

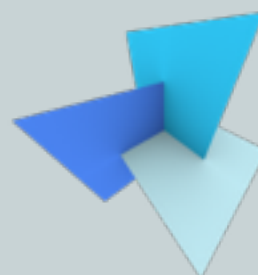
Simplification of digital terrain models using feature-based three-dimensional methods

Hugo Ledoux, Ravi Peters and Jantien Stoter

3rd user committee meeting

2015/05/19

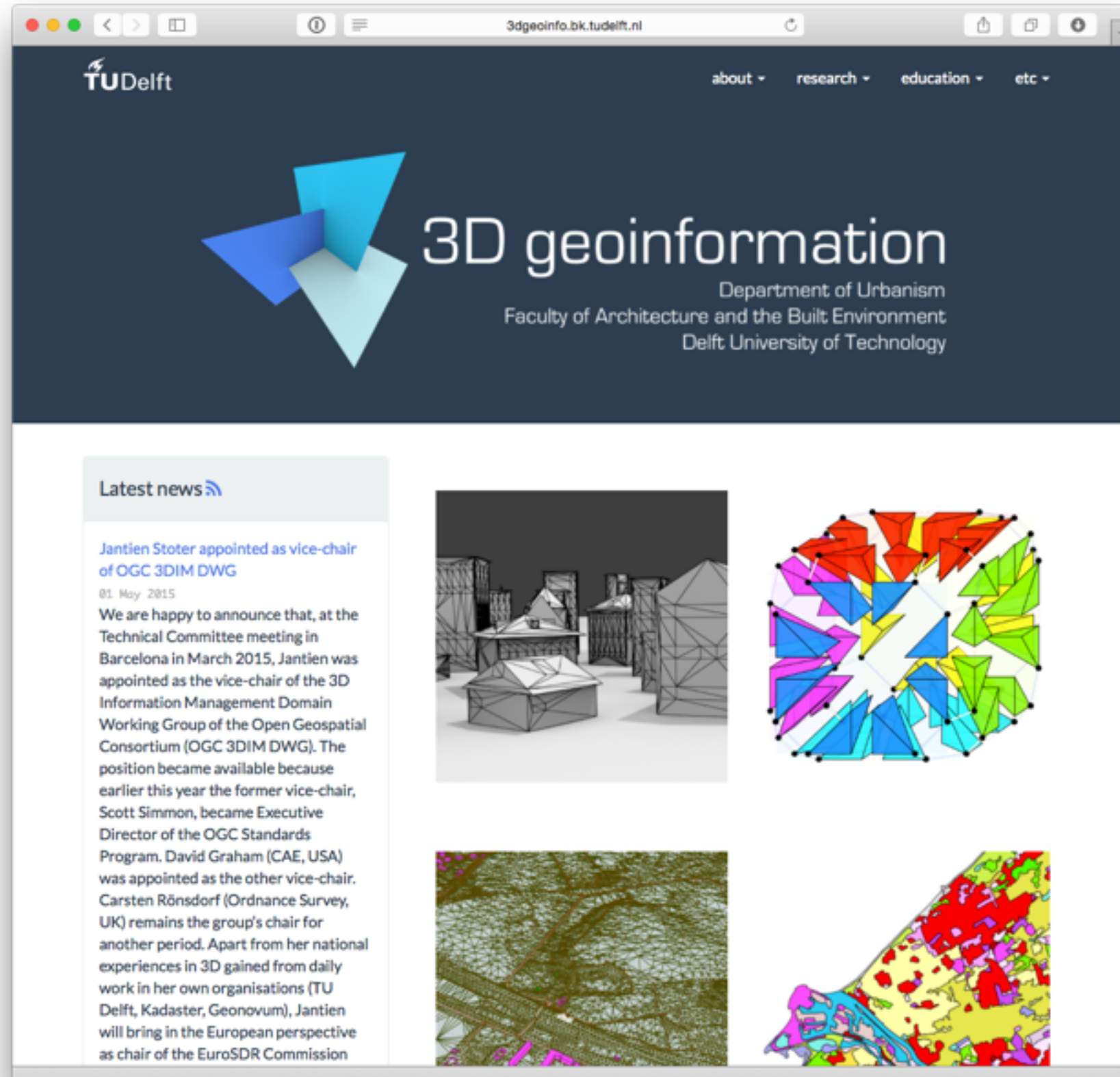
Amersfoort



3D geoinformation
3dgeoinfo.bk.tudelft.nl

 **TU Delft**
Delft
University of
Technology

a new research group!

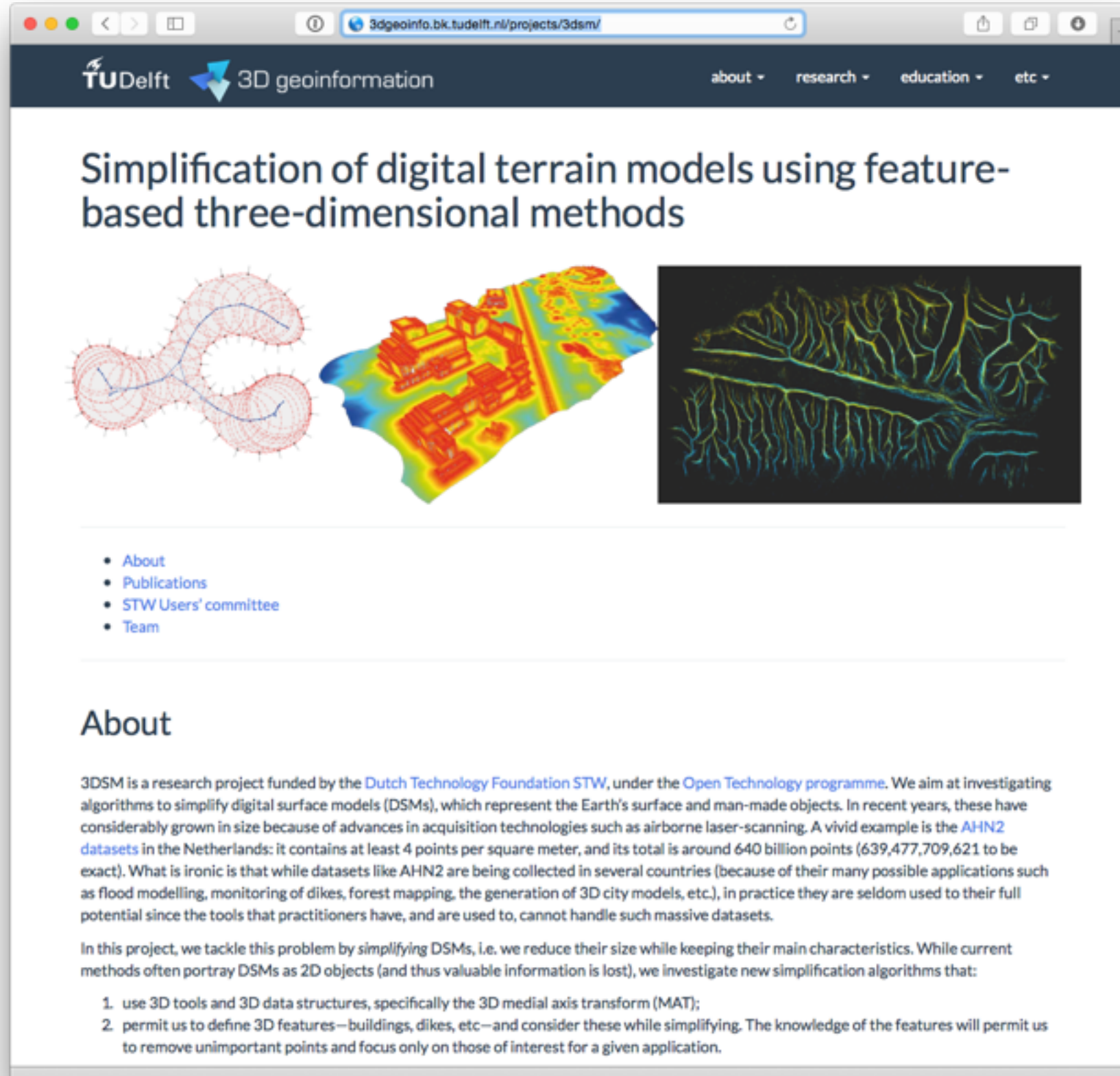


a new research group!

The screenshot shows a web browser window with the address bar displaying `3dgeoinfo.bk.tudelft.nl/about/`. The website header features the TU Delft logo and the text "3D geoinformation". A navigation menu includes links for "about", "research", "education", and "etc". The main content area is titled "Staff" and displays a grid of 12 team members, each with a circular profile picture, name, title, and contact information.

Name	Title	Contact Information
Ken Arroyo Ogori	PhD candidate	kenohori@tudelft.nl , g.a.k.arroyohori@tudelft.nl
Serpil Ates	visiting PhD	s.ates@tudelft.nl
Filip Biljecki	PhD candidate	3dgeoinfo.bk.tudelft.nl/biljecki , f.biljecki@tudelft.nl , @fbiljecki
Linda van den Brink	PhD candidate	l.vandenbrink@geonovum.nl , @brinkwoman
Elif Demir Özbek	visiting PhD	e.demirozbek@tudelft.nl
Hugo Ledoux	Assistant-prof.	tudelft.nl/hledoux , h.ledoux@tudelft.nl , +31 15 27 86114 , @hugoledoux
Liu Liu	PhD candidate	liu-1@tudelft.nl
Pirouz Nourian	PhD candidate	p.nourian@tudelft.nl , +31 6 83 84 6119
Ravi Peters	PhD candidate	3dgeoinfo.bk.tudelft.nl/rypeters , rypeters@tudelft.nl
Jantien Stoter	Professor	3dgeoinfo.bk.tudelft.nl/jstoter , j.e.stoter@tudelft.nl , +31 15 27 81664 , @jantienstoter
Zhiyong Wang	PhD candidate	3dgeoinfo.bk.tudelft.nl/zhiyong , z.wang-1@tudelft.nl , +31 15 27 87934
Sisi Zlatanova	Associate-prof.	3dgeoinfo.bk.tudelft.nl/szlatanova , s.zlatanova@tudelft.nl , +31 15 27 82714

a new research group!



The screenshot shows a web browser window with the URL `3dgeoinfo.bk.tudelft.nl/projects/3dsm/`. The website header features the TU Delft logo and the text '3D geoinformation', with navigation links for 'about', 'research', 'education', and 'etc'. The main heading is 'Simplification of digital terrain models using feature-based three-dimensional methods'. Below this heading are three images: a red wireframe mesh of a terrain, a 3D color-coded terrain model with buildings, and a 3D visualization of a river network. A sidebar on the left contains a list of links: 'About', 'Publications', 'STW Users' committee', and 'Team'. The 'About' section contains a paragraph about the project's funding and goals, followed by a list of two points describing the project's methodology.

