



Complex and Dynamic Civil Structure InSAR Monitoring: A Botlek Bridge Case-Study

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Road network

3000 km highways
2886 viaducts
47 ecoducts
25 tunnels
780 bridges



Waterways

3500 km channels &
rivers
93 sluices

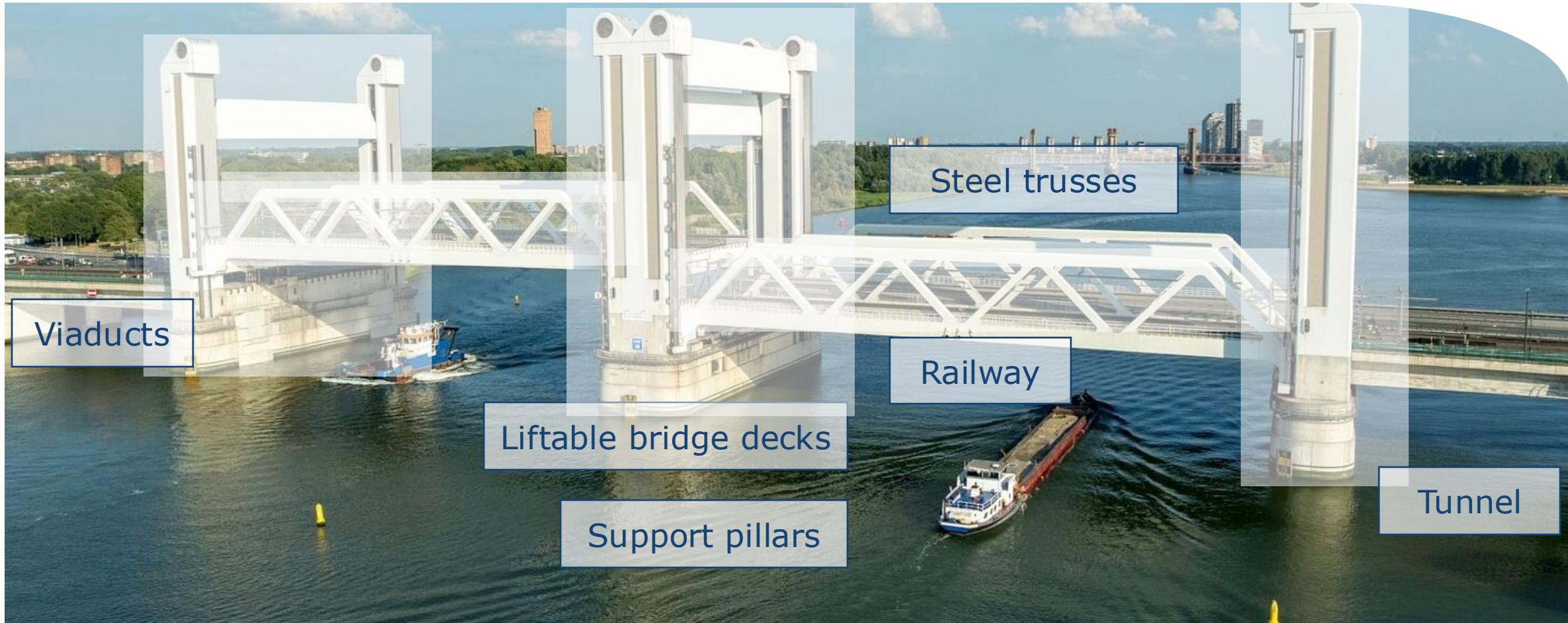


Waterbodies

90.000 km² water
45 km dunes
150 km embankments
6 storm flood barriers

Case Study

Botlek Bridge, Rotterdam





Collaboration

Special thanks to Tom Ingleby, Karsten Spaans and Matthew Bray (**SatSense**) for their involvement in this project



