High Resolution Solar Potential Map for TU Delft Campus and Real Estate

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22nd of January 2021

Delft, the Netherlands

PVMD Delft University of Technology

TU Delft

Main Objectives

Provide a map which visualizes the sunlight and DC yield potential on TU Delft campus

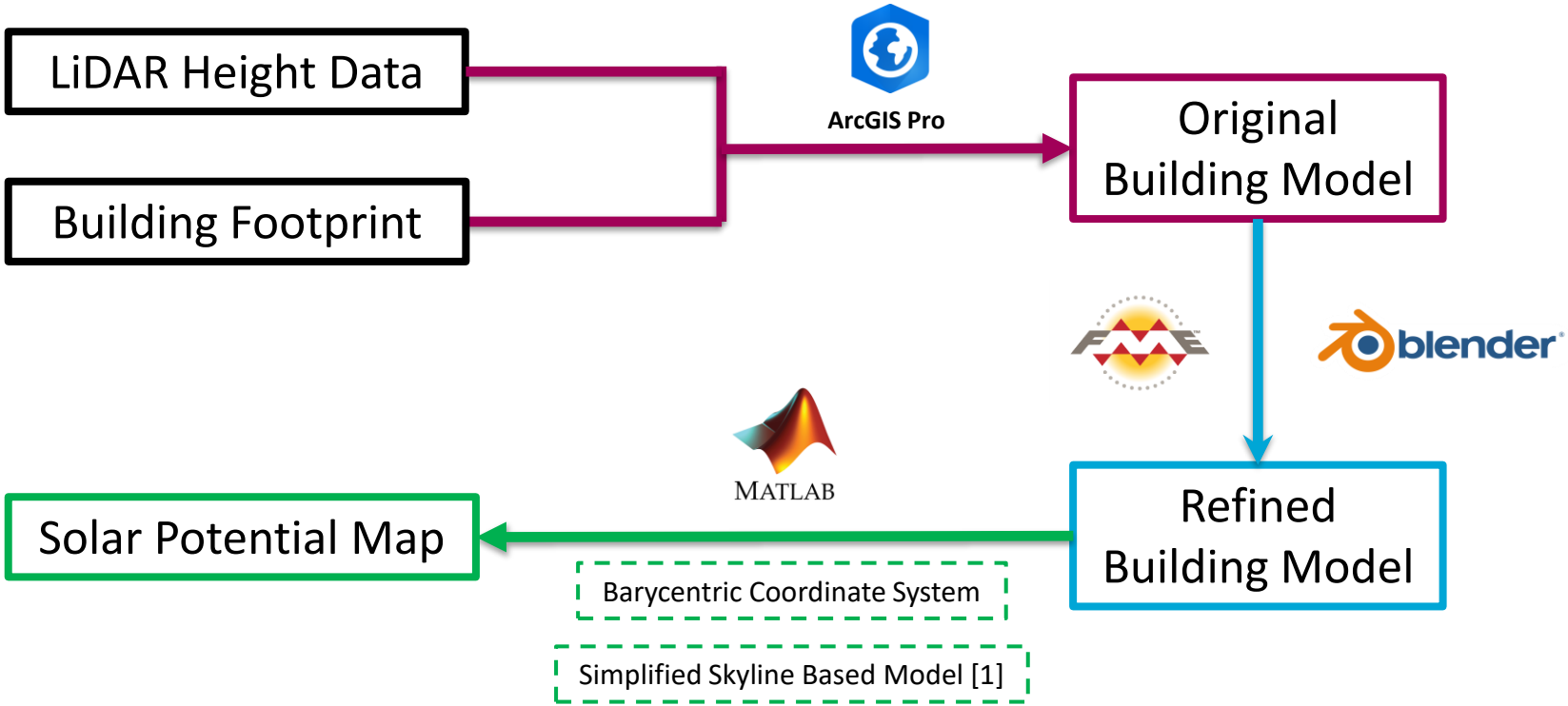
Serve for advisory and consulting purpose to prioritize buildings for PV installation

Research Questions

- How do we reconstruct the 3D building models on TUD Campus?

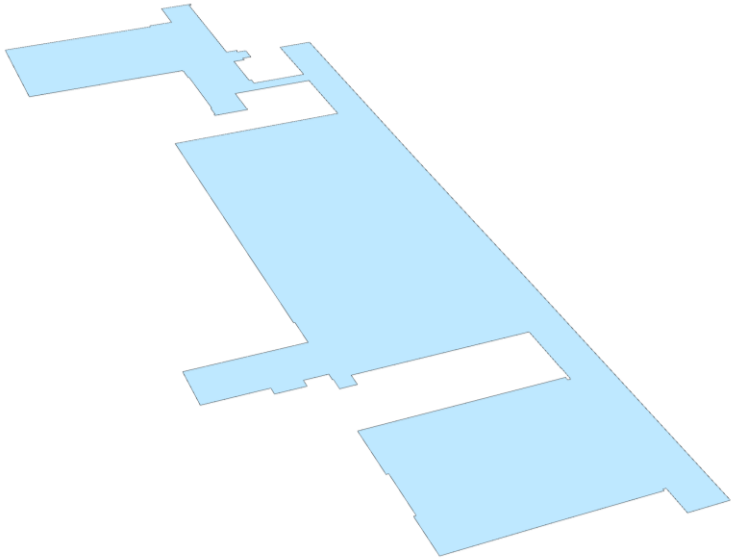
- How do we calculate the solar potential on building roofs and facades?

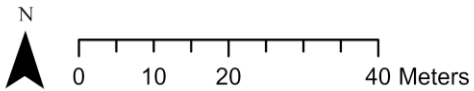
Solar Potential Calculation Workflow



[1] Calcabrini A, Ziar H, Isabella O, et al. Nature Energy, 2019, 4(3): 206-215

3D Building Model Reconstruction





[2] https://www.pdok.nl/datasets, Actueel Hoogtebestand Nederland (AHN3) (2014)

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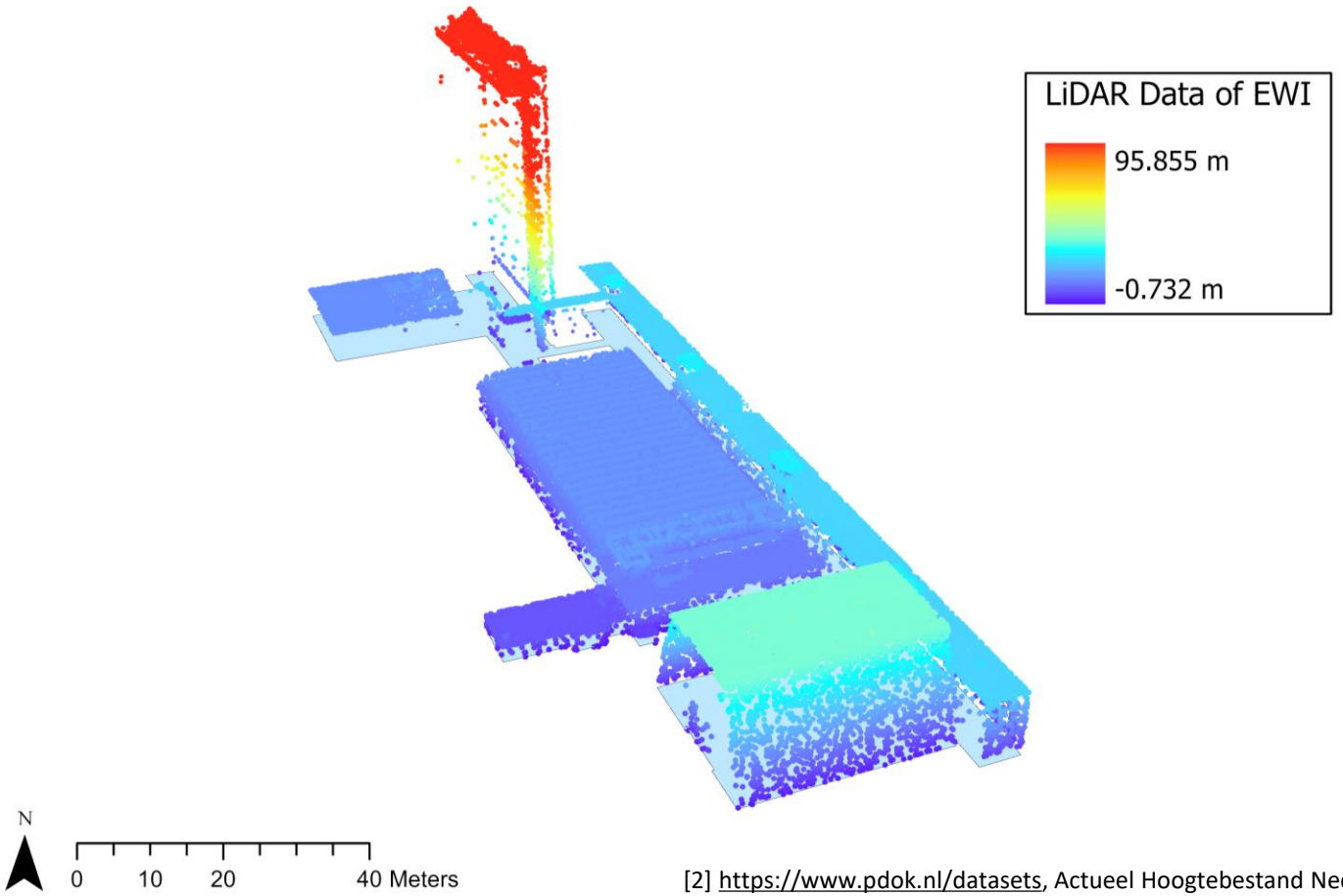

