Tvorba 3D modelov krajiny

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Informačný list predmetu

Výsledky vzdelávania:

Študent získa vedomosti z oblasti tvorby 3D modelov krajiny, oboznámi sa s odbornou terminológiou, vie vyhodnotiť kvalitu dát. Naučí sa pracovať s rôznymi typmi 3D dát, vykonávať filtráciu dát na základe zvolených kritérií, vytvoriť rôzne typy 3D modelov v rôznej úrovni detailnosti, vizualizovať 3D dáta prostredníctvom webových nástrojov. Študent dokáže s vysokou mierou samostatnosti navrhnúť postup pre tvorbu 3D modelov krajiny na základe definovaných požiadaviek a vyhodnotiť kvalitu 3D modelov krajiny a posúdiť ich vhodnosť pre potreby vykonávania priestorových analýz a modelovanie rôznych 3D javov.

Výsledné hodnotenie predmetu je založené na:

- Aktívna účasť na cvičeniach

- Odovzdané výstupy z cvičení - hodnotené systémom splnil/nesplnil

- Odovzdané semestrálne zadanie - zamerané na schopnosť samostatne vypracovať projekt zameraný na tvorbu 3D modelov krajiny (výber metód pre zber dát a tvorbu 3D modelov krajiny, hodnotenie kvality dát a záverečnej prezentácii výsledkov)

Pre záverečné hodnotenie platí hodnotiaca schéma:

A: 100 – 90 %
B: 89 – 80 %
C: 79 – 70 %
D: 69 – 60 %
E: 59 – 50 %

Odôvodnené absencie

konzultácie: pondelok, streda 10:00 – 11:00
email: michaela.novakova@upjs.sk

- Úvod do problematiky, pojmy a definície, dátové modely

- Úrovne detailnosti - sémantika, City GML

- Zdroje geopriestorových 3D dát - vzájomné porovnanie

- Tvorba 3D modelov krajiny - DMR, modelovanie povrchov, vysvetlenie princípu Octree

- Tvorba 3D modelu krajiny - budovy - box model, komplexnejší model, manuálna 3D vektorizácia

- Tvorba 3D modelu krajiny - vegetácia

- Prezentácia 3D geodát pomocou webových služieb

- Výpočet objemov z 3D modelov

- Tvorba časovej série 3D modelu krajiny - prístupy, princípy

- Modelovanie krajinných procesov využitím 3D modelov krajiny

ODPORÚČANÁ LITERATÚRA

- HOFIERKA, J., KAŇUK, J., GALLAY, M., 2014: Geoinformatika. Univerzita Pavla Jozefa Šafárika v Košiciach, p. 192

- ROBINSON, A. H. et al. 1995: ElementsofCartography. Wiley&sons. 674 s.

- ArcGIS10Web Help. ArcGISResource Center. Environmental Research Institute. Dostupné na: http://help.arcgis.com/en/arcgisdesktop/10.0/help/index.html

- LONGLEY, P. A., GOODCHILD, M. F., MAGUIRE, D. J., RHIND, D. W. 2001: Geographic Information Systems and Science. John Wiley & Sons.

- VOSSELMAN, G., DIJKMAN, D. (2001): 3D building model reconstruction from point clouds and ground plans. In International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, volume 34, part 3/W4, pages 37–43, Annapolis, MA, USA, 2001.

- KAŇUK, J., GALLAY, M., HOFIERKA, J. (2015): Generating time series of virtual 3-D city models using a retrospective approach. Landscape and Urban Planning, 139, 40-53.

