



# Innovative Kombination von BIM und SAR zur Überwachung städtischer Bodenbewegungen – Auf dem Weg zum digitalen Zwilling



Gefördert durch:

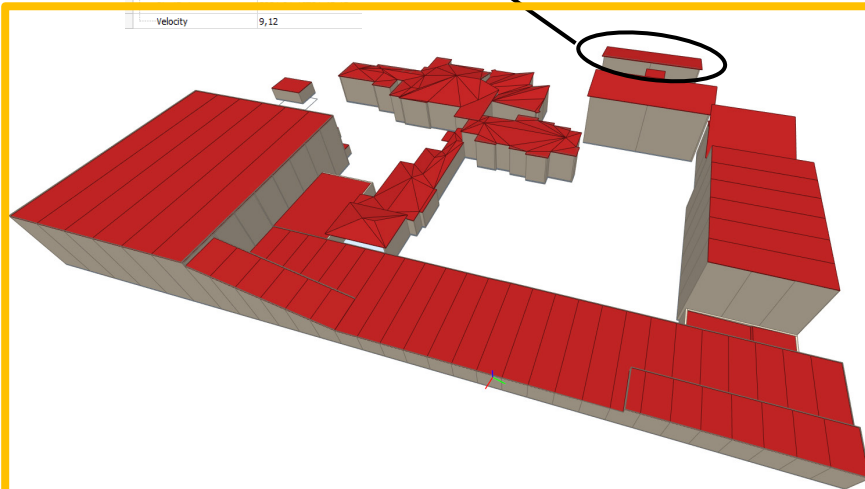
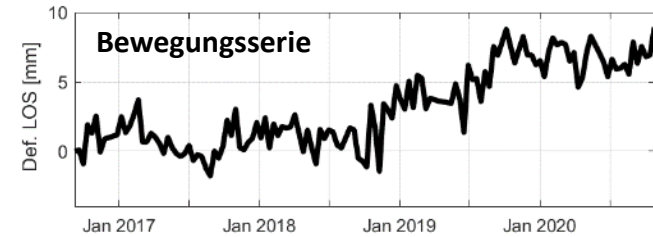


aufgrund eines Beschlusses  
des Deutschen Bundestages

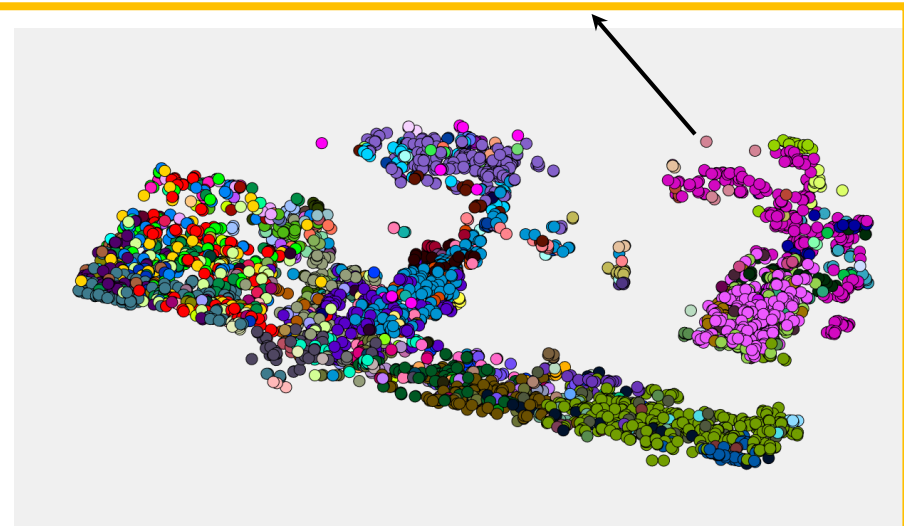


# Ziel: BIM + SAR für interaktives und intuitives Gebäude-Monitoring

Pset_insar	
AquisitionMode	Stripmap
d2021-01-16	0
d2021-01-27	2,1
d2021-02-07	3,9
d2021-02-18	3,3
d2021-03-01	4,02
d2021-03-12	5,03
d2021-03-23	4,7
d2021-04-02	3,6
d2021-04-13	2,3
d2021-04-24	1,2
EndDate	2021-01-16T21:45:15
MeasuresExist	Ja
Number of Measures	42
Satellite	TerraSAR-X
Velocity	9,12



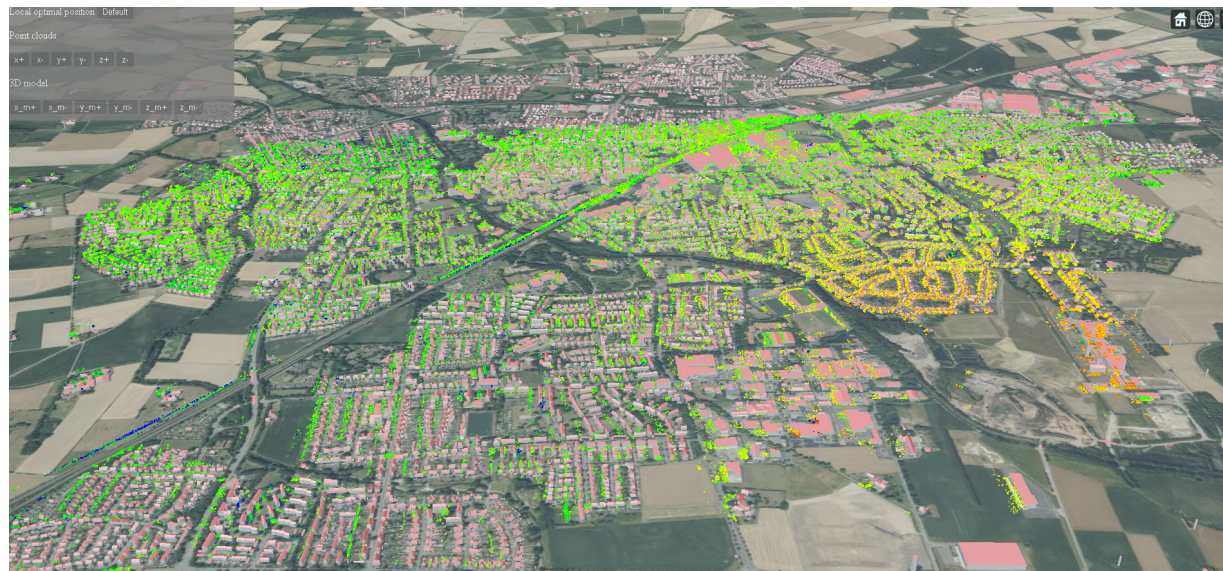
**BIM-Modell**



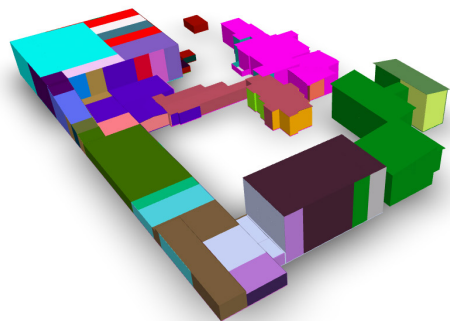
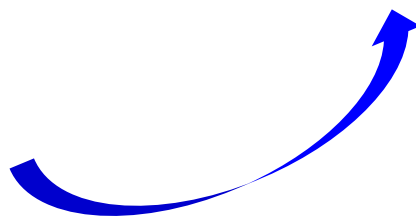
**SAR-abgeleitete PS-Punkte**



# GIS-Plattform zur Bewegungsüberwachung auf Stadtebene



Ahlen, NRW



- Select All
- ClusterID0
  - ClusterID1
  - ClusterID3
  - ClusterID5
  - ClusterID6
  - ClusterID7
  - ClusterID8
  - ClusterID9
  - ClusterID10
  - ClusterID17
  - ClusterID25
  - ClusterID29
  - ClusterID31
  - ClusterID32
  - ClusterID34
  - ClusterID36
  - ClusterID38
  - ClusterID39

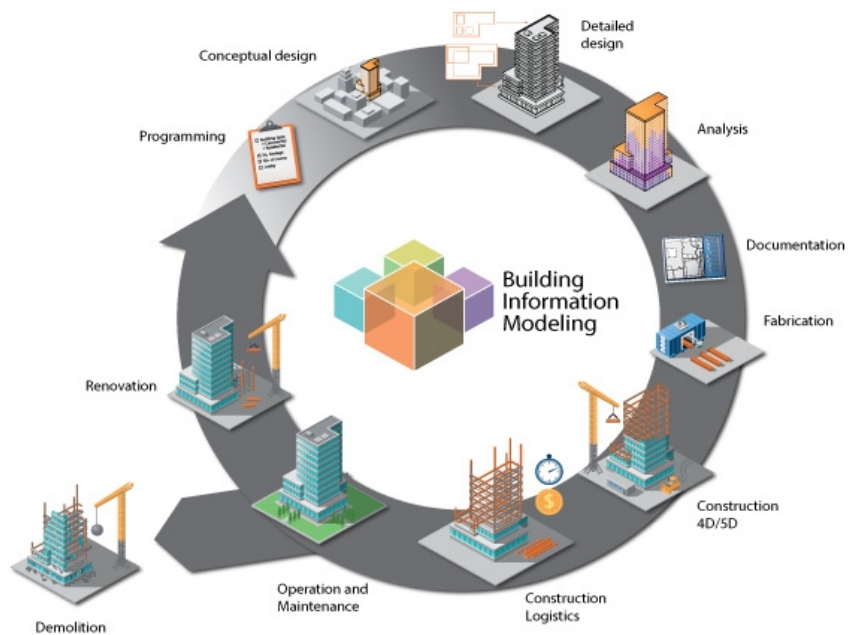


# Inhalt

- **BIM-Modell**
- **SAR-Produkt**
- **Fusion: BIM + SAR**
- **Demo-Plattform**
- **Monitoring in Ahlen**