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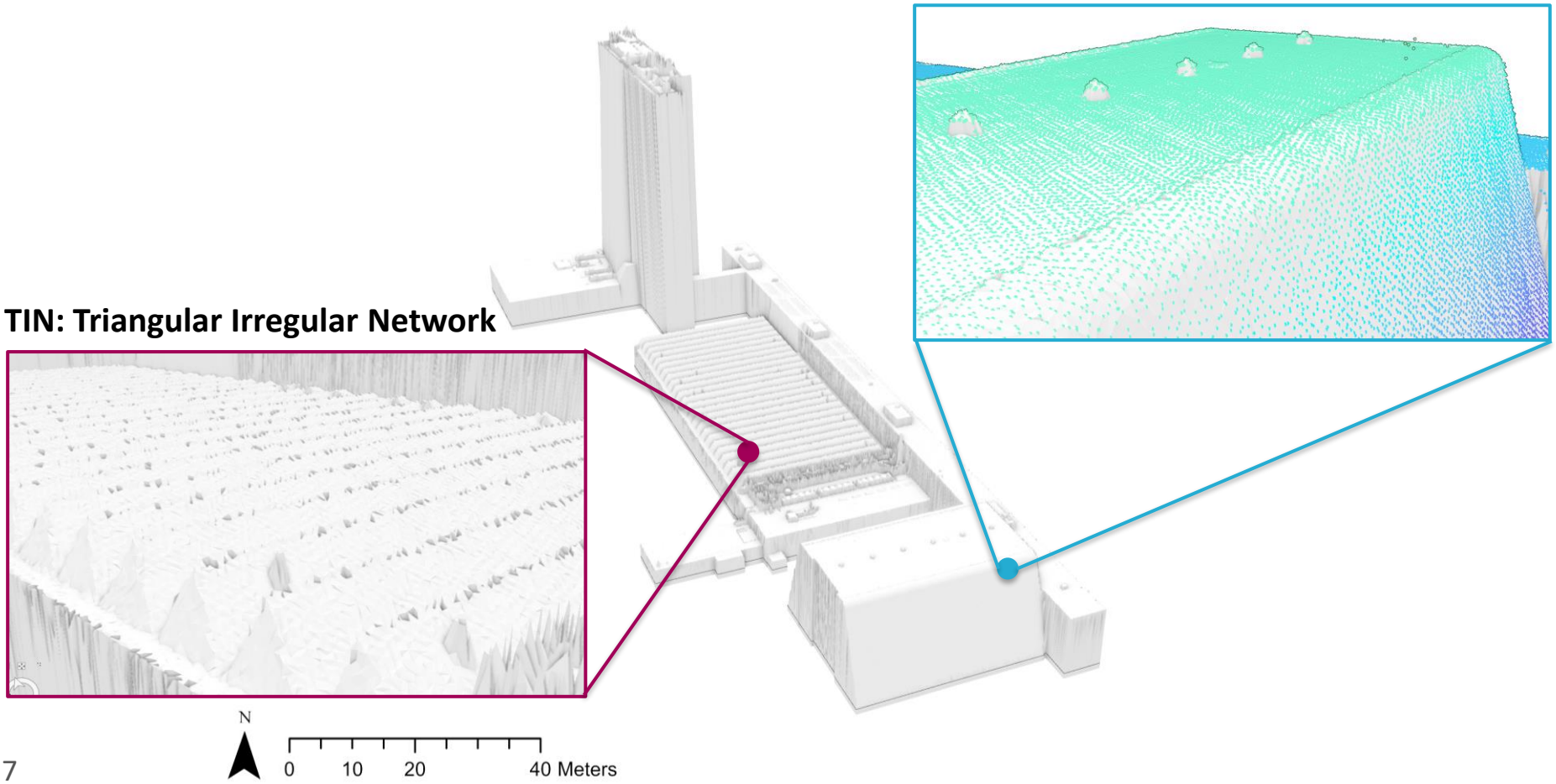
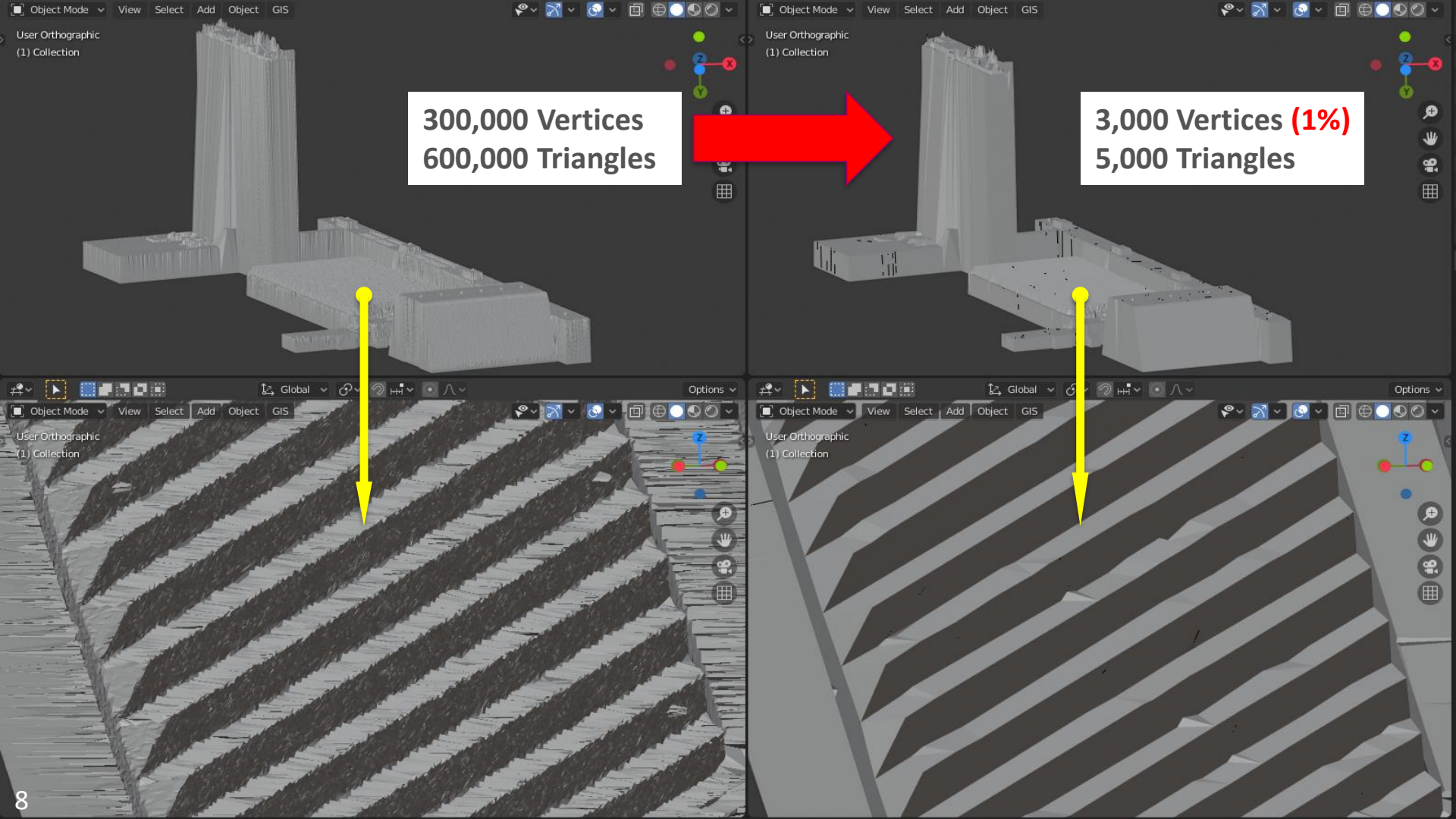
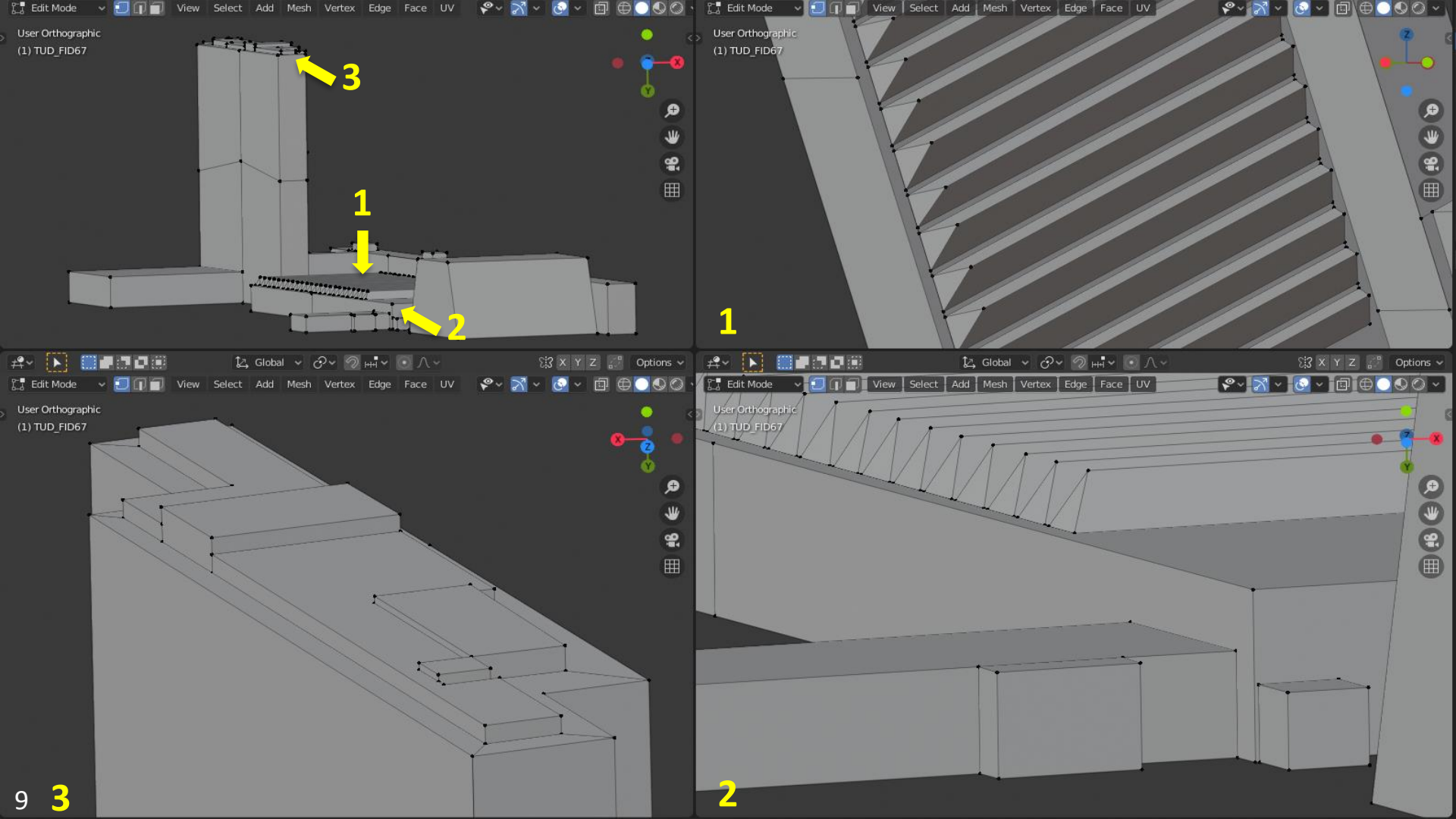
3D Building Model Reconstruction