Simplification of digital terrain models using feature-based three-dimensional methods

- [About](#)
- [Publications](#)
- [STW Users' committee](#)
- [Team](#)

About

3DSM is a research project funded by the [Dutch Technology Foundation STW](#), under the [Open Technology programme](#). We aim at investigating algorithms to simplify digital surface models (DSMs), which represent the Earth's surface and man-made objects. In recent years, these have considerably grown in size because of advances in acquisition technologies such as airborne laser-scanning. A vivid example is the [AHN2 datasets](#) in the Netherlands: it contains at least 4 points per square meter, and its total is around 640 billion points (639,477,709,621 to be exact). What is ironic is that while datasets like AHN2 are being collected in several countries (because of their many possible applications such as flood modelling, monitoring of dikes, forest mapping, the generation of 3D city models, etc.), in practice they are seldom used to their full potential since the tools that practitioners have, and are used to, cannot handle such massive datasets.

In this project, we tackle this problem by simplifying DSMs, i.e. we reduce their size while keeping their main characteristics. While current methods often portray DSMs as 2D objects (and thus valuable information is lost), we investigate new simplification algorithms that:

1. use 3D tools and 3D data structures, specifically the 3D medial axis transform (MAT);
2. permit us to define 3D features—buildings, dikes, etc.—and consider these while simplifying. The knowledge of the features will permit us to remove unimportant points and focus only on those of interest for a given application.

another related STW-funded project

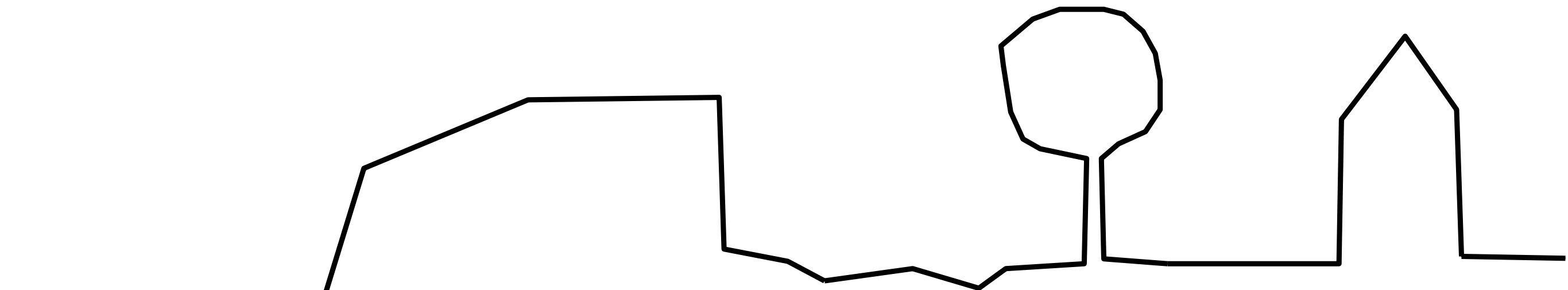


What was the project about again?

