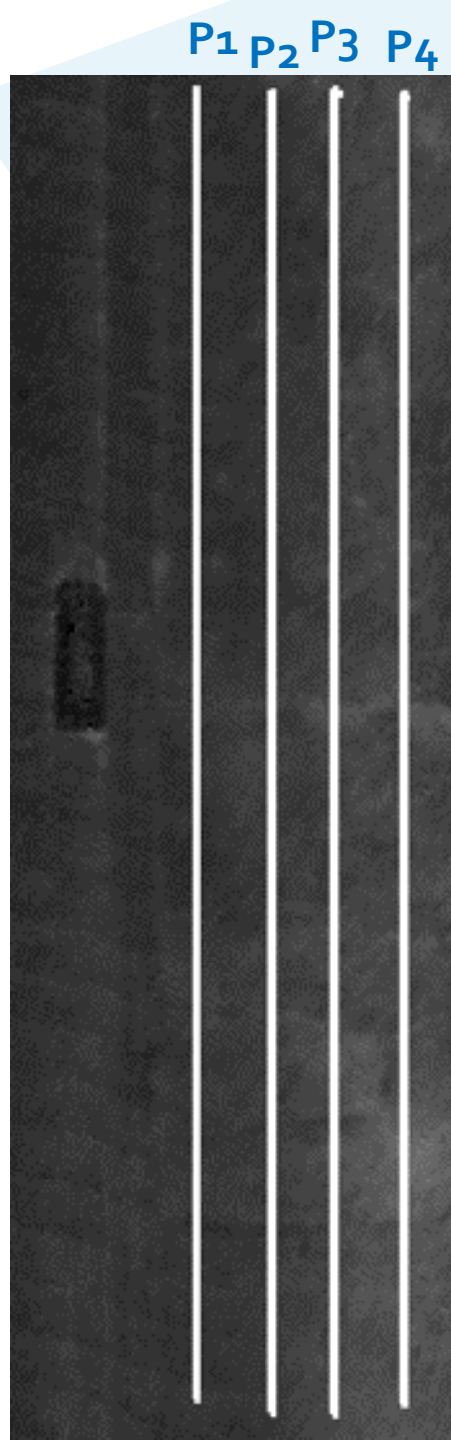
plan3d





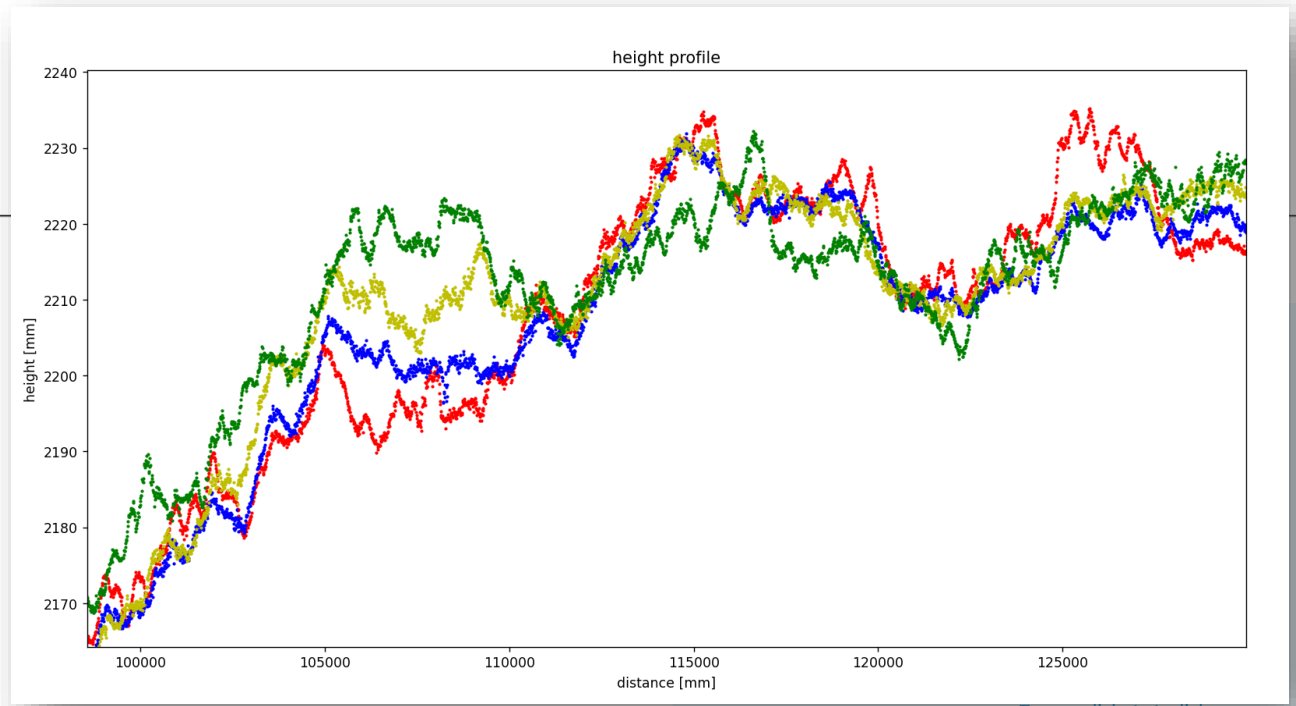
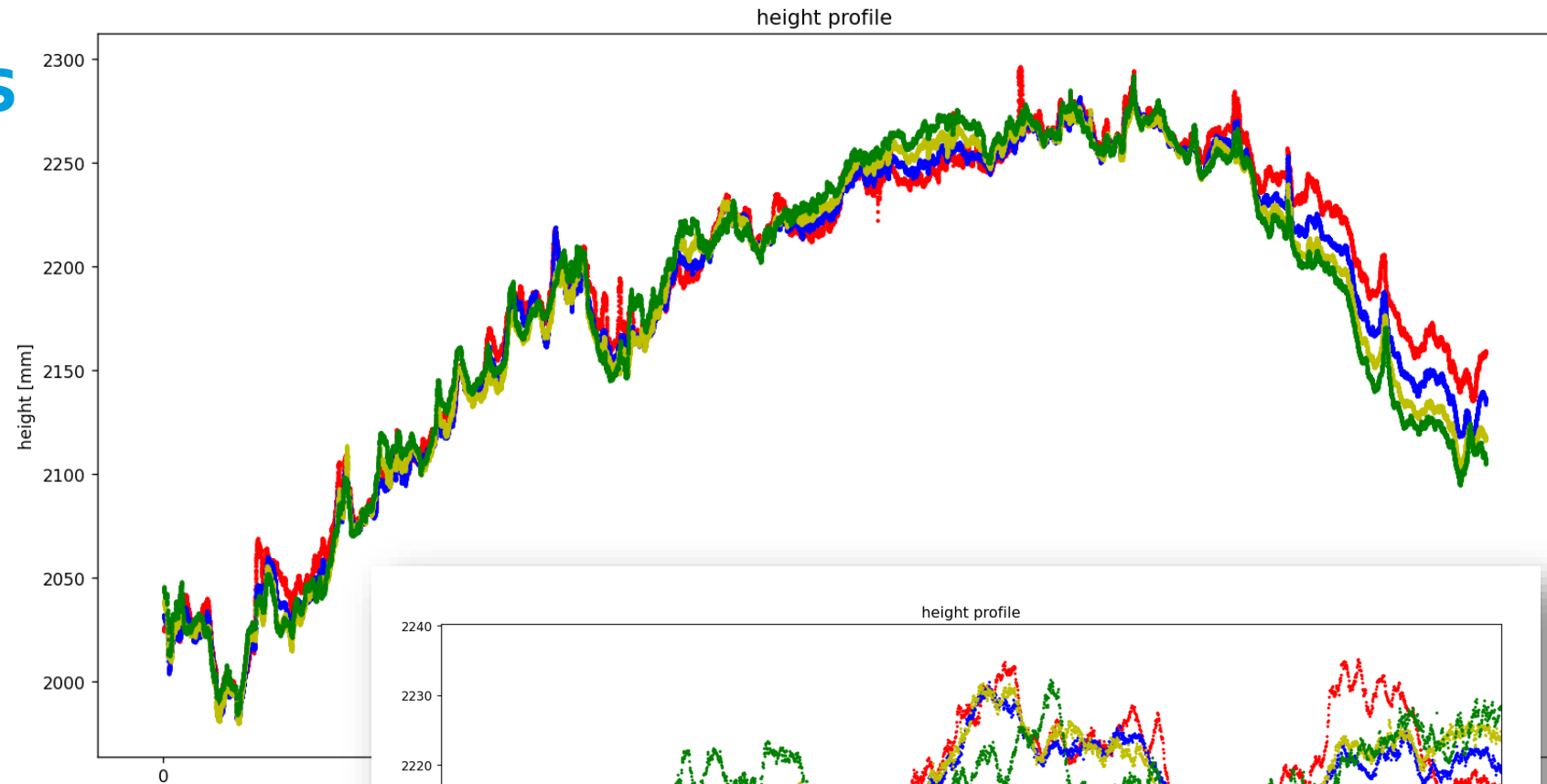
# Bike Lane Profiles

