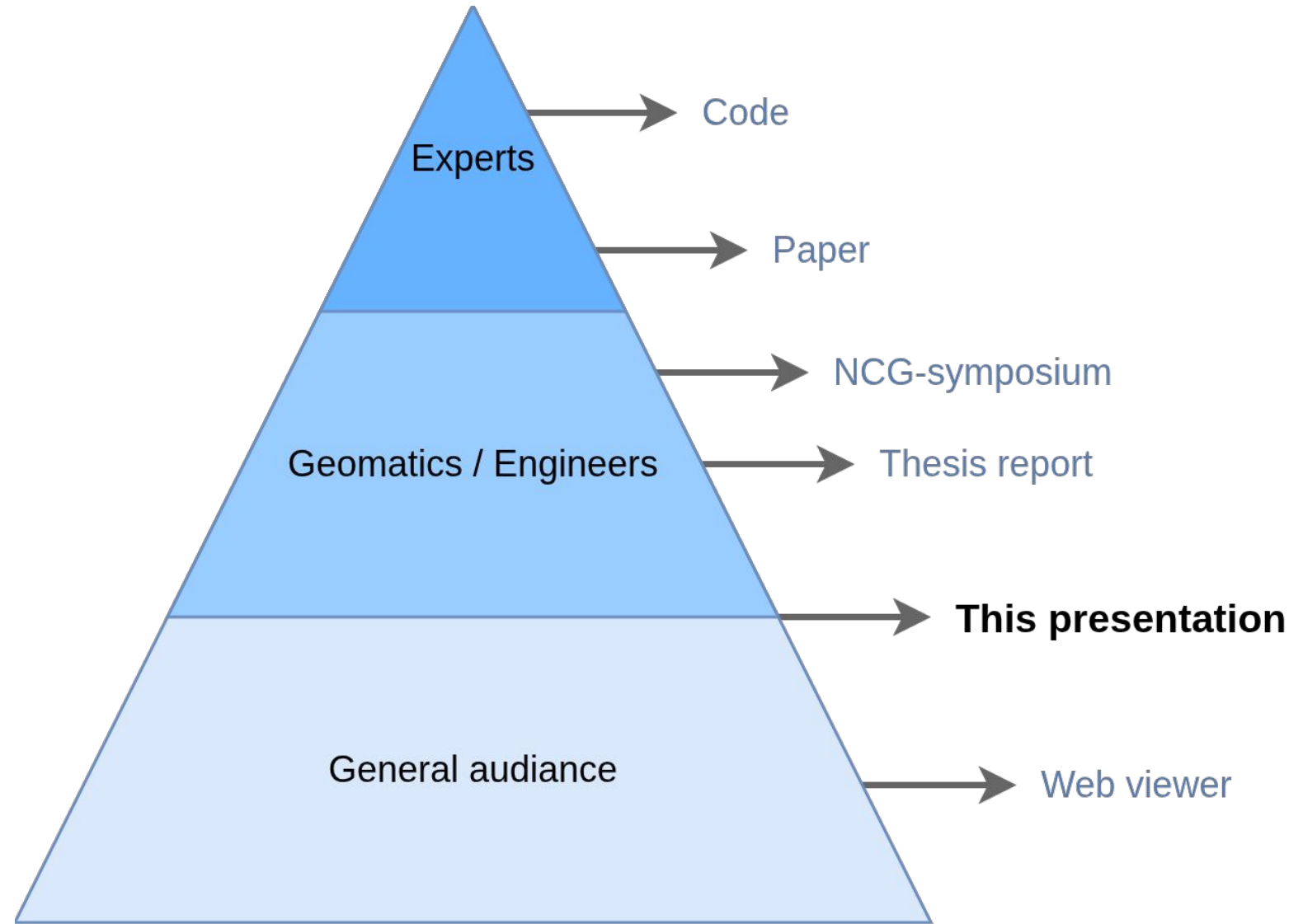


Now you see me, now you don't

Direct LiDAR-Based Intervisibility Modeling with Semi-Transparent
Vegetation for Military Mission Planning





Data science for national security

I got barred from my local Spoons

The pub that changed me

How historian Adam Tooze makes sense of our bewildering age

The long read

The Guardian

Thursday 11 January 2023
£3.00 From £2.50 for subscribers

Trump still intent on 'conquering' Greenland, say Danes after talks

Washington meeting fails to bridge divide between Nato allies

Donald Trump remains intent on "conquering" Greenland, the Danish foreign minister said yesterday, as he urged the United States to "reconsider" its "fundamental disagreement" that has led to a deepening rift between Washington and a Nato ally.

It was "absolutely not necessary" for the United States to take Greenland, a largely self-governing part of the Danish kingdom. Lars Løkke Rasmussen said. "We didn't manage to change the American position. It's clear the president has this wish of conquering Greenland. And we made it very very clear that this is not in the interest of the kingdom."

Rasmussen urged Washington to engage in "constructive" conversations with the Danish government, which is controlled by Copenhagen.

In a sign of European support, France, Germany and Norway all said they would come to Greenland's aid if the United States were to take it.

Greenland and Denmark's foreign ministers met in a working group.

MERCREDI 11 OCTOBRE 2022
3,40€ - FRANCE 12,00€ - ALGERIE 12,00€
FONDATEUR: ALBERT LAFONT
DIRECTEUR: JACQUES FAVRE

Le Monde

SCIENCE & MÉDECINE - SUPPLÉMENT

APRÈS LA TERREUR, LA RIPOSTE D'ISRAËL

Après la terreur, la riposte d'Israël

16 000 personnes se sont rassemblées lundi, à Paris, en soutien à Israël. Nombre de Français de confession juive expriment leur inquiétude de la communauté juive de France

Après la terreur, la riposte d'Israël

Après la terreur, la riposte d'Israël

"All the News That's Fit to Print"

The New York Times

Vol. CLXXXI No. 59,345 NEW YORK, FRIDAY, FEBRUARY 25, 2022

WAR IN UKRAINE

RUSSIANS PUSH INTO OUTSKIRTS OF CAPITAL AS DEATHS RISE AND THOUSANDS FLEE WEST

Big Explosion Is Seen Over Kyiv; Zelensky Says He's 'Target No. 1'

This article is by Michael Schwartz, Eyal Ziv and Neil MacFarlane.

RUSSIA continued its attack on Ukraine early Friday, and as it pushed the country's capital, Kyiv, into a desperate battle, the Russian military and its allies were pushing into the outskirts of the capital, Kyiv, and into the outskirts of the capital, Kyiv, and into the outskirts of the capital, Kyiv.

Russian officials said that Russian troops and military forces were moving swiftly toward Ukrainian cities — one toward Kyiv, another toward Chernobyl, the northern Ukrainian city, near Crimea. The forces were using armor and long-range artillery, the officials said.

By Thursday, and Russian forces were pushing into the outskirts of the capital, Kyiv, and into the outskirts of the capital, Kyiv, and into the outskirts of the capital, Kyiv.

THE SUNDAY TIMES

January 4, 2020 Issue No. 10000

Marisa Abela: 'We're not afraid to upset people'

Leonardo DiCaprio and Paul Thomas Anderson on the fight to save cinema

The experts' guide to (nearly) everything

We'll run Venezuela, vows US after capture of Maduro

Blindfolded president and wife taken to New York
Trump says American companies will get oil flowing

Pro-Palestine activists end prison hunger strike

THE TIMES

Regime teeters in Tehran

Trump says Ayatollah wants to flee amid protests | Starmer urges Iran authorities to show 'restraint'

Why Bowie is bigger than ever

Christmas Appeal Help three amazing charities

The A-list's hair secret

THE TIMES

Russians Wake Up to Discover They Didn't Really Know Putin

By ANTON TROTSKY

Russian officials thought they knew their president. They were wrong.

For most of the 12 years, Vladimir V. Putin presented an image of calm, steady leadership. He was the one who kept the Russian Federation together, the one who kept the Russian Federation together, the one who kept the Russian Federation together.

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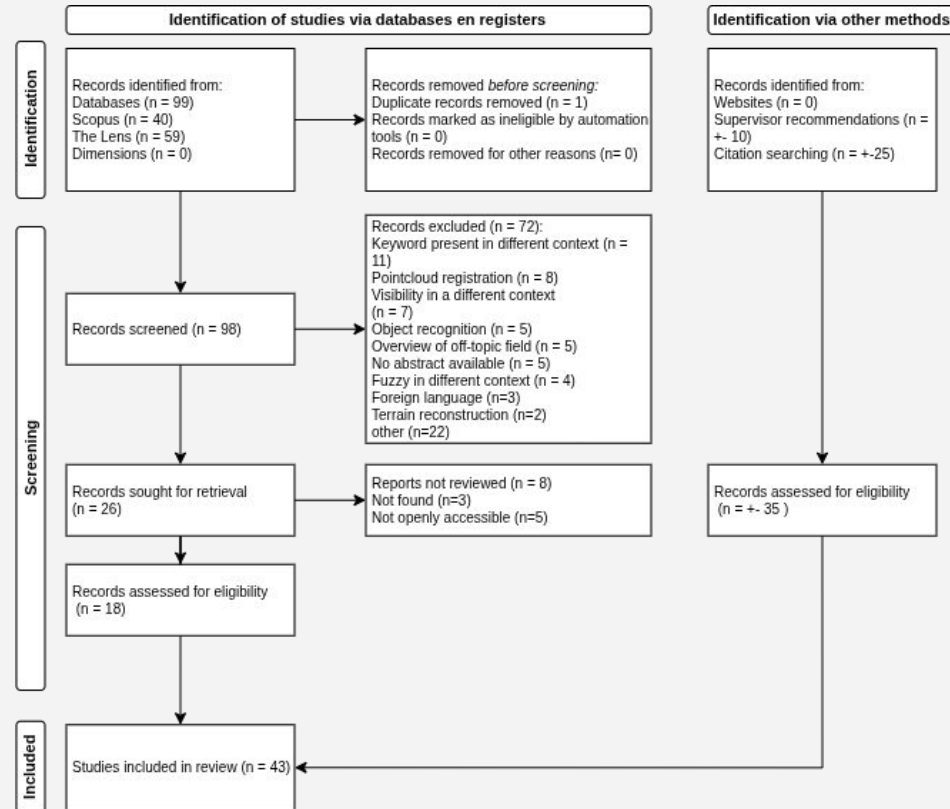
Data science for national security

- Data Science Centre of Excellence
- Airborne missions
- Largely manual process
- Visibility is a crucial factor