dike

tree

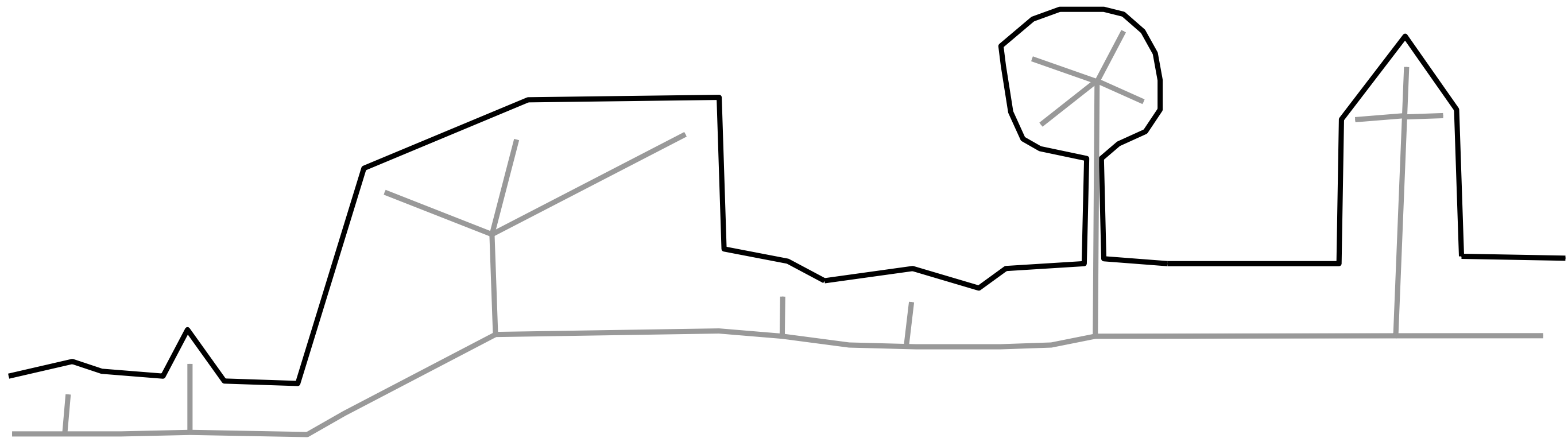
house



dike

tree

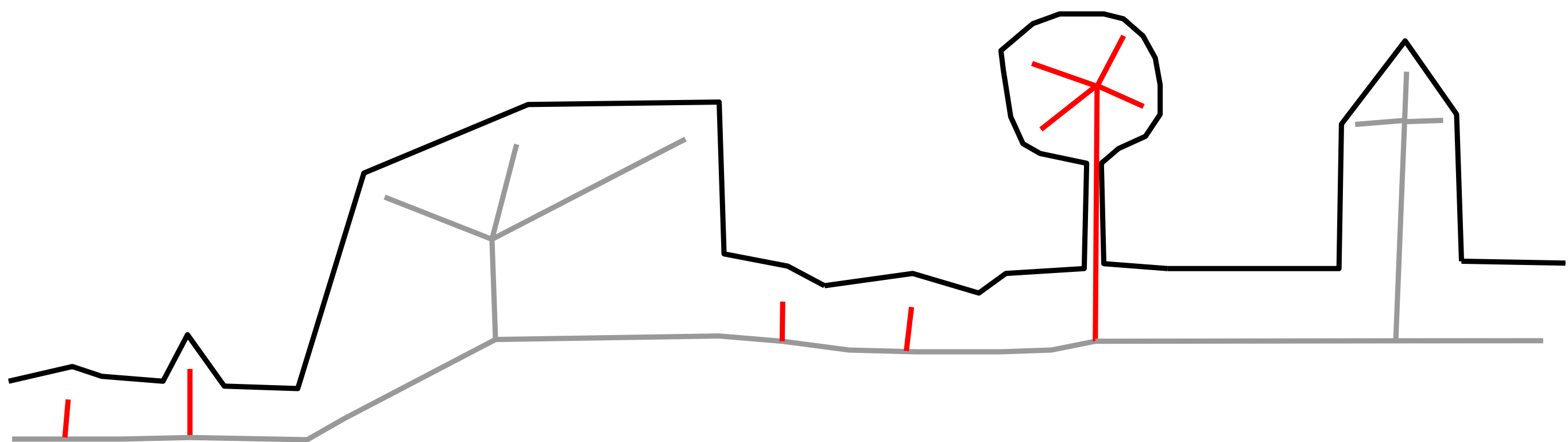
house



dike

tree

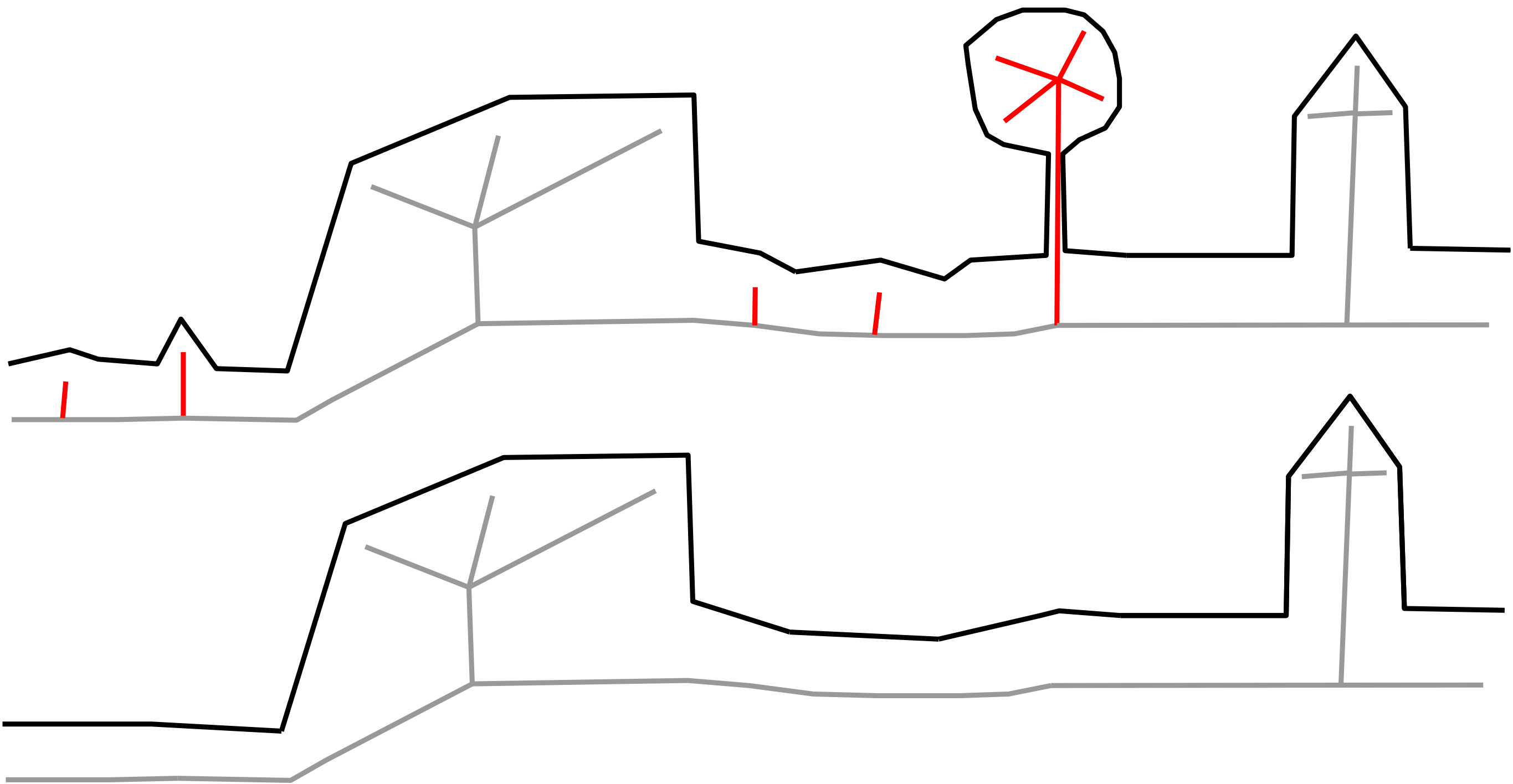
house



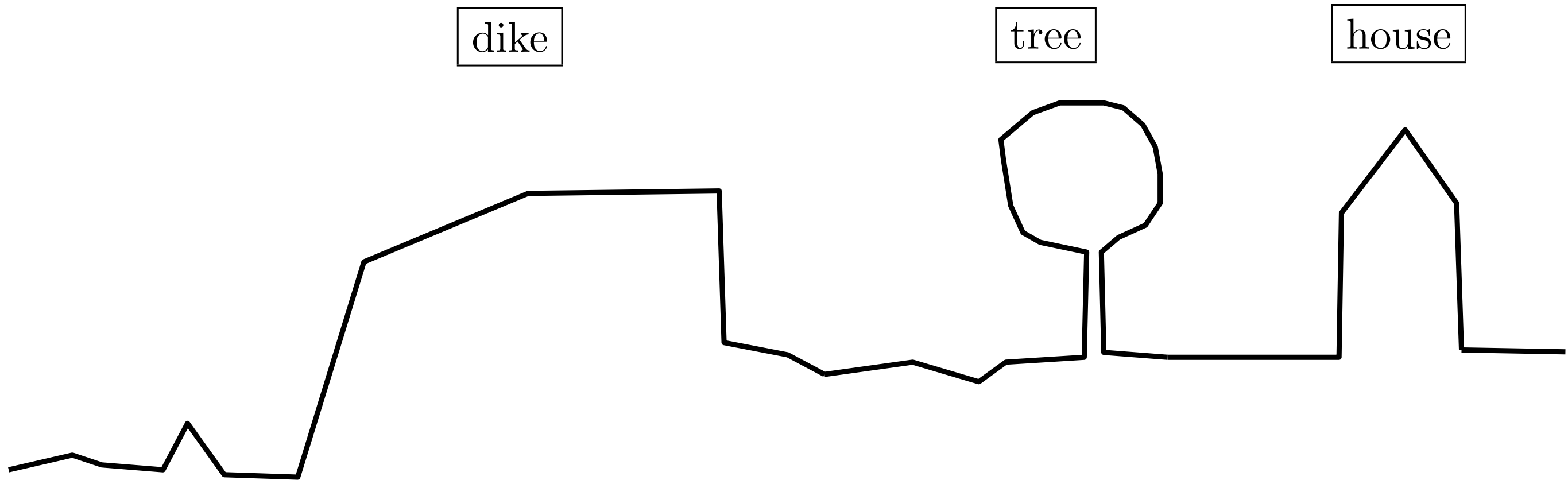
dike

tree

house



no more surface, just the points (eg AHN2)

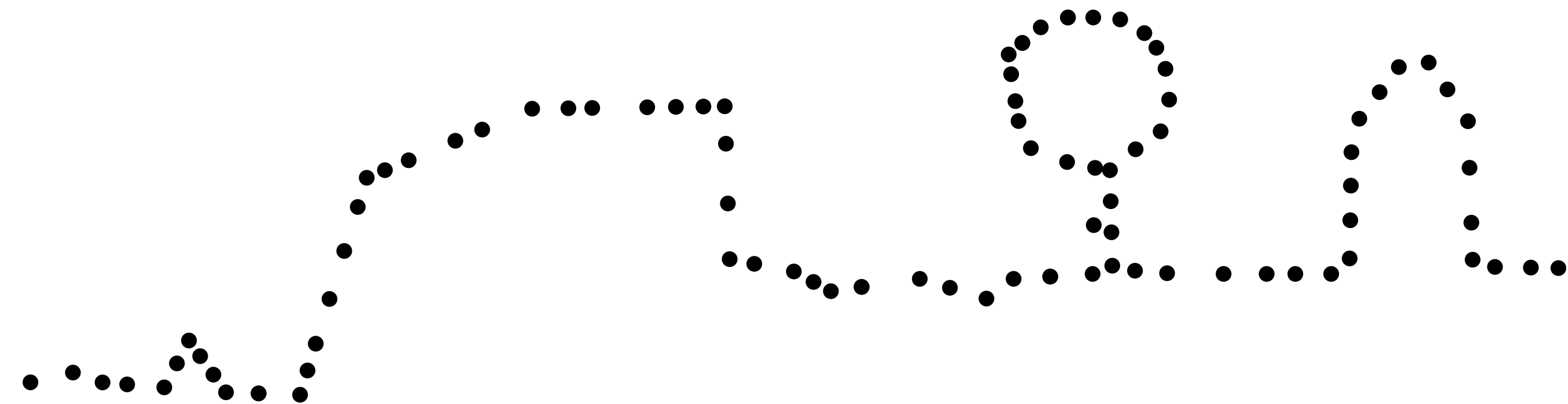


no more surface, just the points (eg AHN2)

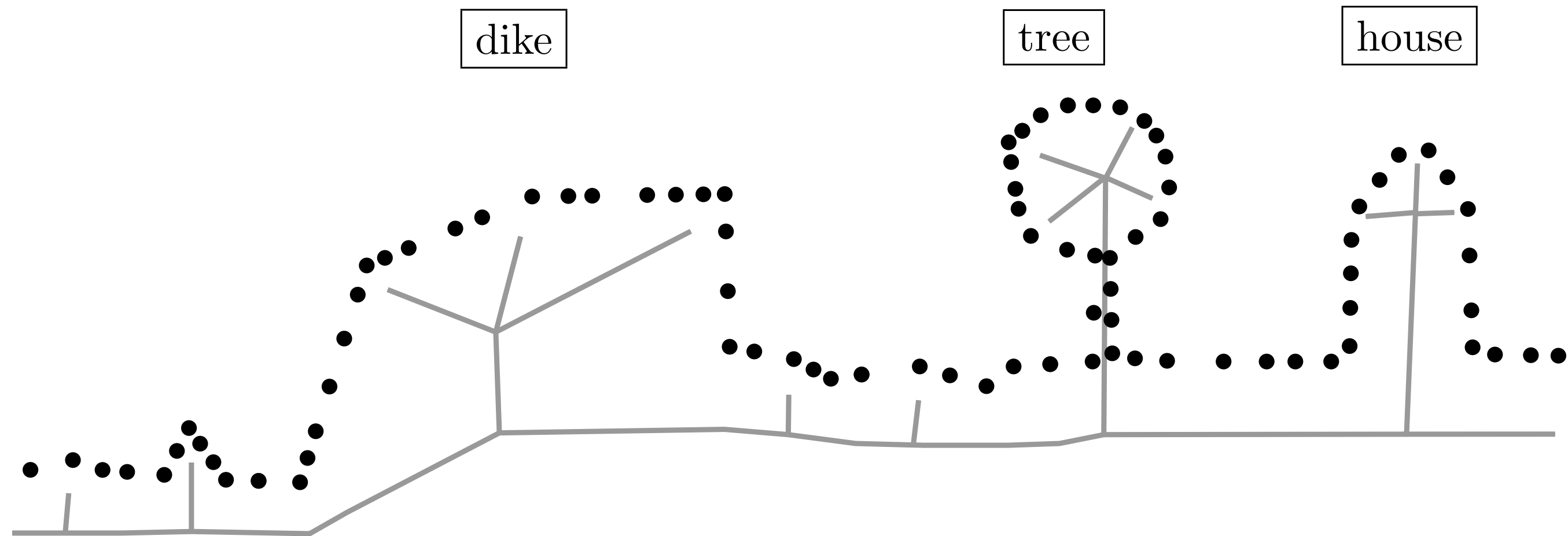
dike

tree

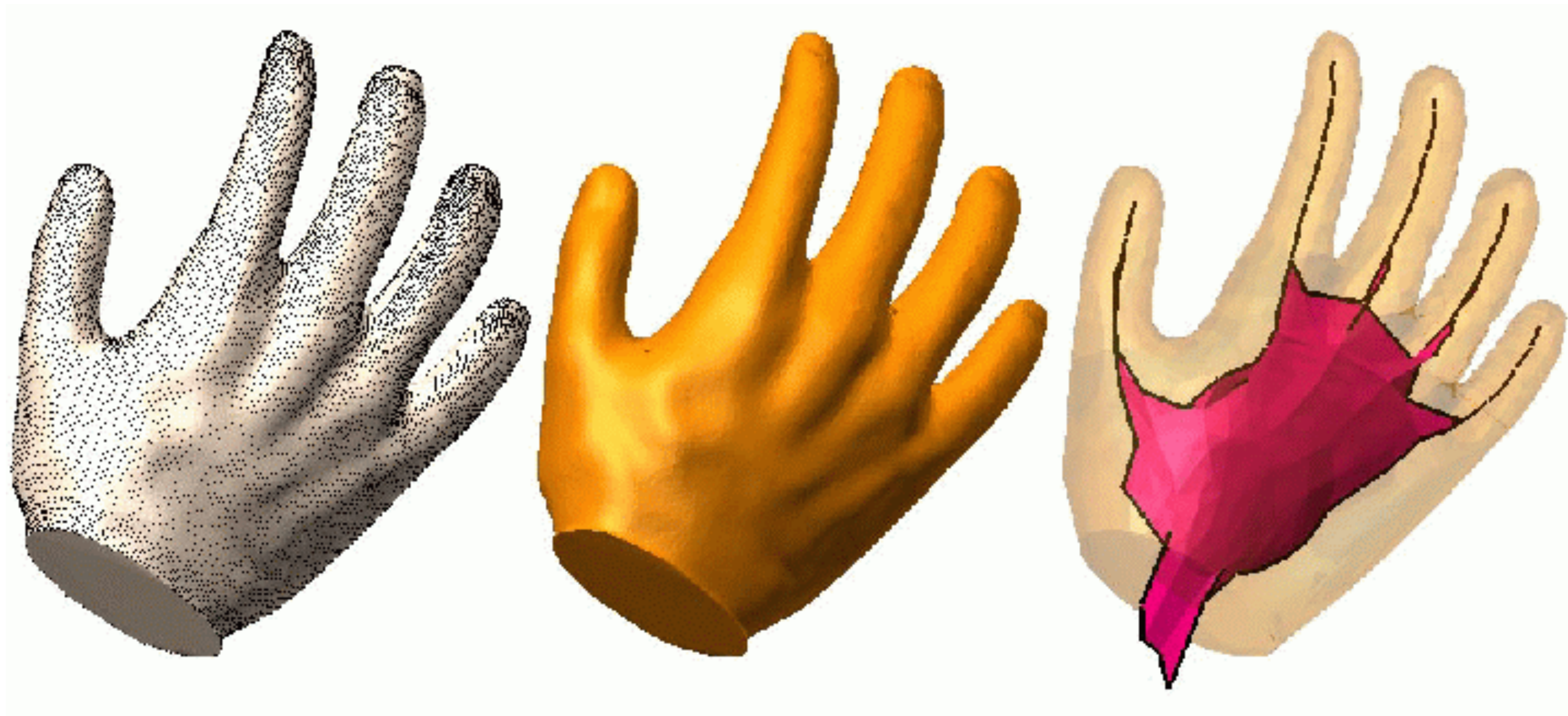
house



no more surface, just the points (eg AHN2)



