

StatEO

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Earth Observation and AI for Construction Statistics Developing an EO-based Approach for Quality Assessment in Building Statistics



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Building permits: Decrease in Building Permits or Delayed?

Permits for new built apartments per building type Germany

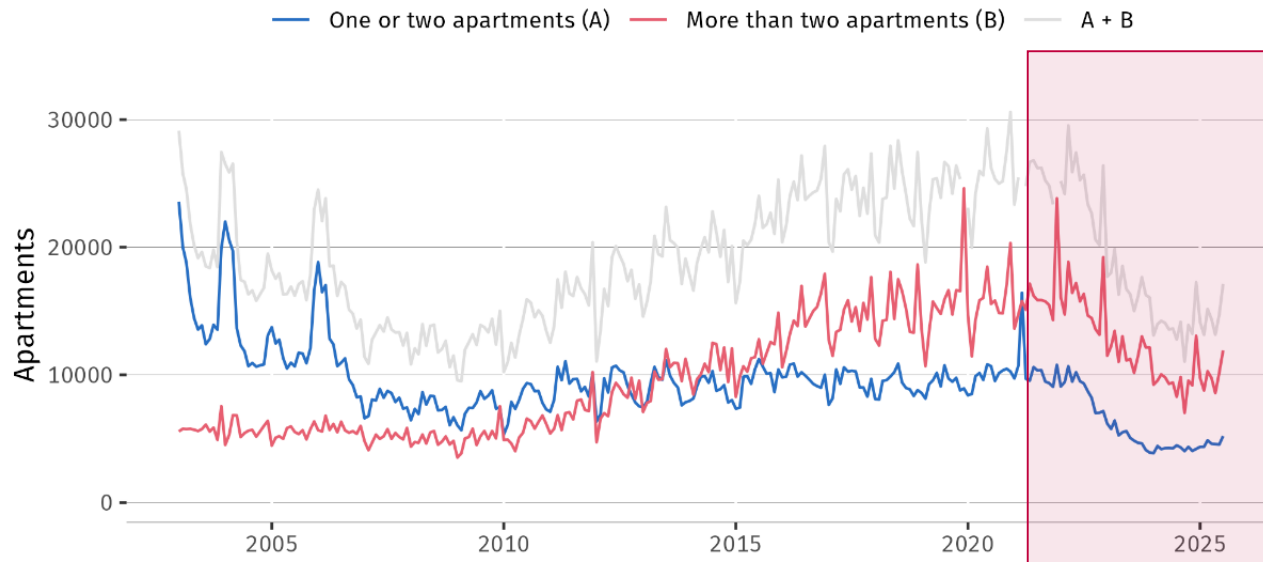


Fig 1: Permits for new built apartments, Statistisches Bundesamt (Destatis), own calculations

Reporting a key indicator:

To assess the success of new laws for reducing the barrier of new housing, the quality of reporting needs to be examined

Demand for new housing:

Projected demand for new housing will continue to rise, with approximately 320,000 housing units annually

(from BBSR, Analysen Kompakt 05/2025)

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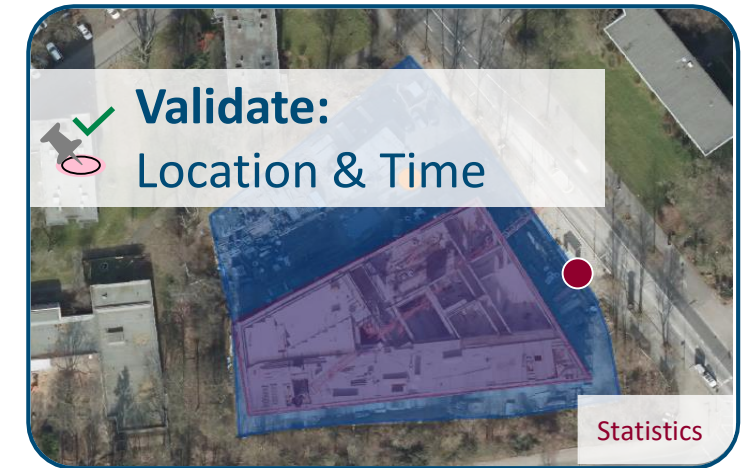