# BIM : Building Information Modeling



<https://bimmda.com/en/what-is-bim>

## 2D data exchange

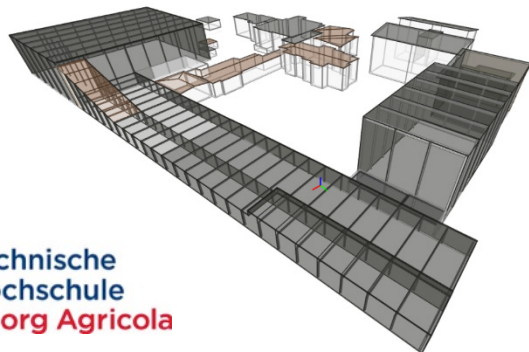


## BIM interoperability

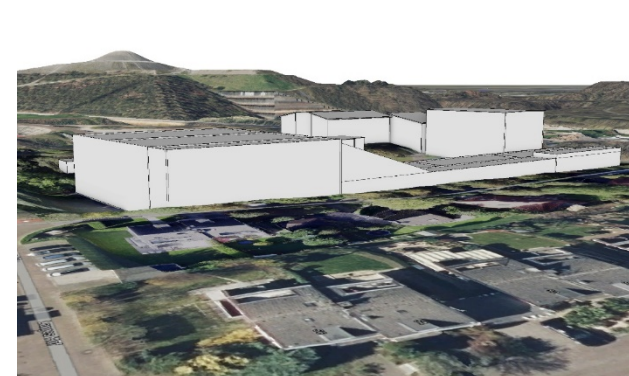
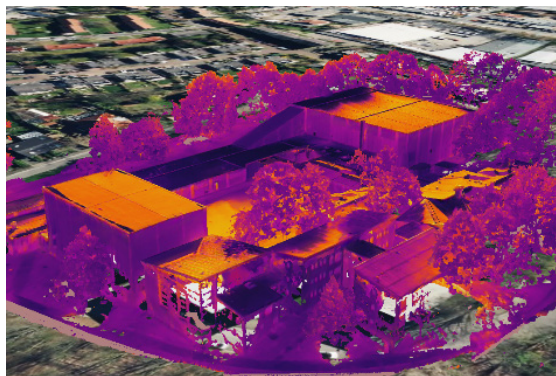
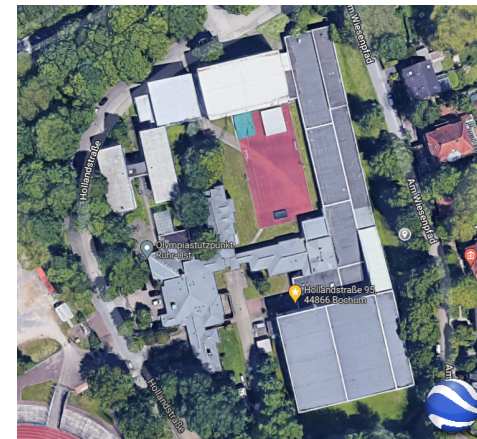
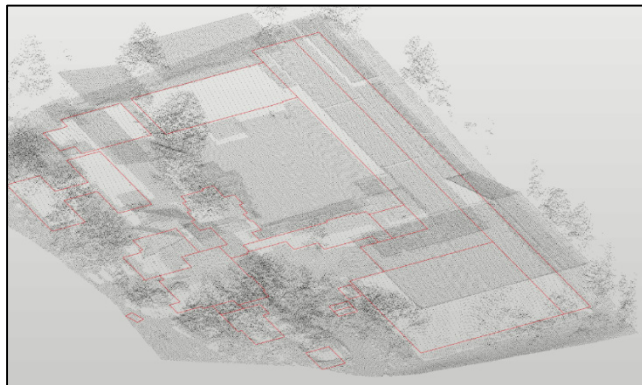


<https://bloggershrutidoshi.wordpress.com/2020/06/10/building-information-modeling-in-construction-industry/>

# Ein BIM von Grund auf neu erstellen - Olympiastützpunkt Westfalen/Bochum

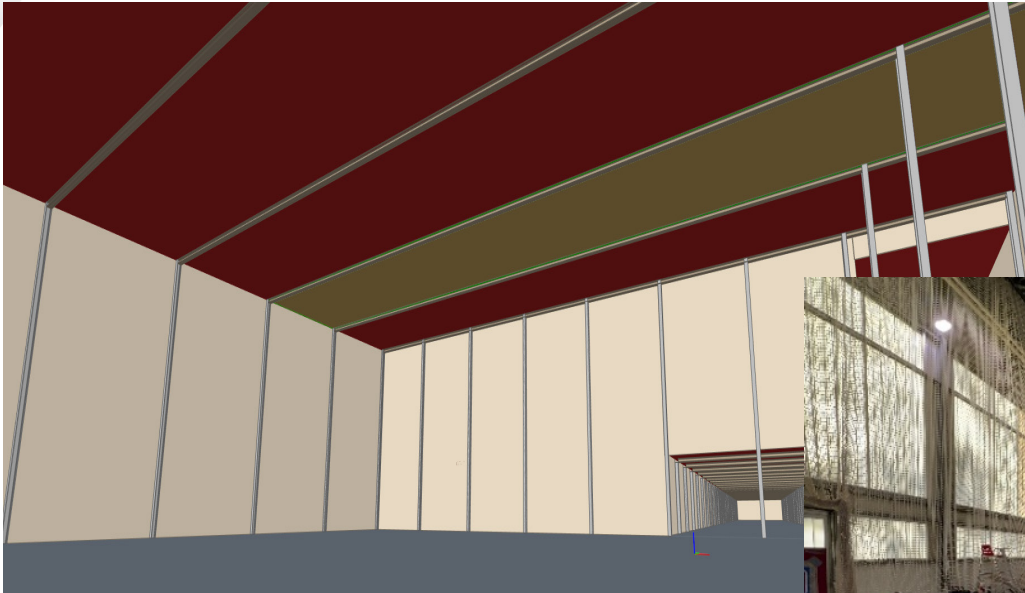


Technische  
Hochschule  
Georg Agricola



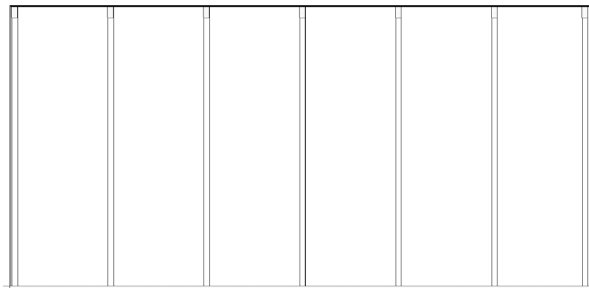
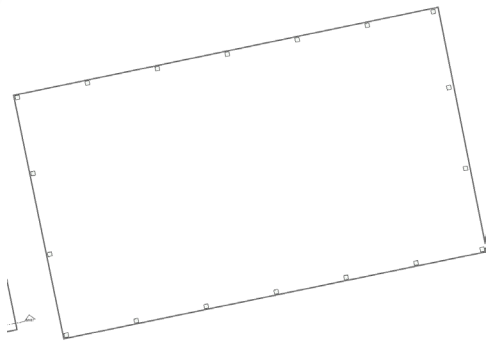


# Inspektion und Untersuchung vor Ort





# Konstruktion mit Autodesk Revit und City2BIM



Georeferencing

Postal Address

Address lines:

Postal Code:  Town:

Region:  Country:

Geographic site coordinates

Latitude [°]:   Deg  DMS

Longitude [°]:  True North [°]:

Projected coordinates

Eastings [m]:  Northings [m]:

Scale:  Grid North [°]:

EPSG-Code (CRS):