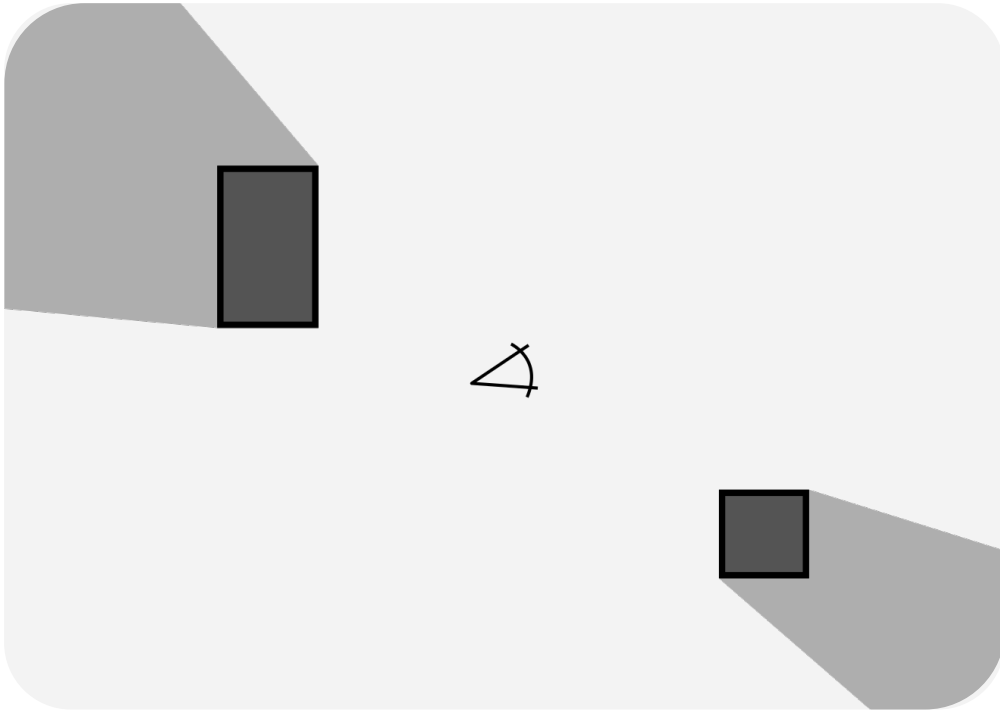


Limitations of current methods

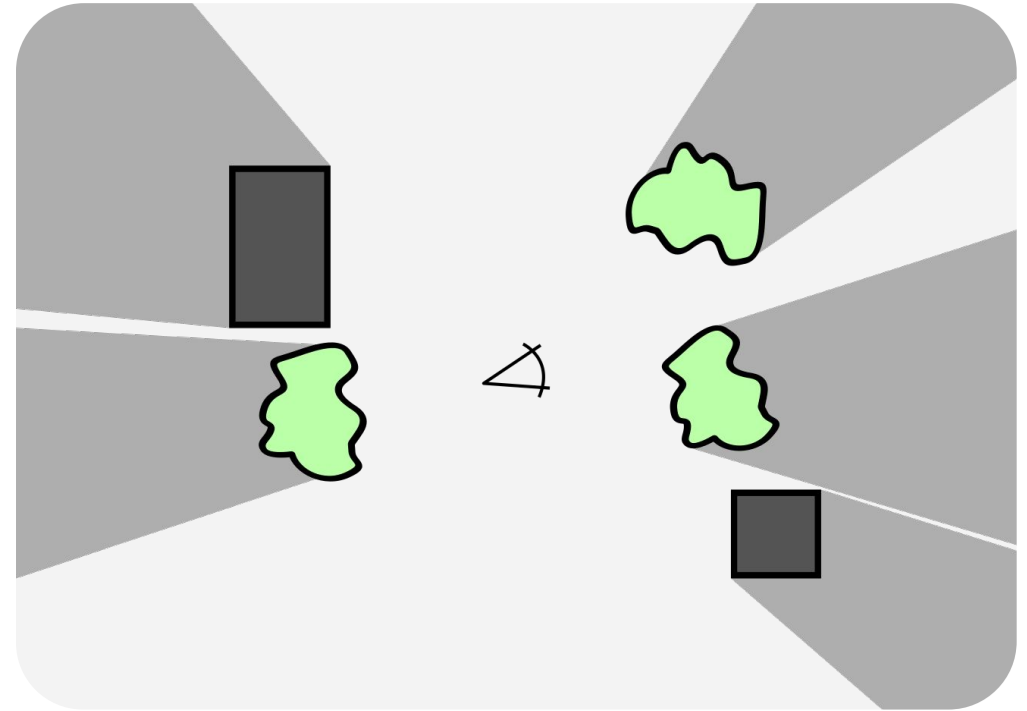
- Vegetation
- Transparency
- Dimensionality
- Representation