- x 4 profiles P<sub>1</sub>, P<sub>2</sub>, P<sub>3</sub> and P<sub>4</sub> taken with 20-30cm between each other
- x White lines represent where the profiles were taken.



# Bike Lane Profiles

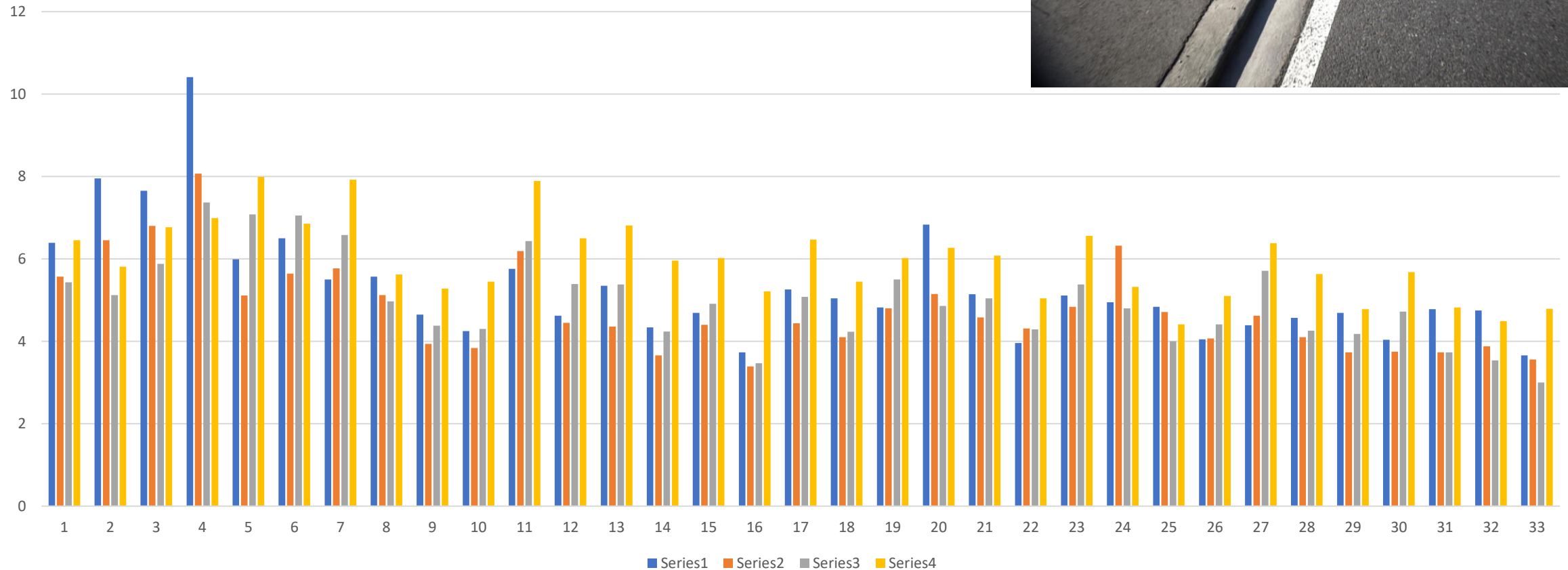
- ✘ Profiles follow the same global trend but differ when zoomed in
- ✘ We can expect differences in the VC values