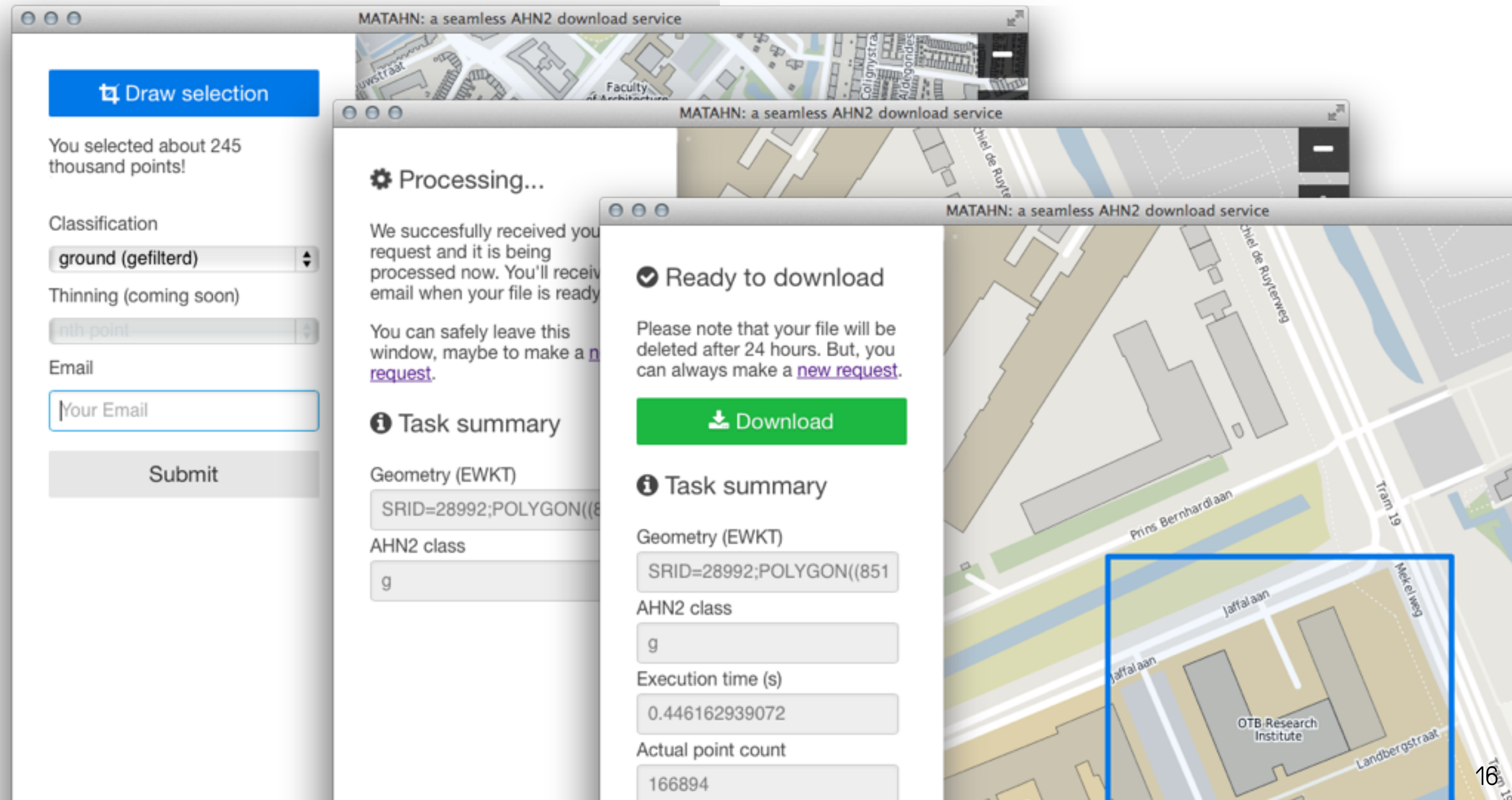
Medial axis transform (MAT) = skeleton



Overview first 2 years

1. MATAHN: an AHN2 download tool

- As simple as possible
- Download only what you need
- No tiles



1. MATAHN: an AHN2 download tool

- As simple as possible
- Download only what you need
- No tiles

working on it

The image displays three overlapping screenshots of the MATAHN web application interface, illustrating the workflow from selection to download.

Left Screenshot (Selection): Shows the "Draw selection" button and a status message: "You selected about 245 thousand points!". The "Classification" dropdown is set to "ground (gefilterd)". The "Thinning" dropdown is set to "nth point". An email input field is visible with the placeholder "Your Email". A red circle highlights the "Classification" and "Thinning" dropdowns, with a red arrow pointing to them from the text "working on it".

Middle Screenshot (Processing): Shows the "Processing..." status. A message states: "We successfully received your request and it is being processed now. You'll receive an email when your file is ready." Below this, it says: "You can safely leave this window, maybe to make a [new request](#)." The "Task summary" section shows: "Geometry (EWKT): SRID=28992;POLYGON((8...)", "AHN2 class: g", and "Execution time (s): 0.446162939072".

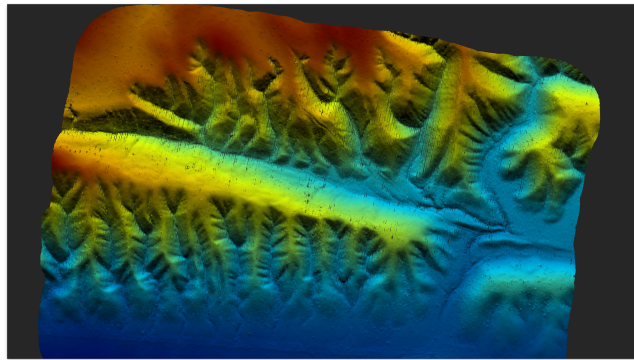
Right Screenshot (Ready to download): Shows the "Ready to download" status. A message states: "Please note that your file will be deleted after 24 hours. But, you can always make a [new request](#)." Below this is a green "Download" button. The "Task summary" section shows: "Geometry (EWKT): SRID=28992;POLYGON((851...)", "AHN2 class: g", "Execution time (s): 0.446162939072", and "Actual point count: 166894".

The background of the screenshots shows a map of a city area, with a blue rectangle highlighting a specific region in the bottom right corner of the rightmost screenshot.

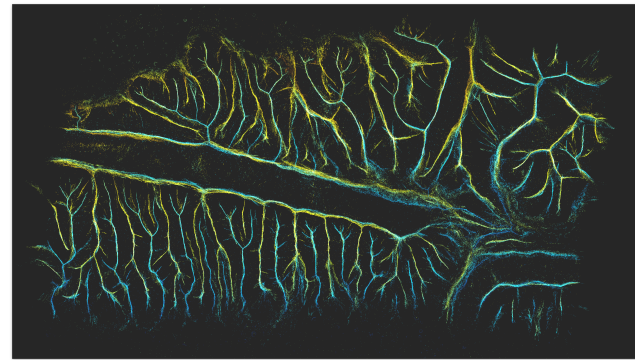
2. several papers/conferences/workshops

- **Visualisation of massive point clouds based on the medial axis transform.** Peters, R. & Ledoux, H., Submitted to Computers & Geosciences (2015)
- **A Voronoi-based approach to generating depth-contours for hydrographic charts**, Peters, R.; Ledoux, H. & Meijers, M., Marine Geodesy 37(2), 145--166 (2014)
- **Het 3D skelet van een puntenwolk.** Ravi Peters. Presentation at the AHN/NCG studiemiddag (Amersfoort, the Netherlands) (2015)
- Peters, R. (2014). **Feature-aware LiDAR point cloud simplification.** Poster at the GeoBuzz conference (November 2014)
- **Approximating the Medial Axis Transform of LiDAR point clouds**, Peters, R., Poster at the Lorentz workshop on geometric algorithms in the field, Leiden, the Netherlands (2014)

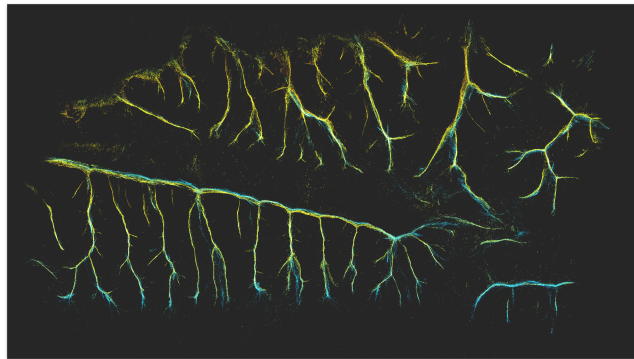
3. new methodology for MAT of real-world LiDAR



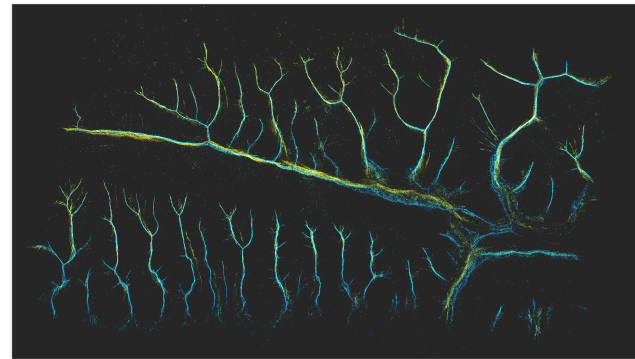
(a) Raw pointcloud.