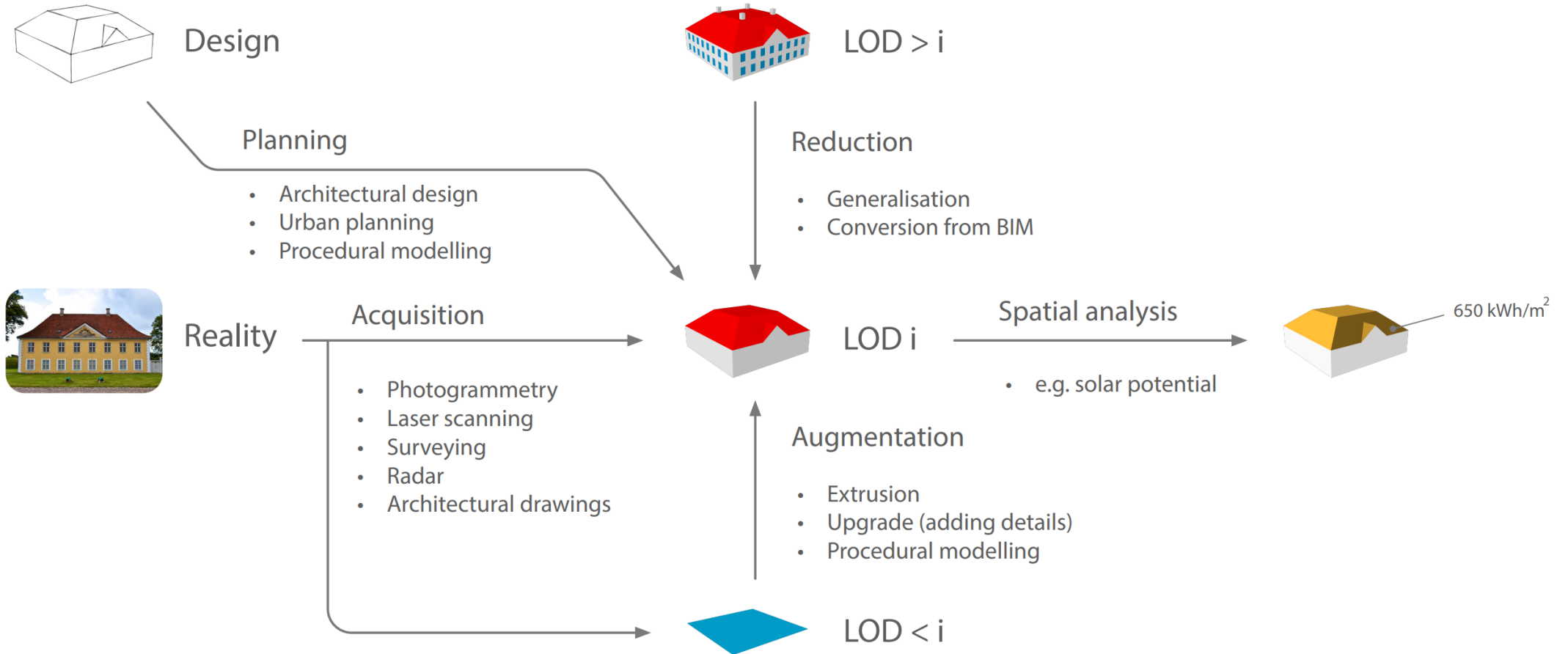# Pojmy a definície, dátové modely, príklady

LOD

BIM

City GML

01

3D city model

(different production workflows from the perspective of the level of detail)

Design

LOD > i

Planning
- Architectural design
- Urban planning
- Procedural modelling

Reduction
- Generalisation
- Conversion from BIM

Reality

Acquisition
- Photogrammetry
- Laser scanning
- Surveying
- Radar
- Architectural drawings

LOD i

Spatial analysis

650 kWh/m^2

- e.g. solar potential

Augmentation
- Extrusion
- Upgrade (adding details)
- Procedural modelling

LOD < i

3D city model

(different production workflows from the perspective of the level of detail)

Design

LOD > i

Planning
- Architectural design
- Urban planning
- Procedural modelling

Reduction
- Generalisation
- Conversion from BIM

Reality

Acquisition

Spatial analysis

LOD i

650 kWh/m²

- Photogrammetry
- Laser scanning
- Surveying
- Radar
- Architectural drawings

- e.g. solar potential

Other applications:

Augmentation
- Extrusion
- Upgrade (adding details)
- Procedural modelling

LOD < i

Visibility analysis

Solar potential estimation

3D cadastre

Energy demand estimation

Infrastructure planning

Emergency response

Shadow estimation

Indoor navigation

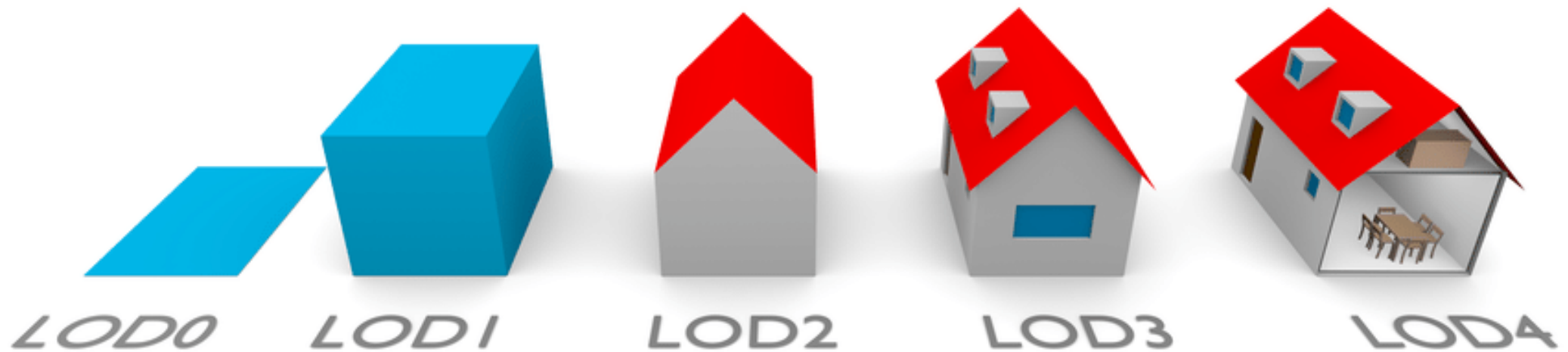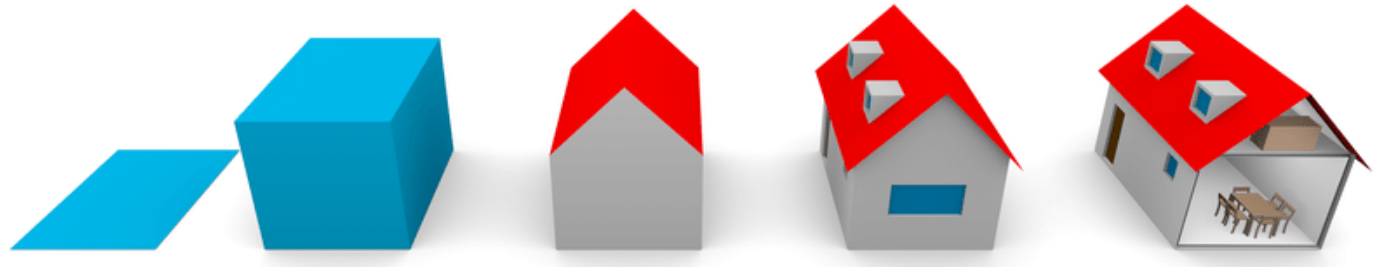Utility management

Noise propagation

TUDelft

LOD

(level of detail)

- úroveň detailnosti - miera detailnosti mapovania objektov

LOD
(level of detail)

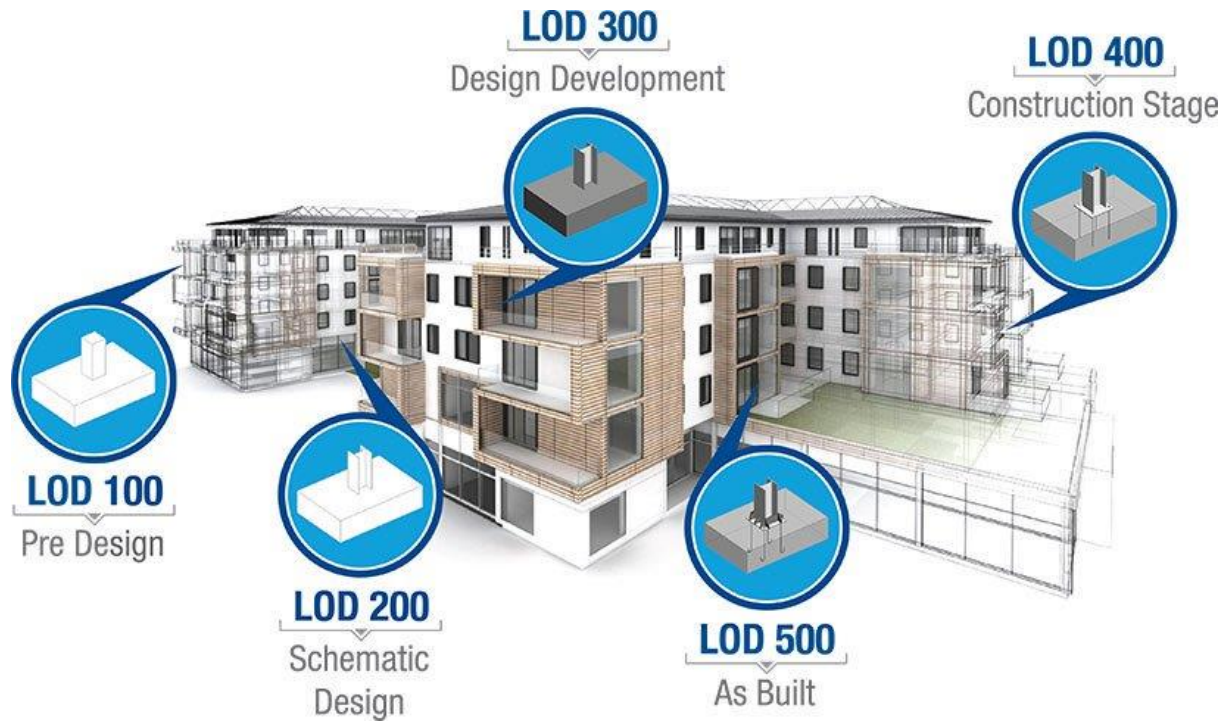|	LOD0	LOD1	LOD2	LOD3	LOD4
Model scale description	regional, landscape	city, region	city districts, projects	architectural models (outside), landmark	architectural models (interior)
Classes of accuracy	lowest	low	middle	high	very high
Absolut 3D point accuracy (position / height)	lower than LOD1	5/5m	2/2m	0.5/0.5m	0.2/0.2m
Generalisation	maximal generalisation (classification of land use)	object blocks as generalised features; > 6*6m/3m	objects as generalised features; > 4*4m/2m	object as real features; > 2*2m/1m	constructive elements and openings are represented
Building installations	-	-	-	representative exterior effects	real object form
Roof form/structure	no	flat	roof type and orientation	real object form	real object form
Roof overhanging parts	-	-	n.a.	n.a.	Yes
CityFurniture	-	important objects	prototypes	real object form	real object form
SolitaryVegetationObject	-	important objects	prototypes, higher 6m	prototypes, higher 2m	prototypes, real object form
PlantCover	-	>50*50m	>5*5m	< LOD2	<LOD2
… to be continued for the other feature themes					