Independent Dataset

Project Members
EO4ConStat



Goal: Develop a methodology for quality assuring German construction statistics



Images: Bezirksregierung Köln, Geobasis NRW / 2023 (dl-zero-de/2.0); Modified Copernicus Sentinel data 2025



Objective

Train a deep learning model to detect construction sites in high-resolution aerial imagery



Training data

Source: Digital Orthophotos (DOPs)

Resolution: 20x20 cm

Time range: 2018 - 2023

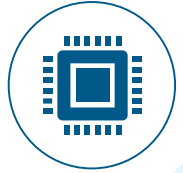
Test region: North Rhine-Westphalia

Labels: Polygons of Construction Sites
4000 Labels / ~ 450 DOPs



Images: Bezirksregierung Köln, Geobasis NRW / 2023 (dl-zero-de/2.0)

Fig 3: Samples of Construction sites for different stages



Model

Model: SAMLoRA¹⁾

Method: Binary Segmentation

¹⁾ Zhang, K. & Liu, D. (2023). Customized segment anything model for medical image segmentation. <https://doi.org/10.48550/arXiv.2304.13785>



Evaluation

For counties:

Object-based

| | Düsseldorf | Herford |
|------------------|------------|---------|
| Precision | 0,60 | 0,52 |
| Recall | 0,83 | 0,84 |
| F1-Score | 0,70 | 0,64 |



Segmentations
 True Positive
 False Positive
 False Negative

Fig 4: Detected construction sites across Düsseldorf

Images: Bezirksregierung Köln, Geobasis NRW / 2023 (dl-zero-de/2.0)



Objective

Date the construction start and dismant based on characteristic breaks in the time series



Data

Source: Sentinel-2 time series

Resolution: 10x10 m

Time range: 2018 - 2023

Test region: North Rhine-Westphalia

Data: Centroids of Construction Sites

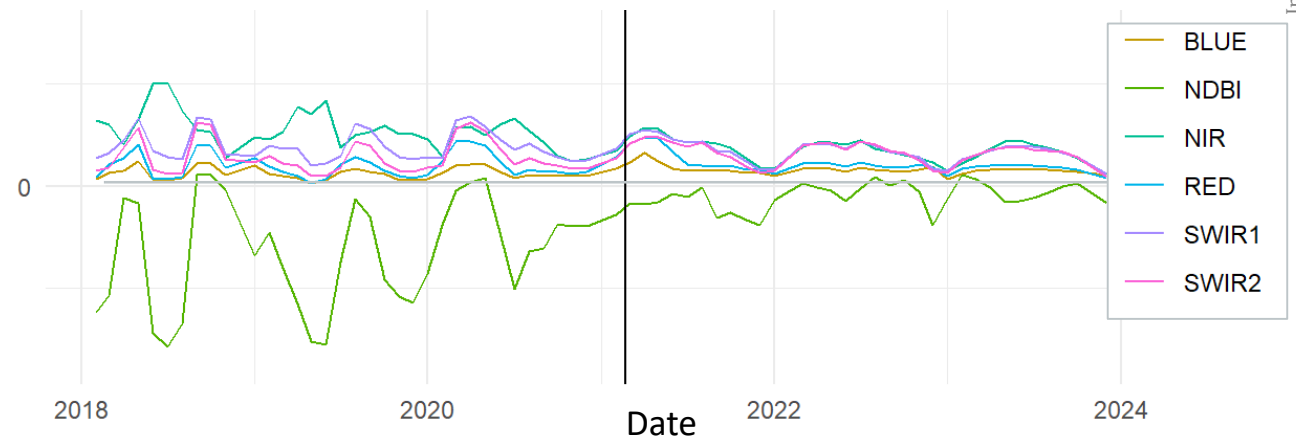
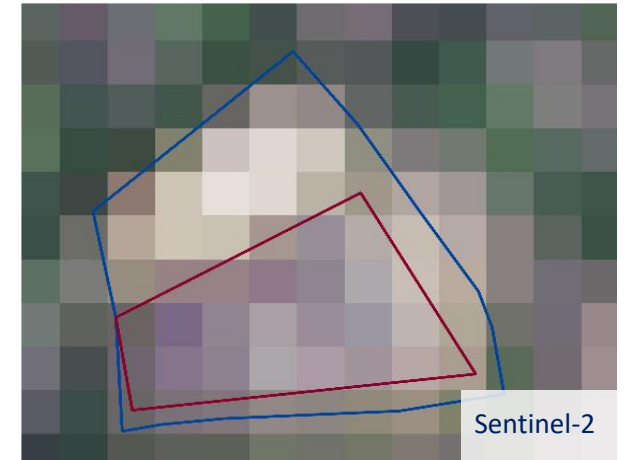