(b) Interior and exterior MAT

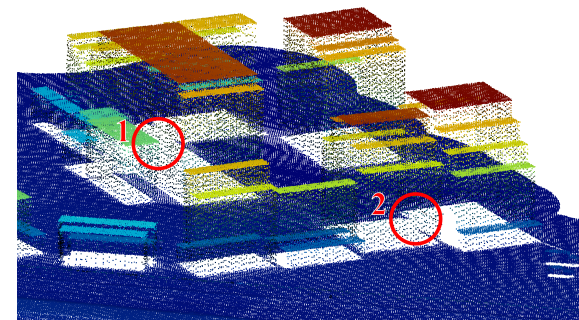


(c) Interior MAT

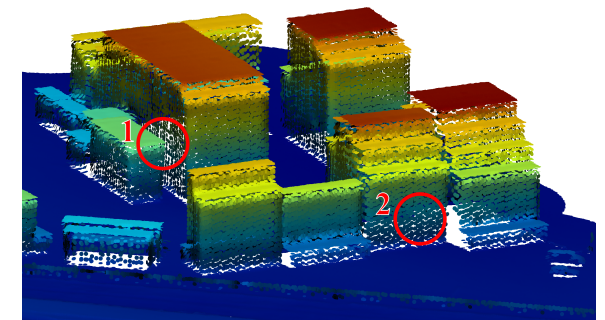


(d) Exterior MAT

deals with noise

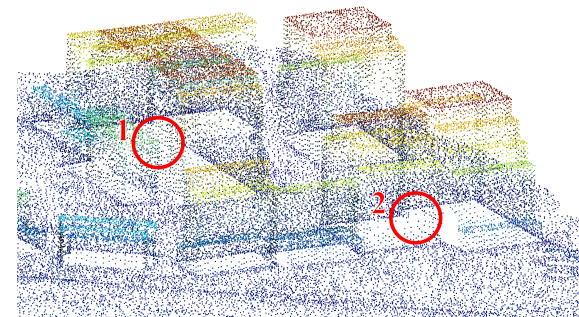


(a) Full point cloud with simple points

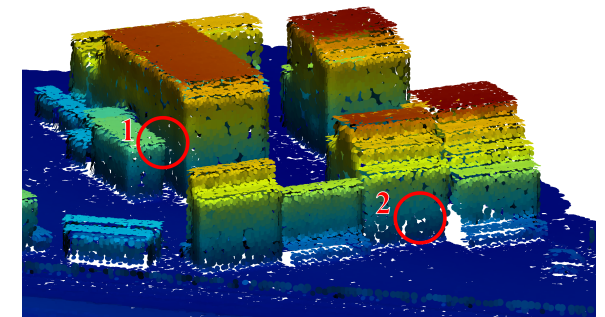


(b) Full point cloud with fixed-radius splats

“smart” simplification

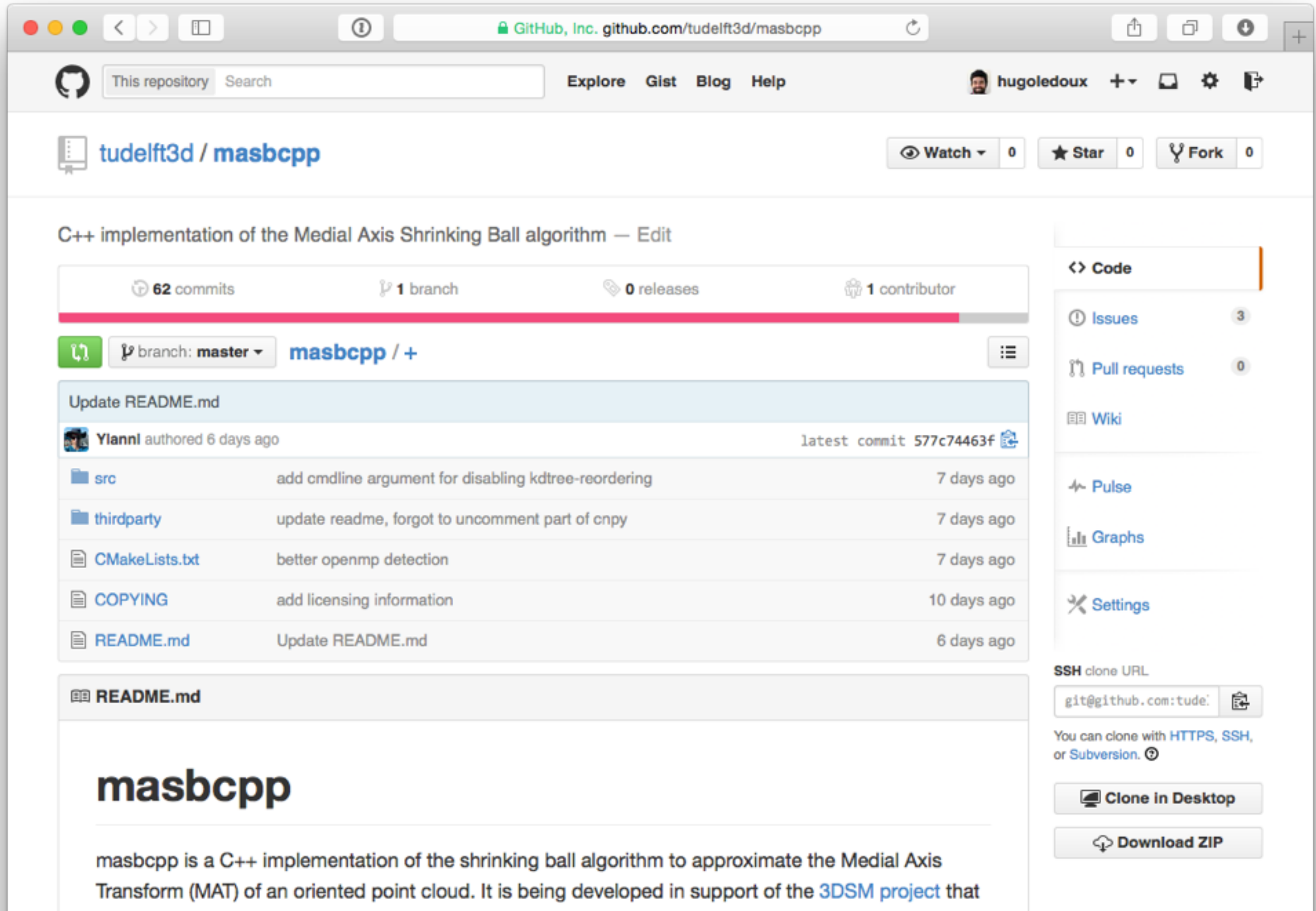


(c) Simplified point (90% of points removed) cloud with simple points



(d) Simplified point (90% of points removed) cloud with lfs-radius splats

4. code released open-source



GitHub, Inc. github.com/tudelft3d/masbcpp

This repository Search Explore Gist Blog Help hugoledoux

tudelft3d / masbcpp Watch 0 Star 0 Fork 0

C++ implementation of the Medial Axis Shrinking Ball algorithm — Edit

62 commits 1 branch 0 releases 1 contributor

branch: master masbcpp / +

Update README.md

Ylanni authored 6 days ago latest commit 577c74463f

src	add cmdline argument for disabling kdtree-reordering	7 days ago
thirdparty	update readme, forgot to uncomment part of cnpy	7 days ago
CMakeLists.txt	better openmp detection	7 days ago
COPYING	add licensing information	10 days ago
README.md	Update README.md	6 days ago

README.md

masbcpp

masbcpp is a C++ implementation of the shrinking ball algorithm to approximate the Medial Axis Transform (MAT) of an oriented point cloud. It is being developed in support of the [3DSM project](#) that

Code

- Issues 3
- Pull requests 0
- Wiki
- Pulse
- Graphs
- Settings

SSH clone URL

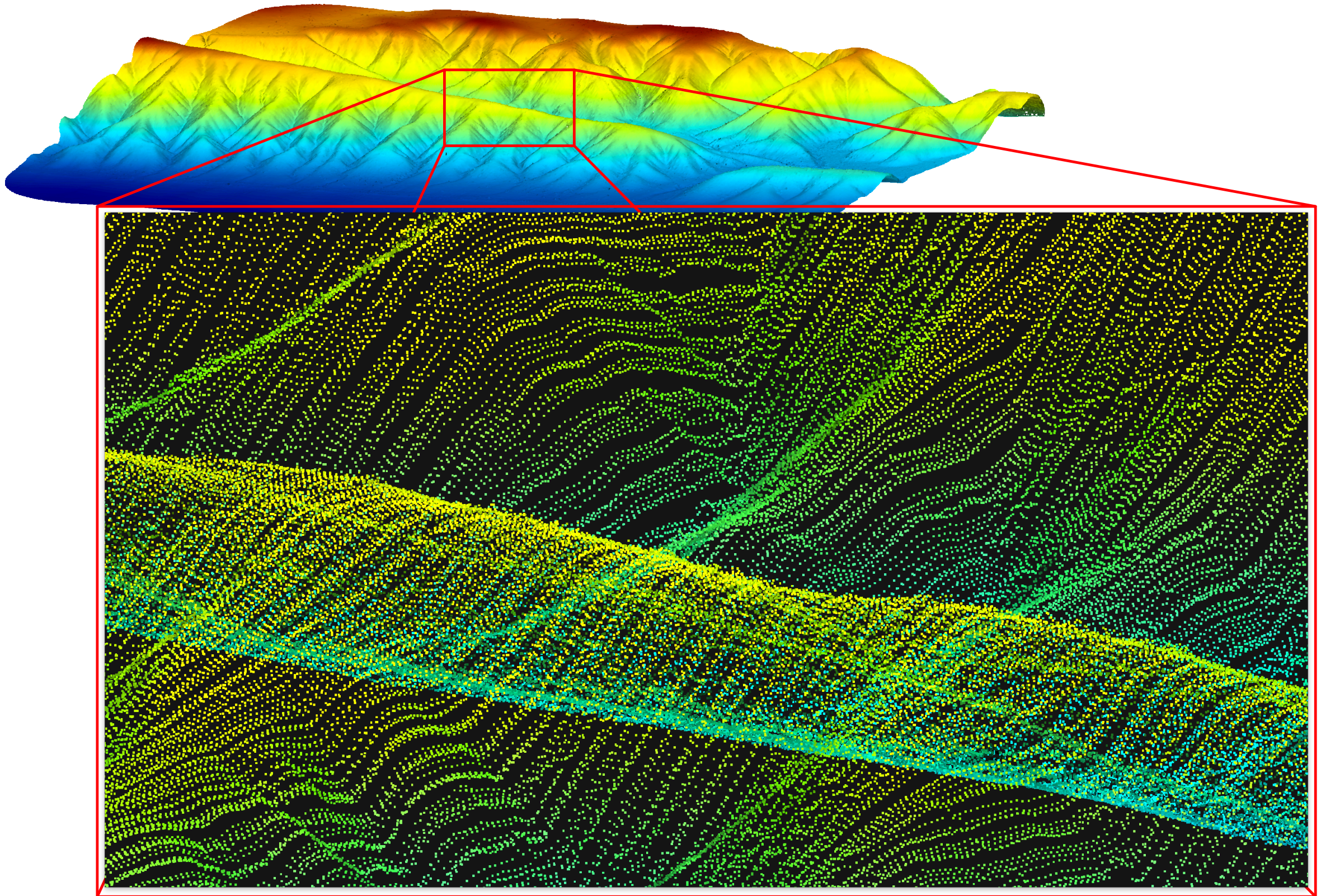
git@github.com:tude:

You can clone with [HTTPS](#), [SSH](#), or [Subversion](#).