# 'Good' bike lane - ECo.5 per 10m

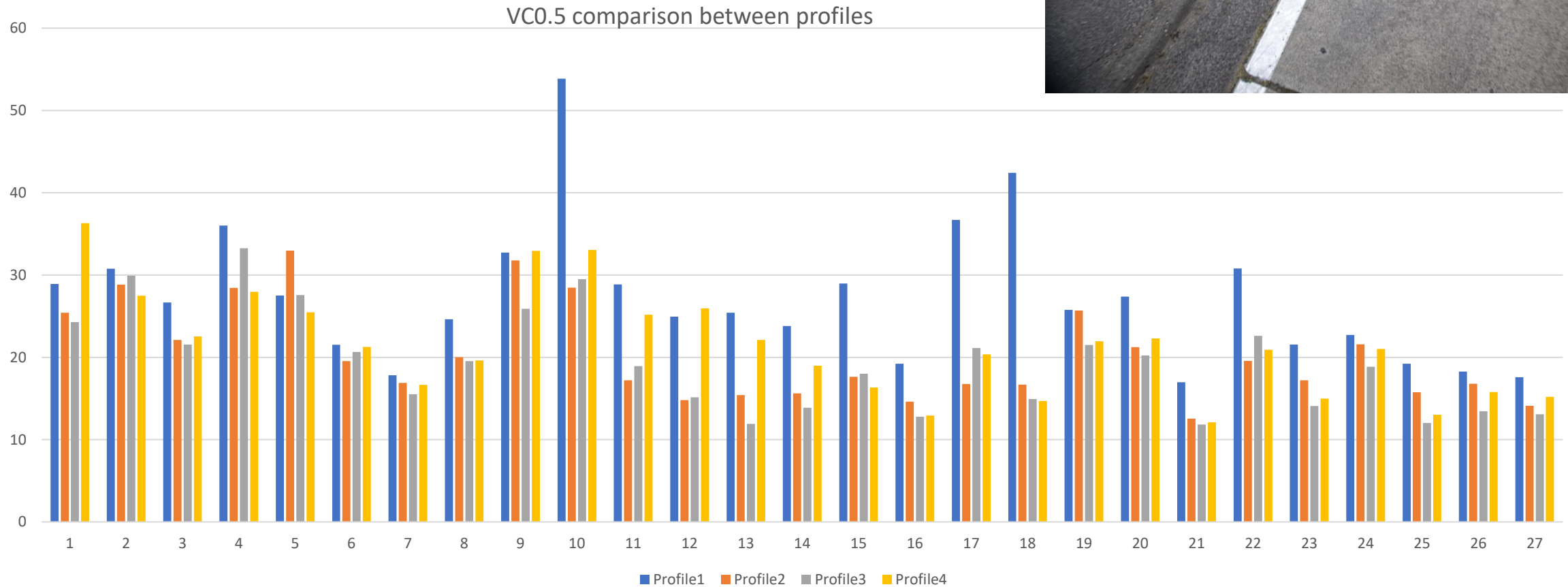
Bike lane in good condition so the difference is not so big in absolute values but in % up to 50%.