Fig 5: Example Sentinel-2 time series including channels and indices

Images: Bezirksregierung Köln, Geobasis NRW / 2023 (dl-zero-de/2.0); Modified Copernicus Sentinel data 2025



Evaluation

Method:
Breakpoint Detection

Data Selection:
11 representative construction sites (rural, urban)

Preprocessed:
**Visually cleaned FORCE Cloud mask
Median + 4 times the deviation**



Images: Bezirksregierung Köln, Geobasis NRW / 2023 (dl-zero-de/2.0)

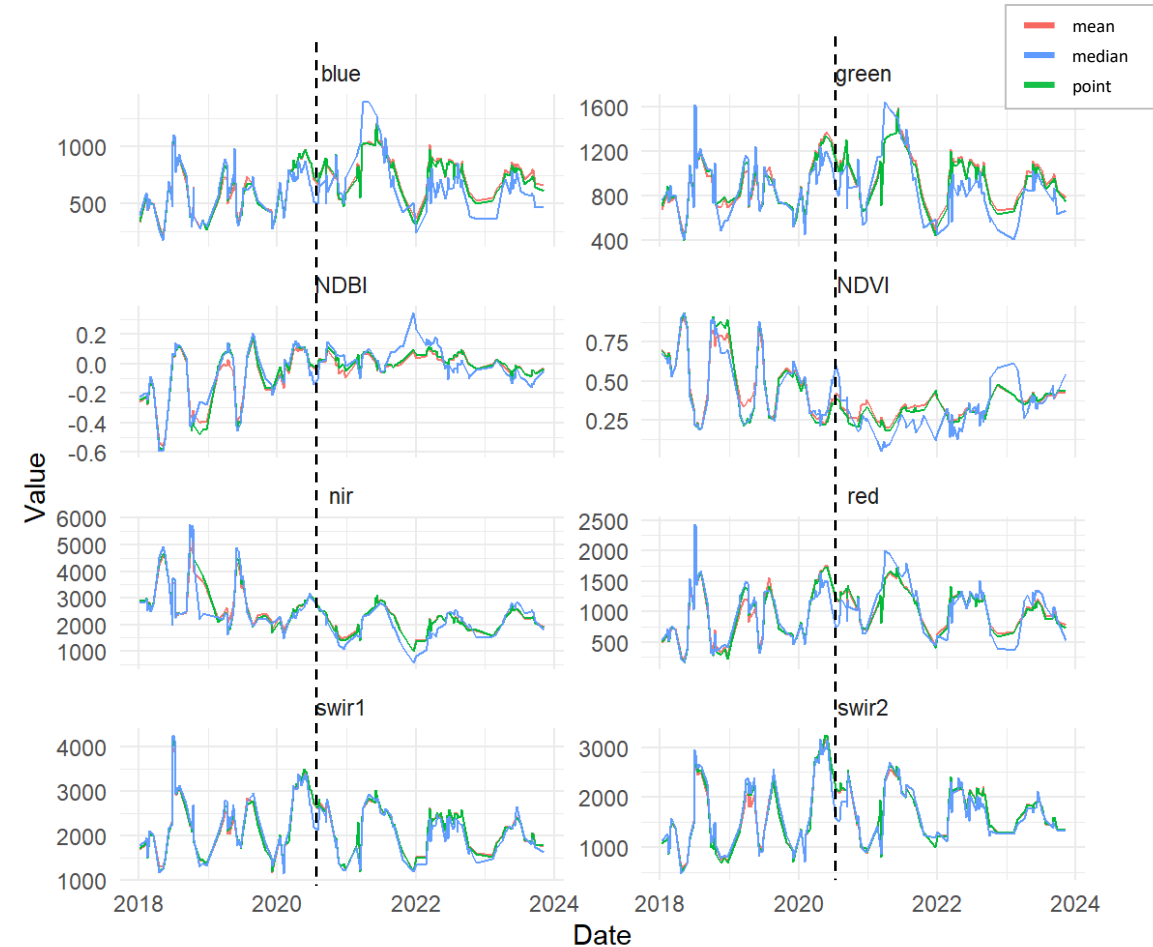


Fig 6: Development of representative construction site over six years separated by channels and indices