TIN: Triangular Irregular Network




300,000 Vertices
600,000 Triangles
3,000 Vertices (1%)
5,000 Triangles


Edit Mode
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Select
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Edge
Face
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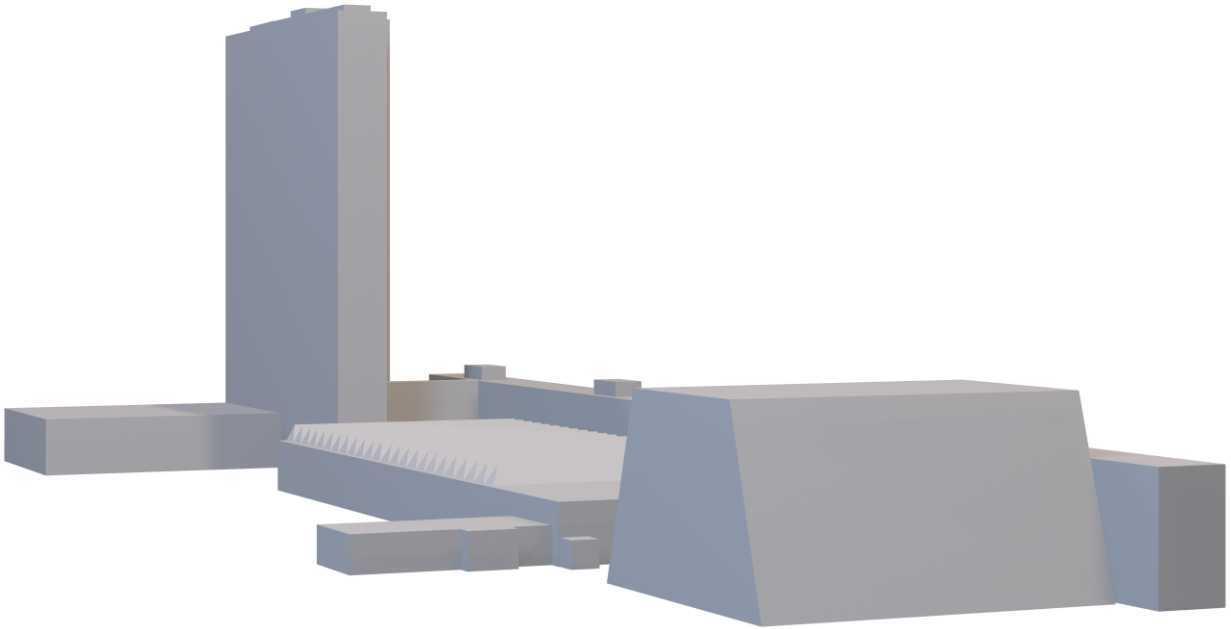
User Orthographic
(1) TUD_FID67
3
1
2
1
Global
Options
X
Y
Z
3
2

3D Building Model Reconstruction



Solar Potential Map on EWI

LiDAR Data

↓

Digital Surface Model (DSM)