VC0.5 for different tracks



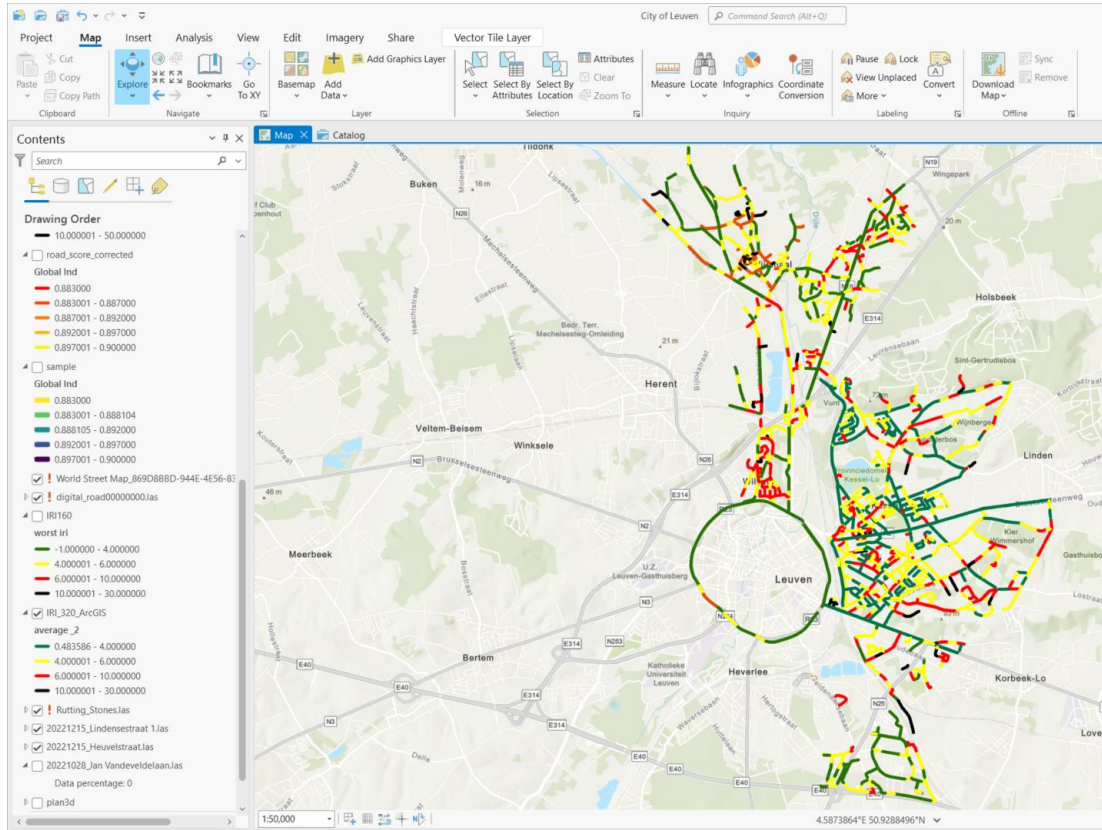
# 'Bad' bike lane - ECo.5 per 10m

Big differences up to 100%, mainly on the sides

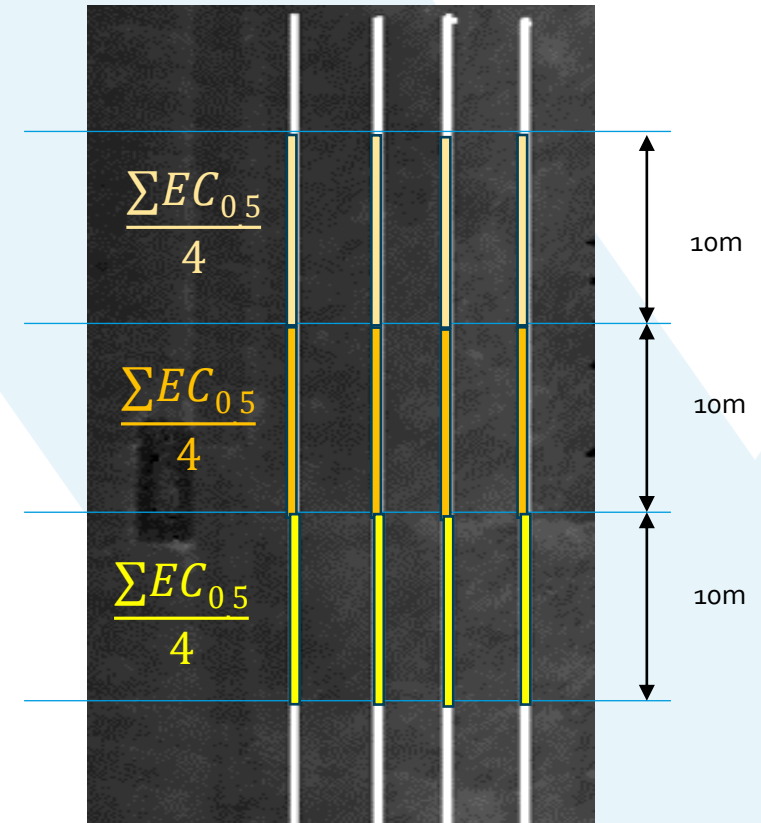




# Trustworthy assessment of Bike Lane quality



P<sub>1</sub> P<sub>2</sub> P<sub>3</sub> P<sub>4</sub>



*Maintenance planning requires a repeatable inspection method so values can be compared over time*

*ECo.5 quantification per section (of 10 meter length) based on multiple (4) tracks*

Pop-up

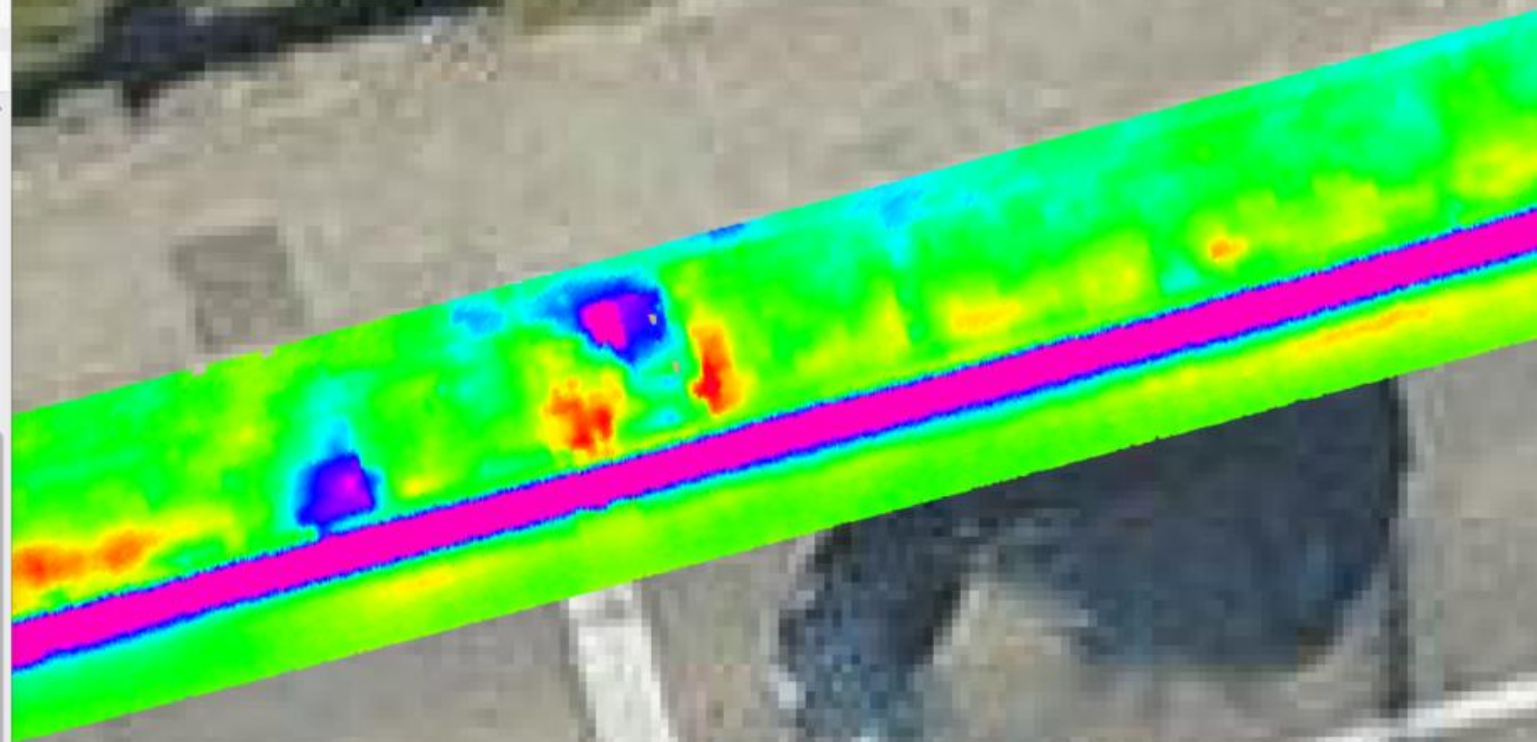
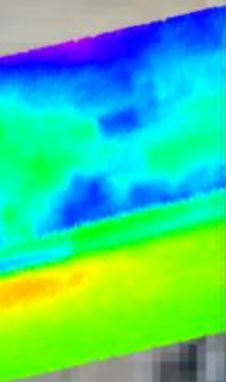