LOD ?

LOD ?

LOD ?

BIM
(Building Information Modeling)

LOD => Level of Development

LOD 100 Conceptual	LOD 200 Approximate geometry	LOD 300 Precise geometry	LOD 400 Fabrication	LOD 500 As-built
The Model Element **may be** graphically represented in the Model with a **symbol or other generic representation**, but does not satisfy the requirements for LOD 200. Information related to the Model Element (i.e. cost per square metre, etc.) can be derived from other Model Elements.	The Model Element **is** graphically represented in the Model as a **generic** system, object, or assembly with **approximate** quantities, size, shape, location, and orientation.	The Model Element **is** graphically represented in the Model as a **specific** system, object, or assembly **accurate** in terms of quantity, size, shape, location, and orientation.	The Model Element **is** graphically represented in the Model as a **specific** system, object, or assembly that is **accurate** in terms of quantity, size, shape, location, and orientation with **detailing, fabrication, assembly, and installation information.**	The Model Element **is** a **field verified** representation **accurate** in terms of size, shape, location, quantity, and orientation.
	Non-graphic information may also be attached to the Model Element.	Non-graphic information may also be attached to the Model Element.	Non-graphic information may also be attached to the Model Element.	Non-graphic information may also be attached to the Model Element.

CityGML
(City Geography Markup Language)

- štandard prijatý OGC (Open Geospatial Consortium)

- 2008 CityGML 1.0   =>   2012 city GML 2.0   =>   2021 CityGML 3.0

- rozšírenie Geography Markup Language (GML)

- konceptuálny model a výmenný formát pre reprezentáciu a ukladanie digitálnych 3D modelov miest a krajiny

- popisuje geometrické, topologické, sémantické a vizuálne vlastnosti 3D objektov
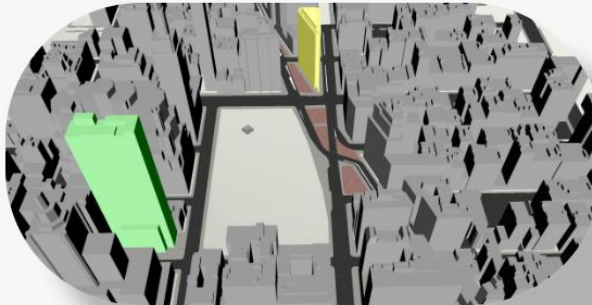
The CityGML Database

Visualization of the 3D City Model of Berlin

A semantic 3D city model of the German capital Berlin is freely available to the public as open data in CityGML format, which contains around 550,000 LoD2 building objects within the whole city area (890 km²).

Visualization of the 3D City Model of New York City

The Chair of Geoinformatics at Technical University of Munich has created the first publicly available big semantic 3D city model of New York City (NYC) derived from existing public 2D, 2.5D, and 3D datasets automatically.