↓

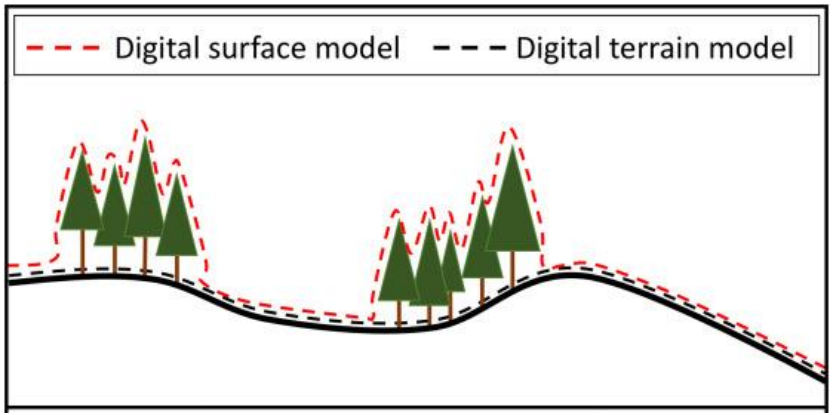
Point Cloud

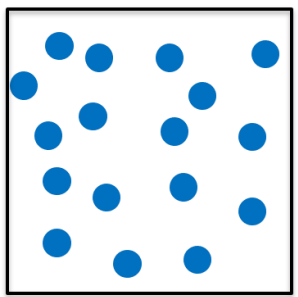
↓

Plane Detection

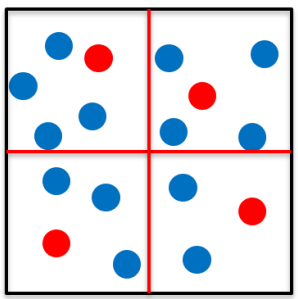
↓

Solar Potential





2m x 2m



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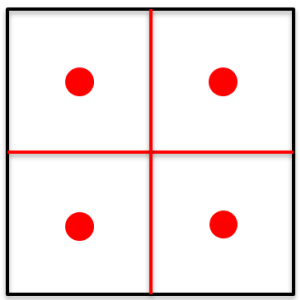

1m x 1m

[3] Meddens A J H, Vierling L A, Eitel J U H, et al. Remote Sensing of Environment, 2018, 218: 174-188.

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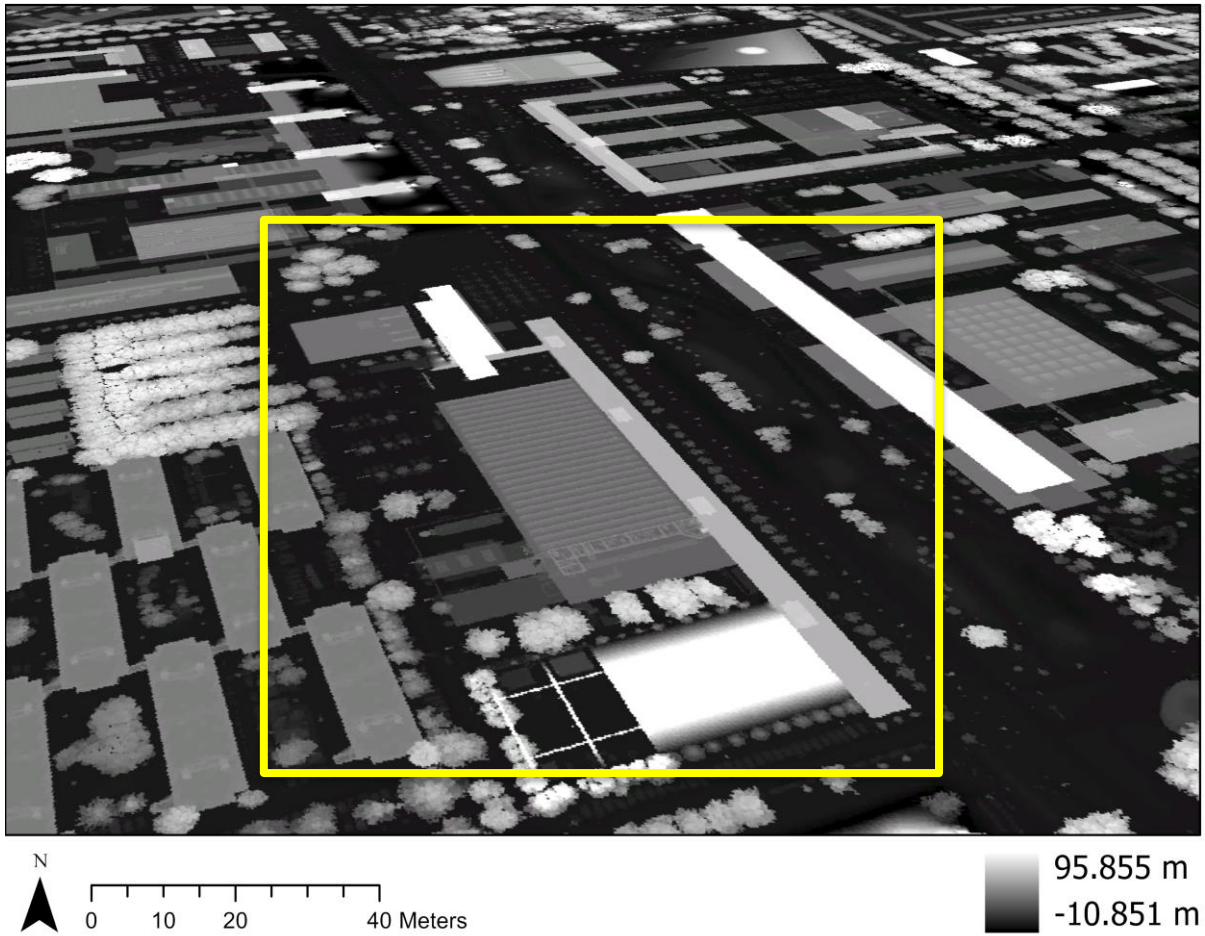

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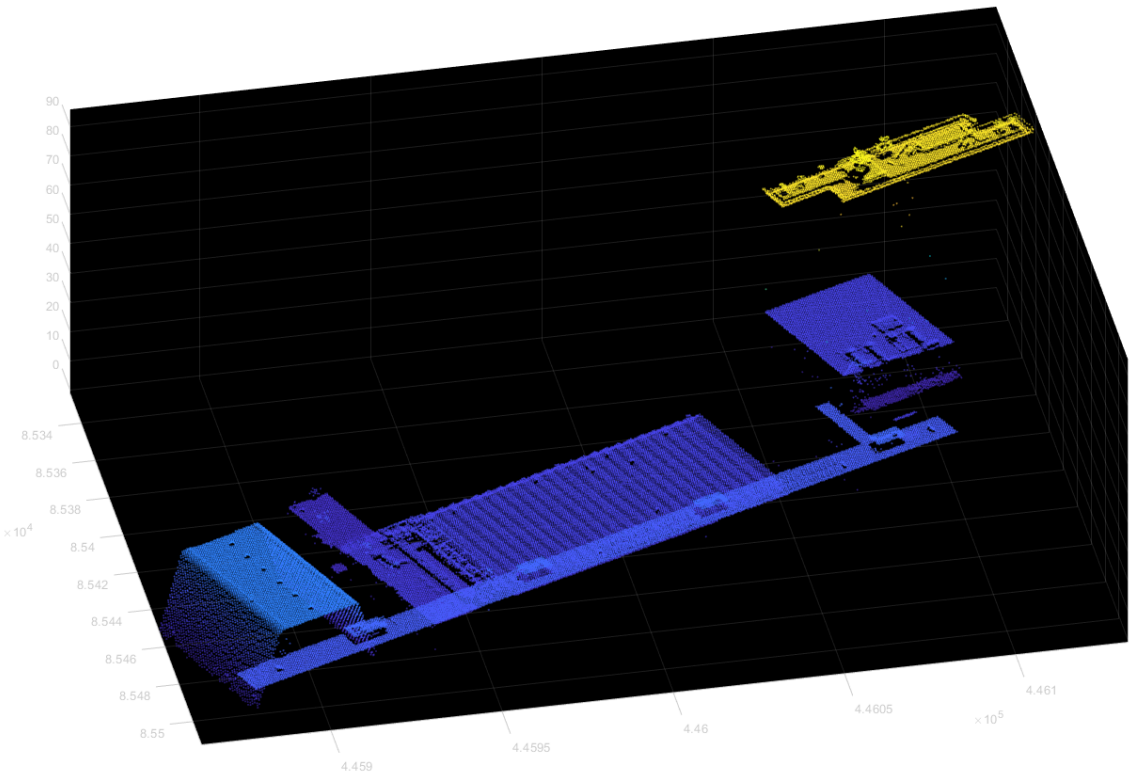