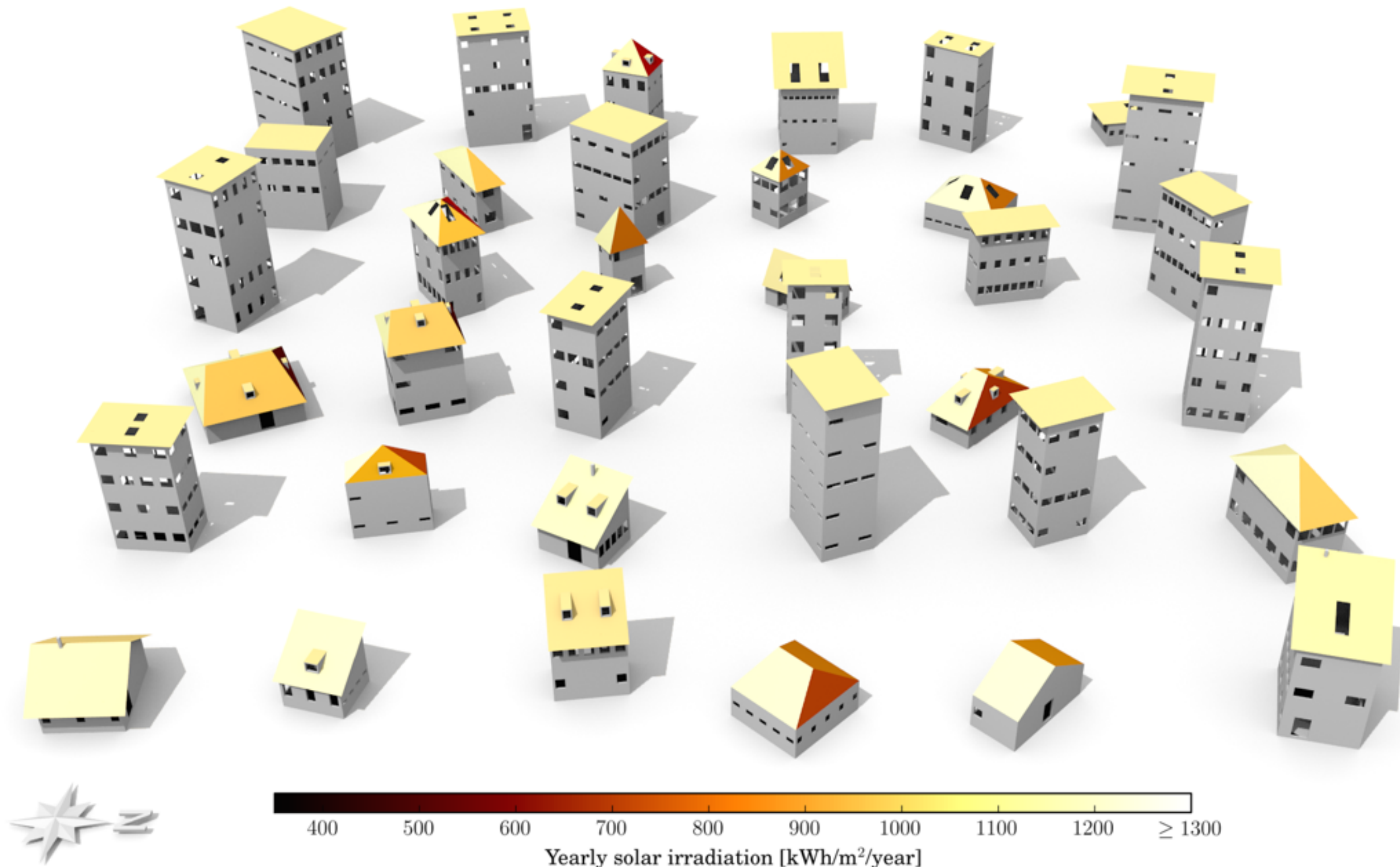
Clone in Desktop

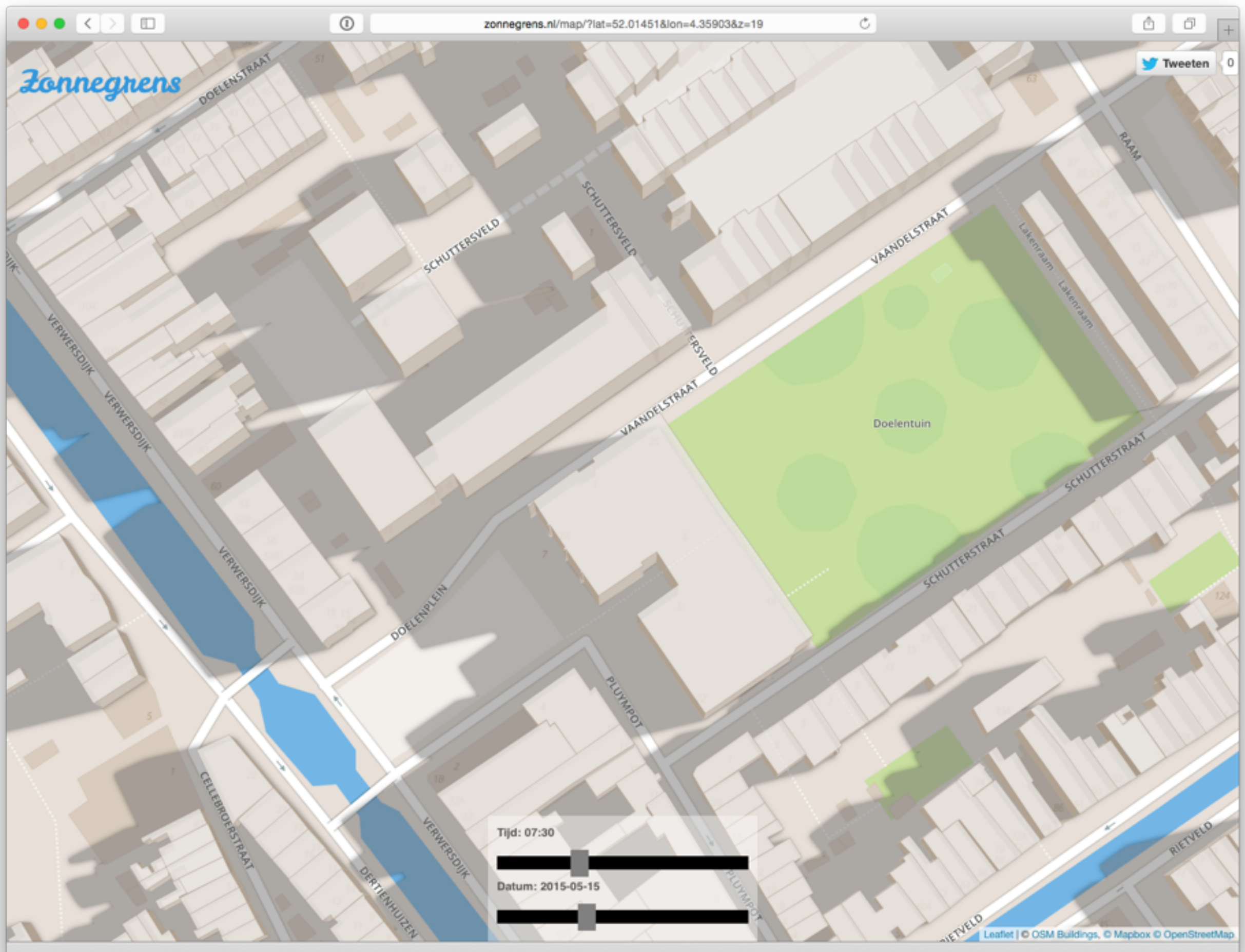
Download ZIP

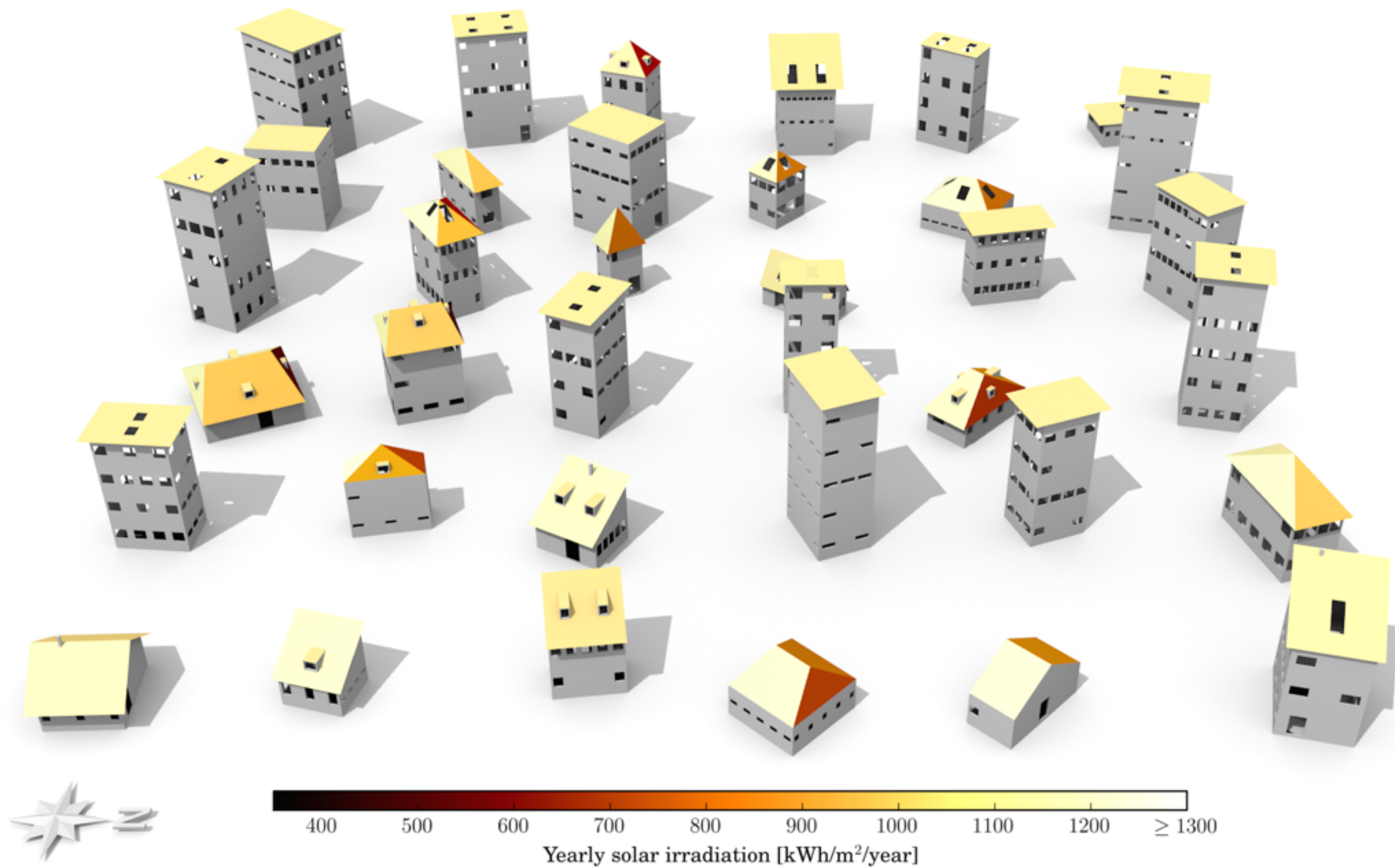
5. use-cases: mostly visualisation up to now

