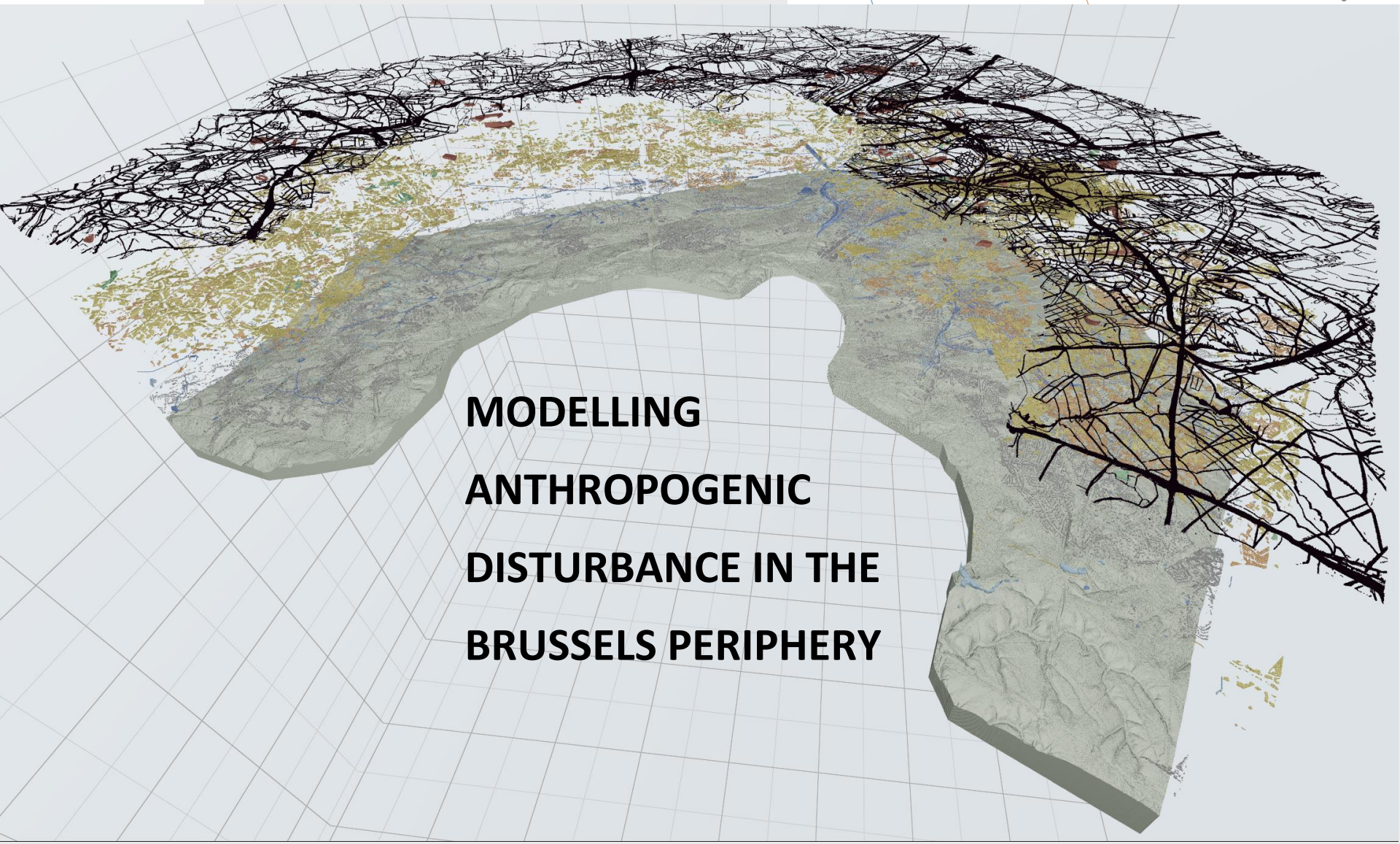


MODELLING ANTHROPOGENIC DISTURBANCE IN THE BRUSSELS PERIPHERY

De Koninck Roel, Dirix Katrijn, Van Haren Tom, De Nil Katrien, Verhaegen Jasper

WHAT IS ANTHROPOGENIC DISTURBANCE*? **mentioned further as 'AD'*

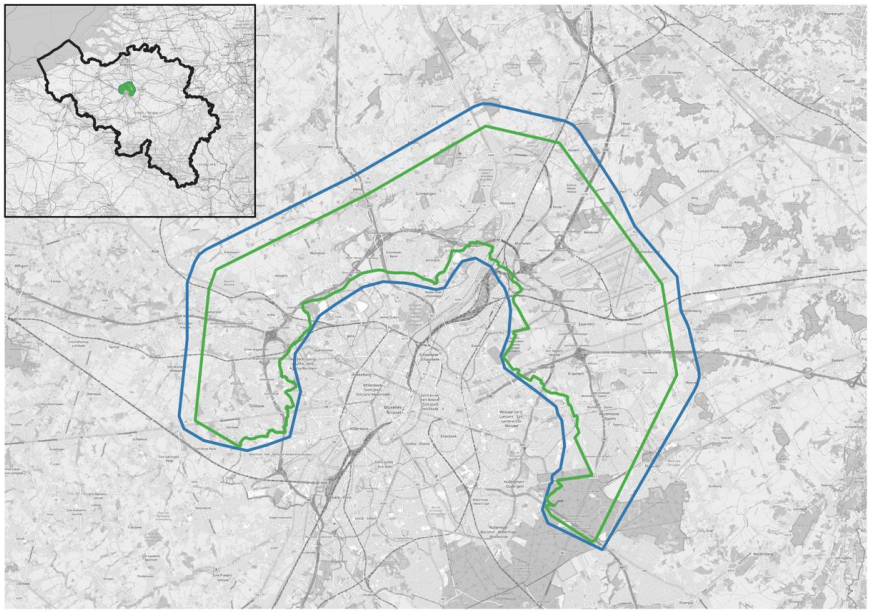
Multiple classifications possible (see GSEU project):