Rijkswaterstaat
Ministry of Infrastructure
and Water Management



satsense

Methodology

From Radar Images to Deformation Timeseries

SAR input

- TerraSAR-X stripmap [3x3m]
- Two tracks
 - Ascending (22 day revisit)
 - Descending (11 day revisit)
- Jan. 2022 – Jul. 2025

Additional input

- Bridge opening times
- High-resolution DEM [0.5m]

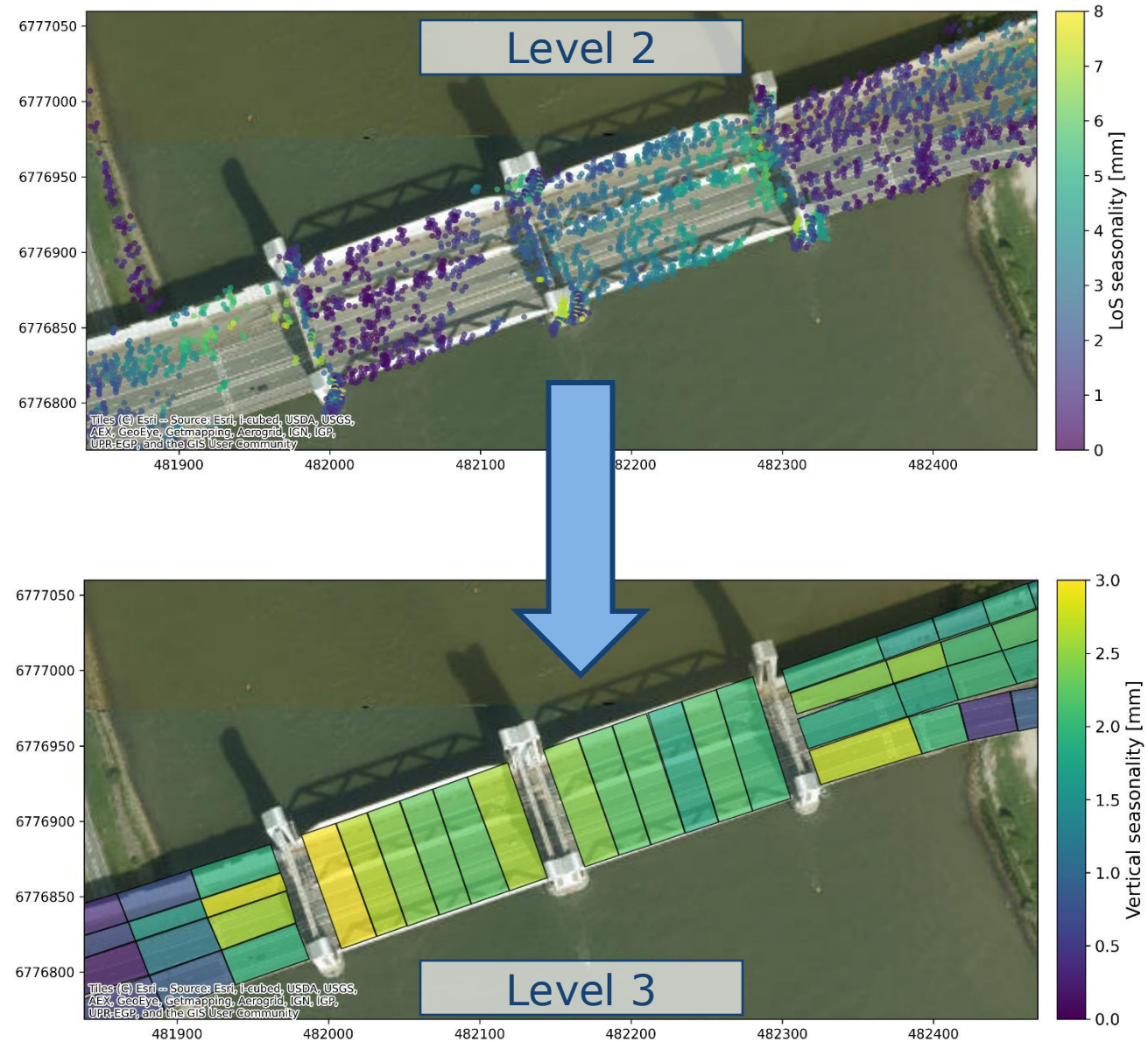
Products