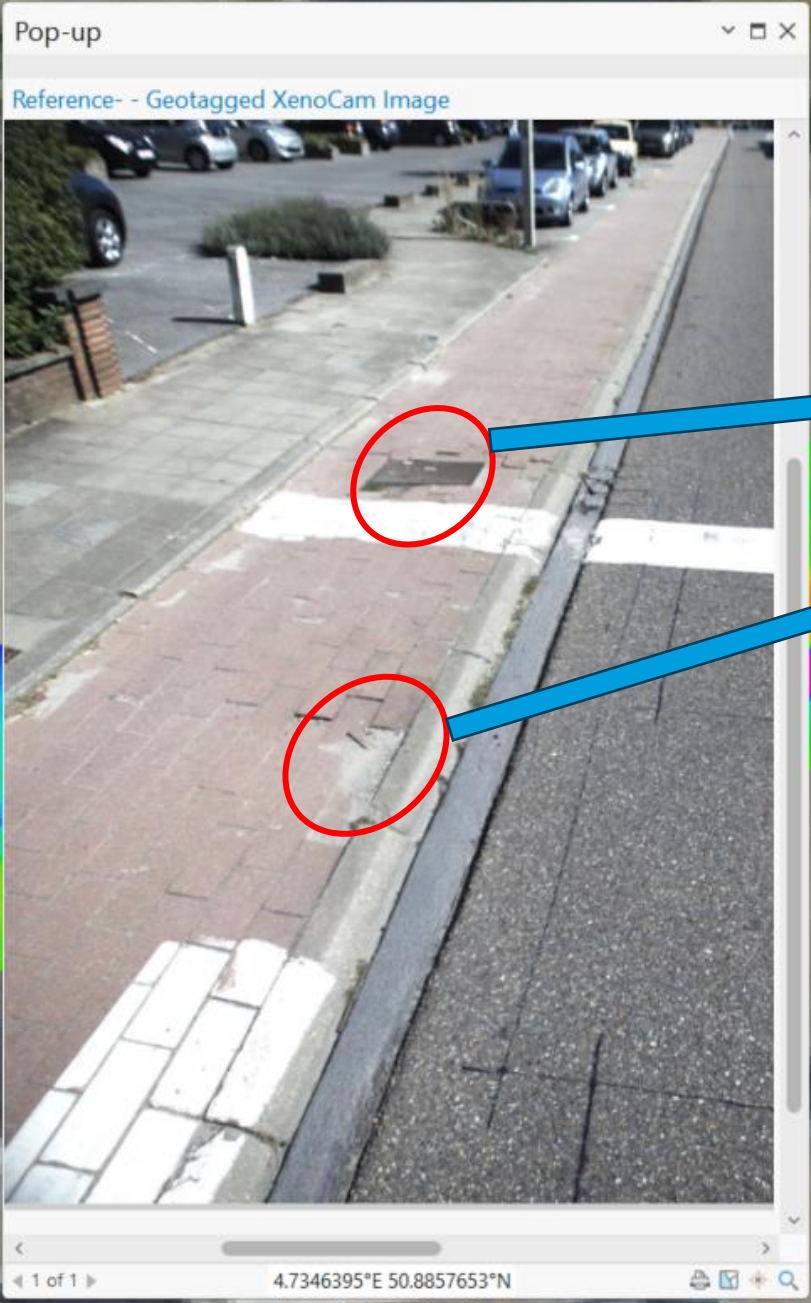
Reference- - Geotagged XenoCam Image



◀ 1 of 1 ▶

4.7346395°E 50.8857653°N





# 14 detail categories of local distresses

*Longitudinal crack*



*Transversal crack*



*Alligator crack*



*Block cracking*



*Damaged shoulder*



*Delamination*



*Pothole*



*Patch*



*Longitudinal Construction Joint*



*Transversal Construction Joint*



*Raveling*



*Polished Aggregate*



*Bleeding*



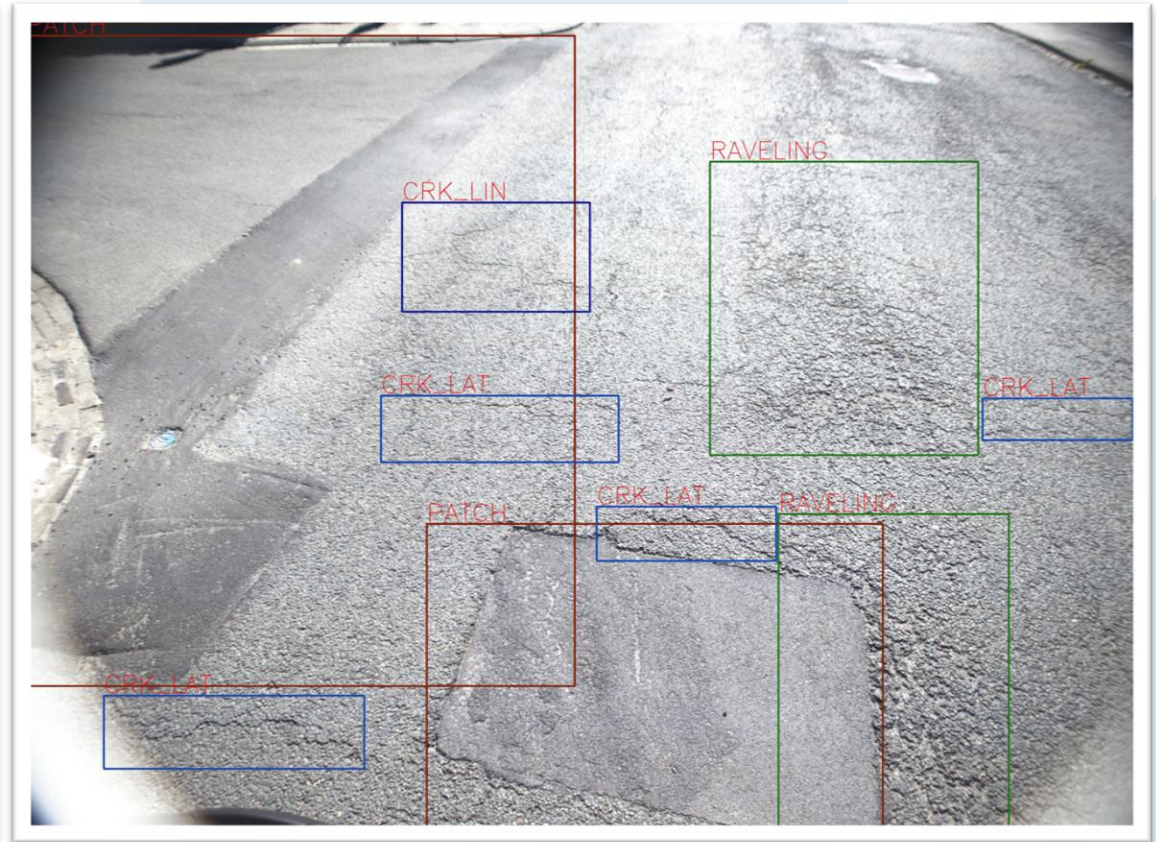
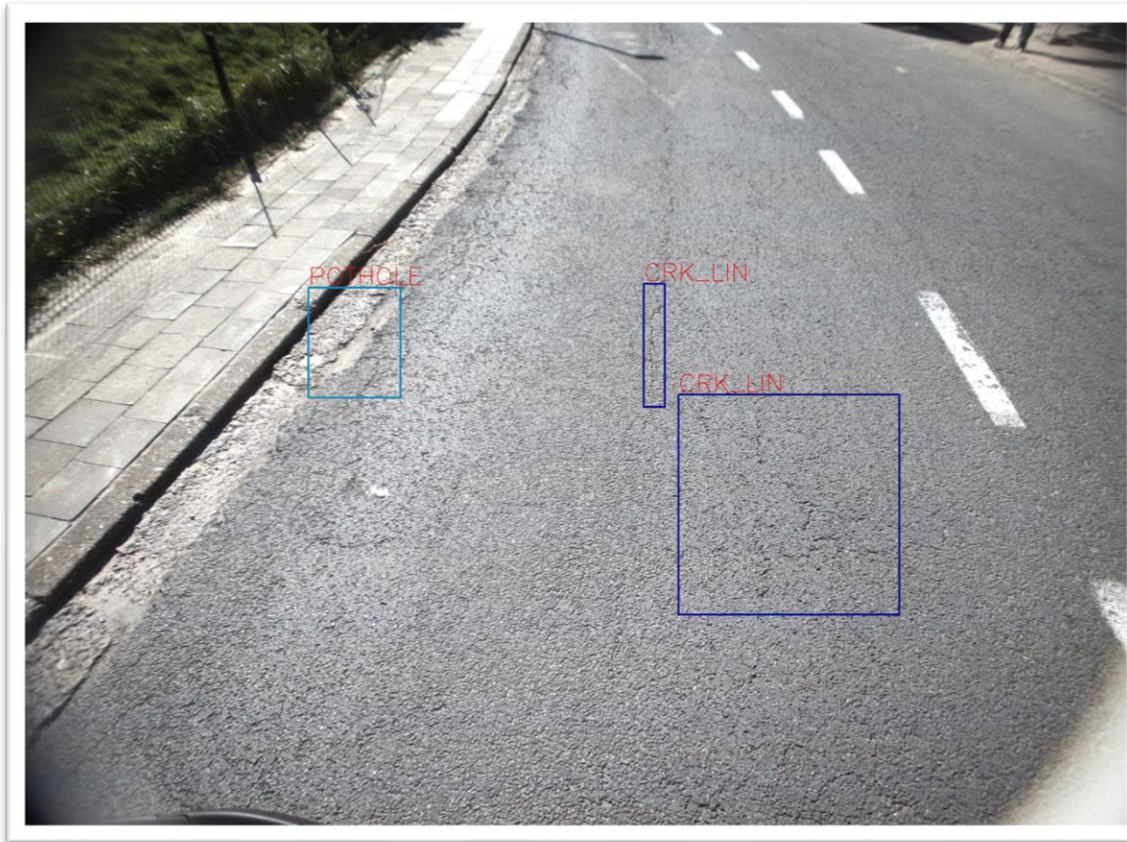
*Seepage*



# Detailed output from the 6D digital model



“Good viewing angle, resolution, exposure and focus of the images results in superior results”



# XenoBike output – Road characteristics

- x **3D height maps:** 3D surface and color-coded pavement model revealing detailed geometry
- x **Intensity maps:** orthoprojected, gray-scale road image, revealing pavement markings and variations in material
- x **2D color images:** High resolution color pictures for visual checking