- **Type of material** >> reworked natural, novel anthropogenic materials, or combination of both – further characterized by lithological properties
- **Origin of material** >> e.g., demolition materials, industrial waste and by-products, mining residues, domestic waste, etc.
- **Purpose of deposit** >> e.g., urban development, infrastructure construction, waste management, mining activities, etc.
- **Anthropic environment (context)** >> e.g. urban, industrial, mining, rural, etc.
- **Morphology (geometry) of deposit** >> raised topography vs. filled depressions

How to (incorporate in a) model?

MODEL AND CONTEXT

- Northern border of Brussels Capital (Belgium): shallow 3D model of a region with substantial AD



- <u>Our goal:</u>
  - Capture **solid** human influence (no contamination)
  - "New" materials as well as disturbed in-situ natural deposits
  - Don't forget to include subsurface infrastructure!

Challenges:

- Typically highly **irregular** in nature and resolution: how to incorporate in large(-scale) 3D-models?
- Abundant 2D information available
- **Limited 3D information** (publicly) available: expert judgement

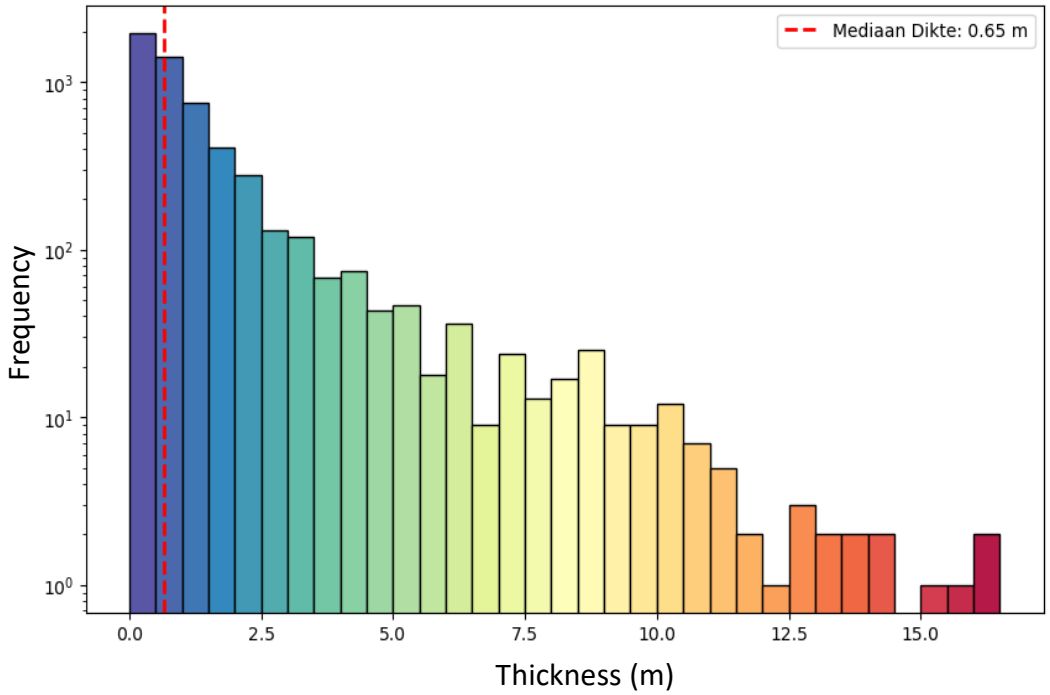
SOURCES: POINT DATA

- Text mining on **borehole descriptions** using regex:
  - incorporation of words associated with human interference
  - Max depth of occurence

- 46% of well descriptions contain information on presence of AD
  - clustered (a lot of data on contaminated sites/old landfills)

- Caveats:
  - Absence in descriptions ≠ absence:
    - Present, but not written down
    - AD can postdate borehole placement
  - Raised or backfilled terrain can mimic in situ material