Visualizations for Different Applications

The 3D City Database contains the semantically rich all-purpose city model based on CityGML. This base data can be exported in different 3D visualization formats and styles to meet specific customer needs.
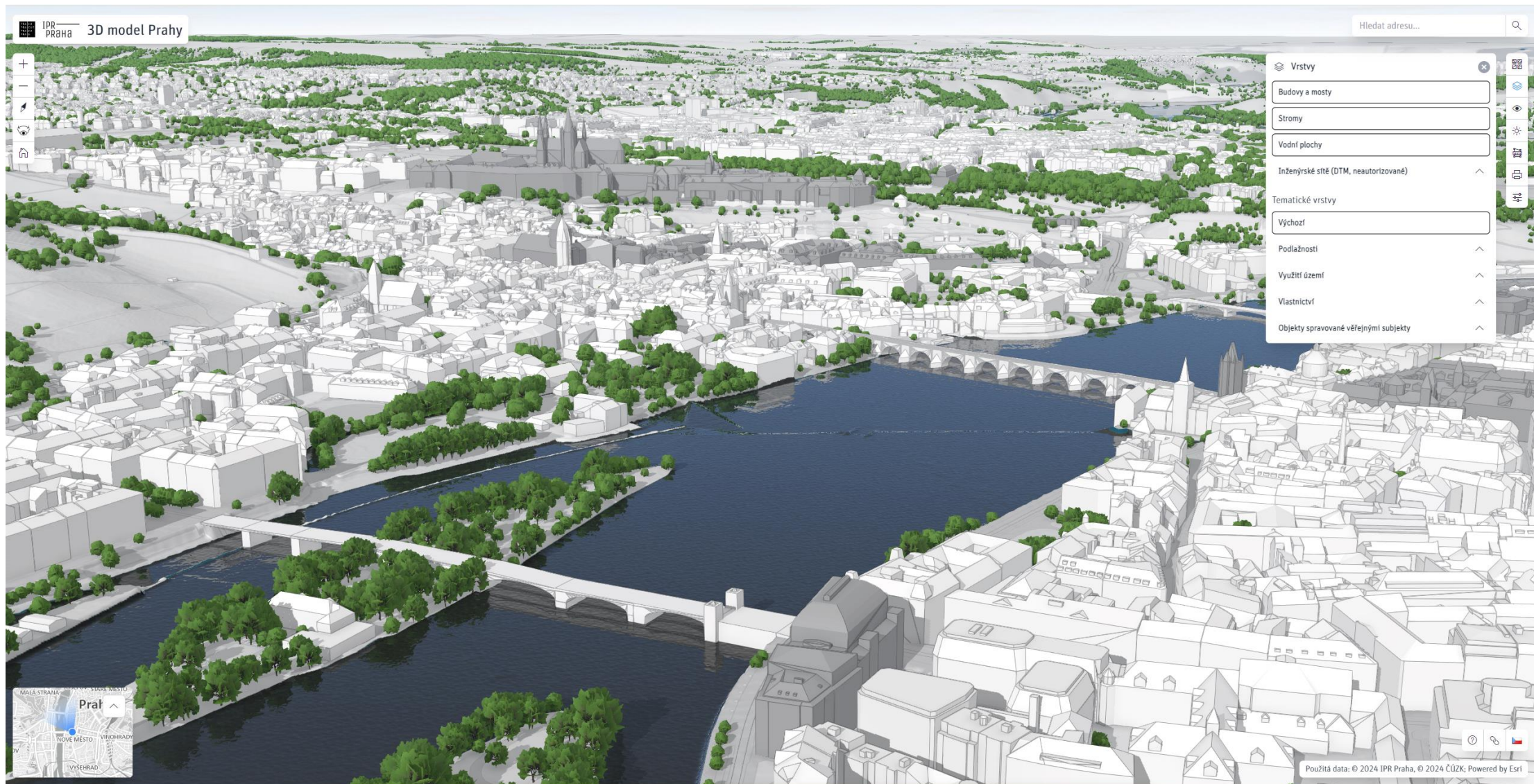
Helsinki - Solar Energy Potential

3D model mesta Brno

Seznam vrstev

- 3D model stromů
- Přesný 3D model
- Orientační 3D model

Analýza viditelnosti

Denní doba

Měření

3D MODEL BRNA

CUZK, Esri, HERE, Garmin, INCREMENT P, USGS

Powered by Esri

3D model Prahy

Bratislava – Staré mesto

3D model Nového Mesta