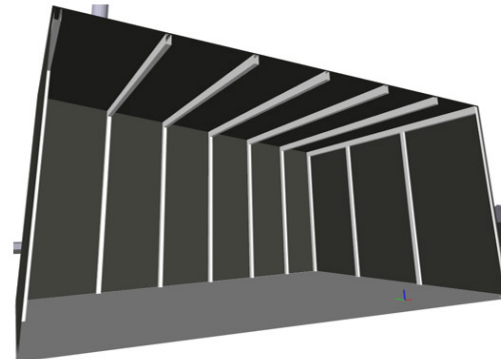
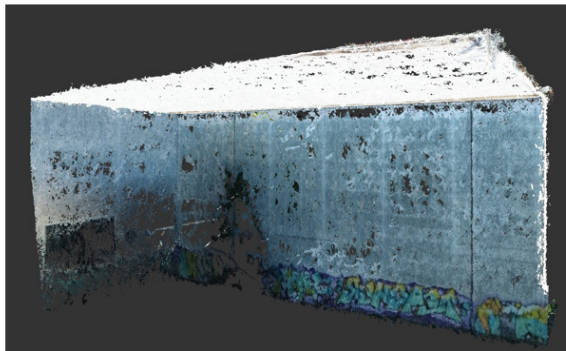
Elevation

Orthometric Height [m]:  Vertical Datum:

UTM transformation

Site (Lat/Lon) to Projection (UTM)

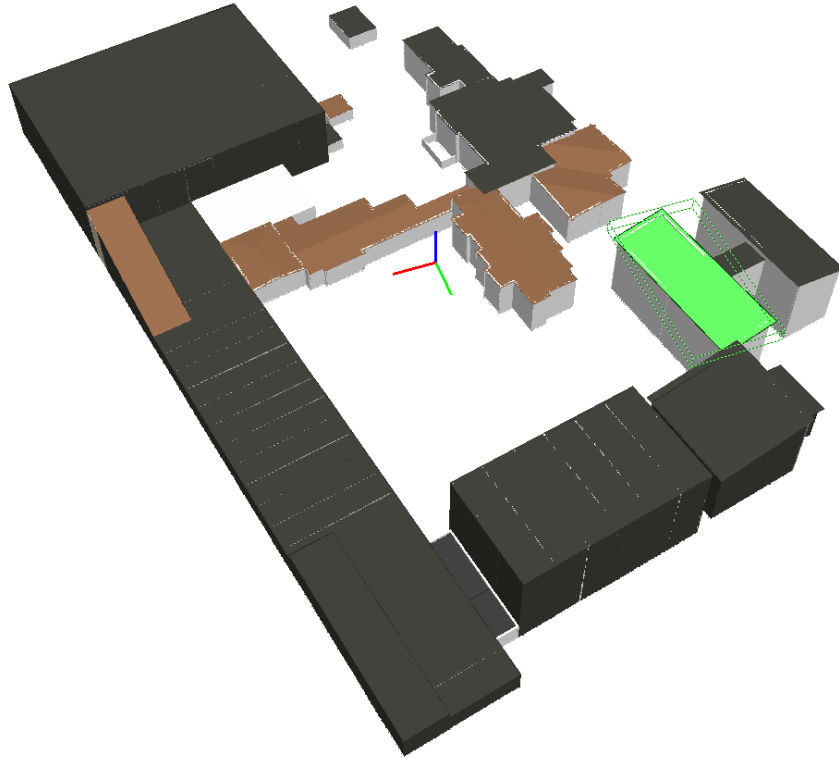
Projection (UTM) to Site (Lat/Lon)







# BIM Olympiastützpunkt Ruhr-Ost



Industry Foundation Classes (IFC) Format  
International Standard ISO 16739-1:2018

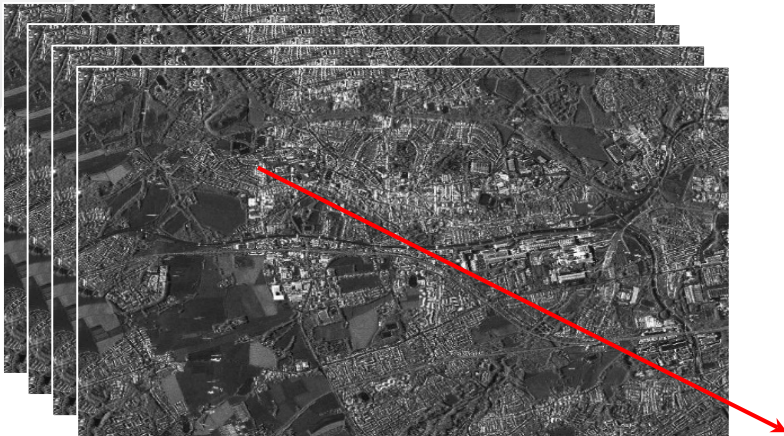


# Inhalt

- BIM-Modell
- **SAR-Produkt**
- Fusion: BIM + SAR
- Demo-Plattform
- Monitoring in Ahlen



# TerraSAR-X-Bilder

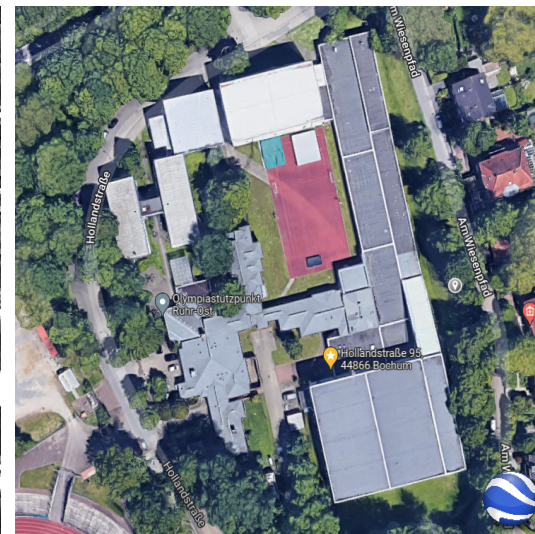
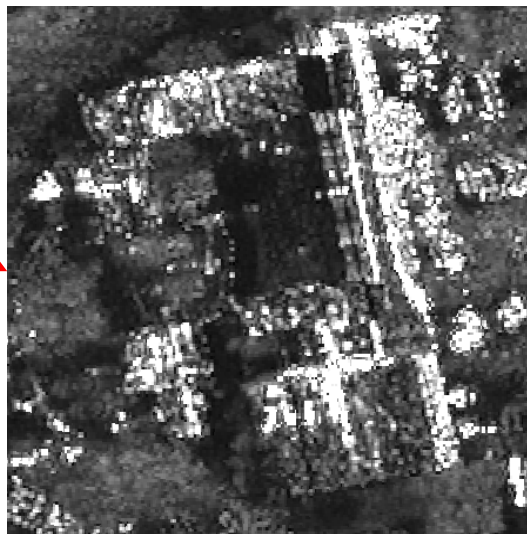


28 Bilder

Zeitraum: Januar 2018 – Oktober 2019

HR SpotLight 300 MHz

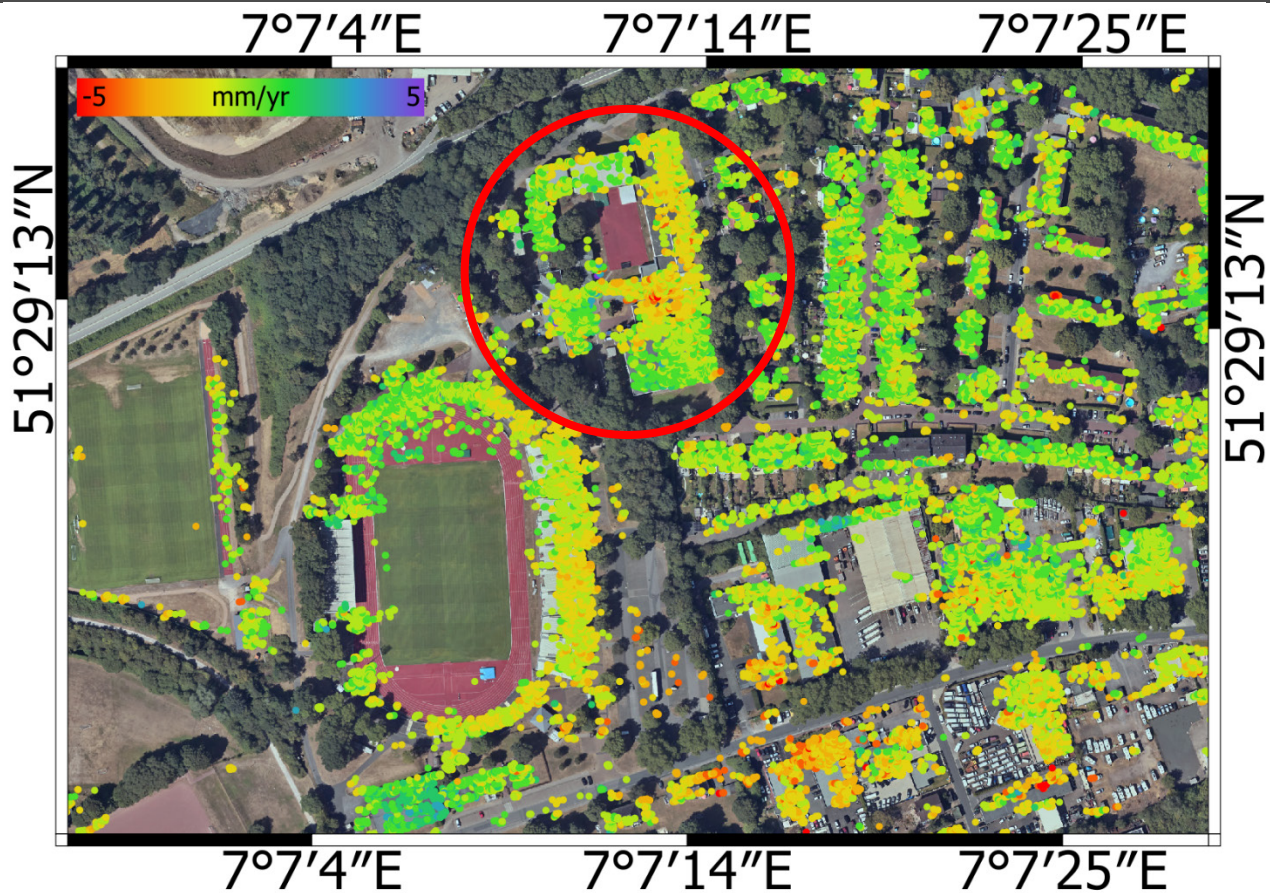
HH-Polarization



(DLR-Project MTH3793)