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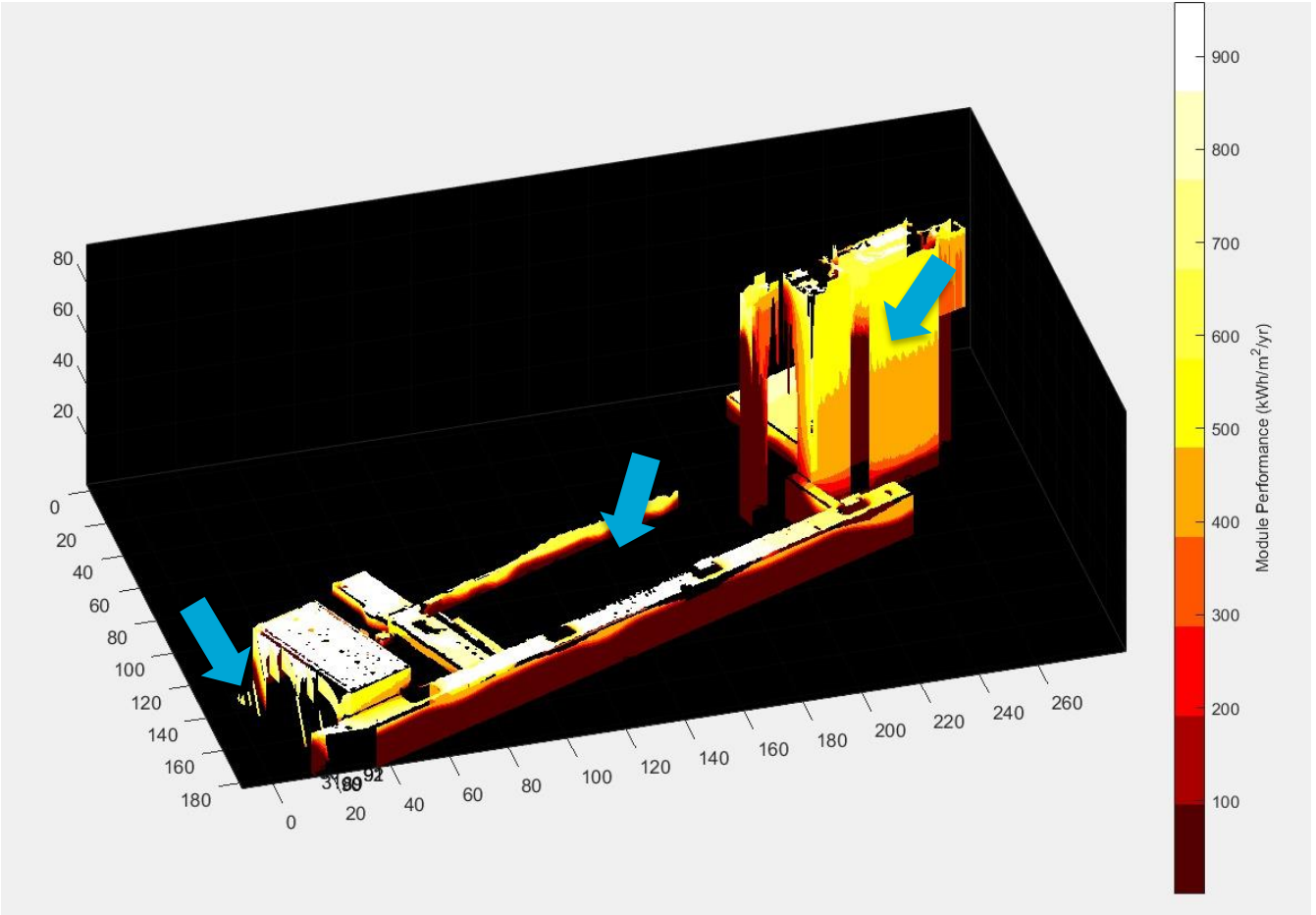


Solar Potential Map on EWI

- **Barycentric Coordinate System**

A coordinate system
in which the location of any point within a triangle can be expressed as

$$P = \alpha A + \beta B + \gamma C$$

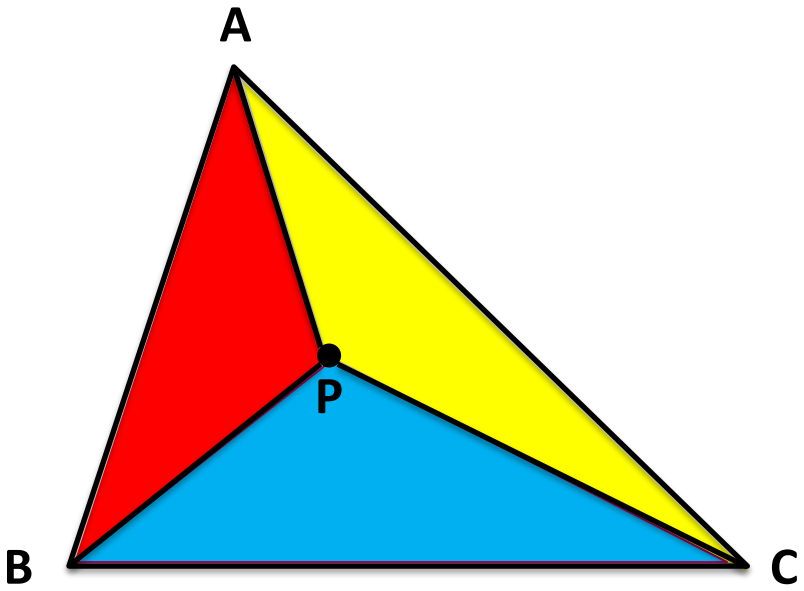
where

$$\begin{cases} \alpha, \beta, \gamma \in [0, 1] \\ \alpha + \beta + \gamma = 1 \end{cases}$$

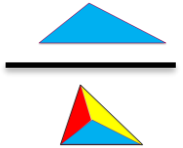
Solar Potential Map on EWI

- **Barycentric Coordinate System**

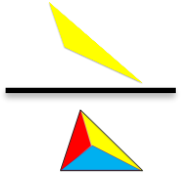
$$P = \alpha A + \beta B + \gamma C$$



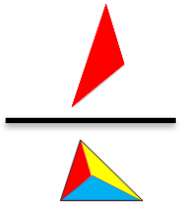
$$\alpha = \frac{\Delta PBC}{\Delta ABC} =$$