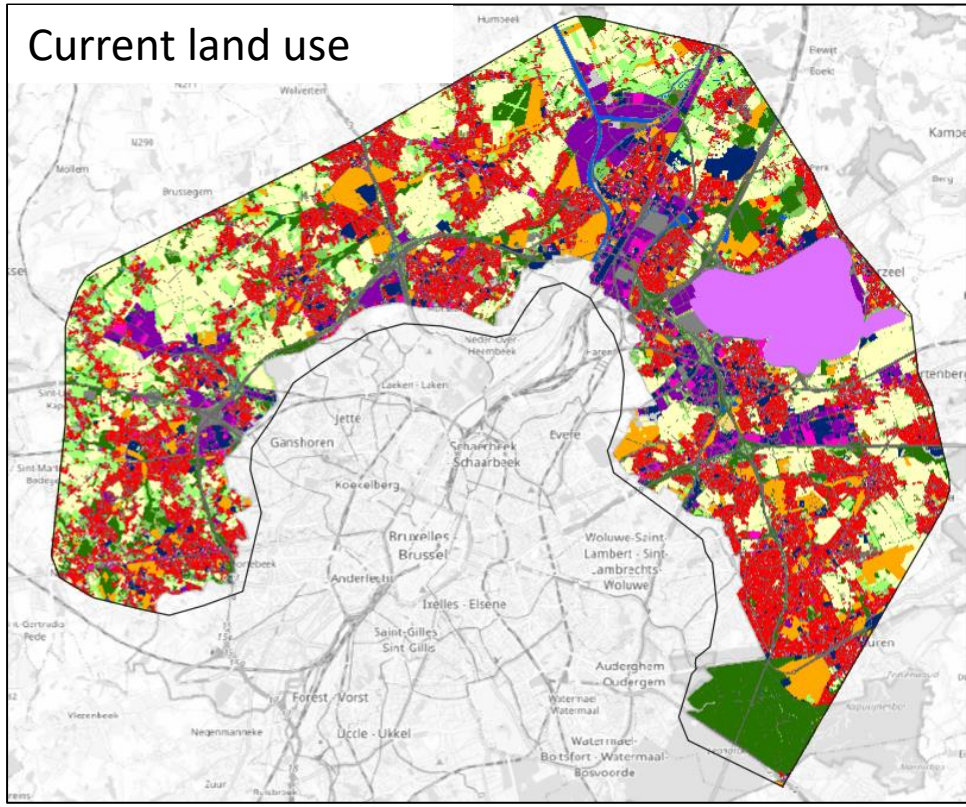
Histogram of AD thickness in borehole descriptions



SOURCES: POLYGON DATA / MAPS

Multiple data sources containing (in)direct information on AD, mostly 2D:

- Digital Terrain Models
- Digital Topographic Maps with detailed information on roads, houses, etc.
- Hydrographical Atlas
- Land use maps (current and historical)
- **All data converted to 5x5 rasters**



Poelmans et al., 2023

METHODOLOGY

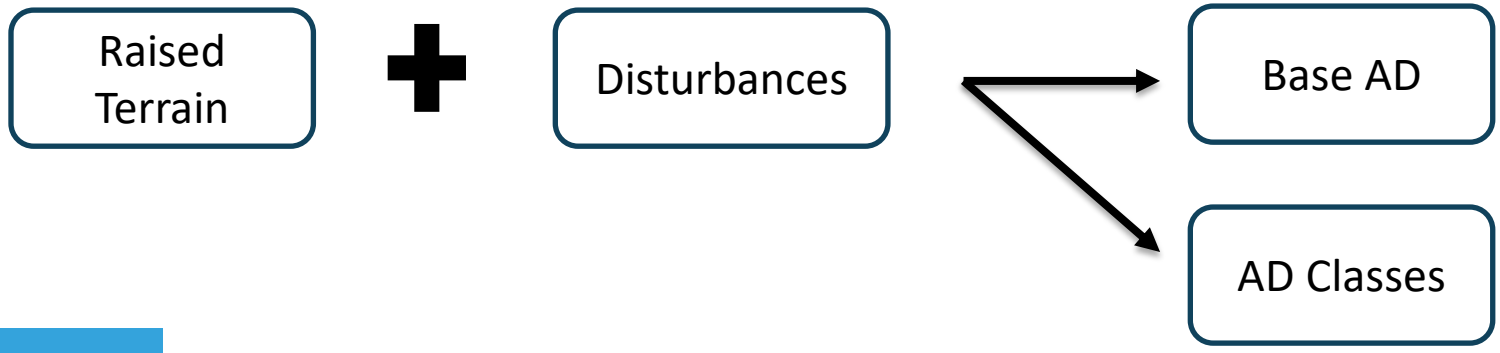
- No vertical differentiation, only lateral

- Based on modelling approach: 2 different types of AD considered:

1. Raised terrain: (rail)roads, bridges, dikes, raised terrains, etc.

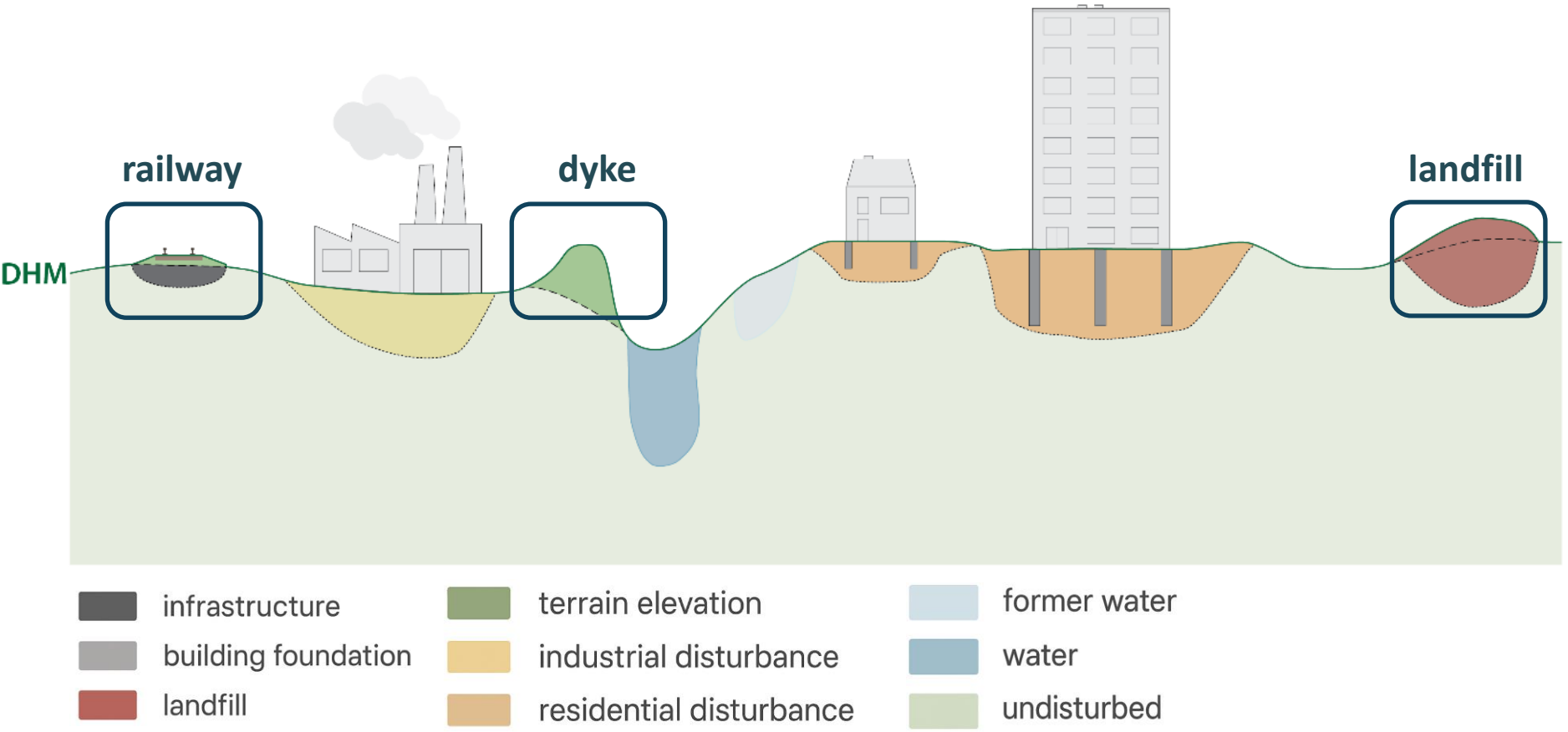
2. Disturbances:
   - Human (infrastructure): building foundations, tunnels, sewers, (rail)roads, etc.

   - Disturbed ground: landfill, former water bodies, residential areas, etc.



METHODOLOGY: RAISED TERRAINS (1)

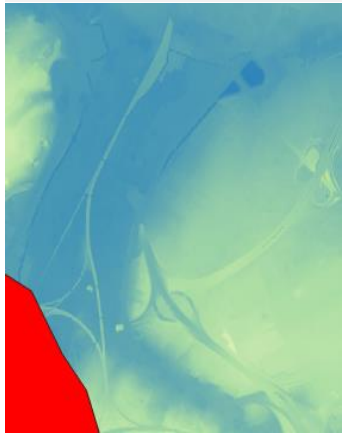
- Digital Elevation model ≠ natural terrain model: raised ground is included



METHODOLOGY: RAISED TERRAINS (2)

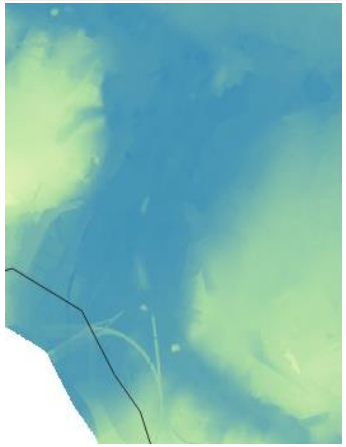
- 2D elements linked to raised terrains selected from Digital Topographic Map
- Incorporated when >0.5m above surrounding surface
- Categorized (a single AD class per pixel (5x5m)):

Original Terrain Model

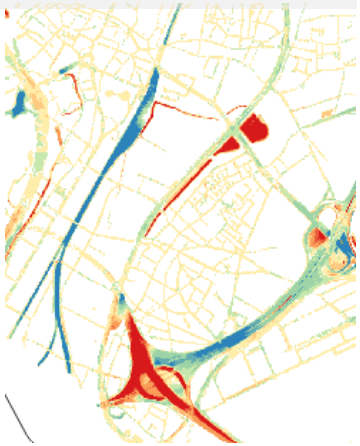


Elimination of roads/dikes/…

Interpolation

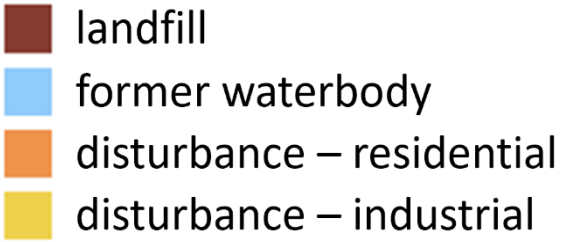


Raised terrain



METHODOLOGY: DISTURBANCE

- **4 classes** based on land use data:



  - Landfill: dedicated dataset
  - Former waterbodies: based on ‘water’ zones in historical land use maps that are no longer ‘water’ in current land use map.
  - Residential and industrial disturbances: based on (historical) land use maps

METHODOLOGY: DISTURBANCE (2)

water
building foundation
infrastructure (roads, etc.)