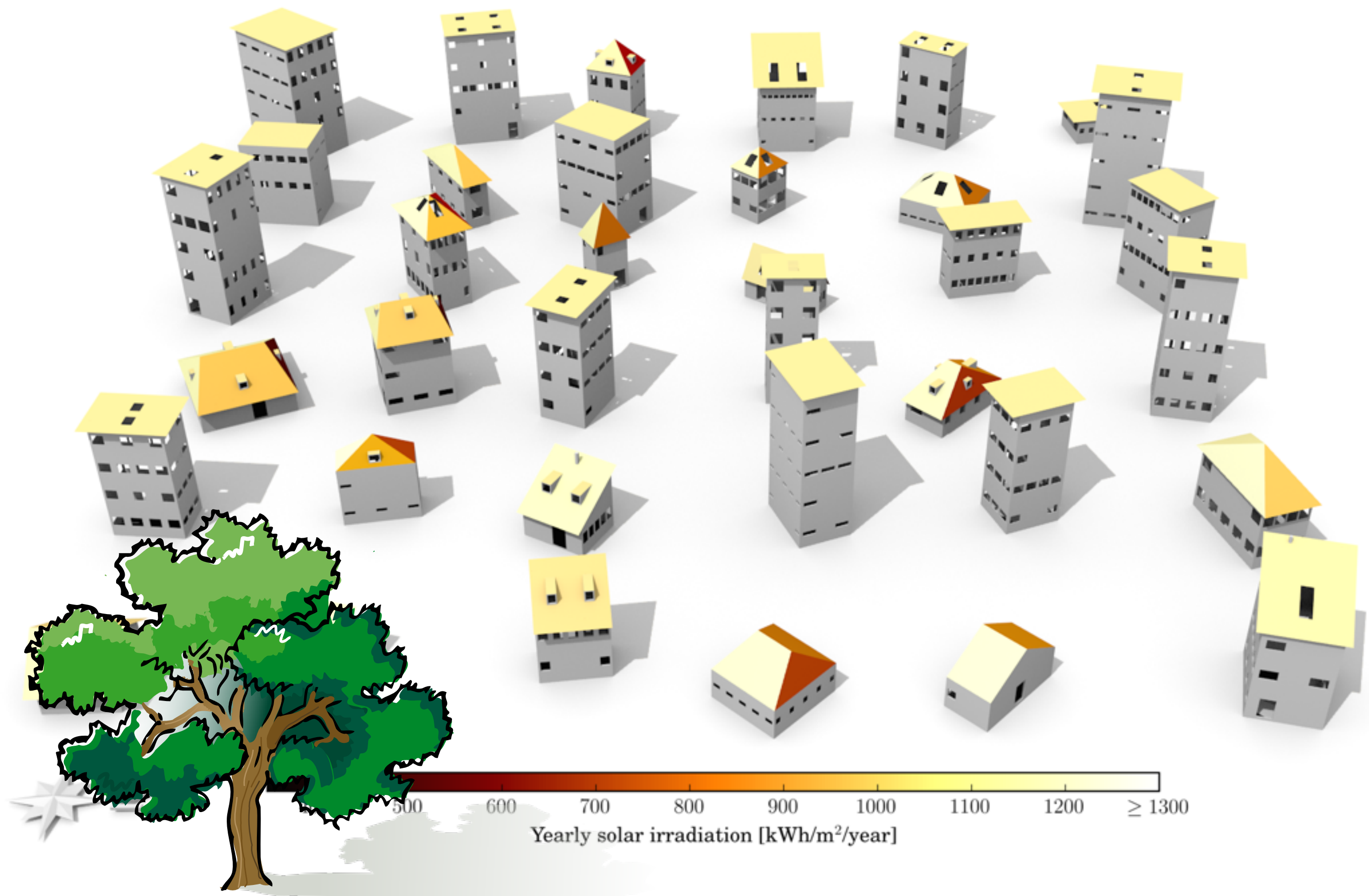


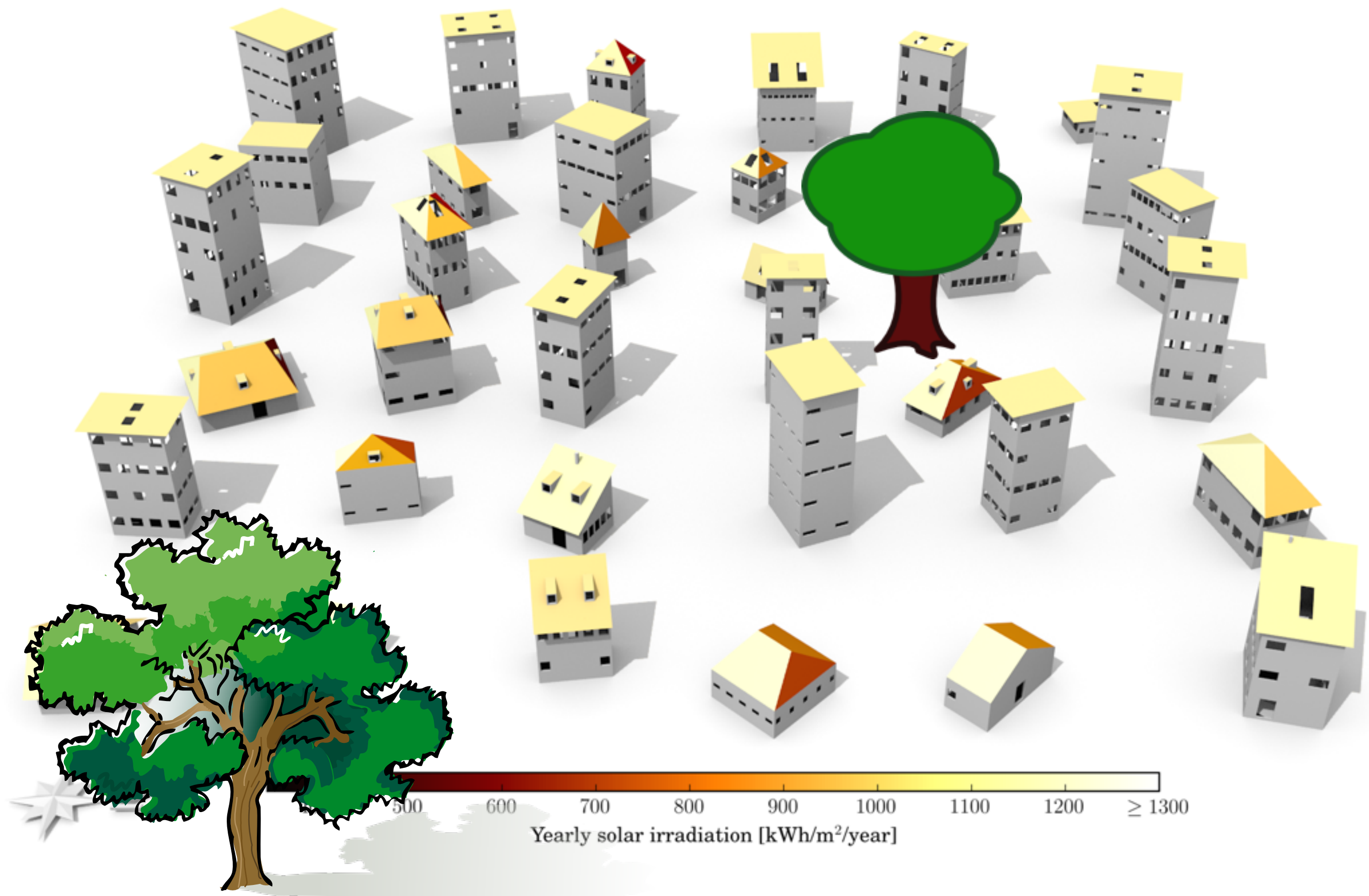
5. use-cases: other visibility-based applications