$$\beta = \frac{\Delta APC}{\Delta ABC} =$$

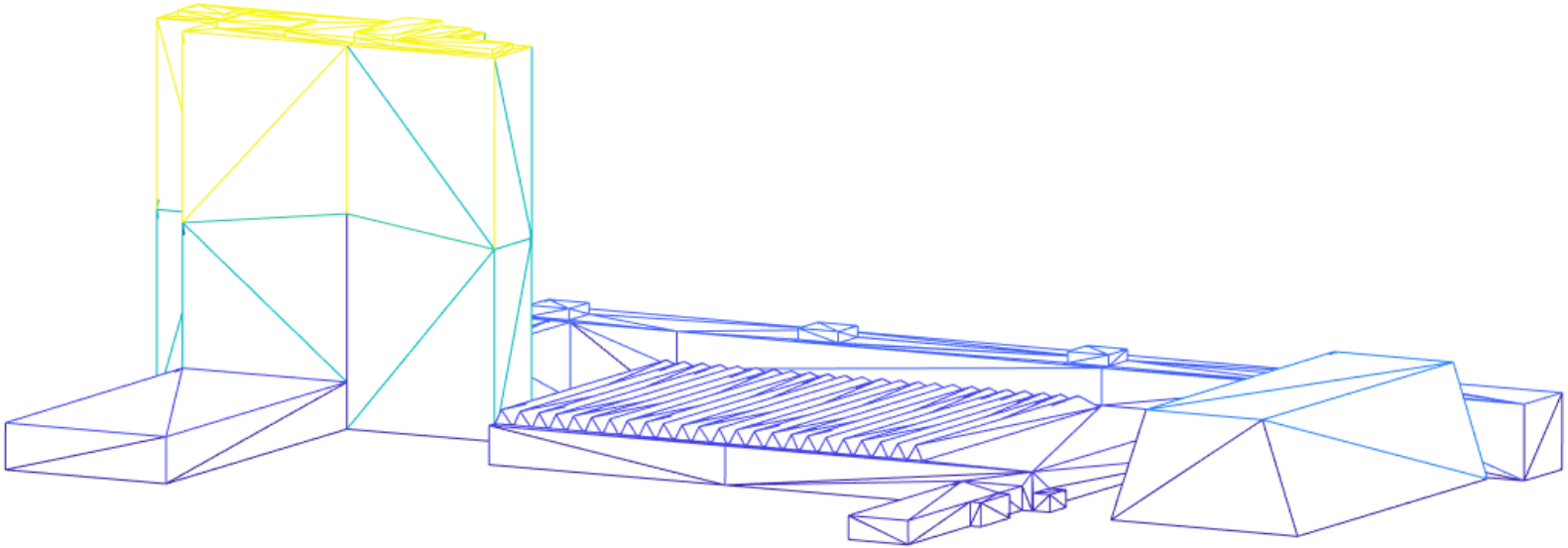


$$\gamma = \frac{\Delta ABP}{\Delta ABC} =$$



Solar Potential Map on EWI

- **Barycentric Coordinate System**



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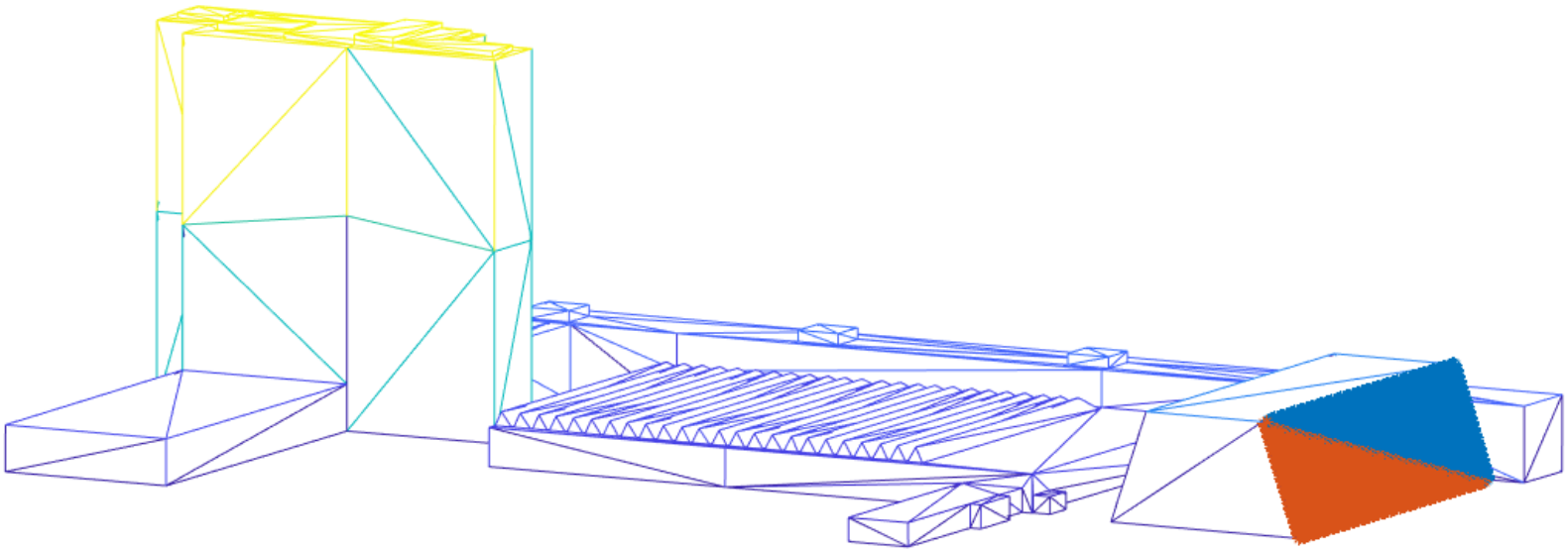
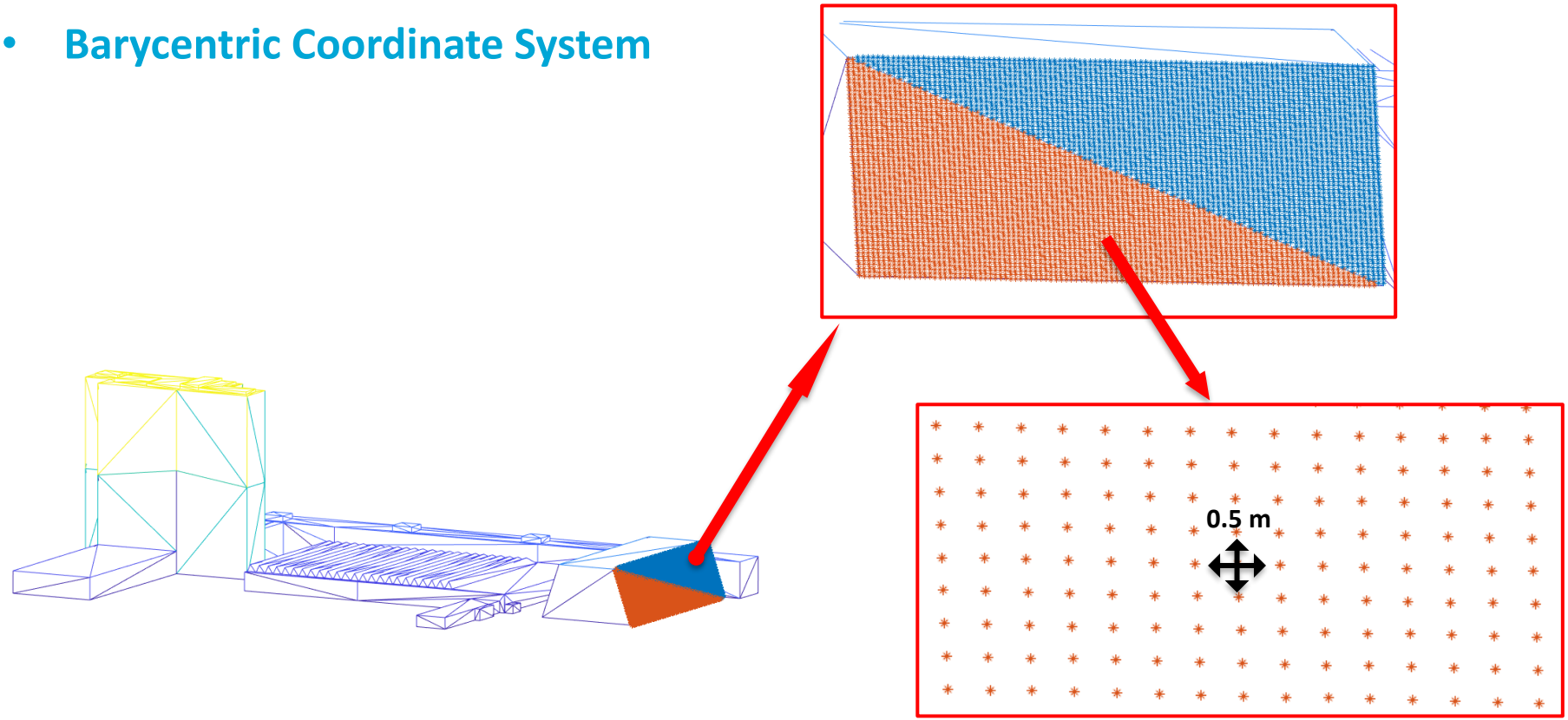