- Level-2 (LoS) timeseries
- Level-3 (decomposed) timeseries

Methodology

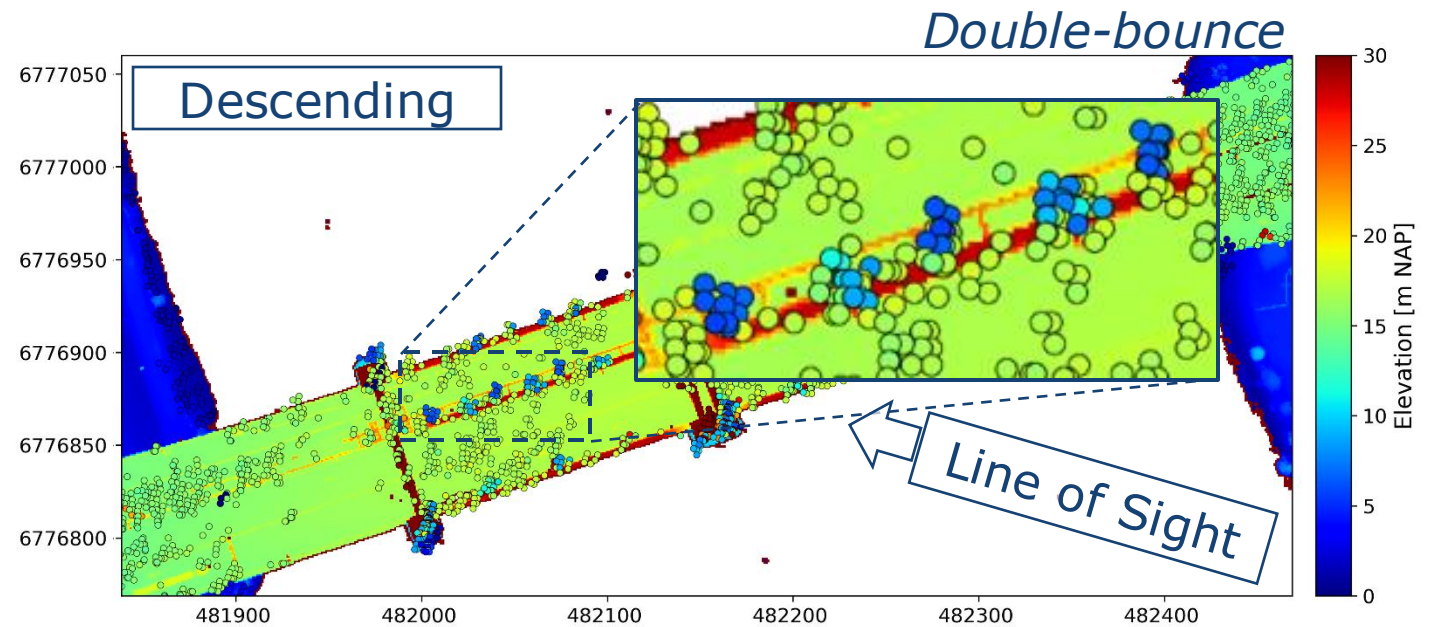
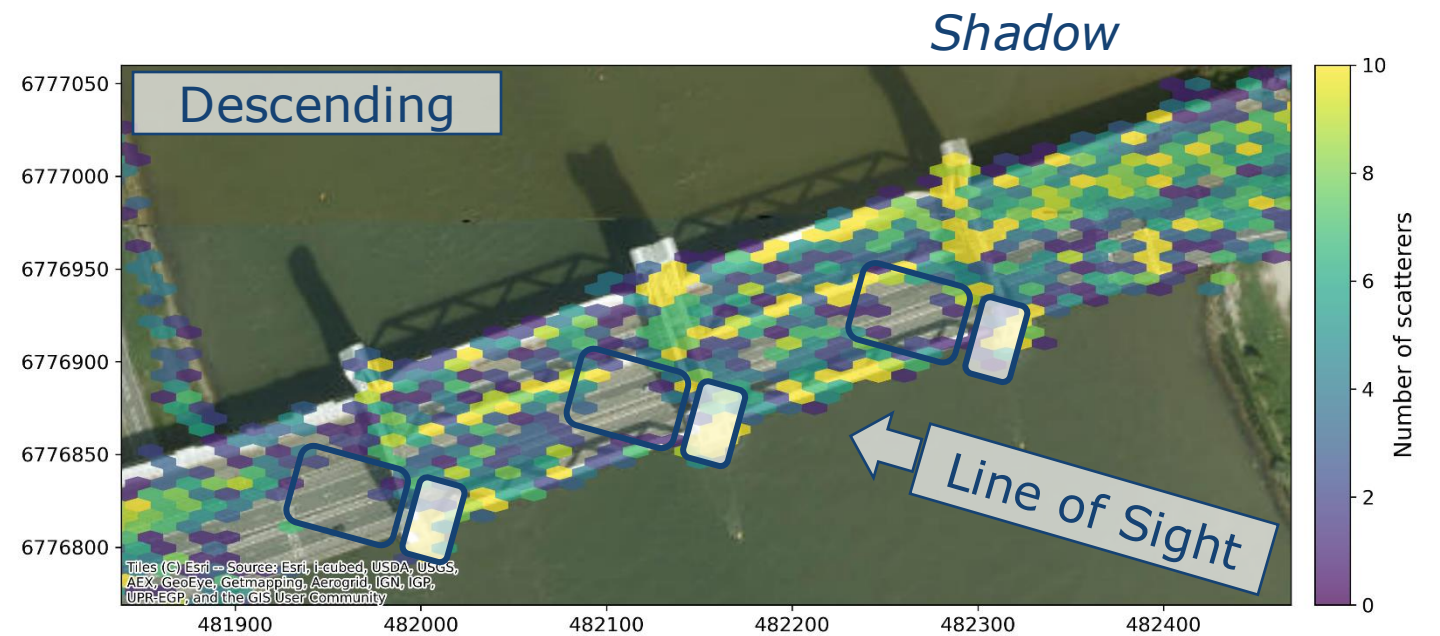
From LoS to Decomposed Deformation