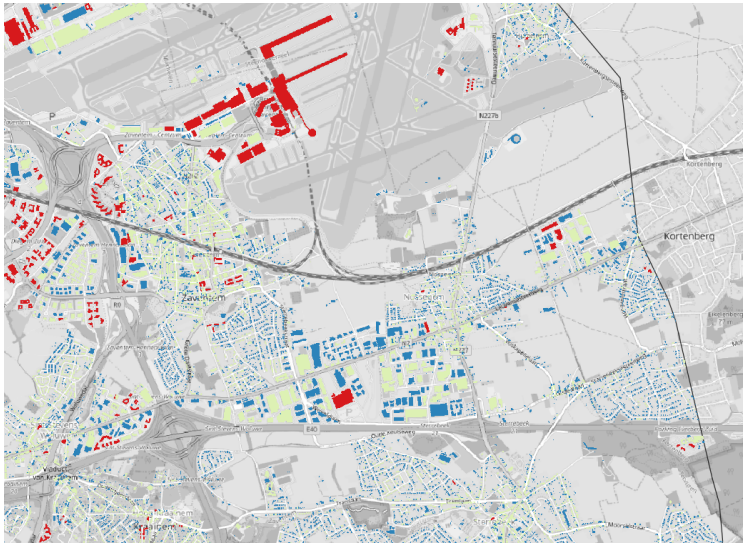
- Water: dedicated dataset including 3D info

- Building foundation: expert assumption based on building height

*cellars etc. omitted due to missing info

Building Height	Foundation thickness
≤ 9m	1.5m
9-15m	2.5m
≥ 15m	4m

- Infrastructure: expert assumption based on type



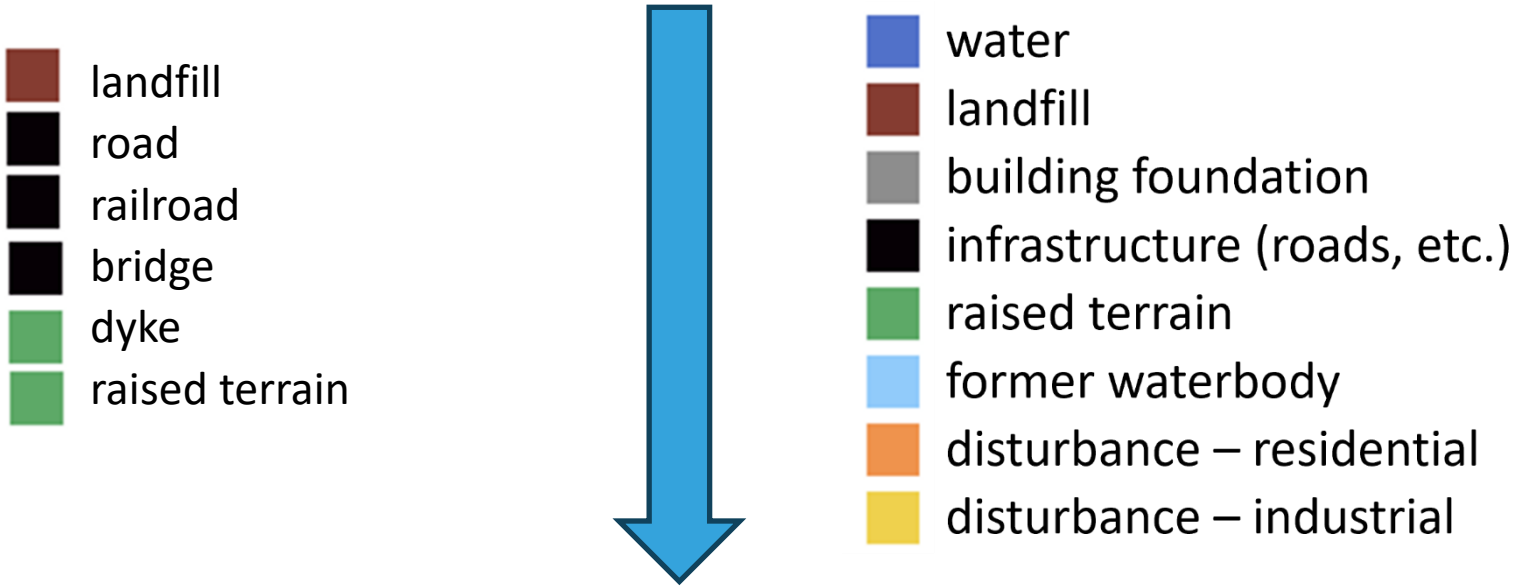
Foundation thickness: blue 1.5m, green 2.5m, red 4m