Vegetation

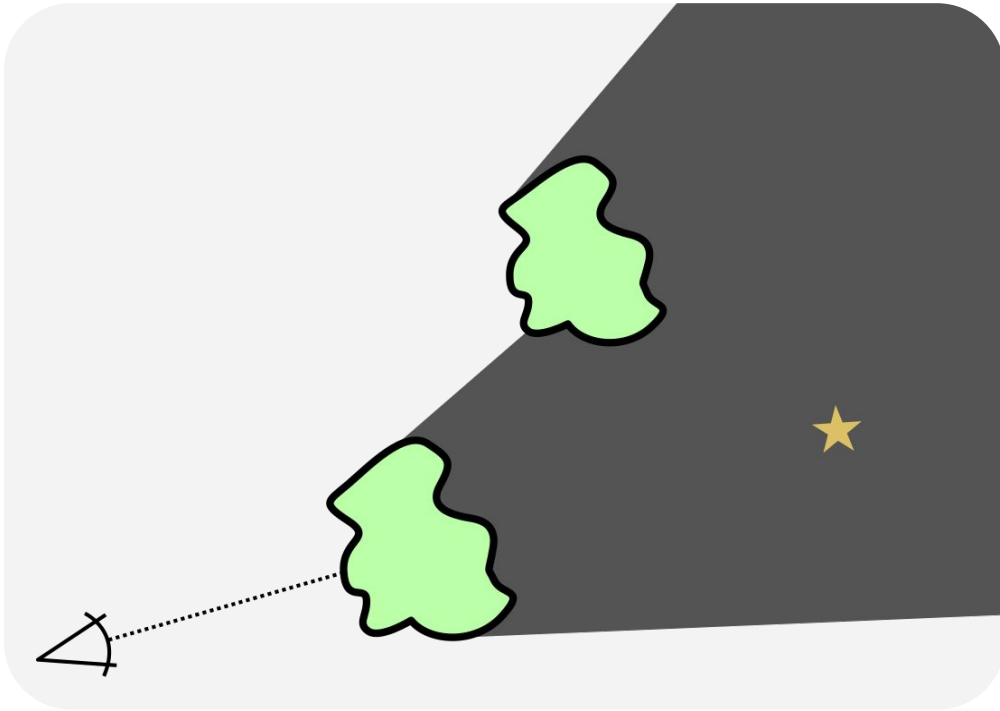


No vegetation

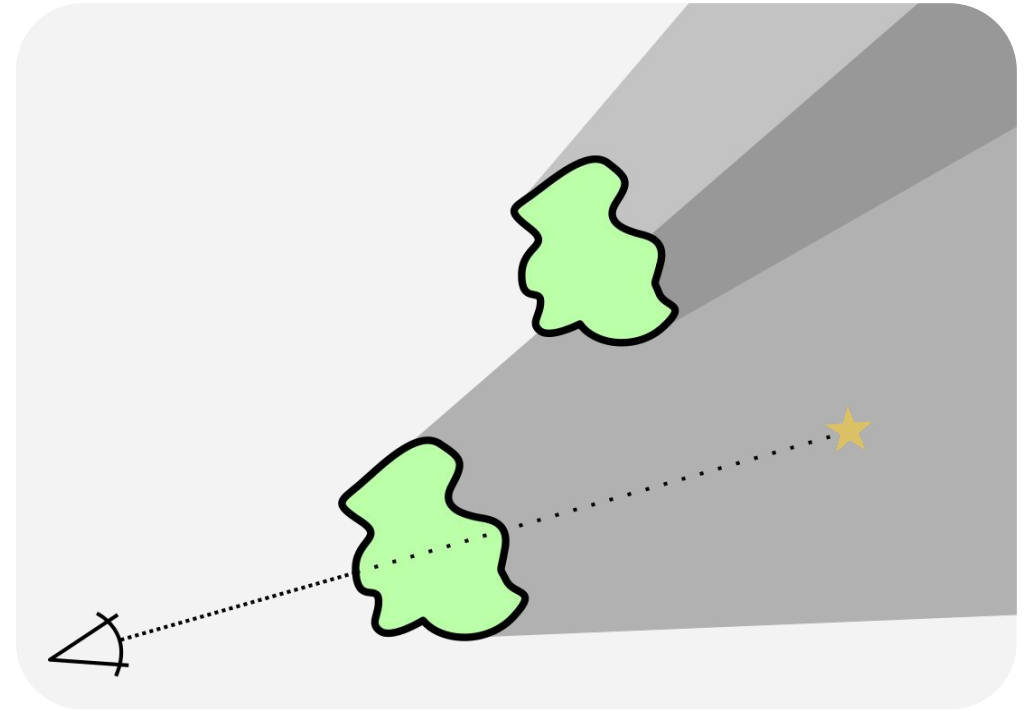


Including vegetation

Transparency

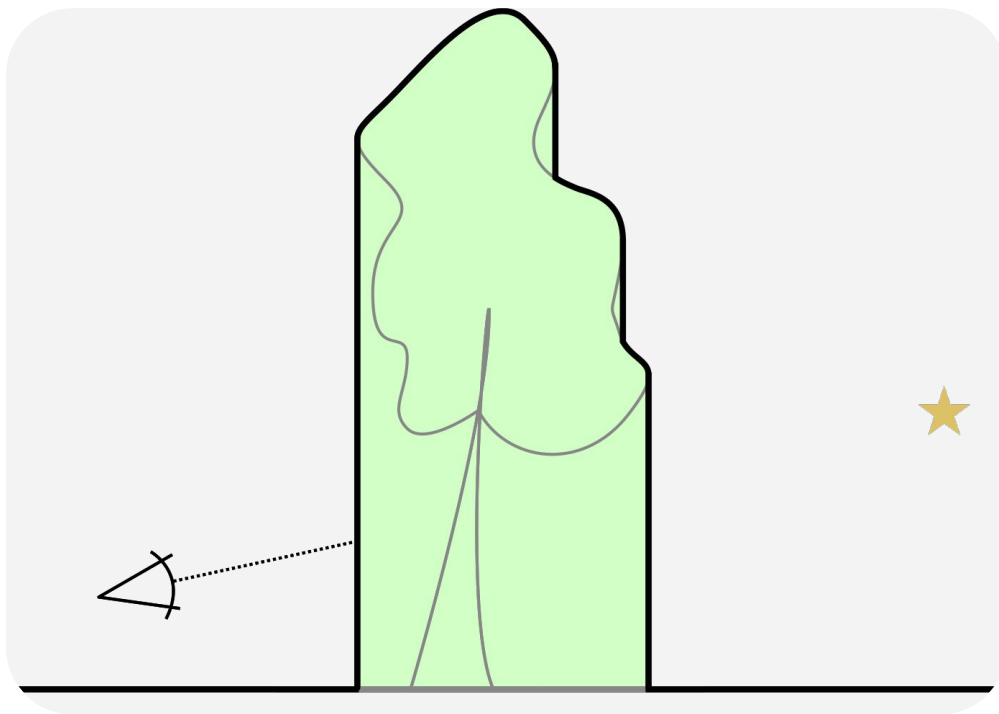


Binary viewshed

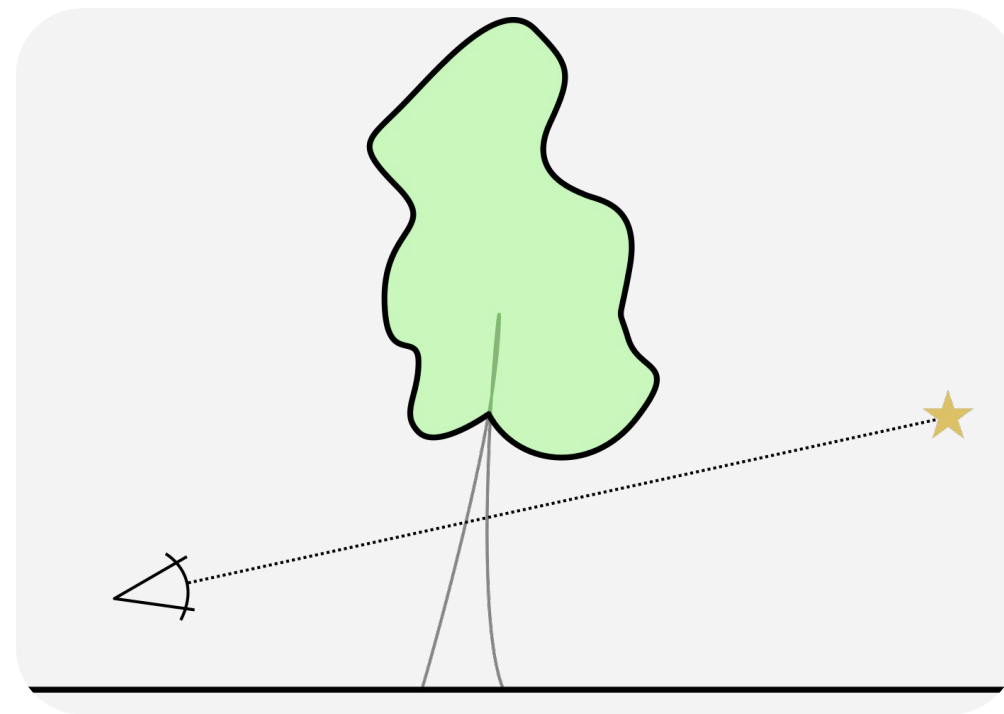


Non-binary viewshed

Dimensionality

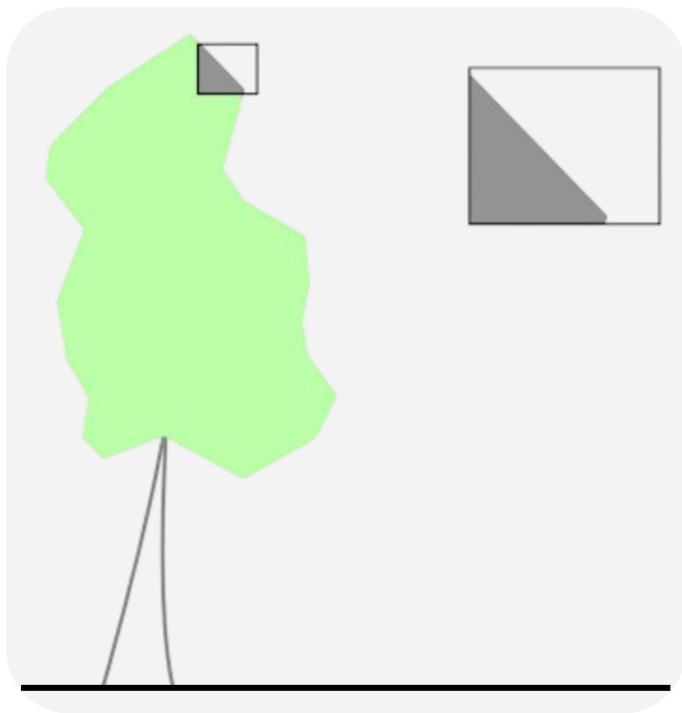


2.5D

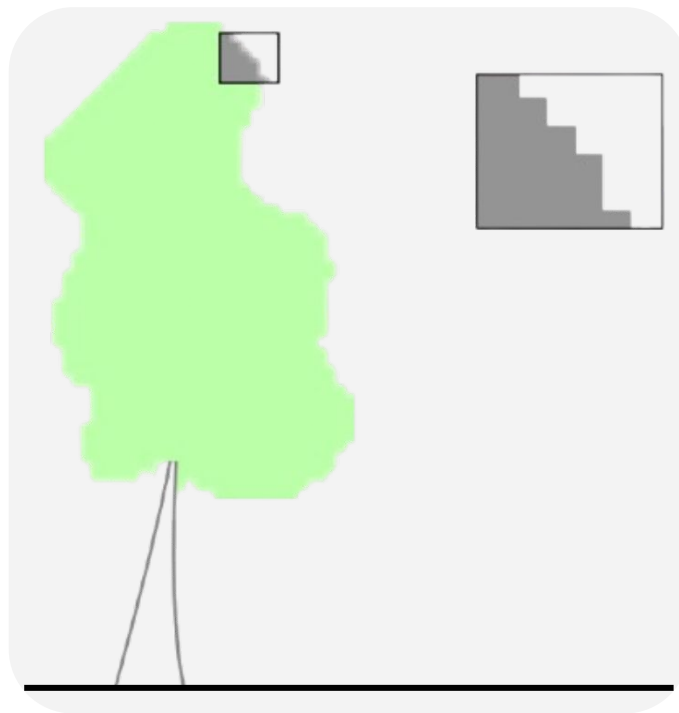


3D

Representation



Mesh



Raster



Point cloud

Method

Select area

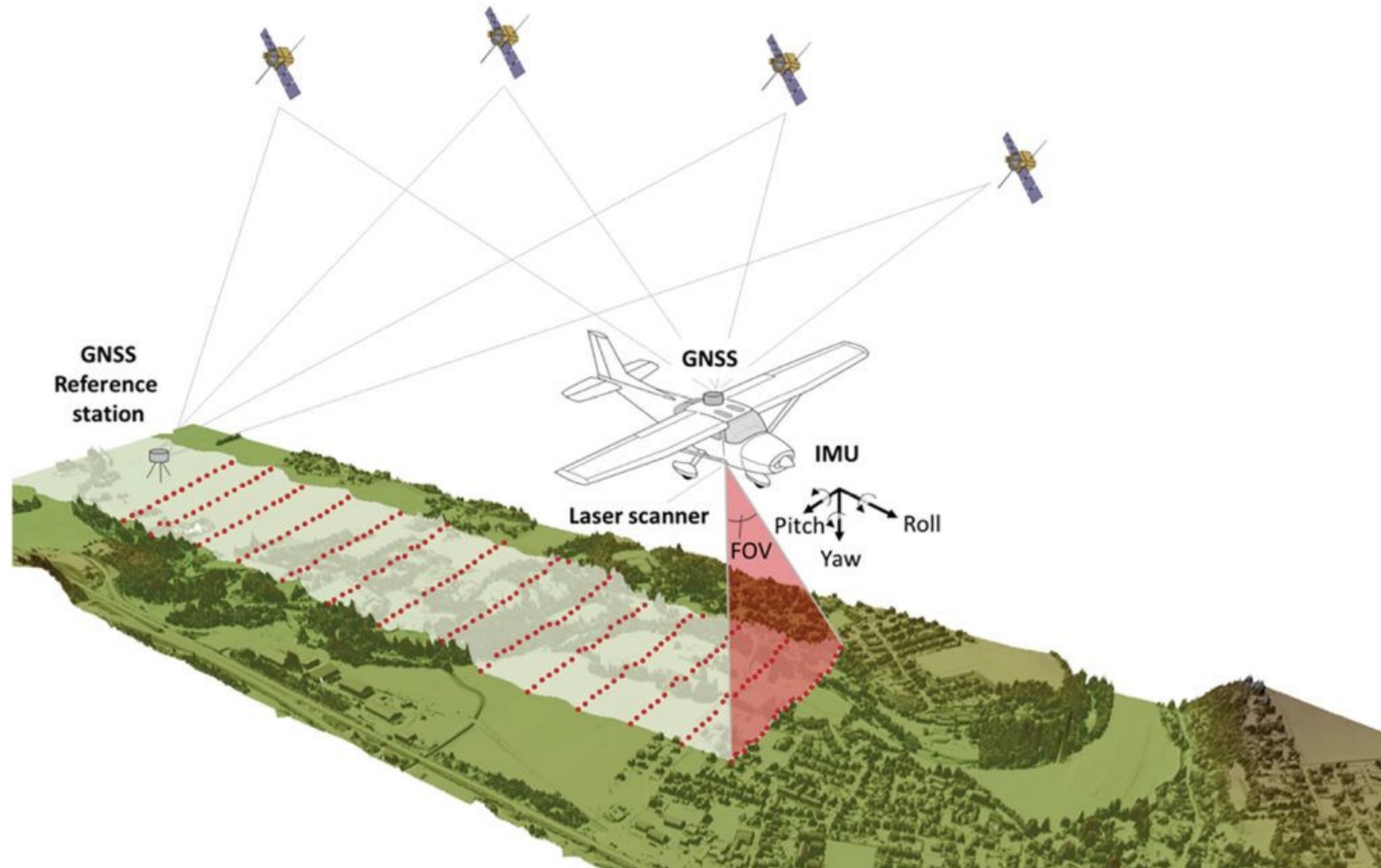
Enhance data

Calculate LoS

Create viewshed

Direct analysis

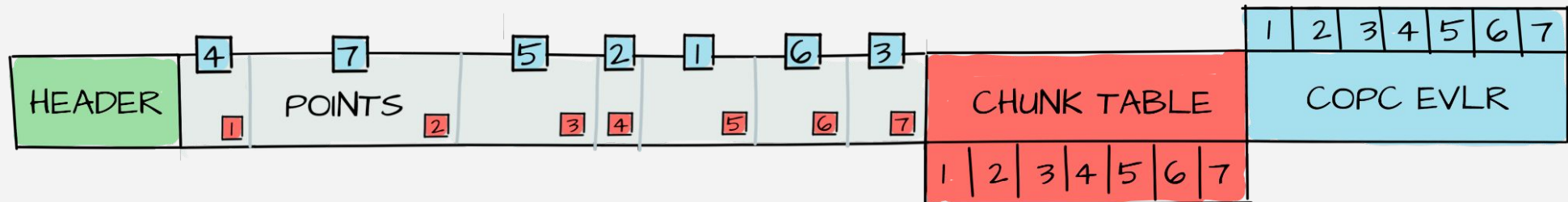
Airborne laser scanning (ALS)





Cloud Optimized Point Cloud (COPC)