## PSI-Karte



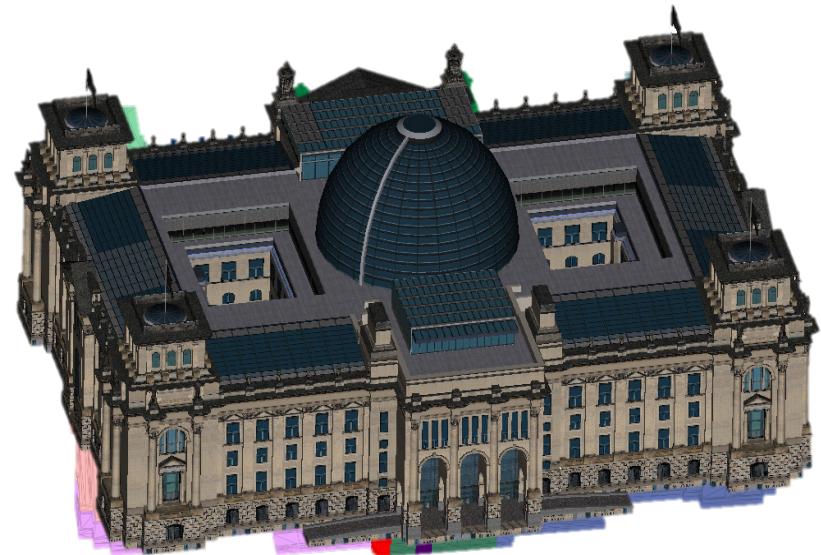
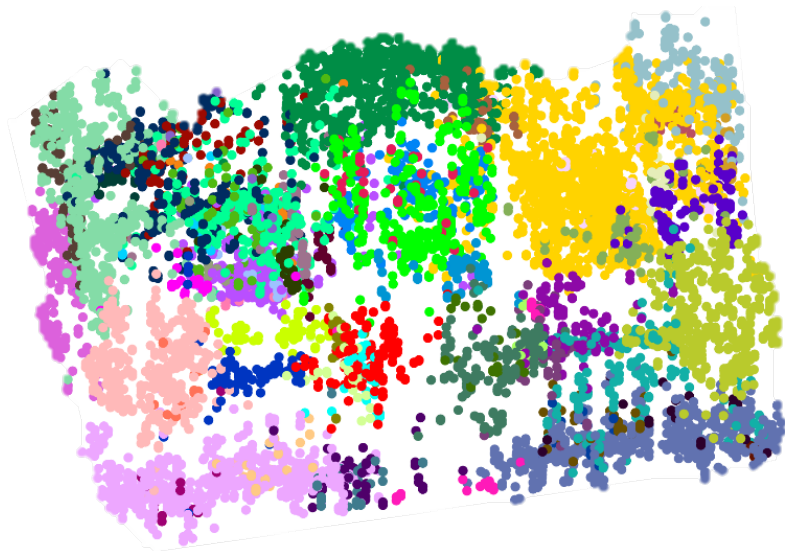


# Inhalt

- BIM-Modell
- SAR-Produkt
- **Fusion: BIM + SAR**
- Demo-Plattform
- Monitoring in Ahlen



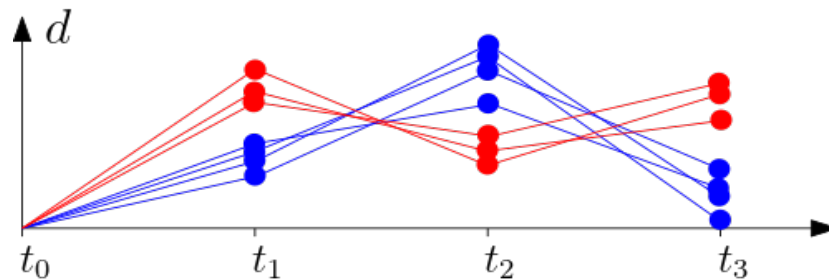
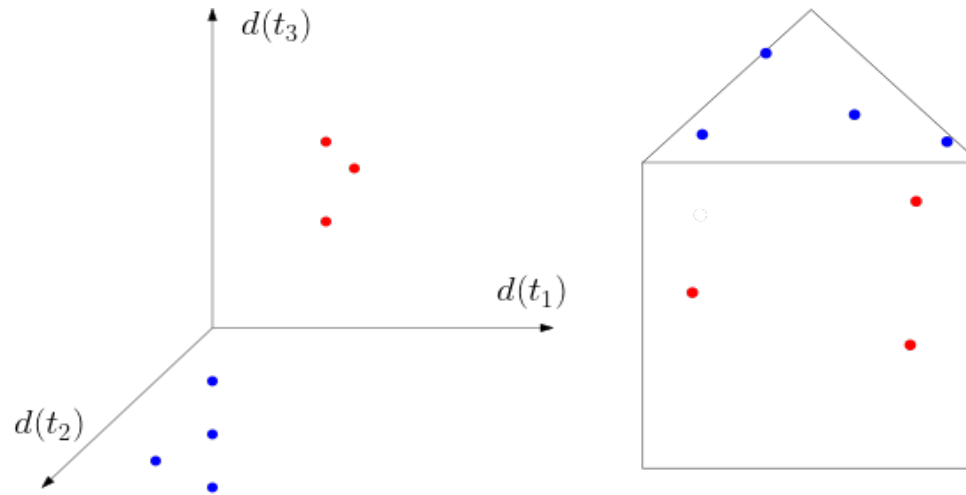
# Zuordnung von PS-Punkten zu Teilstrukturen



Schneider, P. J. & Soergel, U. [2021] Clustering Persistent Scatterer Points Based on a Hybrid Distance Metric. In: Pattern Recognition. DAGM GCPR 2021. Lecture Notes in Computer Science, vol 13024. Springer.

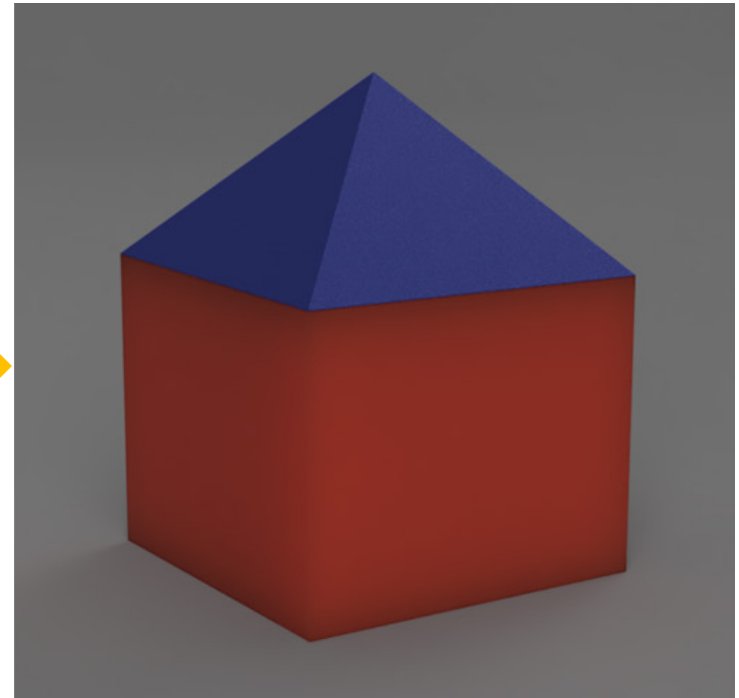
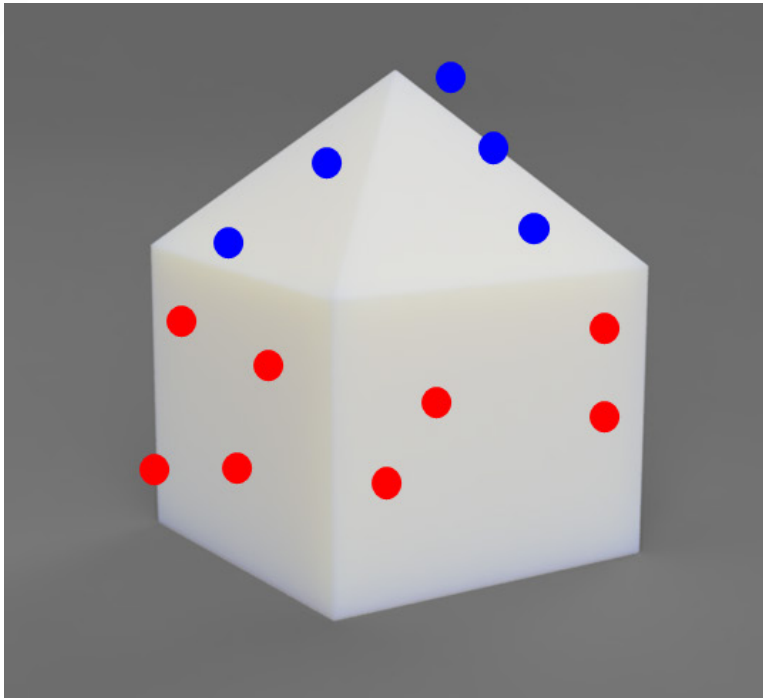


# Clustering von PS-Punkten



Schneider, P. J. & Soergel, U. [2021] Clustering Persistent Scatterer Points Based on a Hybrid Distance Metric. In: Pattern Recognition. DAGM GCPR 2021. Lecture Notes in Computer Science, vol 13024. Springer.