- Aggregate point data within polygons following structural boundaries
- Vector decomposition under a no-deformation assumption



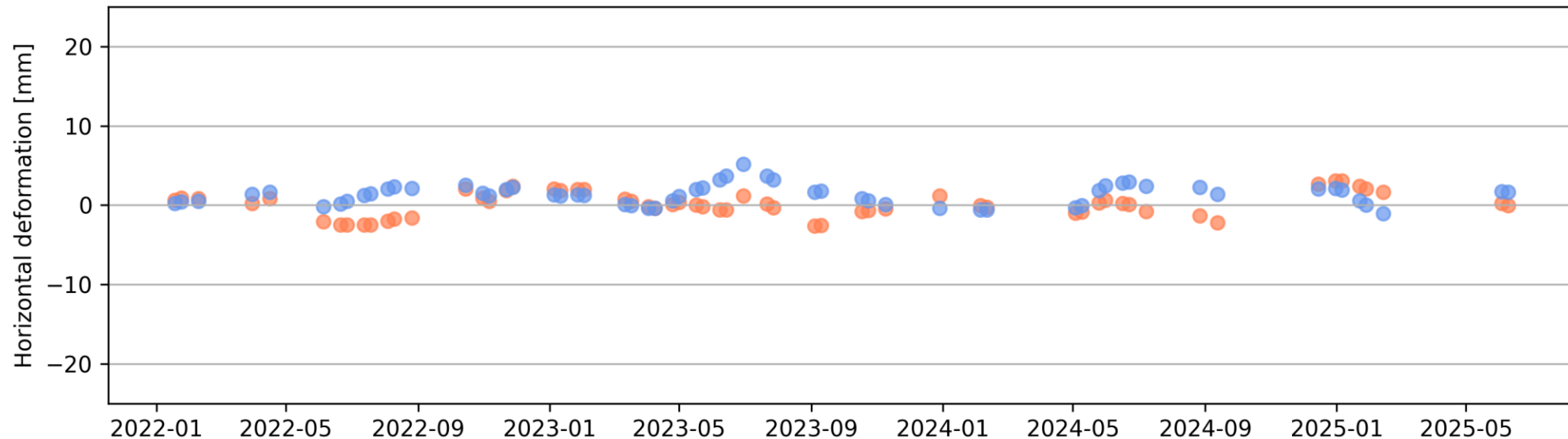
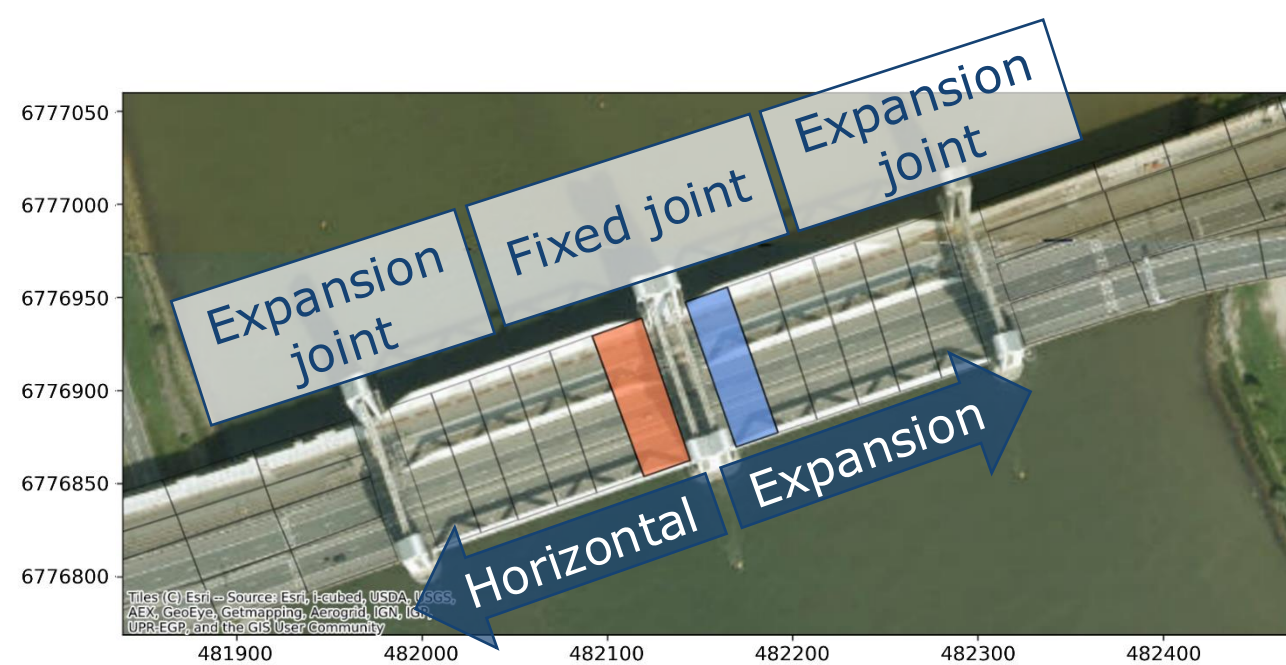
Geometric Radar Artefacts