- Superset of LAZ
- Octree spatial index
- HTTPS range requests



Method

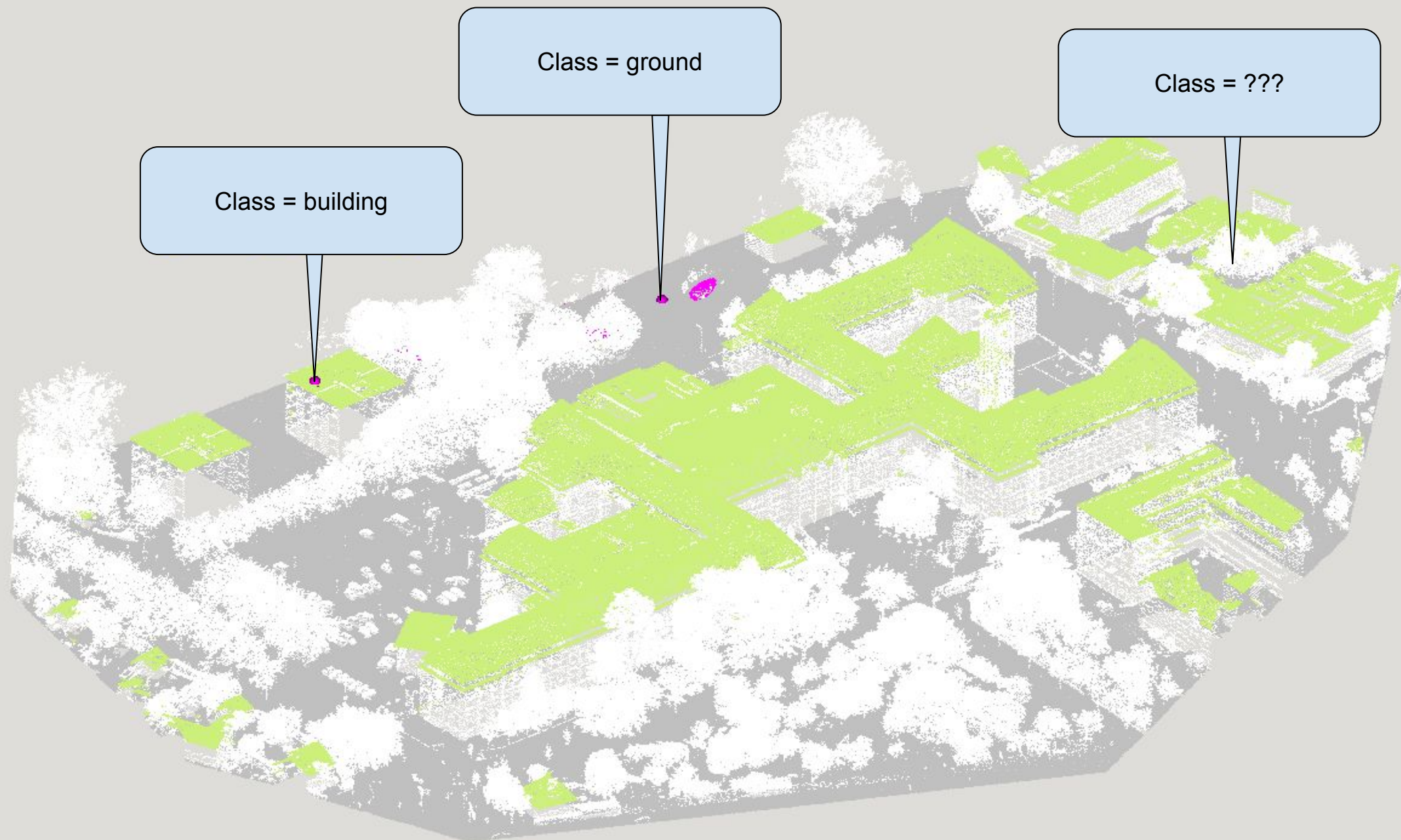
Select area

Enhance data

Calculate LoS

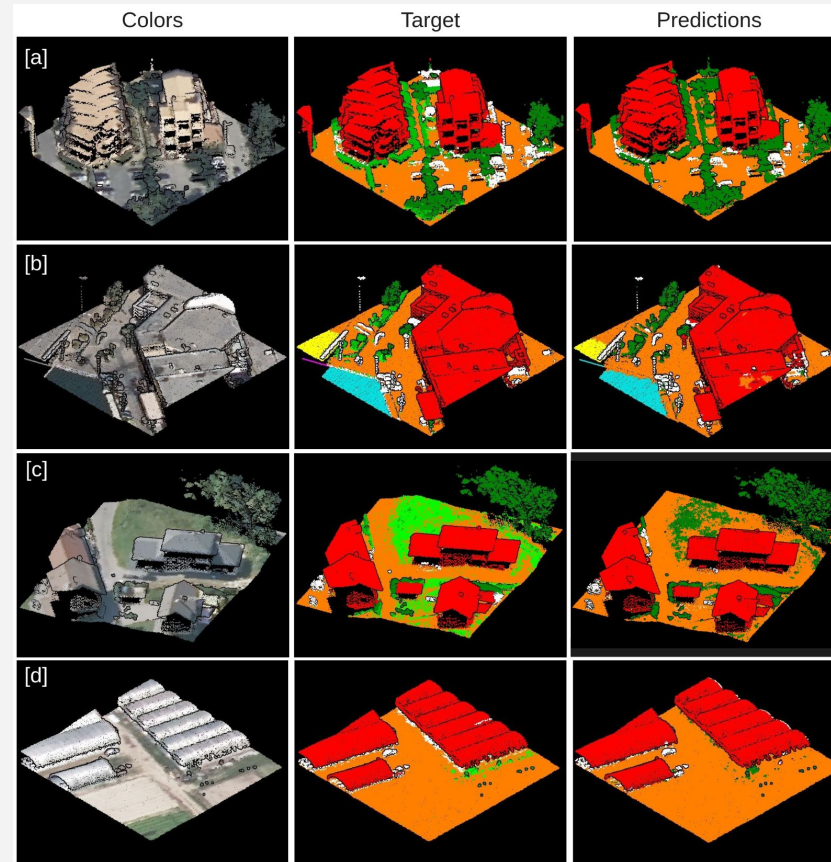
Create viewshed

Direct analysis

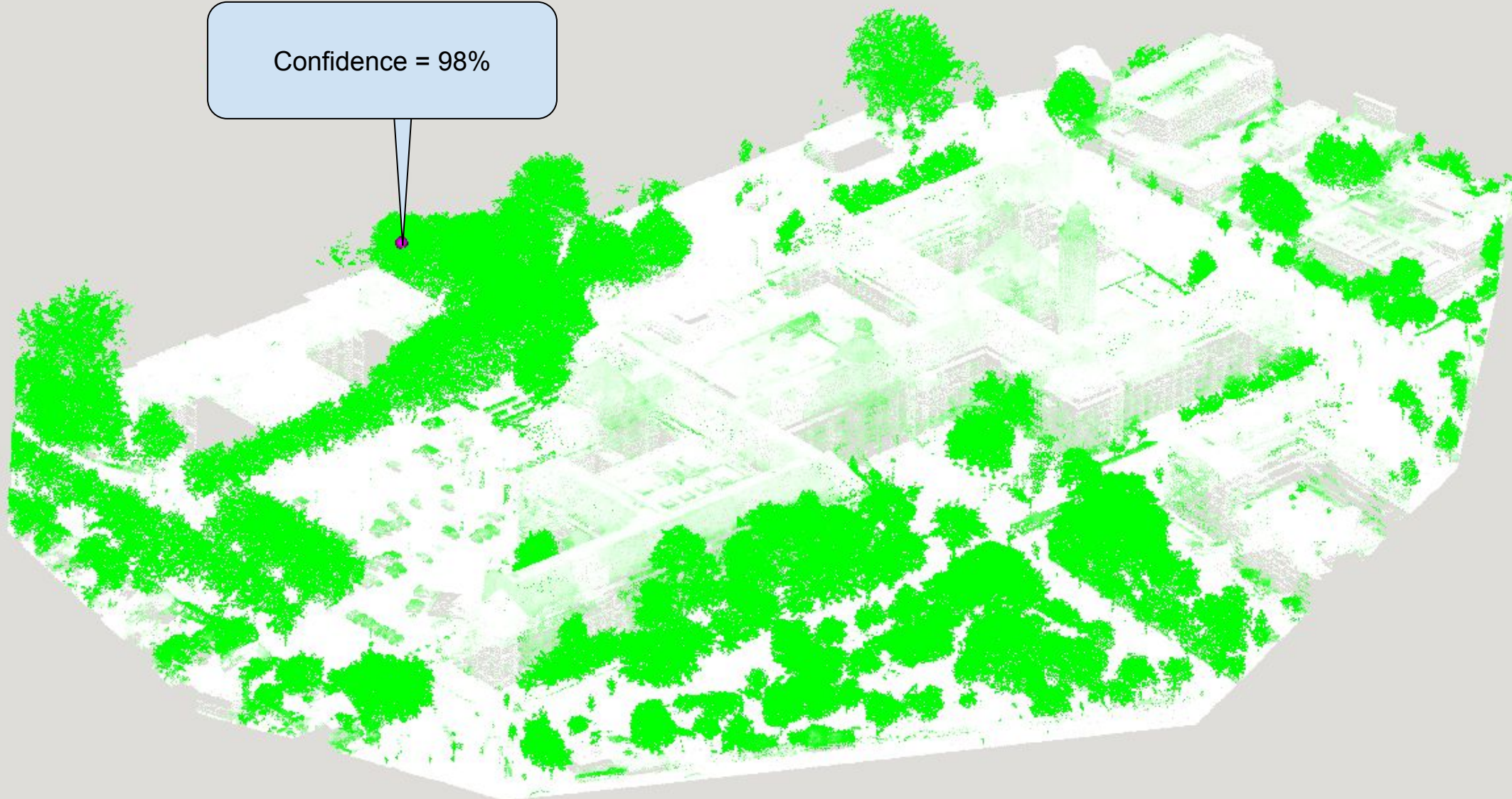


Classify vegetation

- Myria3D model
- Direct point cloud classification
- Ported from French to Dutch data
- Ingests attributes + optional color