Evaluation

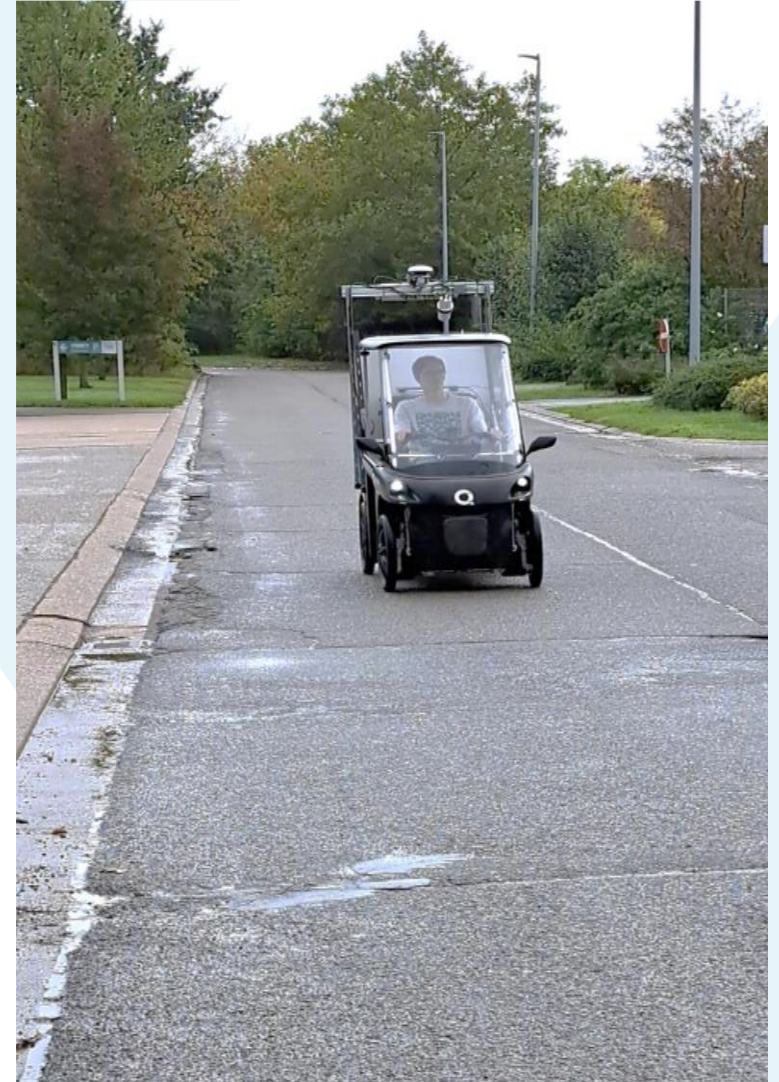
- x **ECo.5 and EC2.5:** Quantification of unevenness
- x **Bike lane width:** the usable width of the lane is critical for safety
- x **Bike lane banking:** the lateral slope is critical for safety
- x **Bike lane slope:** the longitudinal slope is important for attractiveness

Safety

- x **Crack detection:** location, quantity and severity of cracks
- x **Pothole detection:** localization and sizing of potholes
- x **Obstacle detection:** bumps, element elevation, ...

Maintenance

# XenoBike



# XenoBike

1. XenoTrack (4D)  
for lane-wide digitization

2. XenoCam (2D)  
for 12Mpixel images

6. Warning labels  
for safety & visibility

7. Storage space  
for safe storage of  
computing equipment



3. GPS (RTK)  
for precise geo-  
referencing

4. Tablet  
for driver UI

5. Wheelencoder  
for precise distance and  
speed measurement



# Xenomatix

Riding the Path to Safety



# Why XenoBike

- × Zero-emission vehicle
- × Allowed on **all bike lanes** without special permission
- × No driver license required (**anyone** can drive)
- × 4 suspended wheels for **stable** measurements
- × Swappable batteries for long **autonomy**
- × Narrow vehicle (86cm) for **easy access**



## Vehicle specifications

Maximum speed	25 km/h
Range (no batt.swap)	~70 km
Weight	150 kg
Width	86 cm
Drive Train	Chainless
Carrying Capacity	200 kg
Vehicle dim. (LxWxH)	215/86/195 cm

# Credentials XenomatiX bike lane solution

- × XenoBike already digitized thousands of kilometers for local governments



- × Comparison tests confirmed correctness of XenoBike results



- × Based on proven product (XenoTrack) globally used for road inspection



- × Highly automated solution, resulting in superior productivity and traceable results

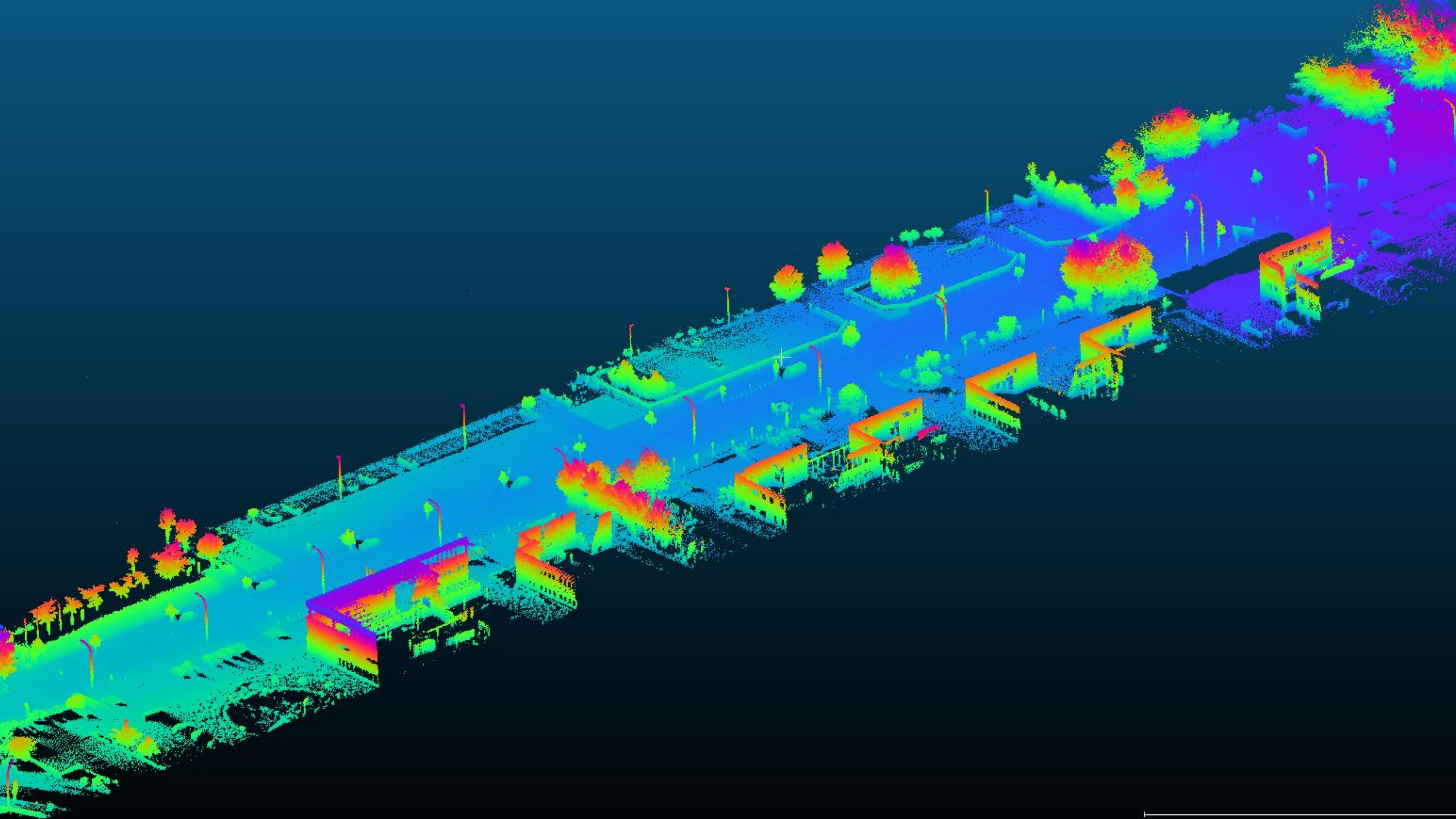
- × Any NEW bike lane index can be extracted