METHODOLOGY: CATEGORISATION

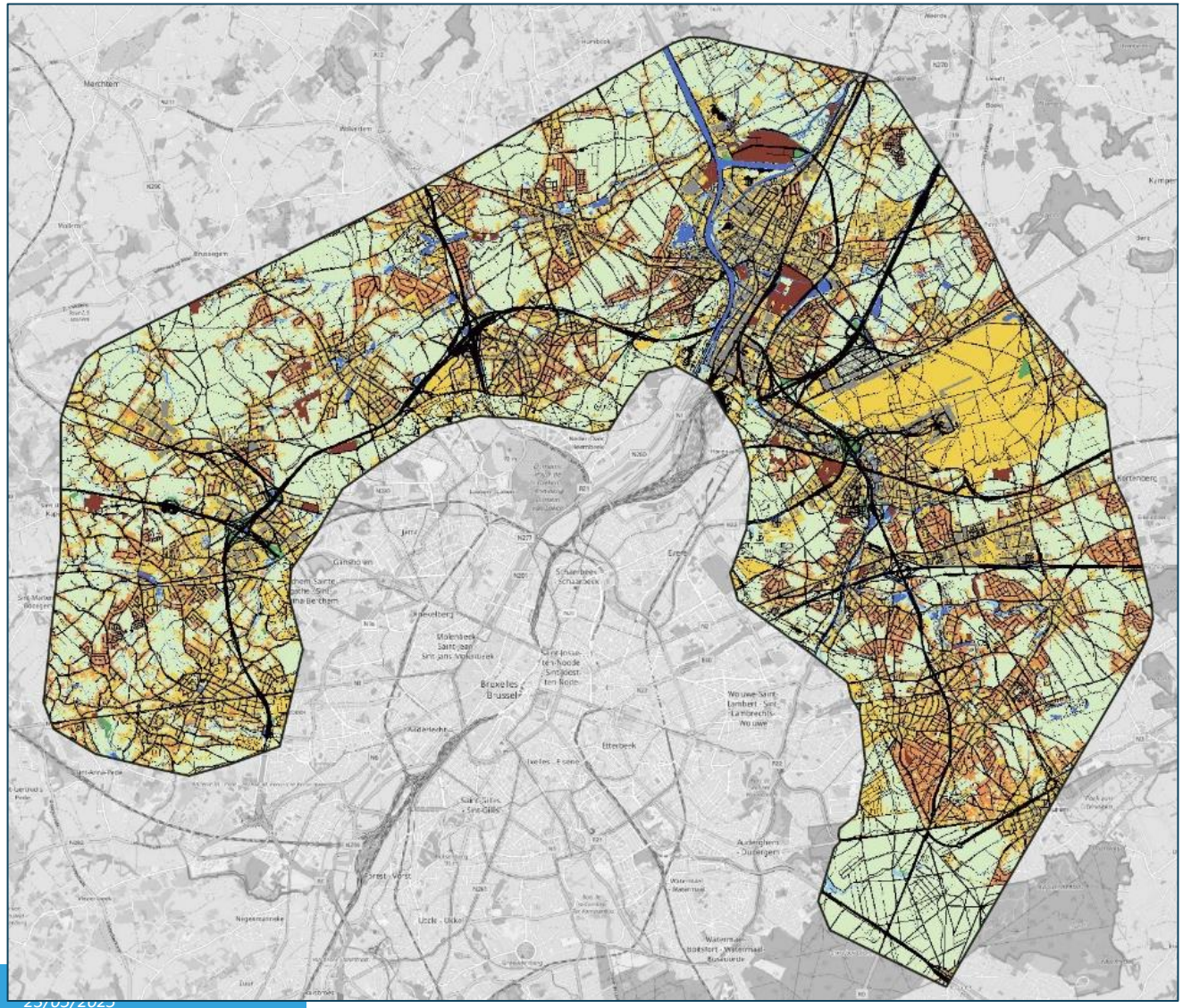
- Priority rules:

Raised Terrain	>	Disturbances

- Internal priority:

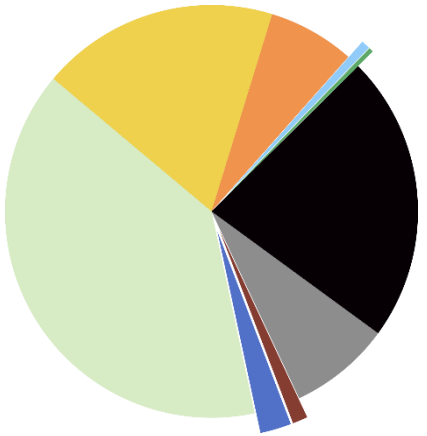


ANTHROPOGENIC DISTURBANCE: RESULTS

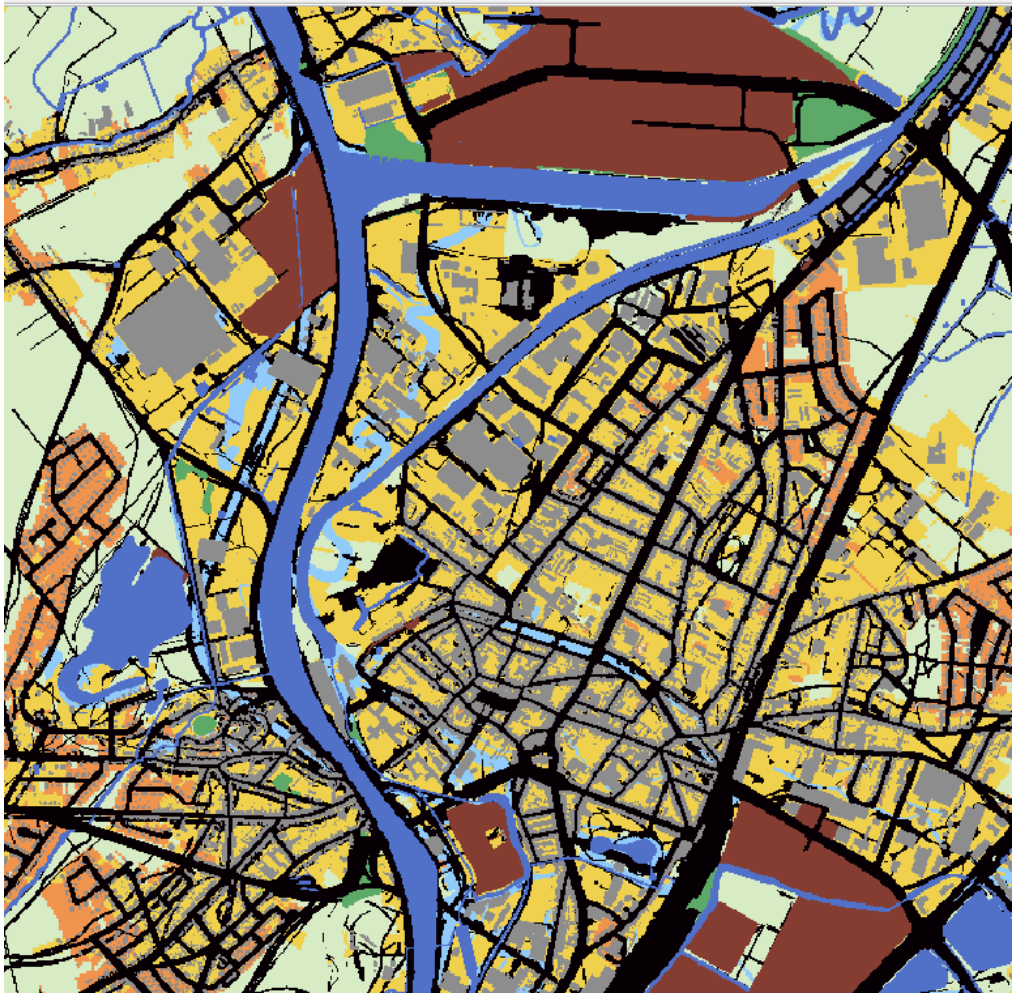


- water
- landfill
- building foundation
- infrastructure (roads, etc.)
- raised terrain
- former waterbody
- disturbance – residential
- disturbance – industrial

Area share per category:



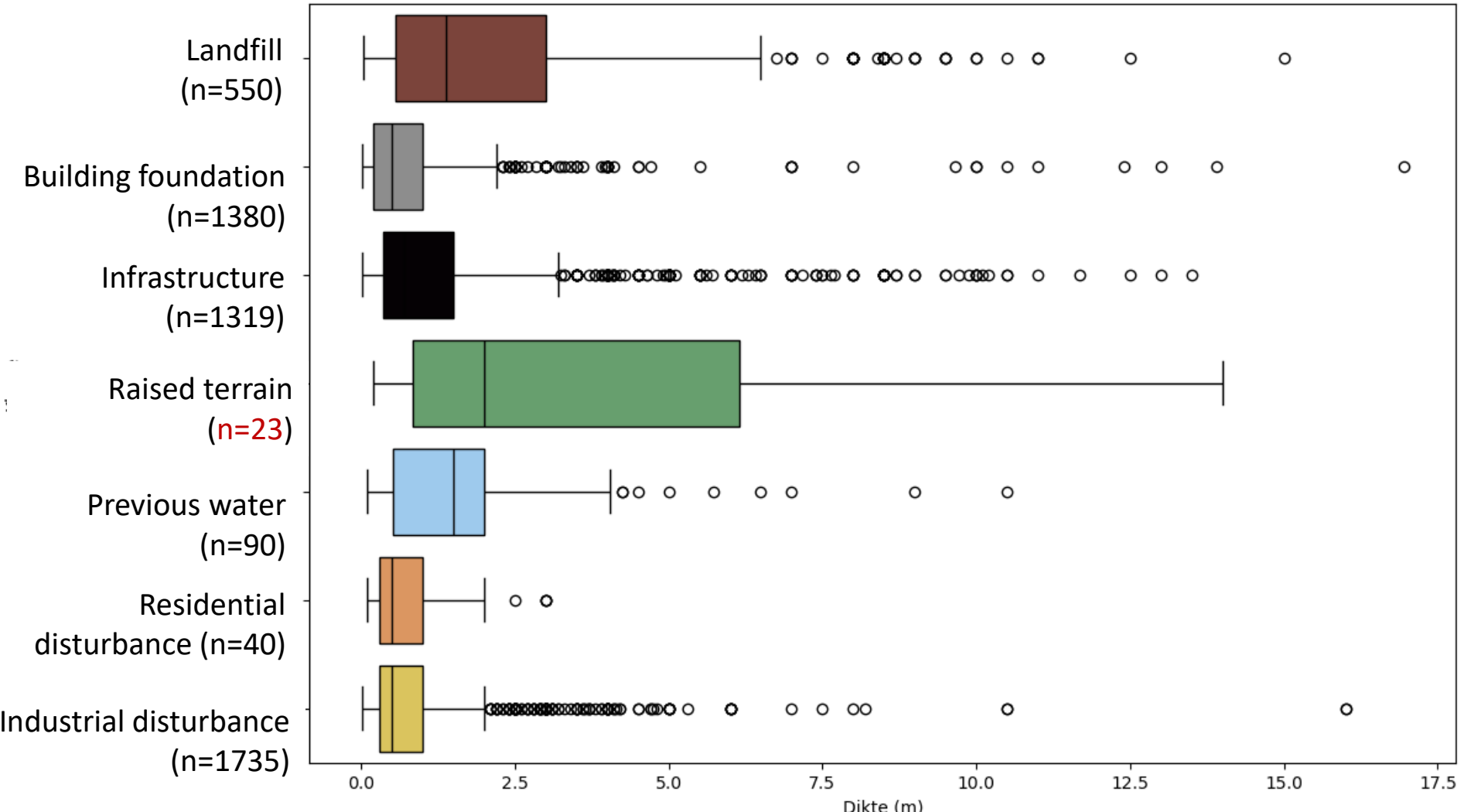
ANTHROPOGENIC DISTURBANCE: RESULTS



- water
- landfill
- building foundation
- infrastructure (roads, etc.)
- raised terrain
- former waterbody
- disturbance – residential
- disturbance – industrial

ANTHROPOGENIC DISTURBANCE: RESULTS

Model sampled on boreholes describing antropogene: thickness patterns

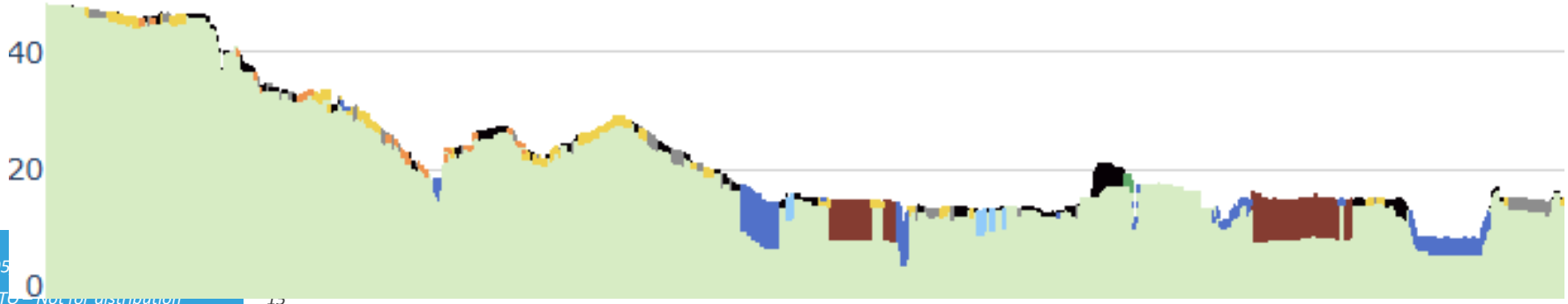


WHAT'S NEXT – LESSONS LEARNED?

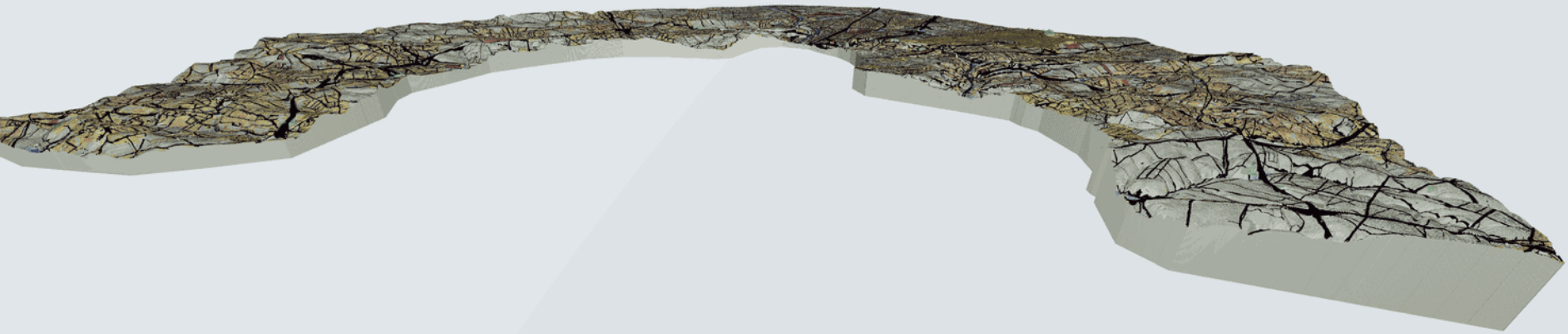
- Incorporation of BIM data could significantly improve the model

- No vertical stratification
- Missing data: cellars, subsurface parking lots
  Not possible to gather within the modeling context: dependent on external sources
- Fixed values used based on expert judgement: basic approach

Is it worth the extra effort?
Big effort, little reward?



Questions?



Thank you!

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