Confidence = 98%





Densify facades

- Detect roofs
- Roofs are supported by walls*
- Extend facades straight down





Method

Select area

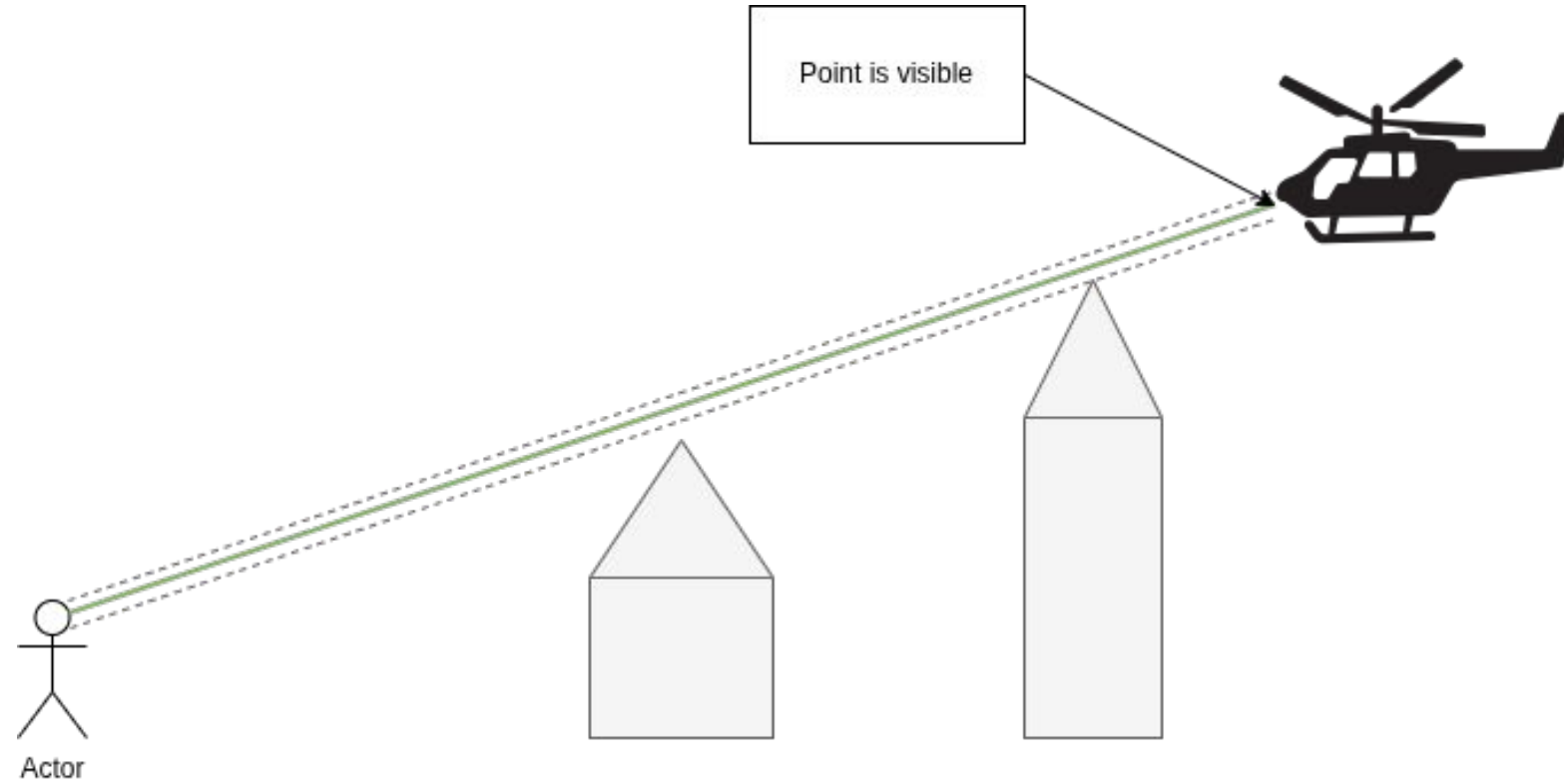
Enhance data

Calculate LoS

Create viewshed

Direct analysis

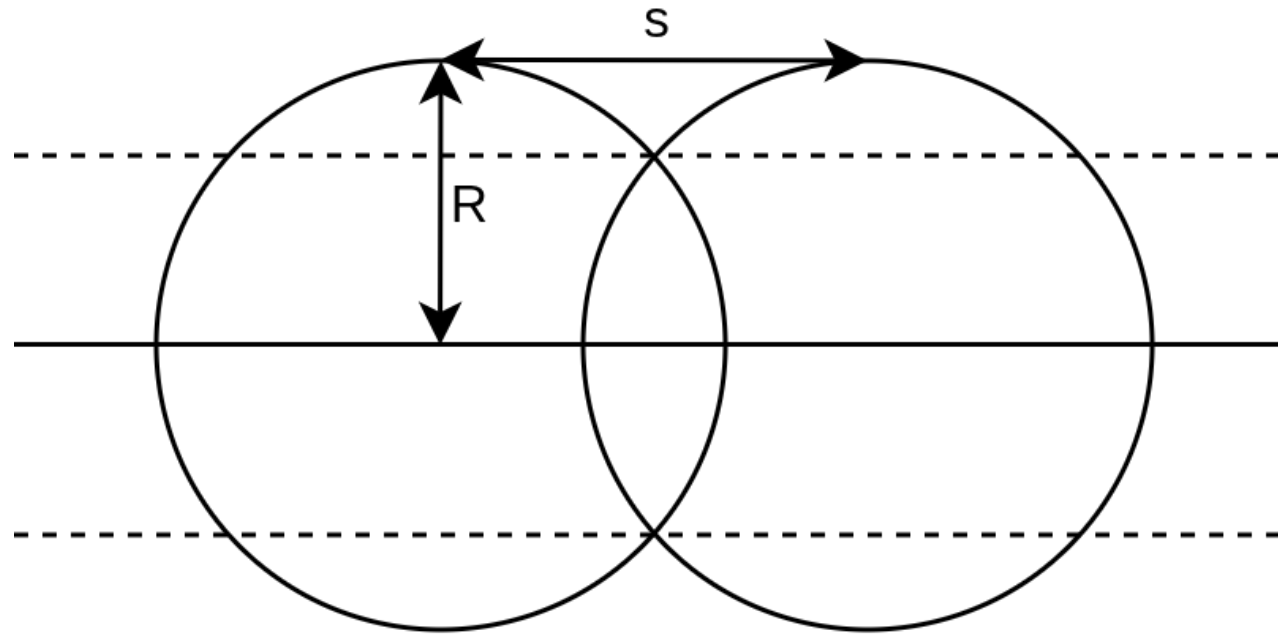
Line of sight



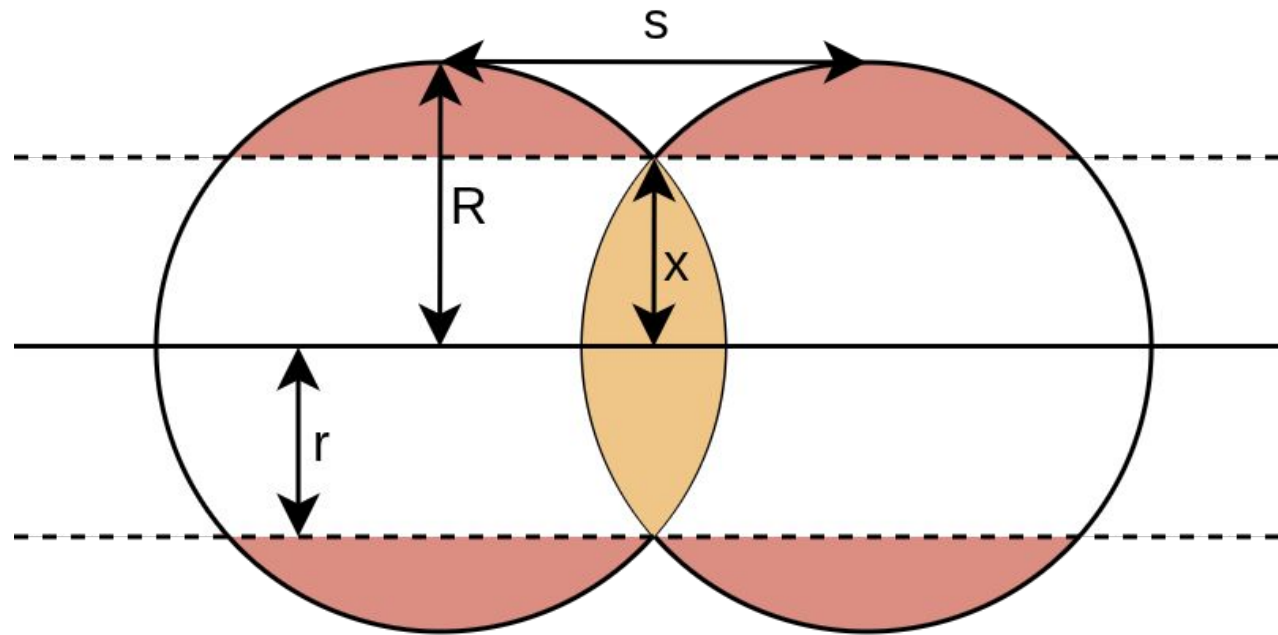
Buffer distance



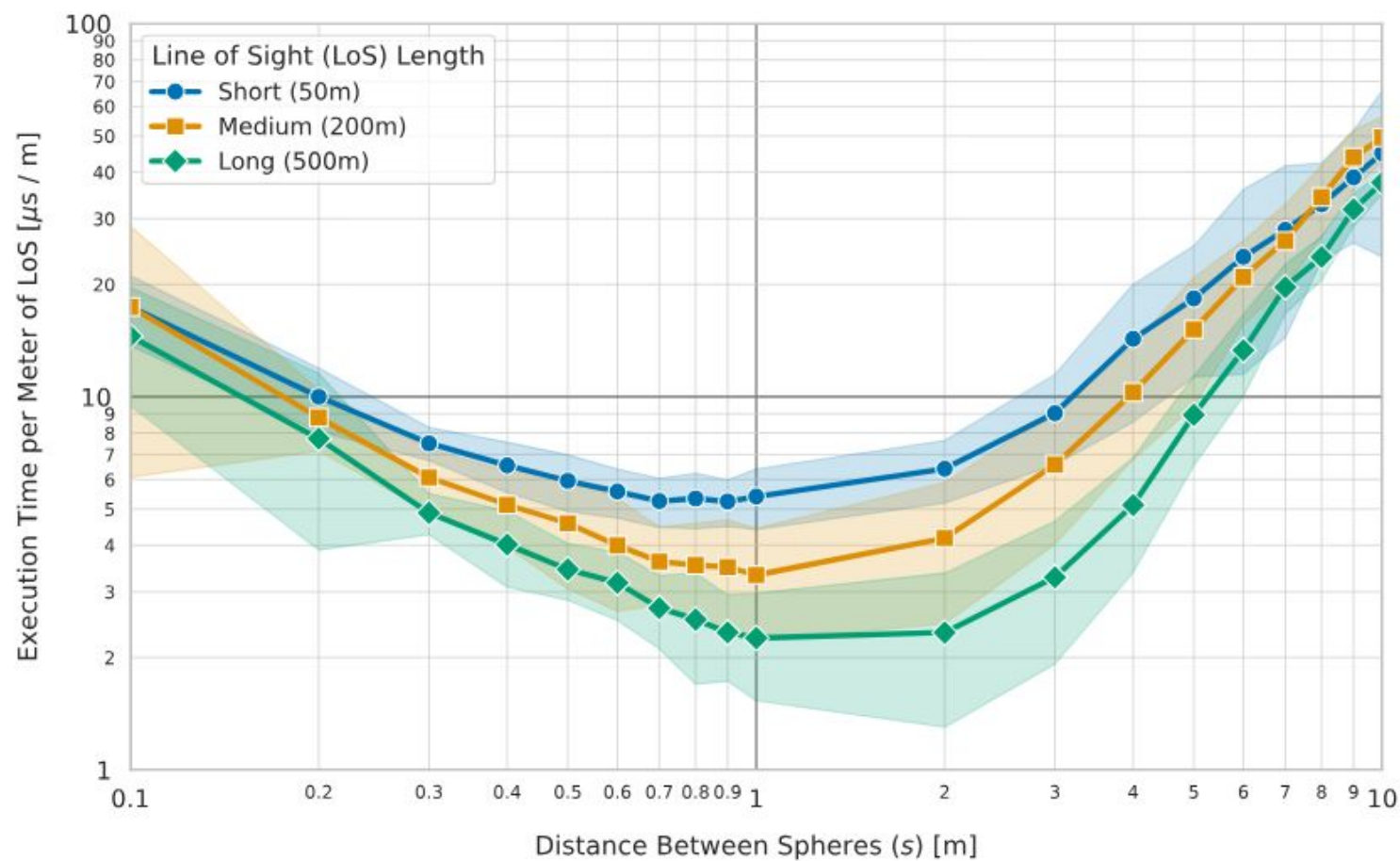
Sphere queries