# Fusion von PS-Gruppen und BIM-Modell

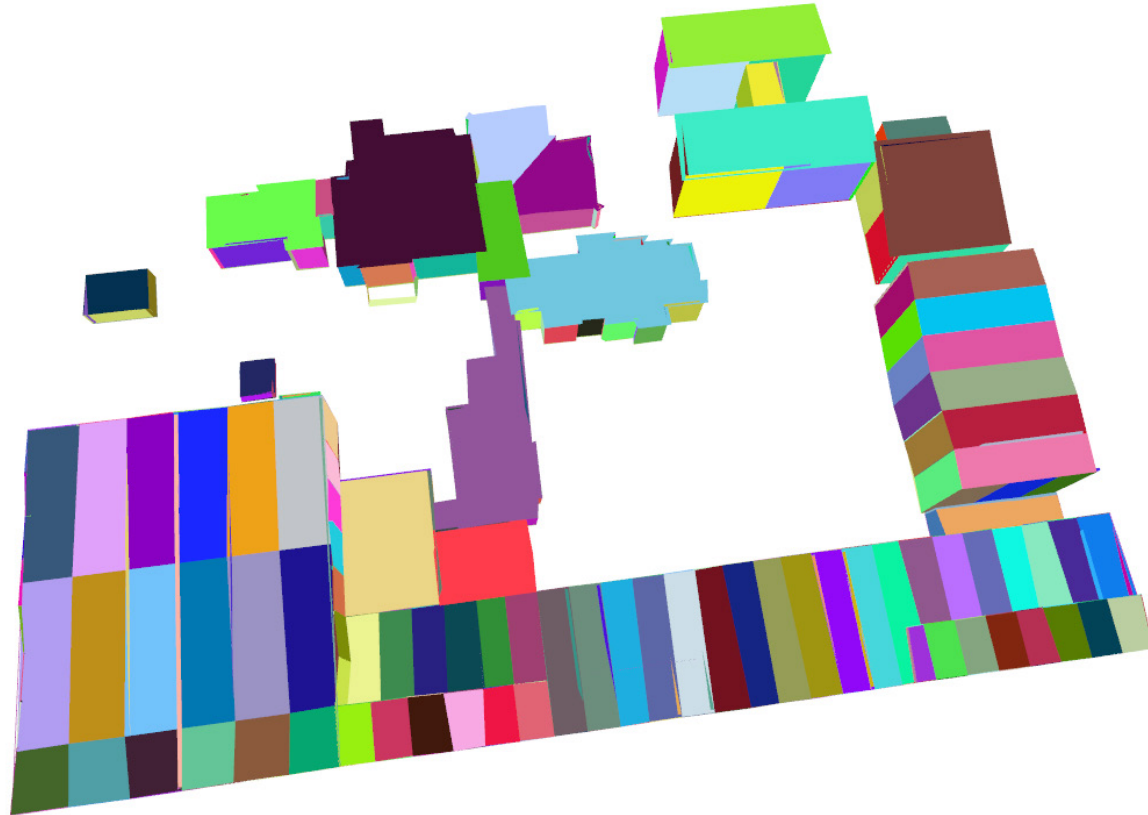


Schneider, P. J. & Soergel, U. [2021] Clustering Persistent Scatterer Points Based on a Hybrid Distance Metric. In: Pattern Recognition. DAGM GCPR 2021. Lecture Notes in Computer Science, vol 13024. Springer.





# Fusioniertes BIM-Modell





# Inhalt

- BIM-Modell
- SAR-Produkt
- Fusion: BIM + SAR
- **Demo-Plattform**
- Monitoring in Ahlen



Video...



# Inhalt

- BIM-Modell
- SAR-Produkt
- Fusion: BIM + SAR
- Demo-Plattform
- **Monitoring in Ahlen**



KEMPER

NEUAHLEN

ROSENDAHL

Ahfen

AHRINGHOFF

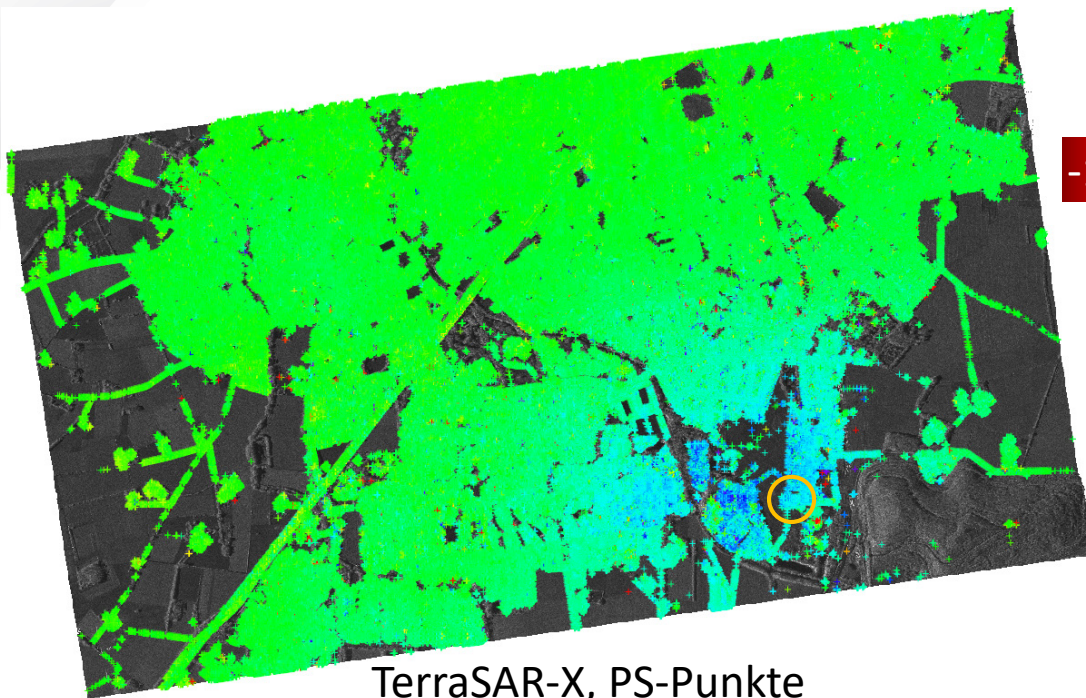
UNTEDT

KORDES

Image © 2025 Airbus



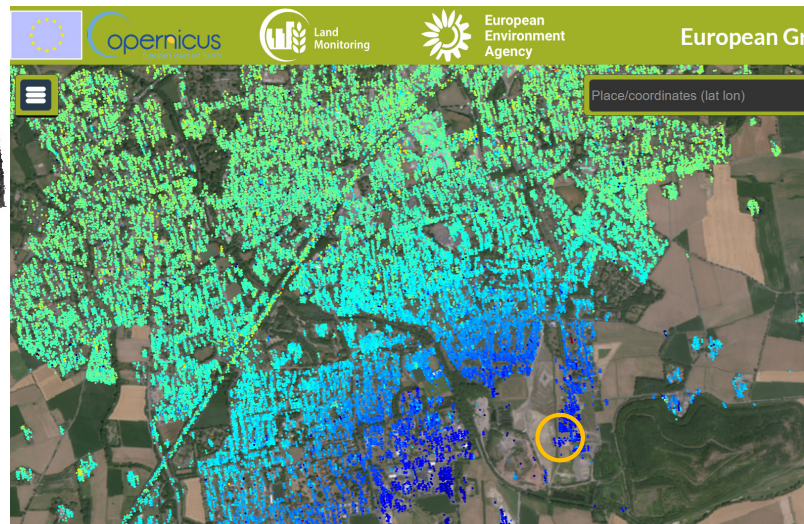
# Bewegungsanalyse von TerraSAR-X-Bildern (Auflösung: 25 cm)