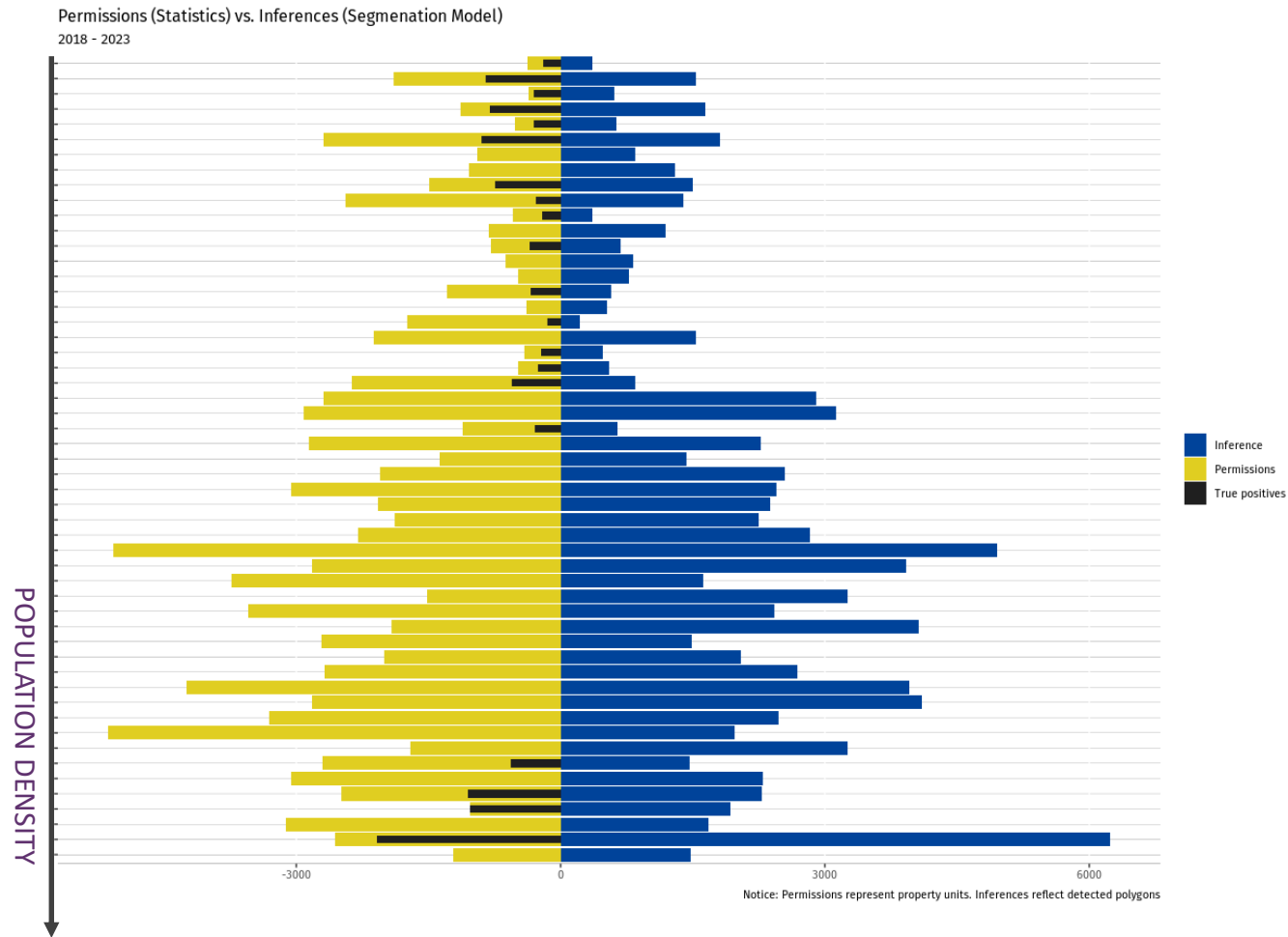


Fig 7: Comparison between permissions over segmentations provided by the model, Statistisches Bundesamt (DESTATIS), own calculations