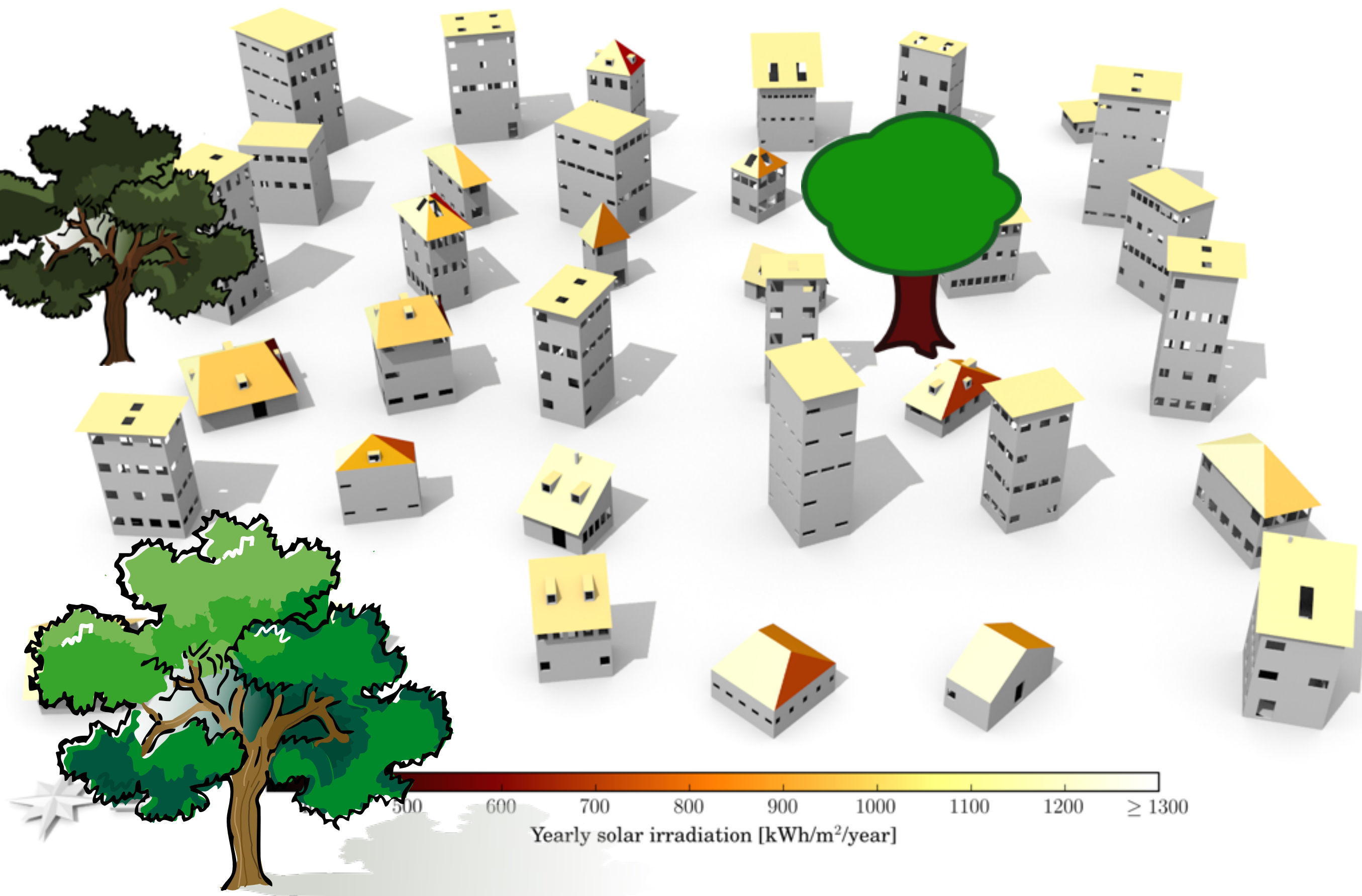


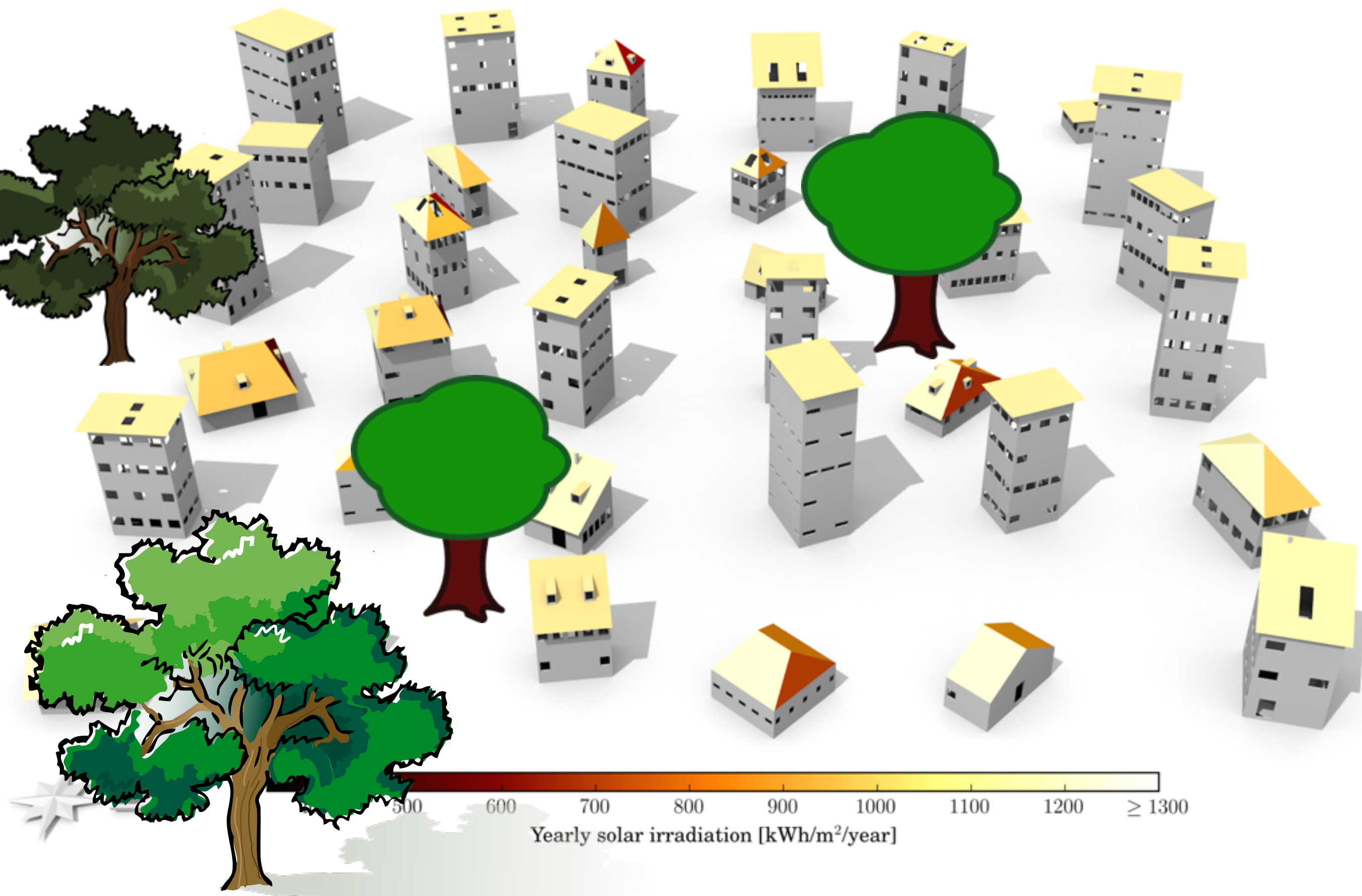


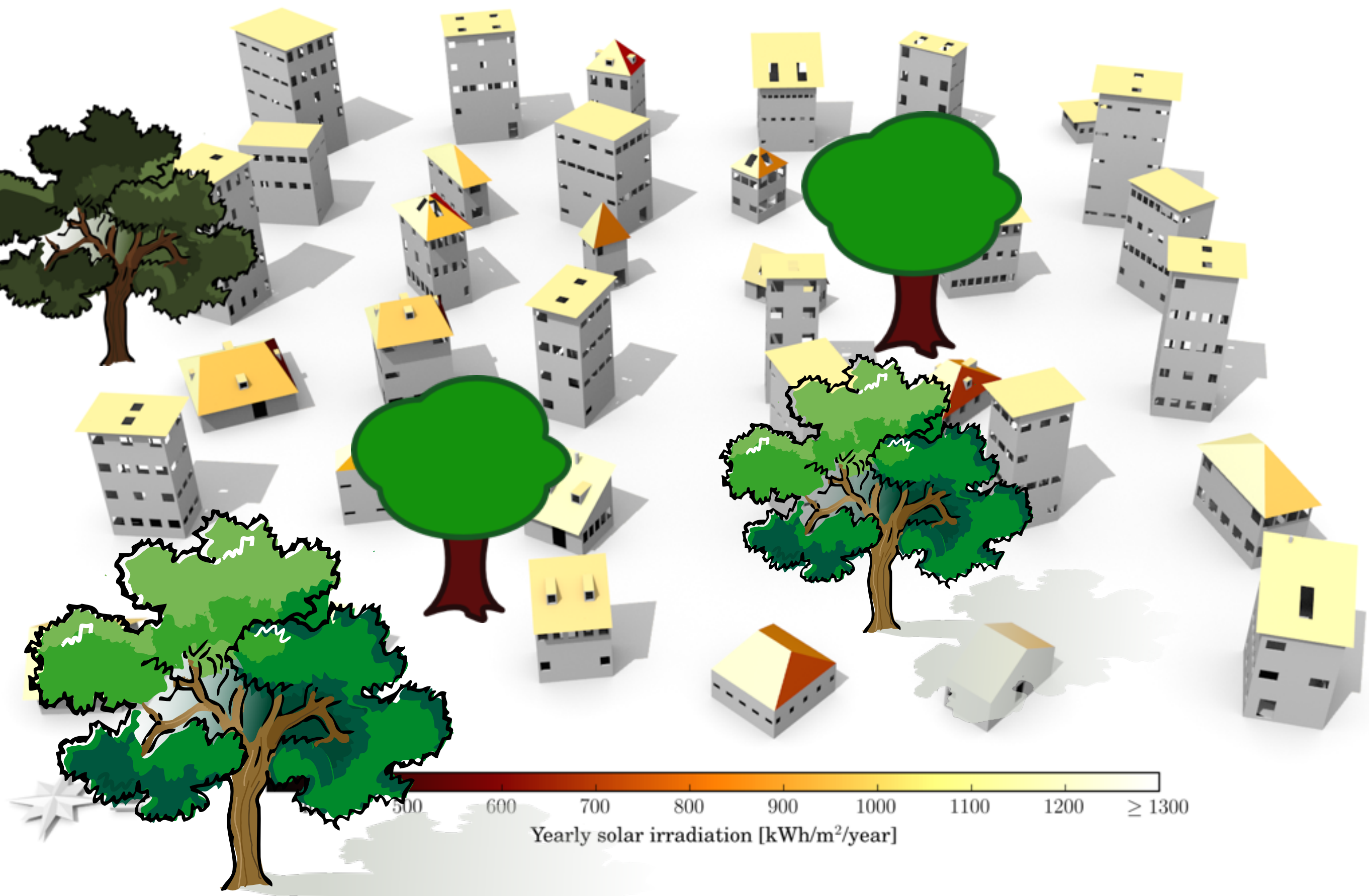












slide from September 2014

Activities coming year:

1. Continue prototype for real-cases
2. attempt to scale to massive datasets
3. starting work on the identification of features in point clouds
4. Ravi will make a research visit in February 2015 to Dr Michela Spagnuolo in Genova, Italy
5. write and publish one conference paper (based on use-cases), and write another journal paper (in collaboration with Michela Spagnuolo)

slide from September 2014

Activities coming year:

1. Continue prototype for real-cases ✓
2. attempt to scale to massive datasets ✓
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4. Ravi will make a research visit in February 2015 to Dr Michela Spagnuolo in Genova, Italy [→ postponed to end of this year]
5. write and publish one conference paper (based on use-cases), and write another journal paper (in collaboration with Michela Spagnuolo) ✓ [partly]

objectives next ~9 months

- Use-cases and the use of the MAT for different applications. We will first continue exploring how it can be used for “**visibility applications**” (which is very promising) and for other use-cases previously discussed with the users’ committee.
- Explore how can **features be identified** in a point cloud (with the help of the MAT obviously). Once identified, these could be deleted (and thus we would obtain a simplified point cloud). In the coming period we expect to develop the theory (with synthetic datasets), and in the next one (final year of the project) to apply it to the use-cases of the members of the users’s committee.
- Better scaling of altos (with MSc student Marco Lam).

questions/comments from Joris Goos

- Interesting to see whether the method can be scaled to large datasets, whether datasets from Niels (AHN3) and Marc (**point from image matching**) yield similar results and whether noise in the datasets can be found
- I did come across the following: How about discussion/insights into the **use of generalised terrain models in 3D city models**? We are currently investigating. More specifically: Is the idea of constrained generalisation indeed the way to go, and if so, can it be combined (now or in the future) with the methods in this project? In other words: **can we mark specific points to be 'non-deletable'**? This might definitely be off-topic and if so: do forgive me and feel free to skip. Just some of my thoughts.

3dsm.bk.tude1ft.nl