TerraSAR-X, PS-Punkte

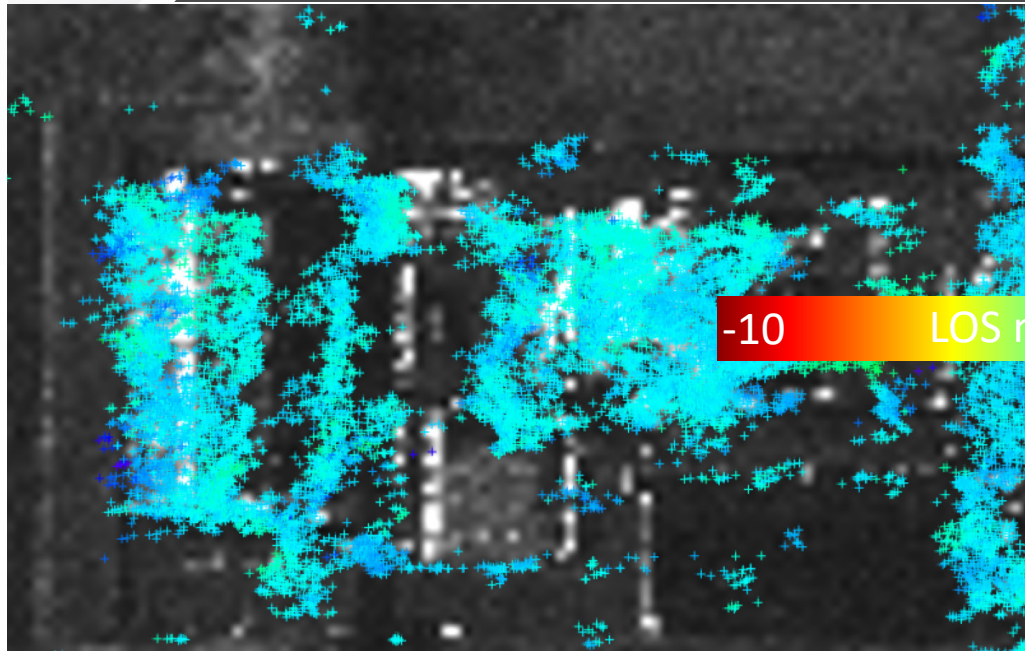


## Sentinel-1, PS-Punkte



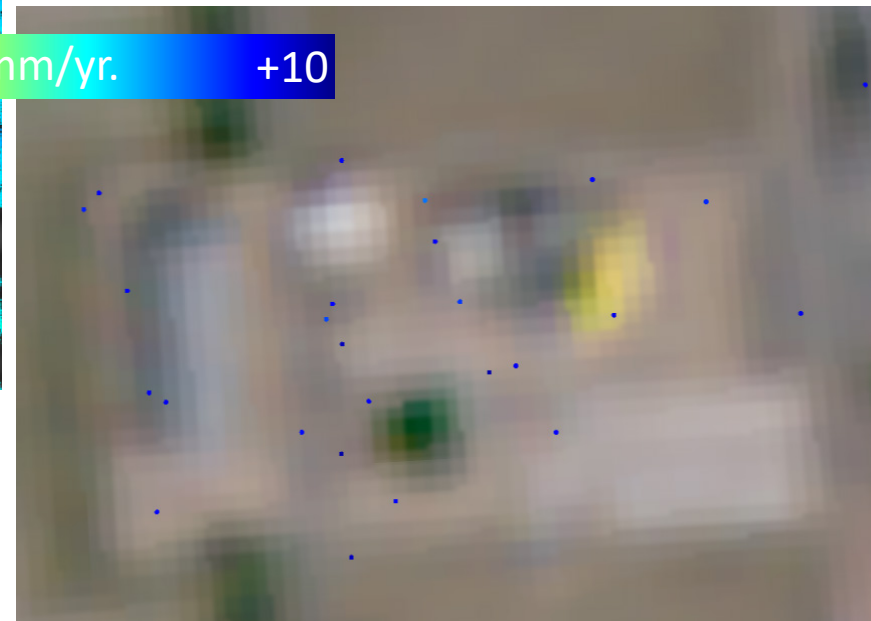


# Bewegungsanalyse von TerraSAR-X-Bildern (Auflösung: 25 cm)



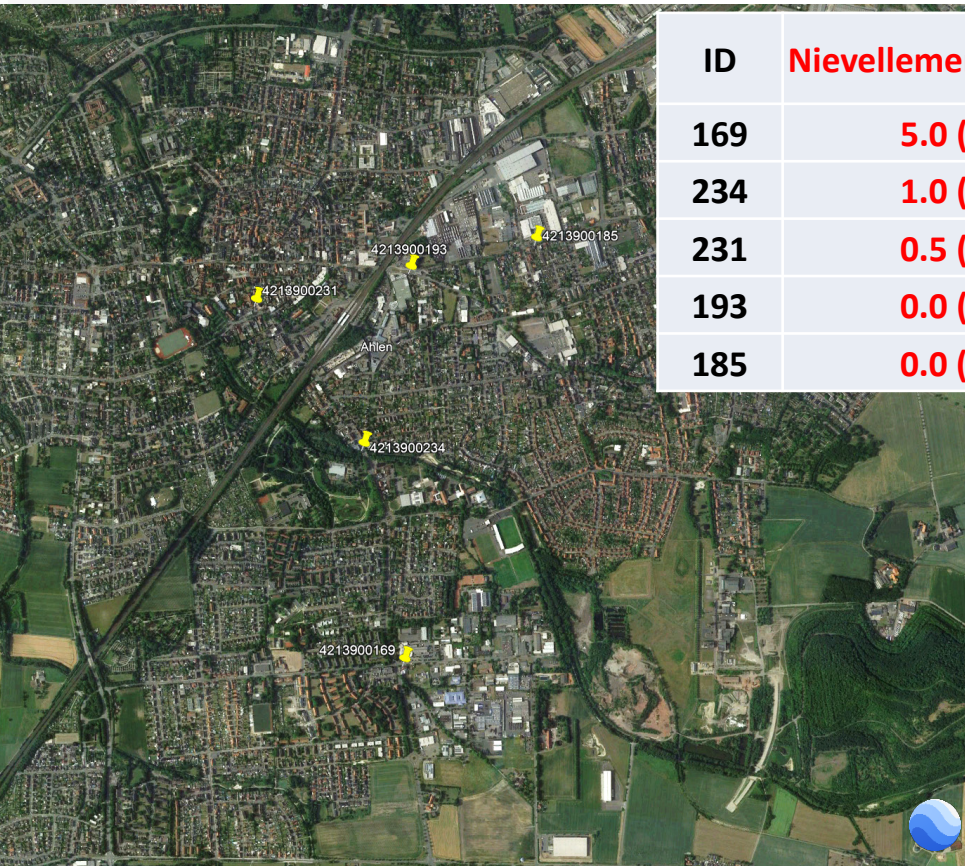
TSX, Asc, HH, Jan 2022 – Juli 2023

Sen1, Asc, VV, Jan 2018 – Dez 2022





# Vertikalgeschwindigkeit: Nivellement vs TerraSAR-X



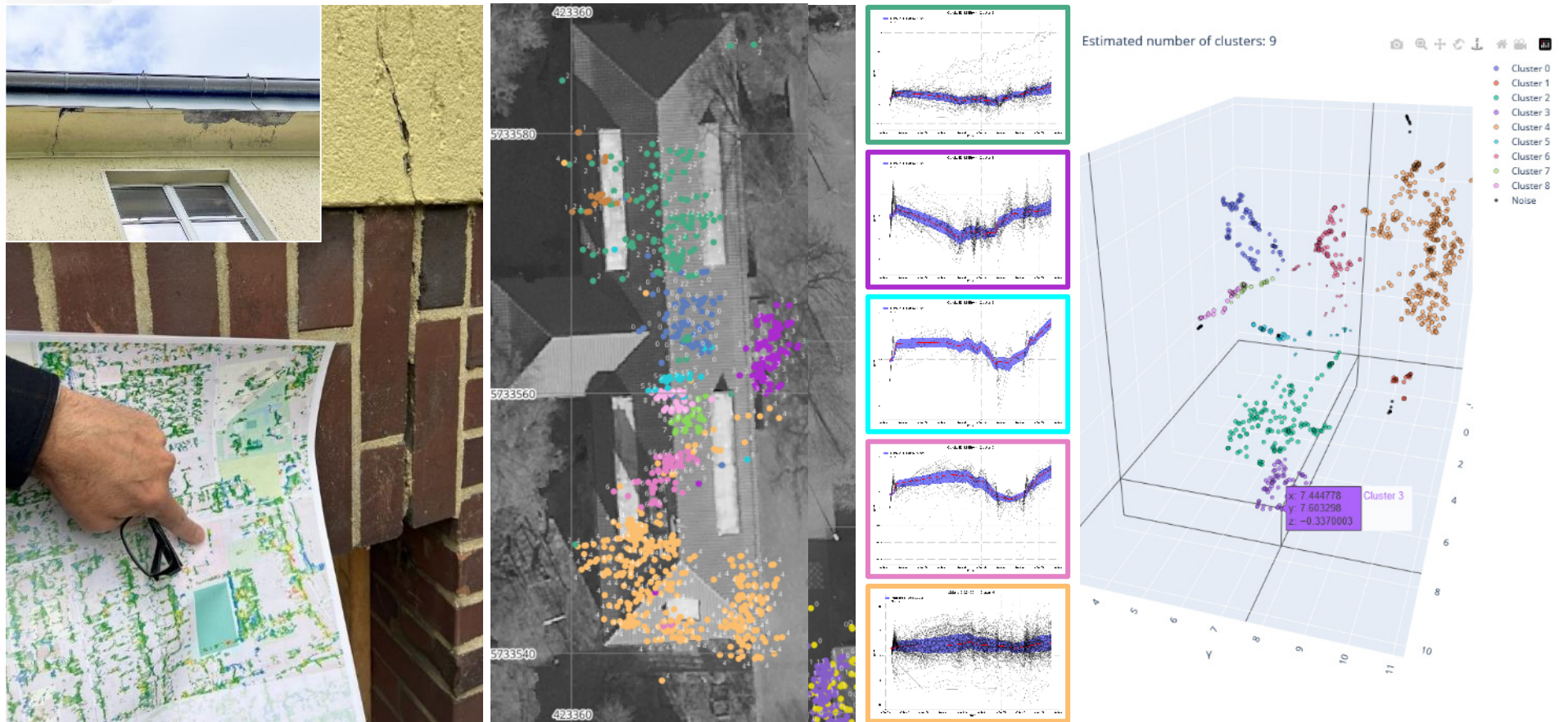
ID	Nivellement (2020 - 2022)	TerraSAR-X (2022 - 2023)	Diff
169	5.0 (mm/yr.)	5.2 (mm/yr.)	0.2 (mm/yr.)
234	1.0 (mm/yr.)	0.6 (mm/yr.)	0.4 (mm/yr.)