Value of using a foundation model

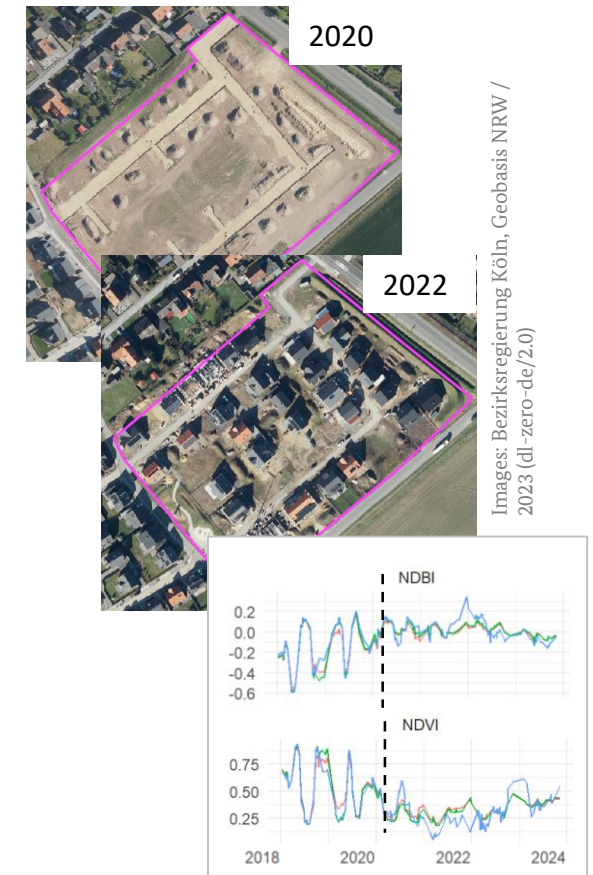
The SAM backbone combined with LoRA, enables fine-tuning on our dataset even in environments with limited computational power

Heterogeneity & Similarity Barriers

High intra-class heterogeneity of construction sites and significant spectral/morphological overlap with similar land cover types (e.g., storage yards and industrial depots)

Spatiotemporal Constraints: Resolution Limits and Permit Lags

Precise event dating is complicated due to spatial resolution of Sentinel-2 and the temporal misalignment between administrative building permits and actual physical onset



The Way Forward

Our EO-based quality assessment approach retrieves independent construction site information to serve as indicators

Enhancing the Precision

For increase precision, additional datasets are integrated to filter out hard-to-distinguish objects, such as industrial yards or existing buildings

Evaluation of representative nation-wide counties

Based on topography, population density, and out-of-sample temporal data, counties across Germany were selected to evaluate generalizability

Pipeline for reporting

The detection approach has been adapted to segment orchards in high-resolution aerial imagery to complete orchard datasets.

Thank you for your kind attention!

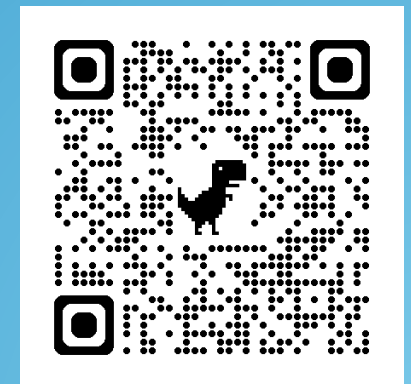
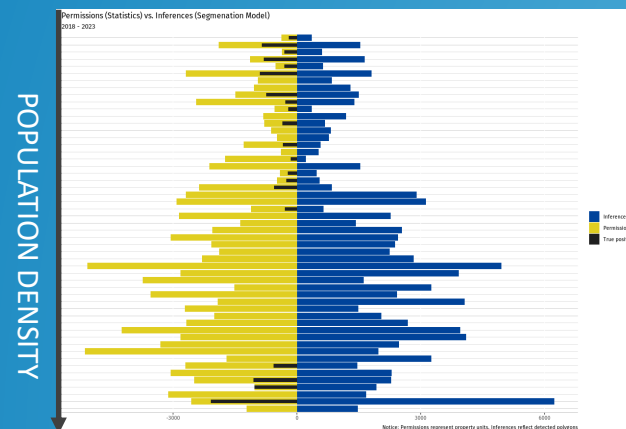
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ZENODO