Viewing and structure geometries influence data: coverage and consistency may not be uniform across a project area



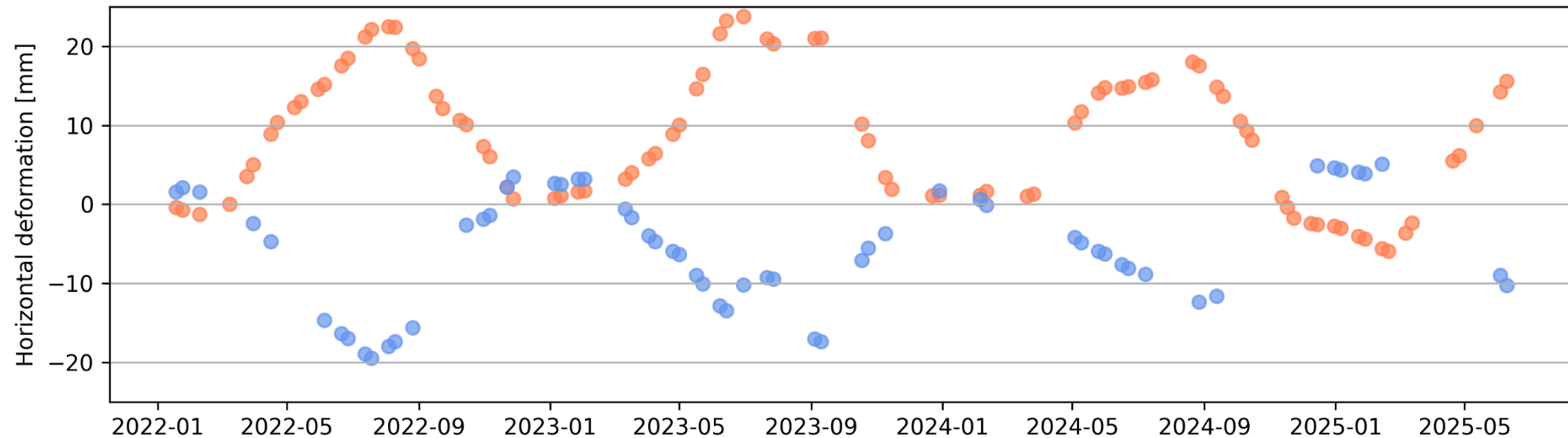
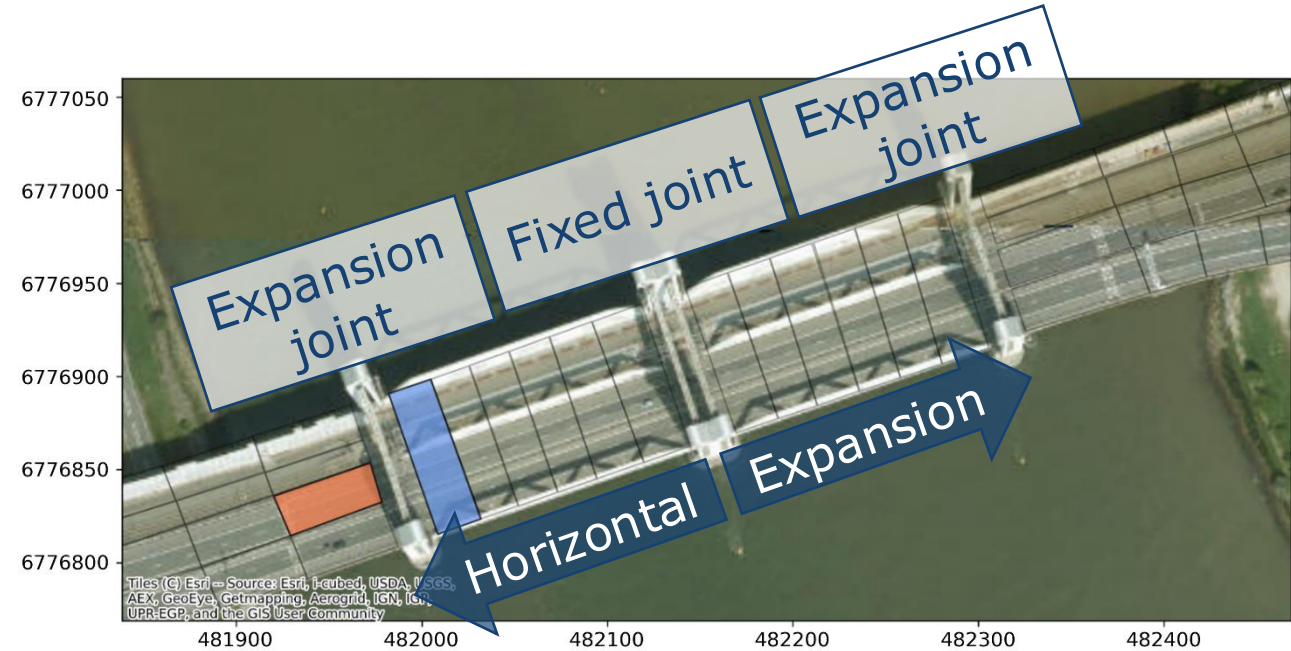
Structural Boundary Motion