231	0.5 (mm/yr.)	1.0 (mm/yr.)	0.5 (mm/yr.)
193	0.0 (mm/yr.)	-1.2 (mm/yr.)	1.2 (mm/yr.)
185	0.0 (mm/yr.)	0.6 (mm/yr.)	0.6 (mm/yr.)

- LoS → Vertikal durch Trigonometrie
- Geschwindigkeitsberechnung durch lineare Funktion
- Standortverschiebung



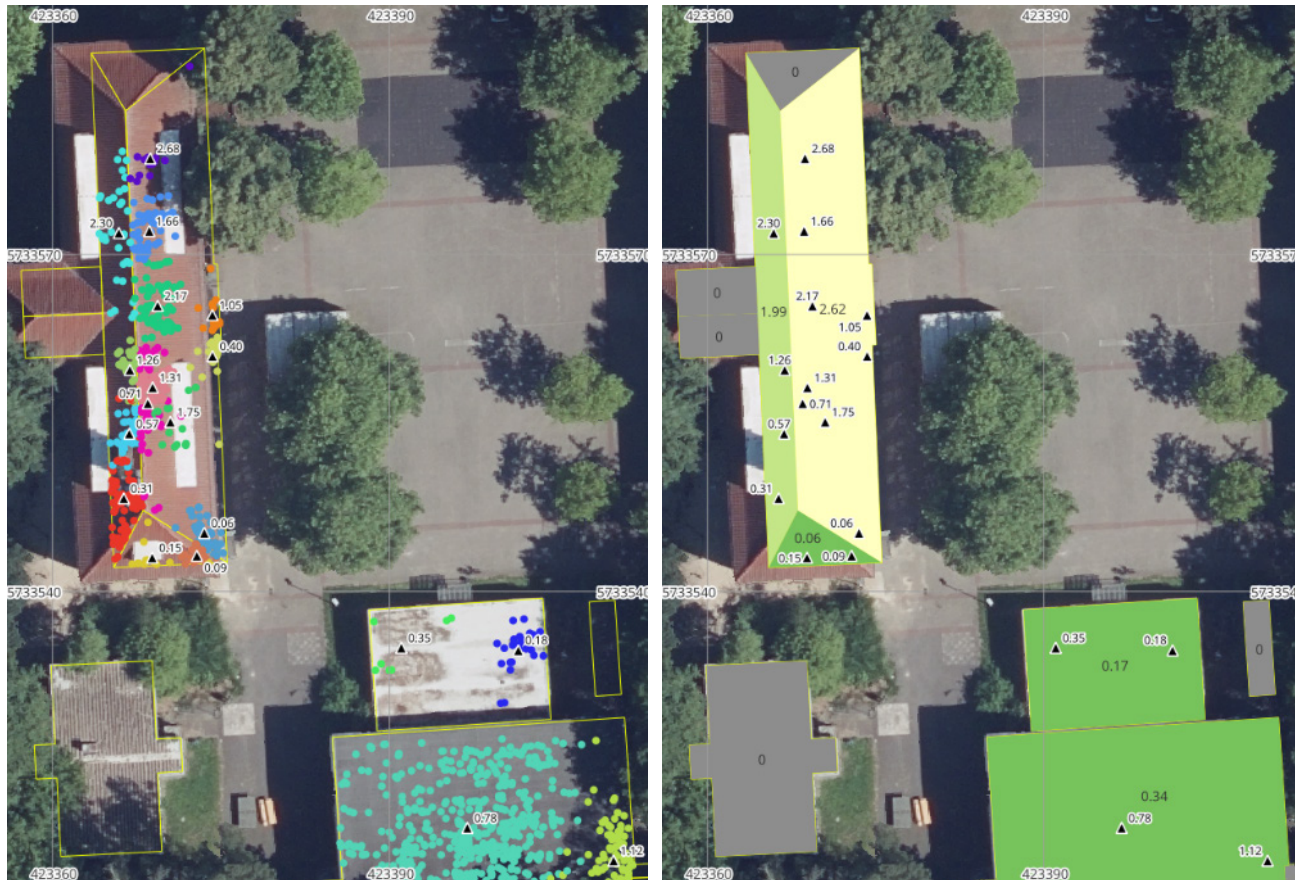


# Auswertung Objektebene – Beispiel Standort “Mammutschule”



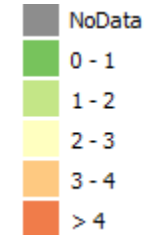


# Auswertung Objektebene – Beispiel Standort “Mammutschule”



▲ Cluster-Centroid  
[LOS Geschwindigkeit]

Abweichung  
LOS Geschwindigkeit  
[mm/a]