Query tradoff

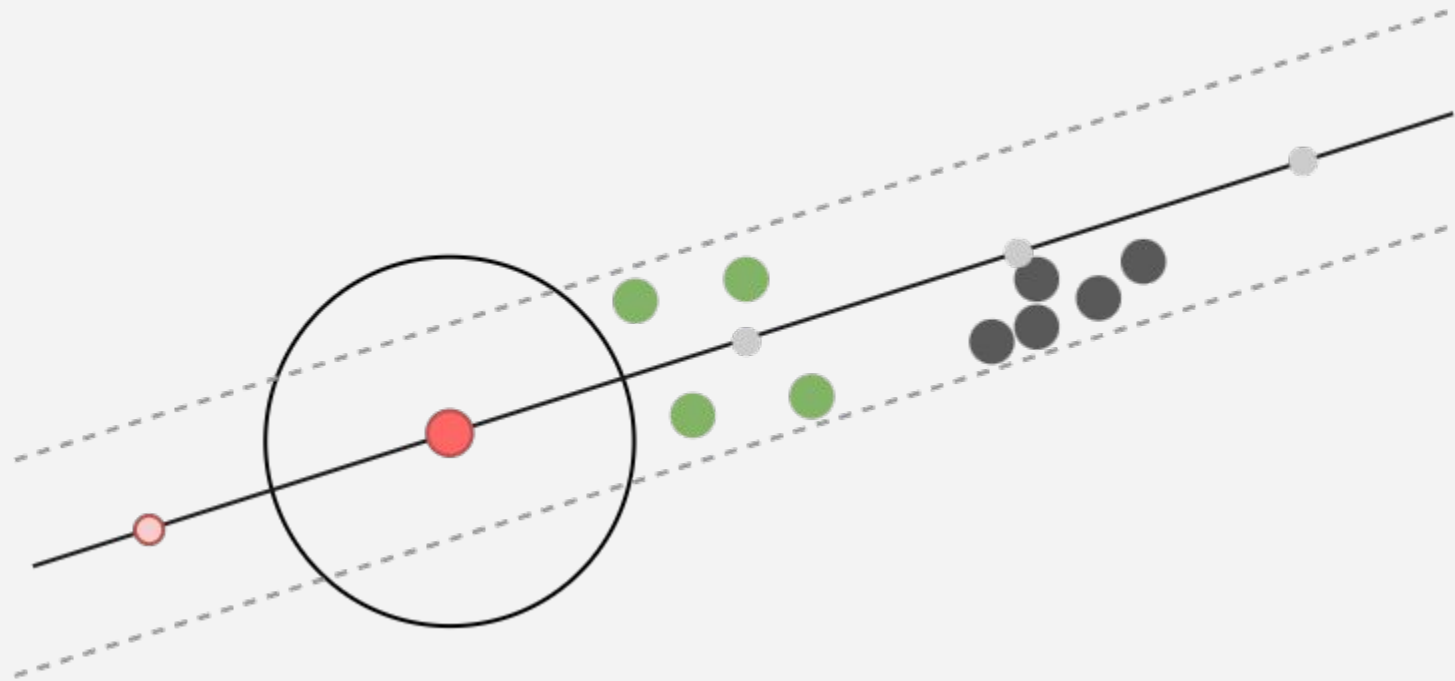


Benchmark



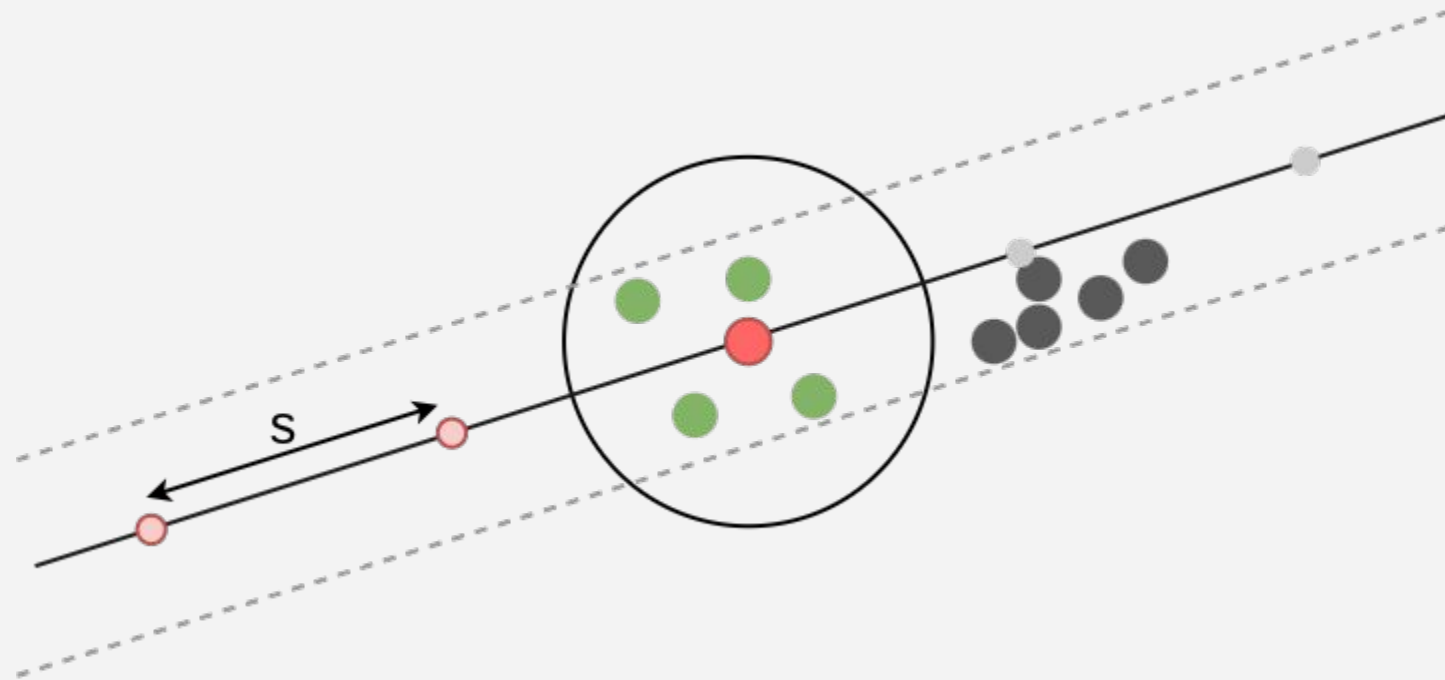
Calculate

- Step = 1
- Count = 0
- Class = None
- Visibility = 1



Calculate

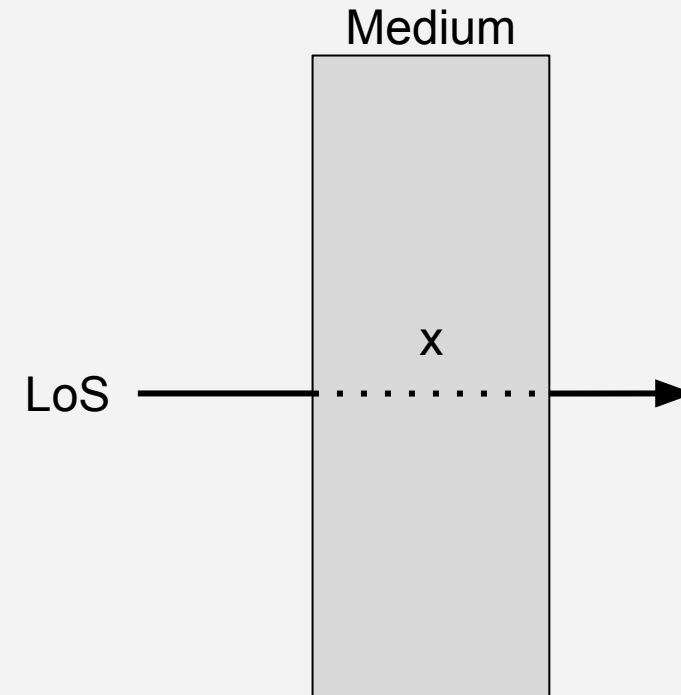
- Step = 2
- Count = 4
- Class = Vegetation
- Visibility = 0.8



Attenuation

$$p(x) = e^{x * -k(x)}$$

$p(x)$ = probability of visibility
 x = distance through medium
 $k(x)$ = permeability