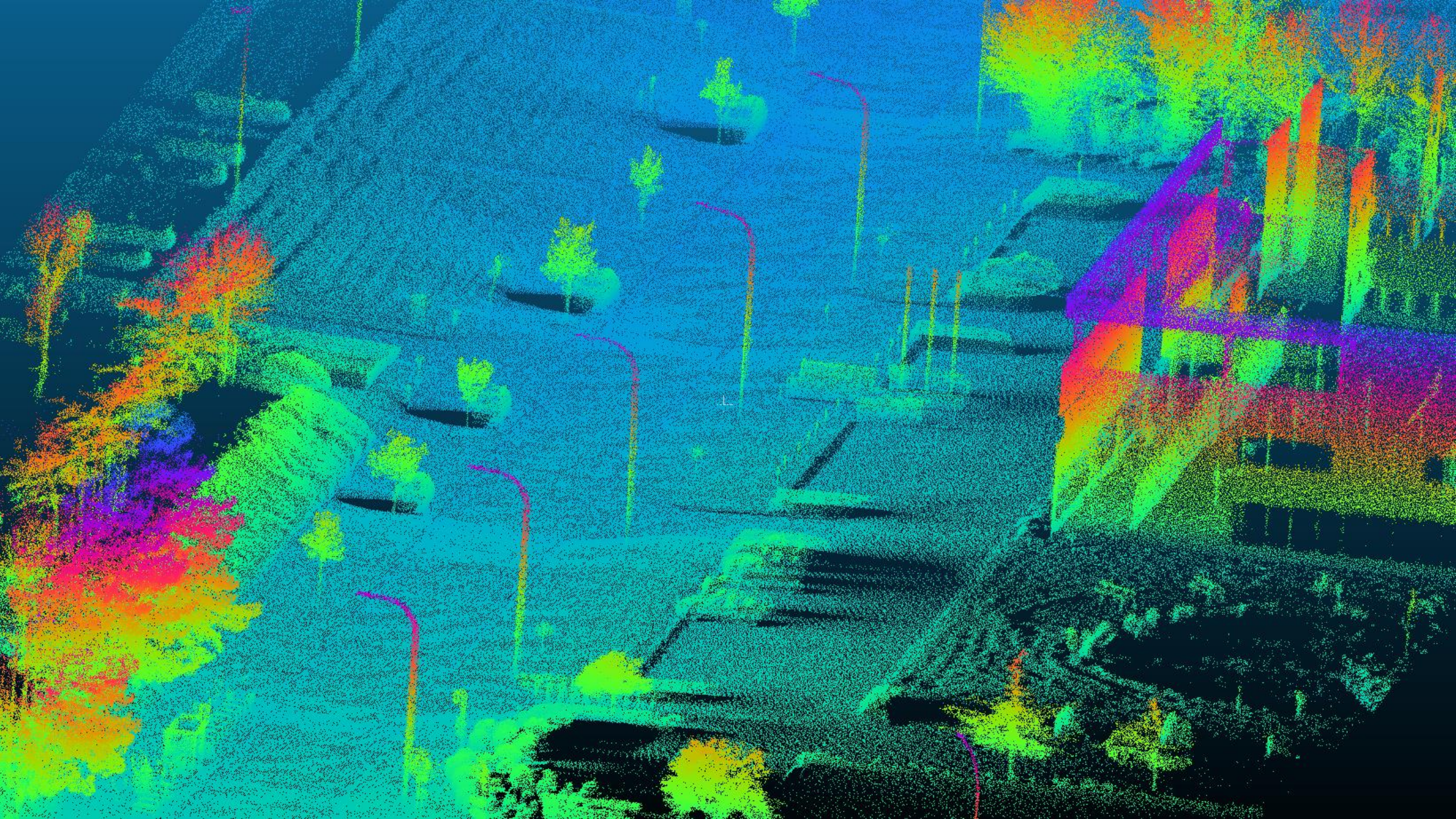


**XenomatiX**  
True solid state lidar

# a. Inspection of Bike Lanes with XenoBike







# Time for Q & A

**XenomatiX**

Single Lane, Dual Lane and XenoBike  
*Bringing Productivity through Innovative Technology*

# XenoBike - Advantages

- × Same **productivity** as a vehicle in slower speed areas – 140km/day
- × **No driver-license** required
- × **Speed independent, including start-and-stop, ego-motion accurately corrected**
- × **Green & safe & easy** (power-by-wire) & attraction
- × **Multi-Purpose** = road – bike – pedestrian 'lanes'- warehouse - parking lot- harbour quay ...
- × No need for a car – **fixed vehicle for fast use** – pricing includes bike
  
- × **Top survey in accuracy and georeferencing** – level of MFV
- × **Full 3D geometry + lane markings + 2D photo's**
- × **All 6D data and indices with very precise localization**
- × **Any lane or road – any width – any pavement type – day & night**
- × Results are **speed-independent, including start & stop (!)**
- × **Automatic and fast processing** – on-board
- × Any (**international**) **quality standard** can be offered or programmed autonomously
- × Fully compatible with **your GIS or platform**