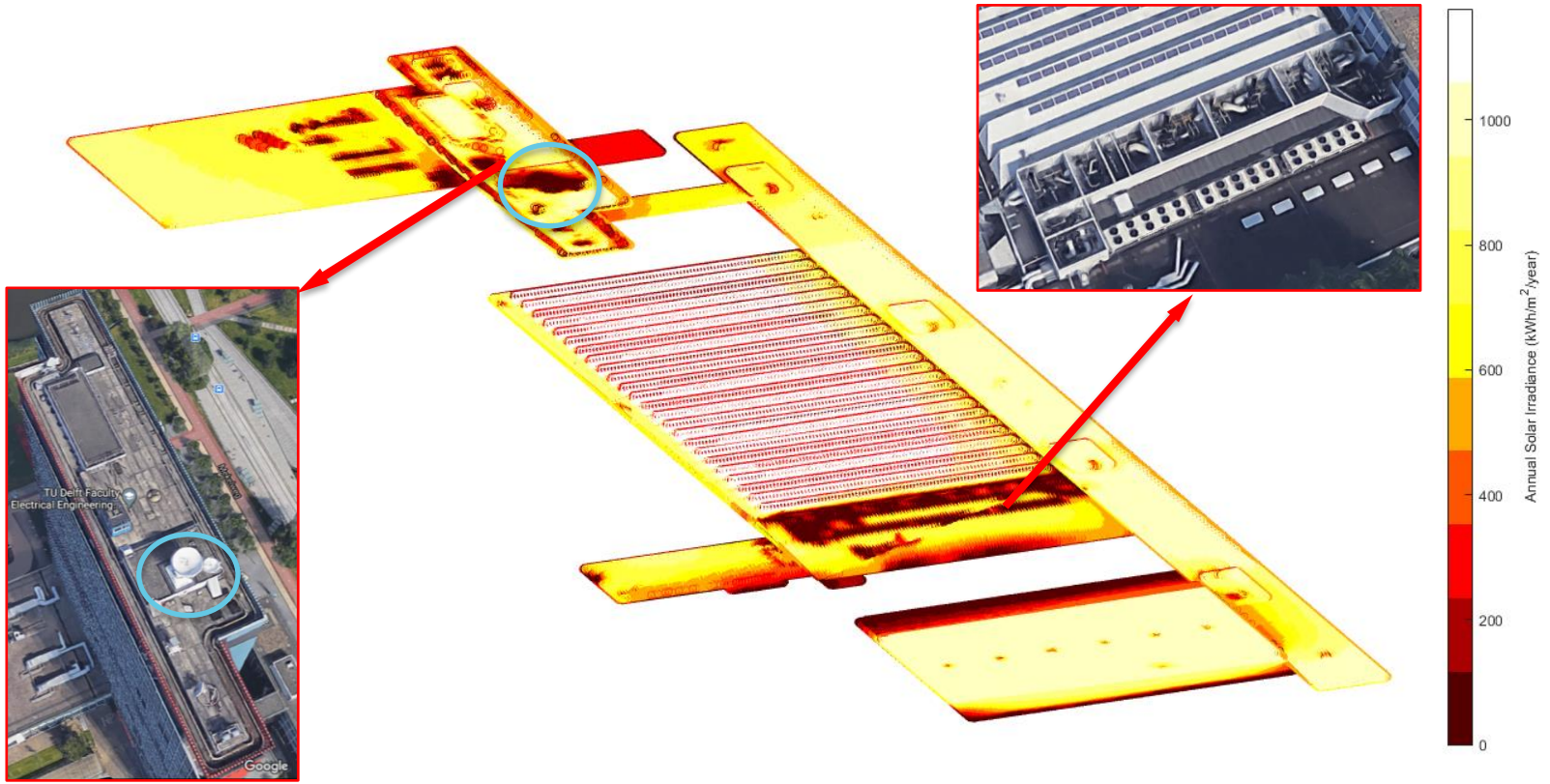
Solar Potential Map on EWI

- **Barycentric Coordinate System**



Solar Potential Map on EWI

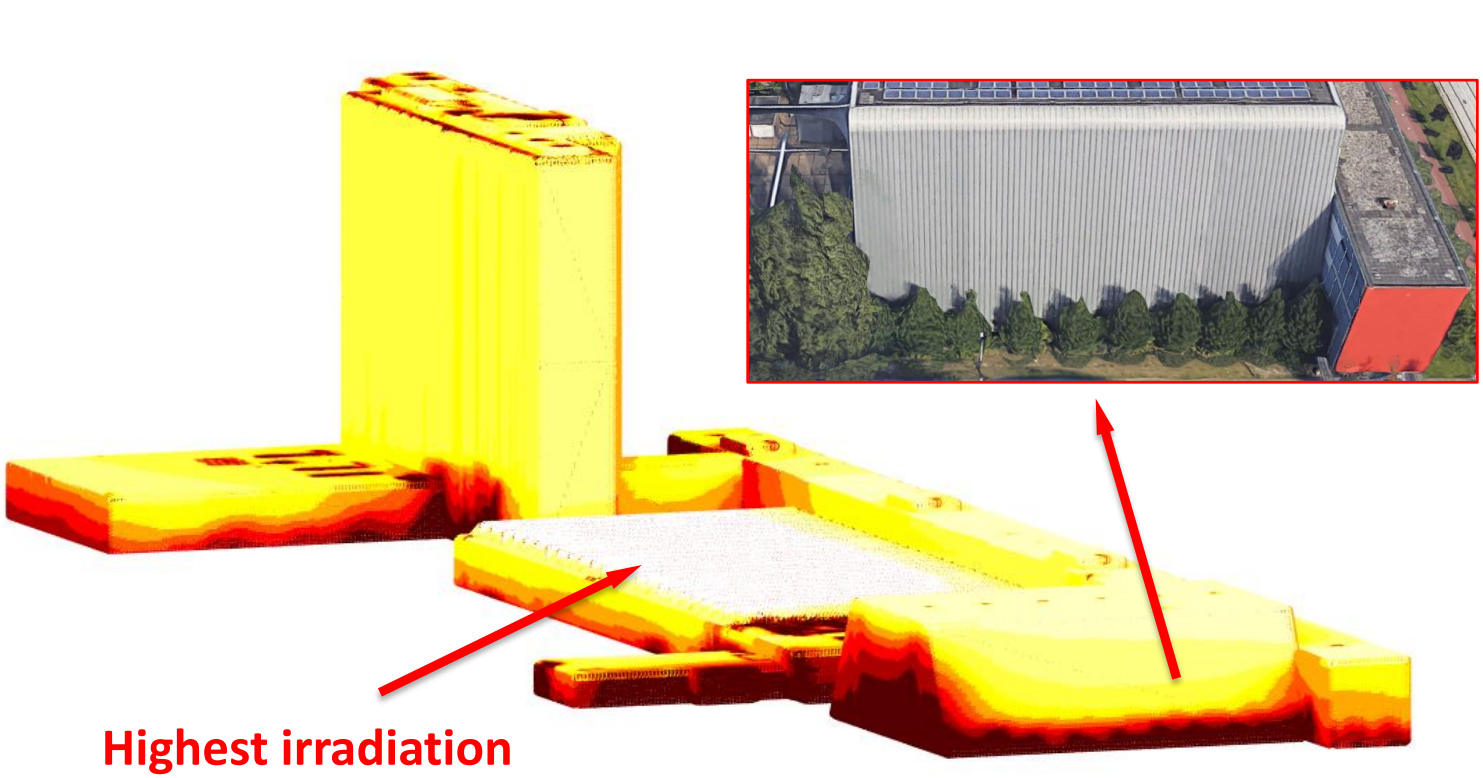
- **PV Potential Map using simplified skyline-based model**