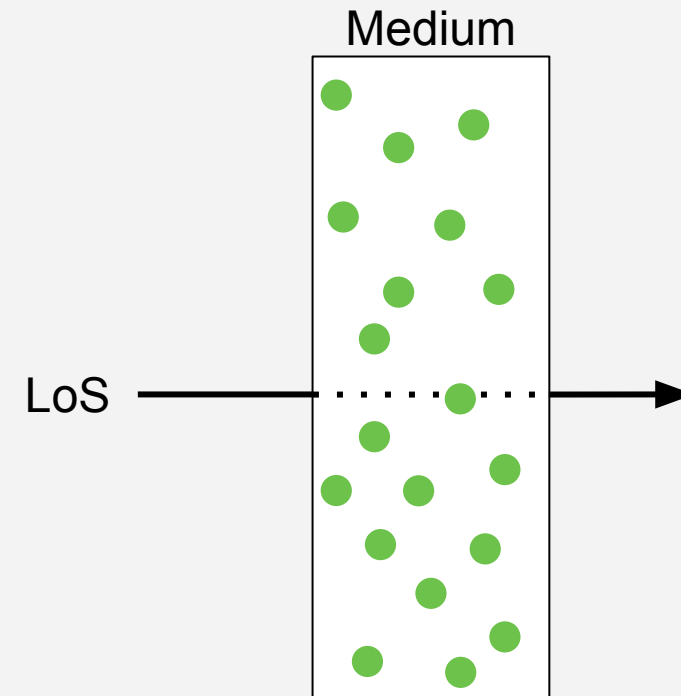


Attenuation

$$k(x) = \rho * c$$

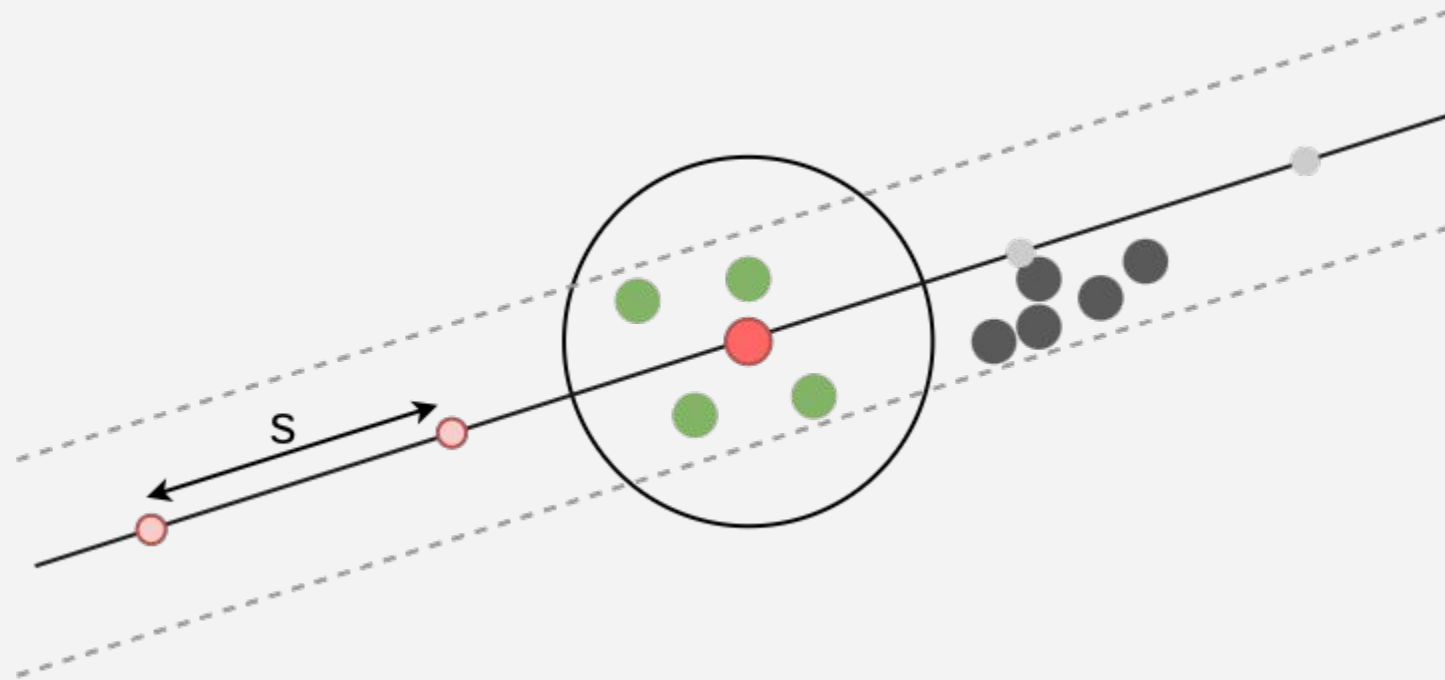
ρ = point density

c = attenuation constant



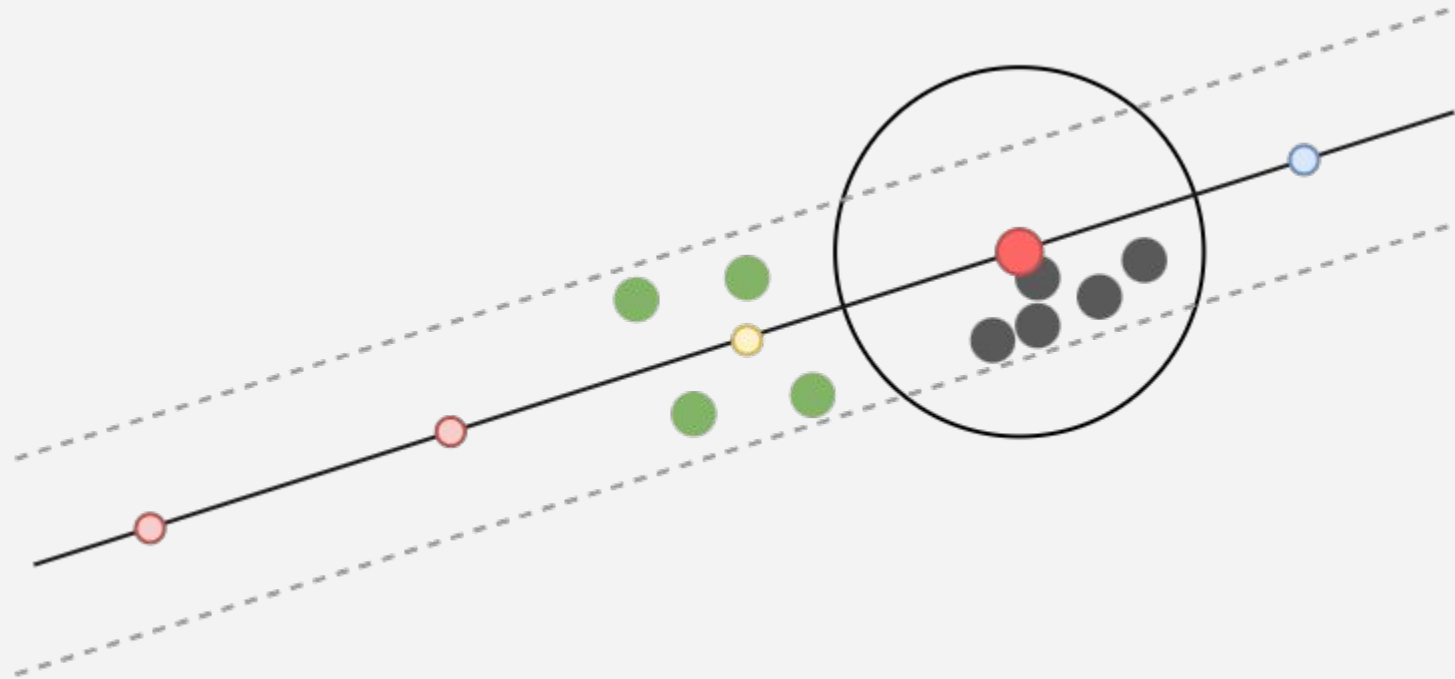
Calculate

- Step = 2
- Count = 4
- Class = Vegetation
- Visibility = 0.8



Calculate

- Step = 3
- Count = 5
- Class = Building
- Visibility = 0



Method

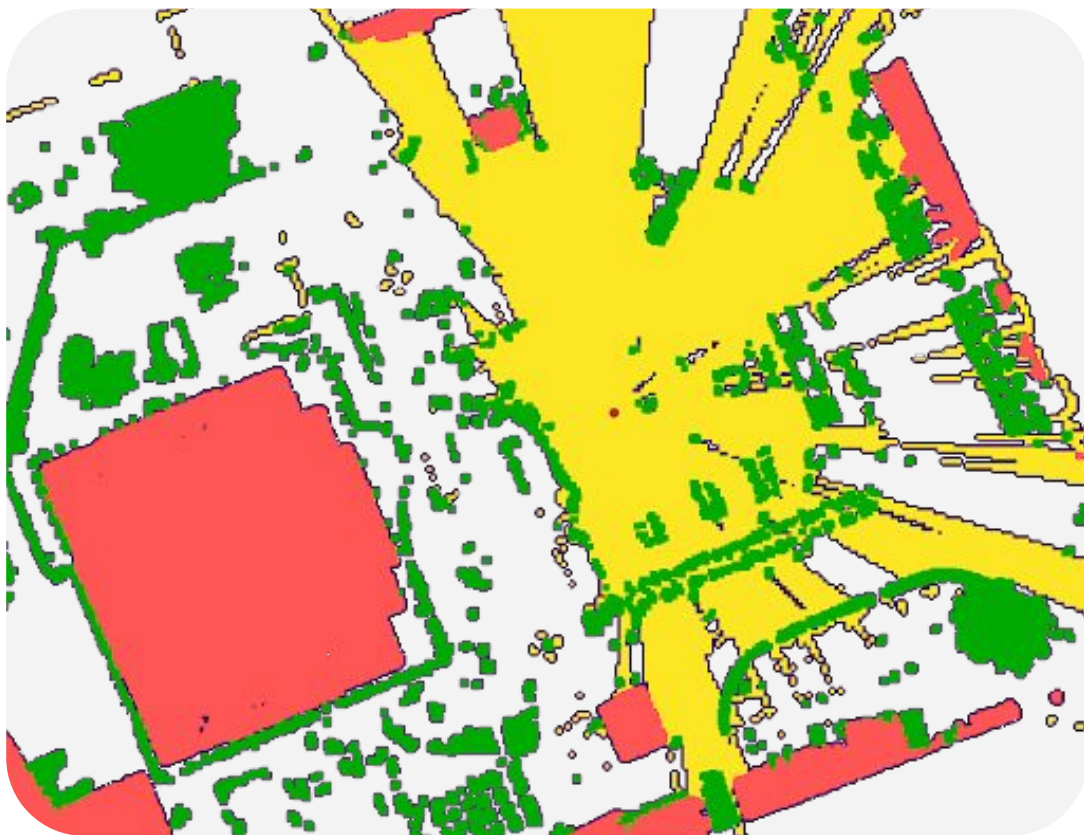
Select area

Enhance data

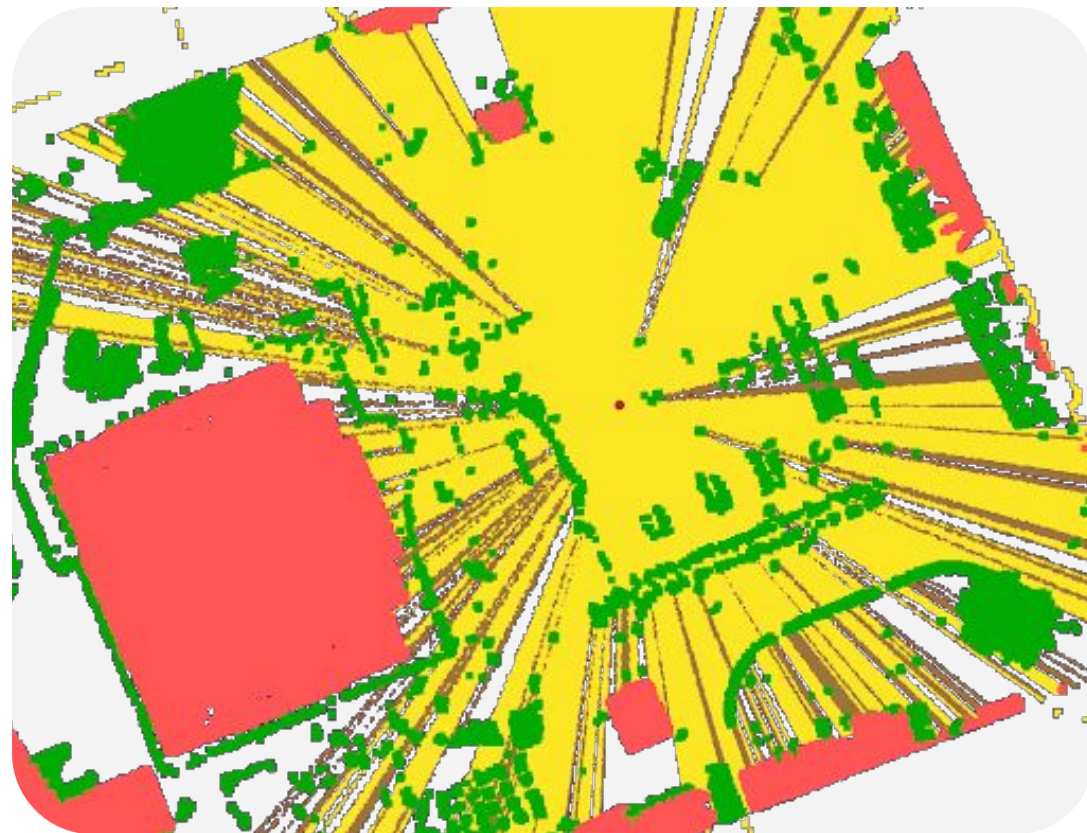
Calculate LoS

Create viewshed

Direct analysis



Conventional raster method



Our method

Method

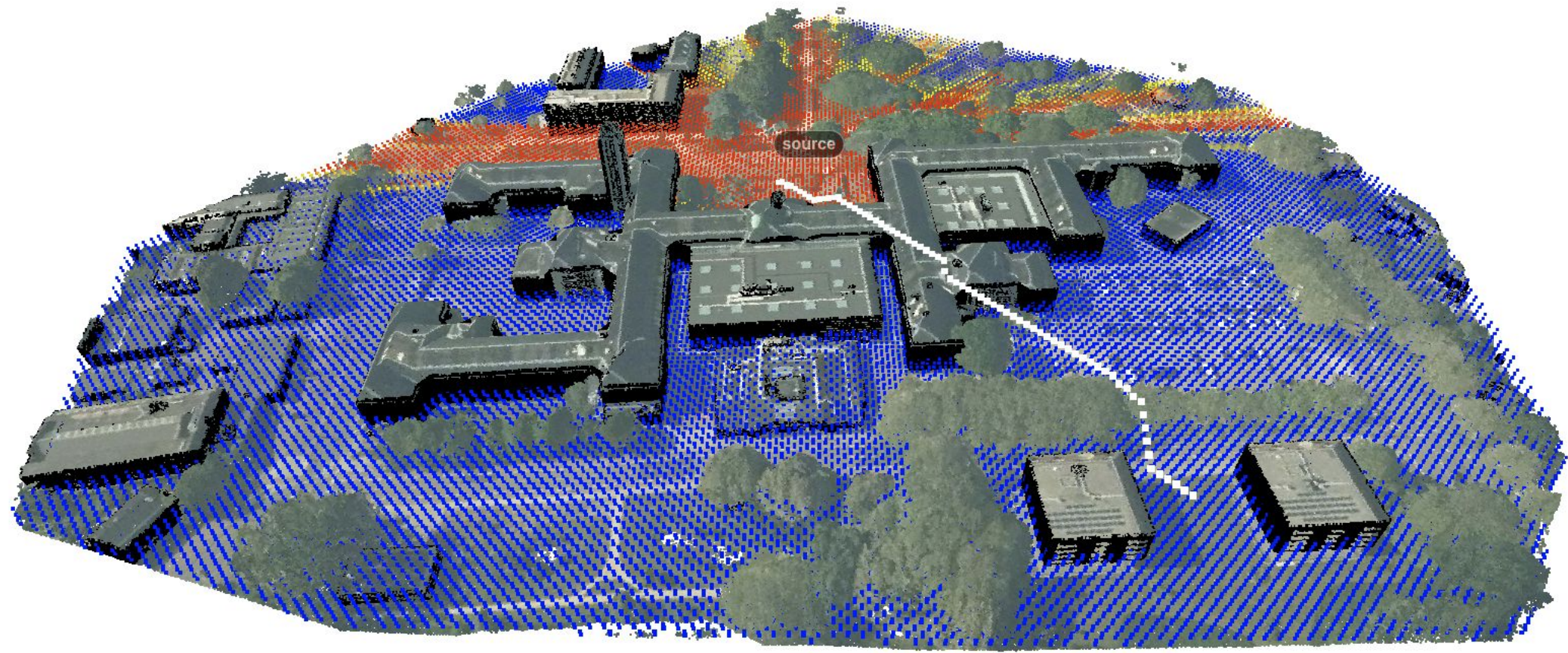
Query

Enhance

Calculate

Produce

Apply

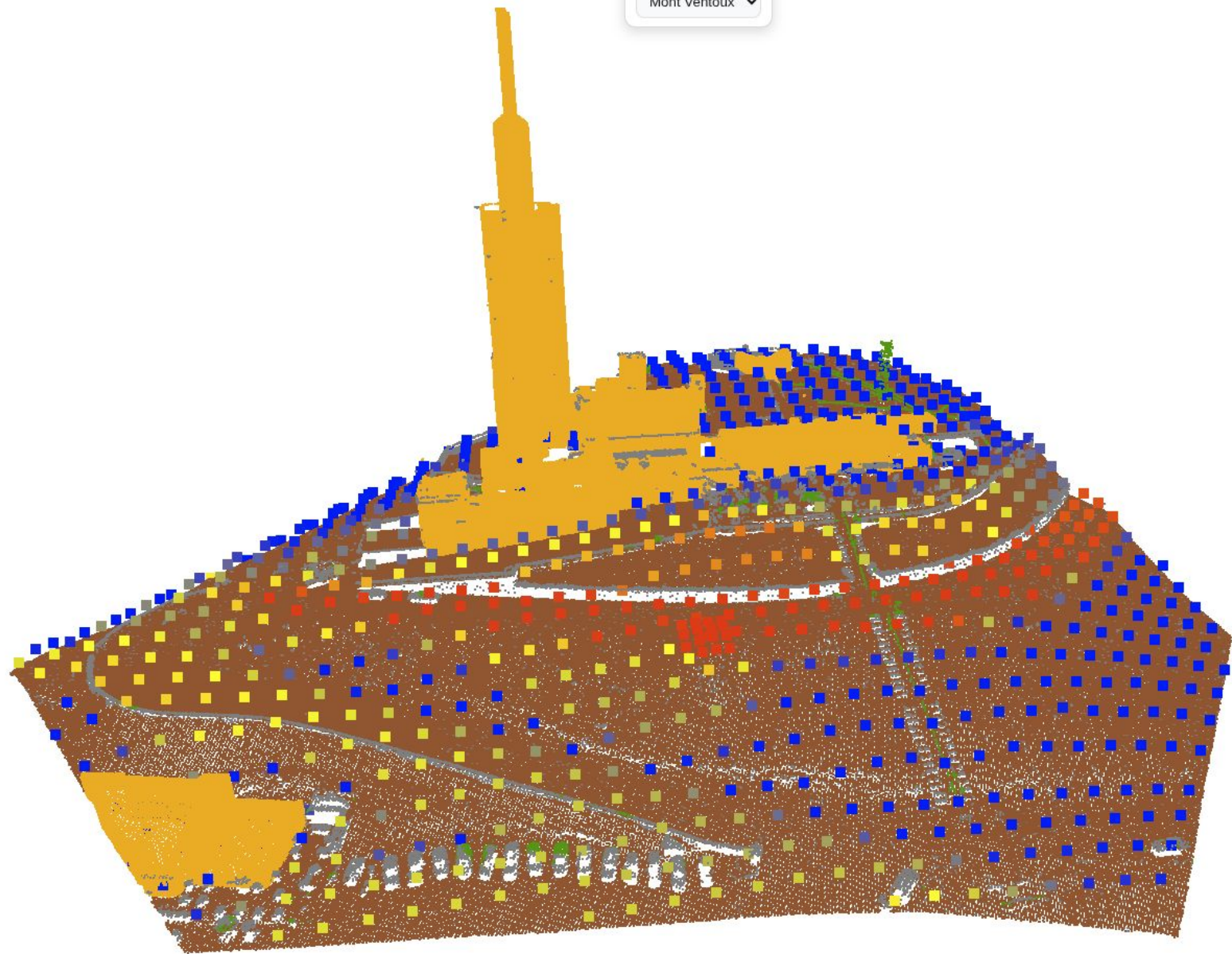


Z-Slice
Height:
6.0m





Mont Ventoux ▾



Conclusions

Progress on shortcomings

- Outperforms industry standard
- vegetation, transparency, dimensionality, representation

Performance

Smart point clouds

Flexible and nuanced

Conclusions

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Performance