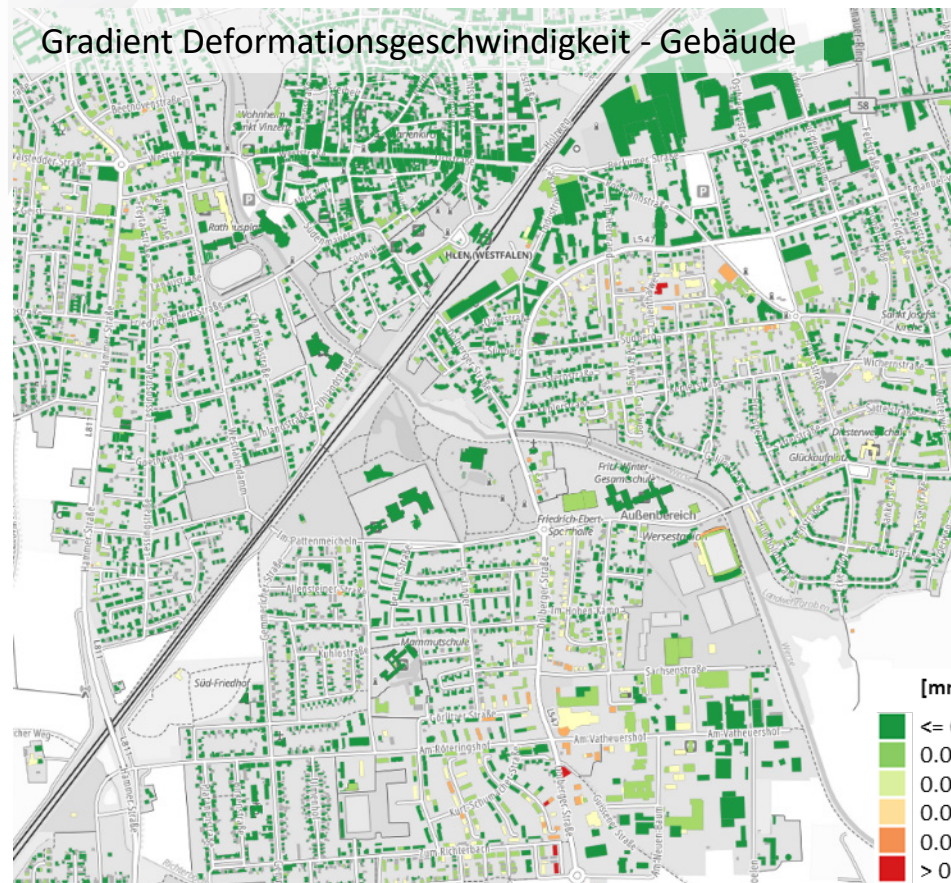




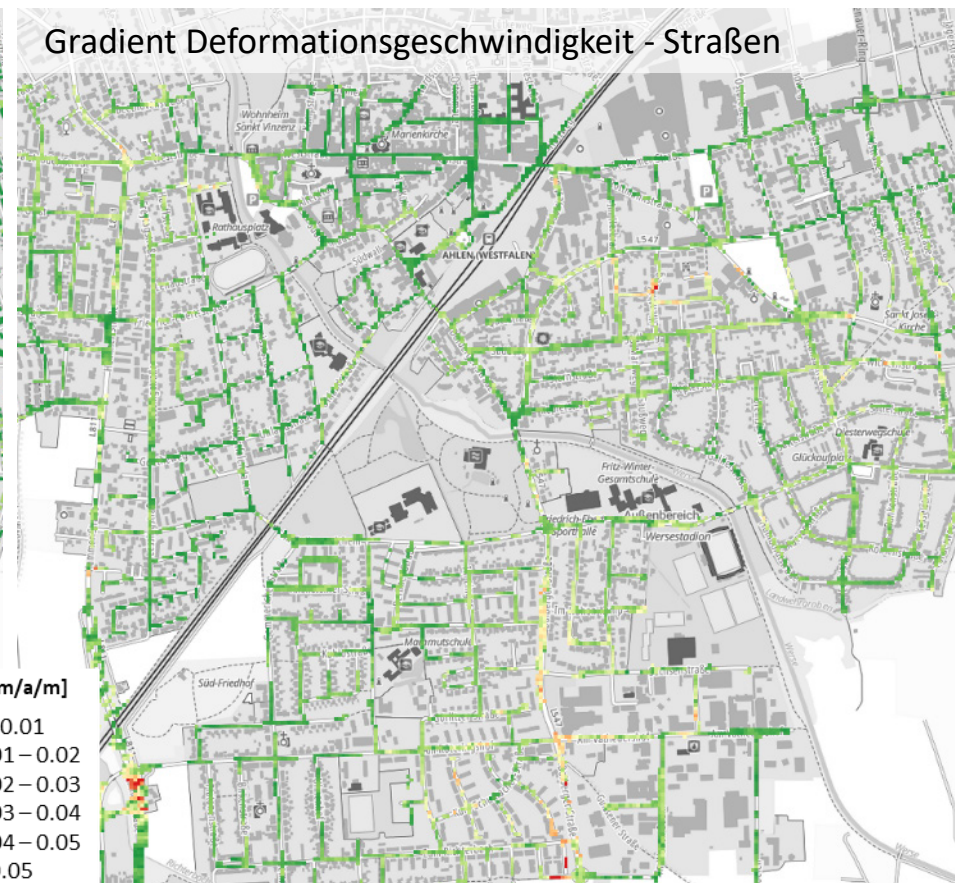


# Gefährdungspotenzial für die Infrastruktur

## Gradient Deformationsgeschwindigkeit - Gebäude



## Gradient Deformationsgeschwindigkeit - Straßen





## Datenquellen

### ^ Hintergrundkarten

- Basemap DE Farbe
- Basemap DE Grau
- NRW Orthophoto
- Höhenlayer

### ^ Überlagerungen

- PSI Gradient LOS-Geschw...

### ^ Datensätze

- Stadtmodell Ahlen Gesamt
- Stadtmodell (Attribute)
- Abbaueinwirkungen (RAG)
- Punktwolke (geojson)
- PSI Punktwolke.las



PSI Punktwolke.las

Legende

≤-10      mm/Jahr      ≥+10

X: 423819    Y: 5733770    Alt: 88m

📄 Datei importieren

🏠 🌑 🧑 📄

X: 425398    Y: 5734240    Alt: 79m



# Datenquellen



## ^ Hintergrundkarten

- Basemap DE Farbe
- Basemap DE Grau
- NRW Orthophoto
- Höhenlayer

## ^ Überlagerungen

- PSI Gradient LOS-Geschw...

## ^ Datensätze

- Stadtmodell Ahlen Gesamt
- Stadtmodell (Attribute)
- Abbaueinwirkungen (RAG)
- Punktwolke (geojson)
- PSI Punktwolke.las



📁 Datei importieren





# Datenquellen

## ^ Hintergrundkarten

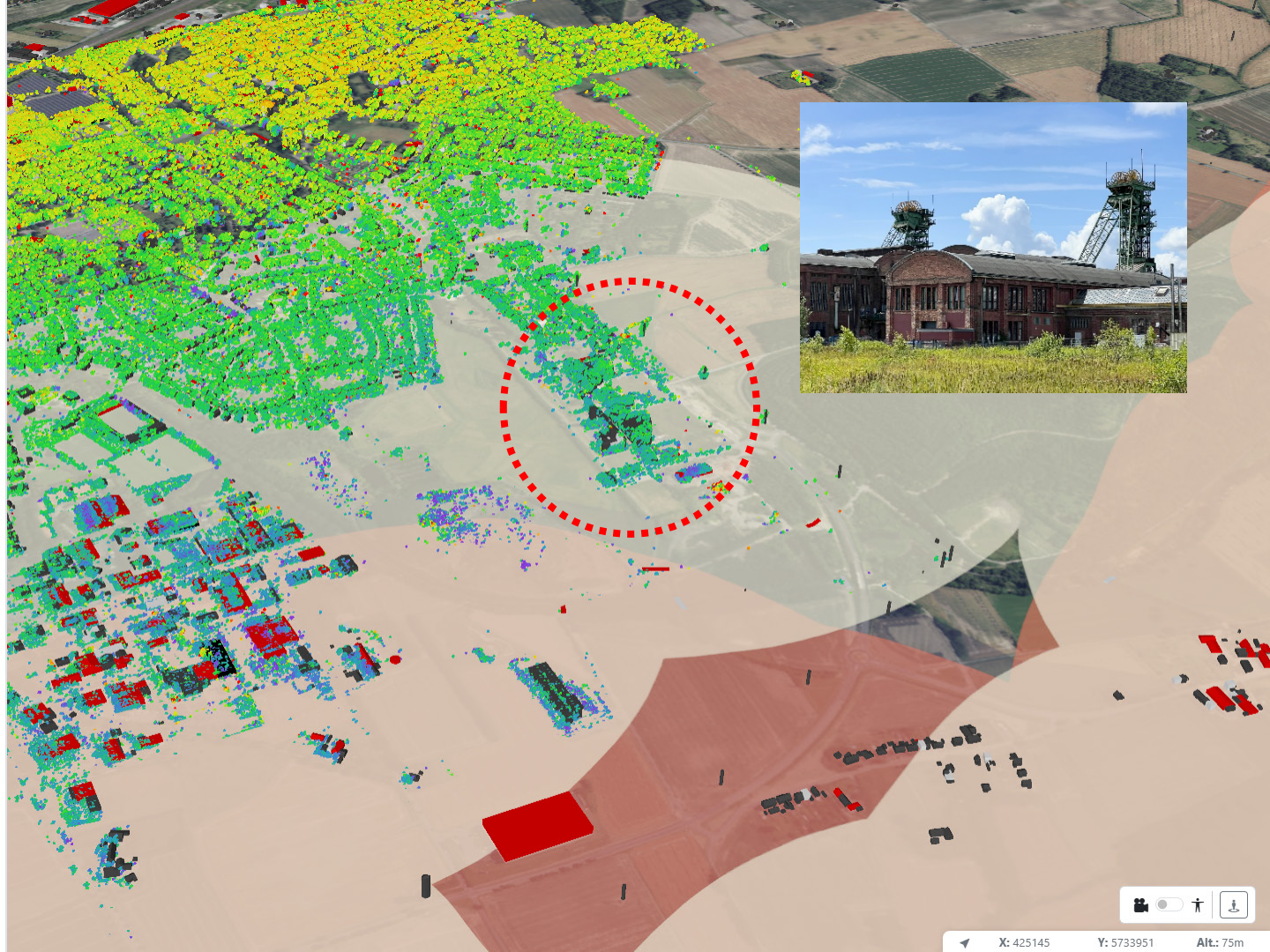
- Basemap DE Farbe
- Basemap DE Grau
- NRW Orthophoto
- Höhenlayer

## ^ Überlagerungen

- PSI Gradient LOS-Geschw...

## ^ Datensätze

- Stadtmodell Ahlen Gesamt
- Stadtmodell (Attribute)
- ^ Abbaueinwirkungen (RAG)
  - Abbaueinwirkungen 1969-1979
  - Abbaueinwirkungen 1980-1989
  - Abbaueinwirkungen 1990-1999
  - Abbaueinwirkungen 2000-2009
- Punktwolke (geojson)
- PSI Punktwolke.las



← Datei importieren









**EFTAS.GeoIT**  
PRECISELY FOR YOUR WORLD

Dr.-Ing. Chia-Hsiang Yang  
[Chia-Hsiang.Yang@eftas.com](mailto:Chia-Hsiang.Yang@eftas.com)

BIMSAR: <https://bimsar.eftas.services/>

Demo (Einzelgebäude):  
<https://ifcviewer.bimsar.eftas.services/>



[www.eftas.com](http://www.eftas.com)