Structural boundaries have effect on the observed deformation: motion remains relatively uniform across fixed joints



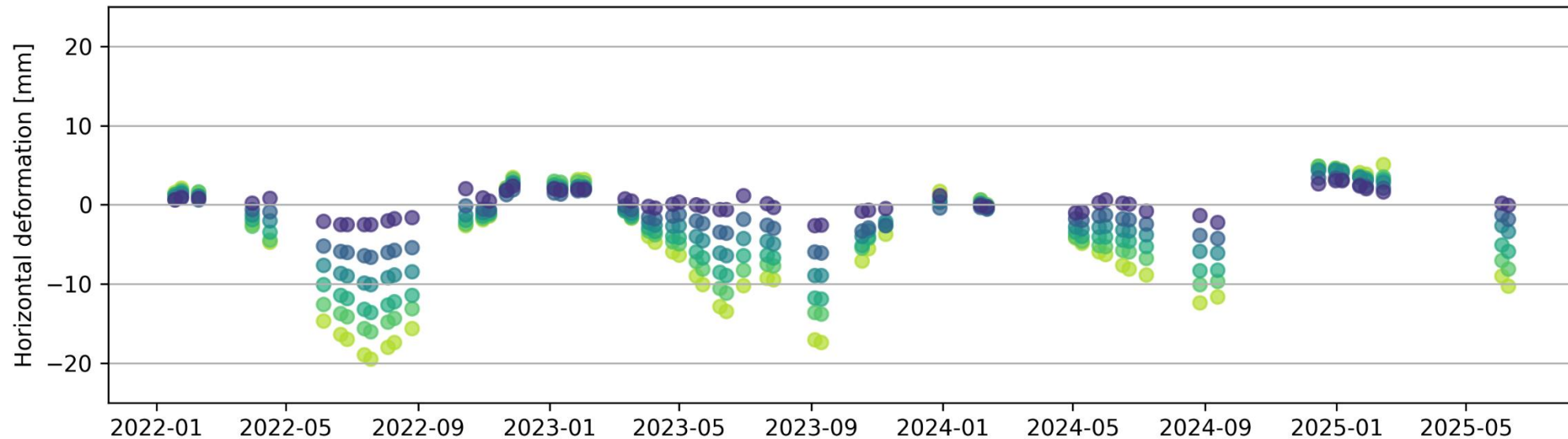
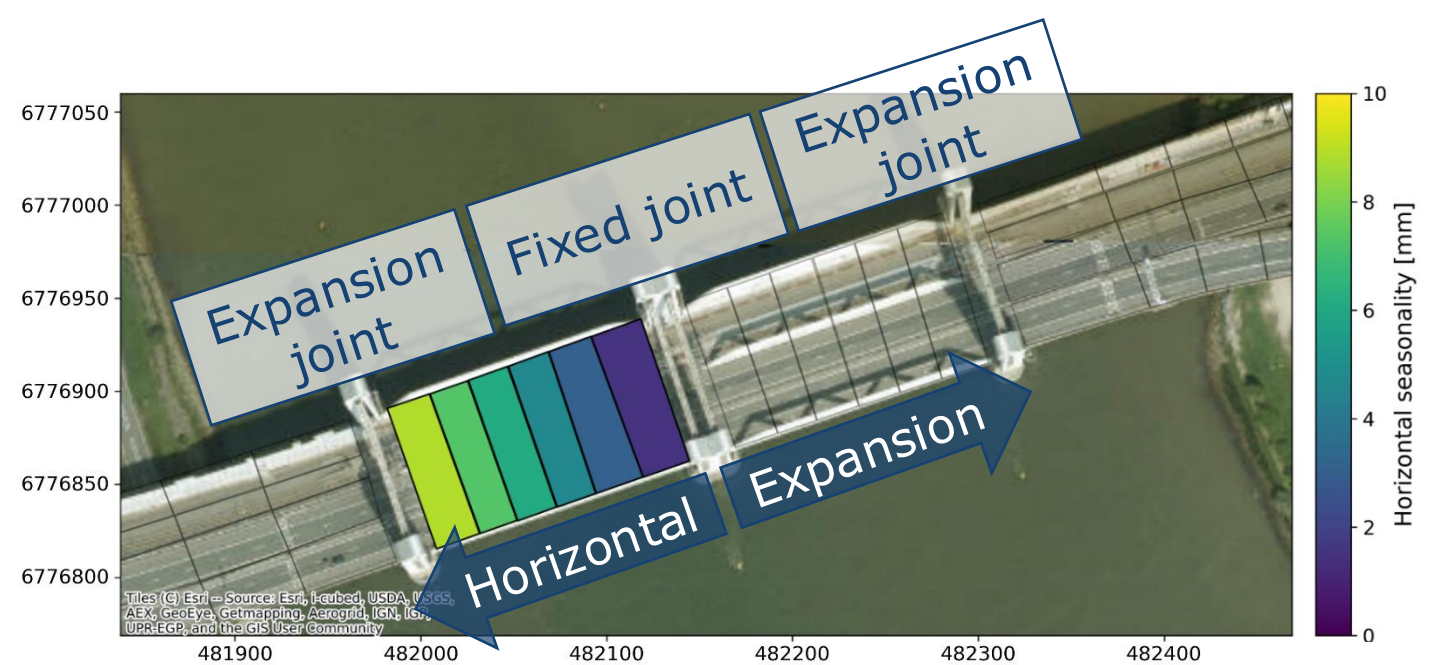
Structural Boundary Motion

Structural boundaries have effect on the observed deformation: large and opposed horizontal movement occurs around expansion joints



Internal Expansion

Internal expansion of structural elements becomes visible after sub-segmentation: element delineation influences what signals are preserved



Lessons learned

- **Big success: successfully mapped (large) deformation in a complex and dynamic setting**
- Segmentation must accommodate structural characteristics to retrieve meaningful deformation information
- Effects of artefacts such as shadow and layover can be estimated prior to any processing
- Alongside horizontal and vertical deformation, internal expansion can be a deliverable



Next steps

- Develop methodologies to assess InSAR-suitability **prior** to any processing
- Integrate InSAR to support ongoing monitoring of Rijkswaterstaat's assets as a 'scanning' tool
- Establish object-type-specific processing guidelines



Thank you

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