- 100-500 x speedup
- Spatial index, optimized queries, early exit

Smart point clouds

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- Same data, more information

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Smart point clouds

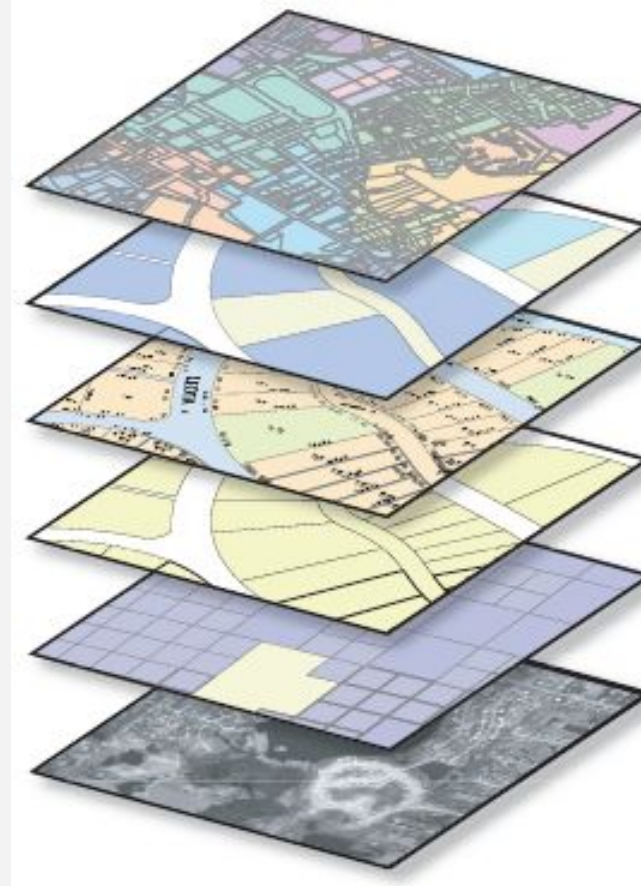
- Vegetation, facade enhancements
- Same data, more information

Flexible and nuanced

- Control over parameters and risk
- Flight height, routing, lookouts

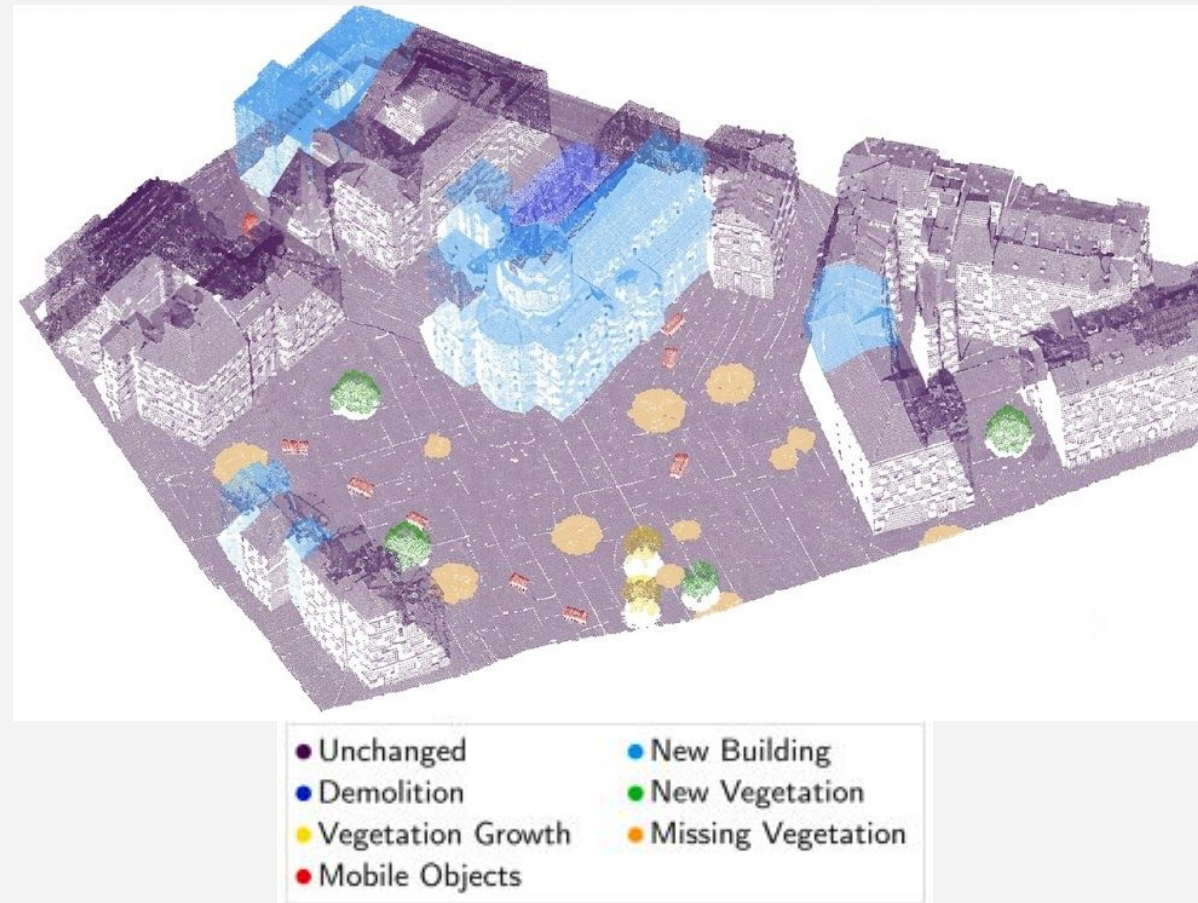
Future work

- Tree species
- Camouflage, Acoustics
- 3D Gaussian splats, radar



Future work

- 4D point cloud
- Change detection
- Detecting (un)reliable obstacles



More information

- Codebase [link](#)
- Cloudfetch package on PyPI [link](#)
- Online viewer [link](#)
- Presenting at NCG symposium [link](#)
- Paper for ISPRS journal



Viewer

Now you see me, now you don't:

Direct LiDAR-Based Intervisibility Modeling with Semi-Transparent
Vegetation for Military Mission Planning