[4] Picture obtained from GoogleMap

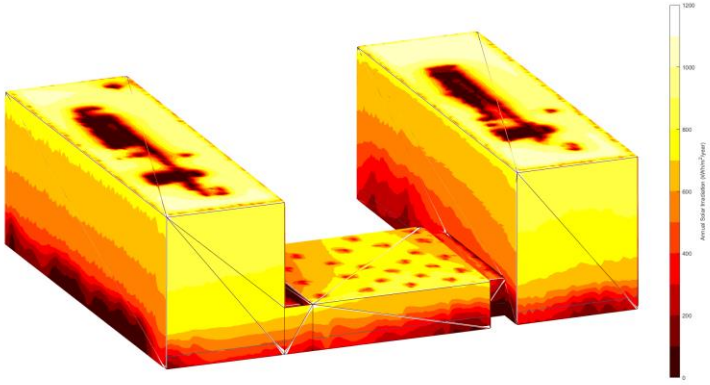
Solar Potential Map on EWI

- **PV Potential Map using simplified skyline-based model**

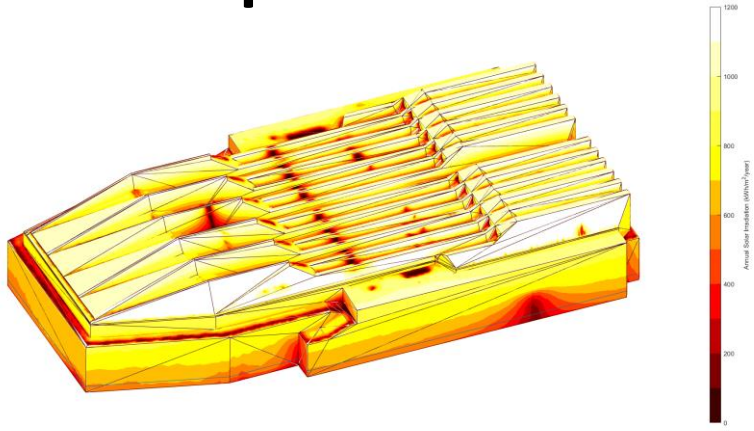


[5] Picture obtained from GoogleMap

Solar Potential Map on Campus

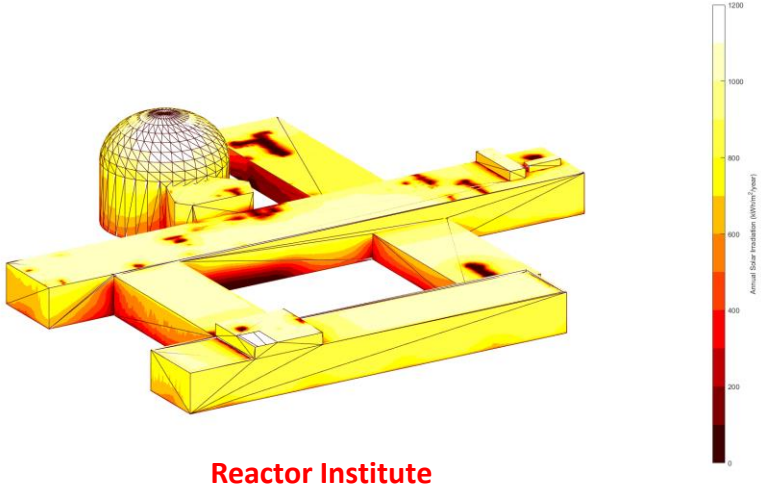


CRE Building



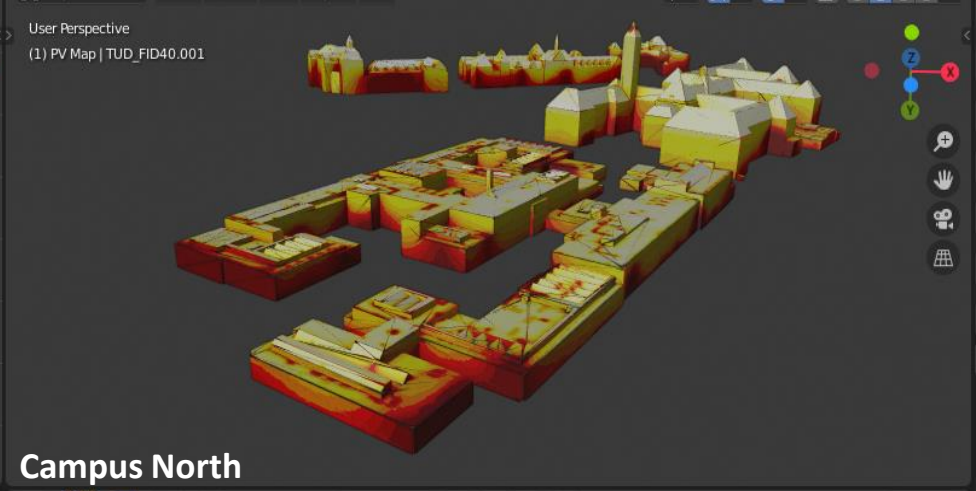
AULA

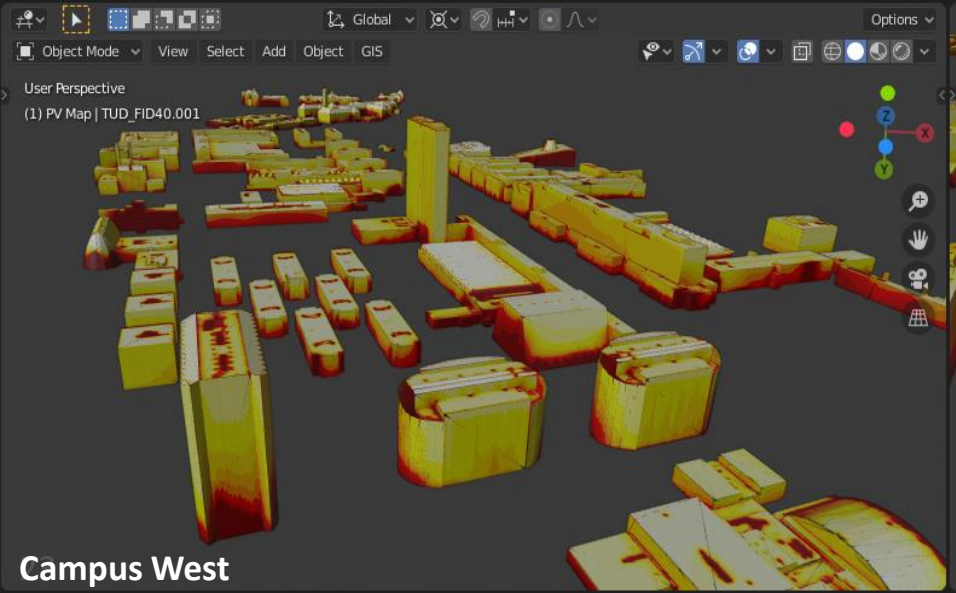
Faculty of Applied Science



Reactor Institute

Front Orthographic
(1) PV Map | TUD_FID40.001
10 Meters
Bird View


User Perspective
(1) PV Map | TUD_FID40.001
Campus North


Global
Options
Object Mode
View
Select
Add
Object
GIS
User Perspective
(1) PV Map | TUD_FID40.001
Campus West

Global
Options
Object Mode
View
Select
Add
Object
GIS
User Perspective
(1) PV Map | TUD_FID40.001
Campus East

Conclusions

- 3D Building model can be reconstructed from LiDAR data and building footprint
  - **Input data are freely available and reliable**
  - **Reconstructed 3D model is fairly accurate with ± 5 cm deviation**
  - **Process is not fully automated and requires some manual work**

- Using Barycentric Coordinate System can uniformly generate grid for solar potential analysis
  - **User-defined grid density**
  - **Works successfully with simplified skyline-based model to calculate solar potential on building roofs and facades**

Thank you for your attention!

Funder

TU Delft Campus and Real Estate (CRE)

TU Delft Urban Energy platform

SOLAR URBAN
Delft University of Technology
Amsterdam Institute for Advanced Metropolitan Solutions

https://www.tudelft.nl/en/tu-delft-urban-energy/

Partners

PVMD Delft University of Technology

TU Delft BK Bouwkunde
Delft University of Technology
Faculty of Architecture and the Built Environment

Visit our web-lab: **dutchpvportal.tudelft.nl**

For info about the *3rd International PV Systems Summer School* visit: **www.tudelft.nl/pvsss**