

Working with Semantic 3D City Models - Tools based on CityGML and 3DCityDB

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A clarification concerning point 2: non-commercial usage means that this tutorial is not allowed to be used in a commercial training course. It is, however, allowed to use this tutorial for learning about the presented topics within commercial companies or projects.

A brief introduction to CityGML and 3DCityDB

3D City Models in CityGML

Application independent Geospatial Information Model

for semantic 3D city and landscape models

- ▶ comprises **different thematic areas** (buildings, vegetation, water, terrain, traffic, tunnels, bridges etc.)
- ▶ **International Standard** of the **Open Geospatial Consortium**
 - V1.0.0 adopted in 08/2008; **V2.0.0** adopted in 3/2012
- ▶ **Data model (UML) + Exchange format** (based on GML3)



CityGML represents

- ▶ 3D geometry, 3D topology, semantics, and appearance
- ▶ in 5 discrete scales (Levels of Detail, LOD)

Disaster management

Kreis Recklinghausen

Radio network planning

T-Mobile

Noise immision mapping

Stapelfeldt GmbH



CityGML

for 3d city models

Police simulator

Rheinmetall Defence Electronics

Business development
& tourism

Google

Kaufhof

Springfield

Leffers

Münsterplatz

Navigation

Facility management

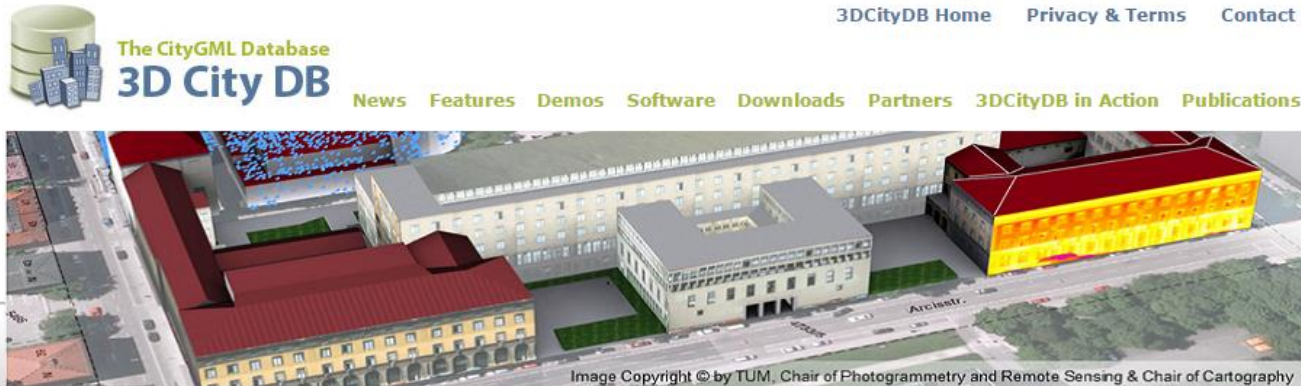
Urban planning

Architecture

Architekturwerkstatt SenStadt Berlin

Learn more about CityGML

► <http://www.3dcitydb.org/3dcitydb/CityGMLCourse/>



CityGML Training Course

Please note that this training course was produced in the year 2008 by the Institute for Geodesy and Geoinformation Science at Technical University Berlin. The course was held in 2008 and 2009 within the "EduServ" distance e-learning program of **EuroSDR**. Since the contents are still mostly up-to-date and the original web pages are no longer online, we present the course here. A flash browser plugin is required to view the interactive presentations with full video recordings of my explanations. The overall production and technical concept of the presentation was done by Robert Kaden. He won the **CATCON 5 Award on Computer Assisted Teaching** of the International Society for Photogrammetry and Remote Sensing at the ISPRS Congress 2008 in Beijing.

- Thomas H. Kolbe

1 Introduction – CityGML and GML

[Start Lecture on Demand](#) - [Lecture Notes \(PDF\)](#) as print out version

2 GML – Concepts and Application Modeling

[Start Lecture on Demand](#) - [Lecture Notes \(PDF\)](#) as Print Out Version

3 CityGML – Capabilities in Detail I

[Start Lecture on Demand](#) - [Lecture Notes \(PDF\)](#) as print out version

Publications

- [CityGML](#)
- [CityGML Podcasts](#)
- [CityGML Training Course](#)

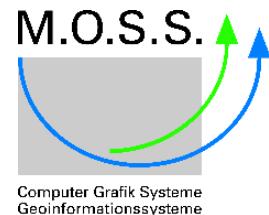
Enjoy Online Lectures

Enjoy presentations about CityGML and Urban Information Modeling, the 3D City Database, and the Importer/Exporter as an online lecture, provided by the TU Delft. Start the stream [here](#)



3D City Database (3DCityDB)

- ▶ “A free **Open Source** (Apache License, Version 2.0) package consisting of a database schema and a set of software tools **to import, manage, analyse, visualize, and export** virtual 3D city models according to the **CityGML** standard.” **(The latest major release: v3.3.0)**
- ▶ The 3D City Database is currently being developed jointly by the following cooperation partners lead by Prof. Thomas H. Kolbe
 - Chair of Geoinformatics, Technical University of Munich
 - virtualcitySYSTEMS GmbH, Berlin
 - M.O.S.S. Computer Grafik Systeme GmbH, Taufkirchen



3D City Database software suite

► 3D City Database

- Oracle/PostGIS Relational Geodatabase Schema
- SQL scripts and functions

► Import/Export Tool

- CityGML Import/Export of arbitrary file sizes (>>4GB)
- KML/COLLADA/glTF Exporter for 3D visualization
- Plugins (e.g. Spreadsheet Generator)

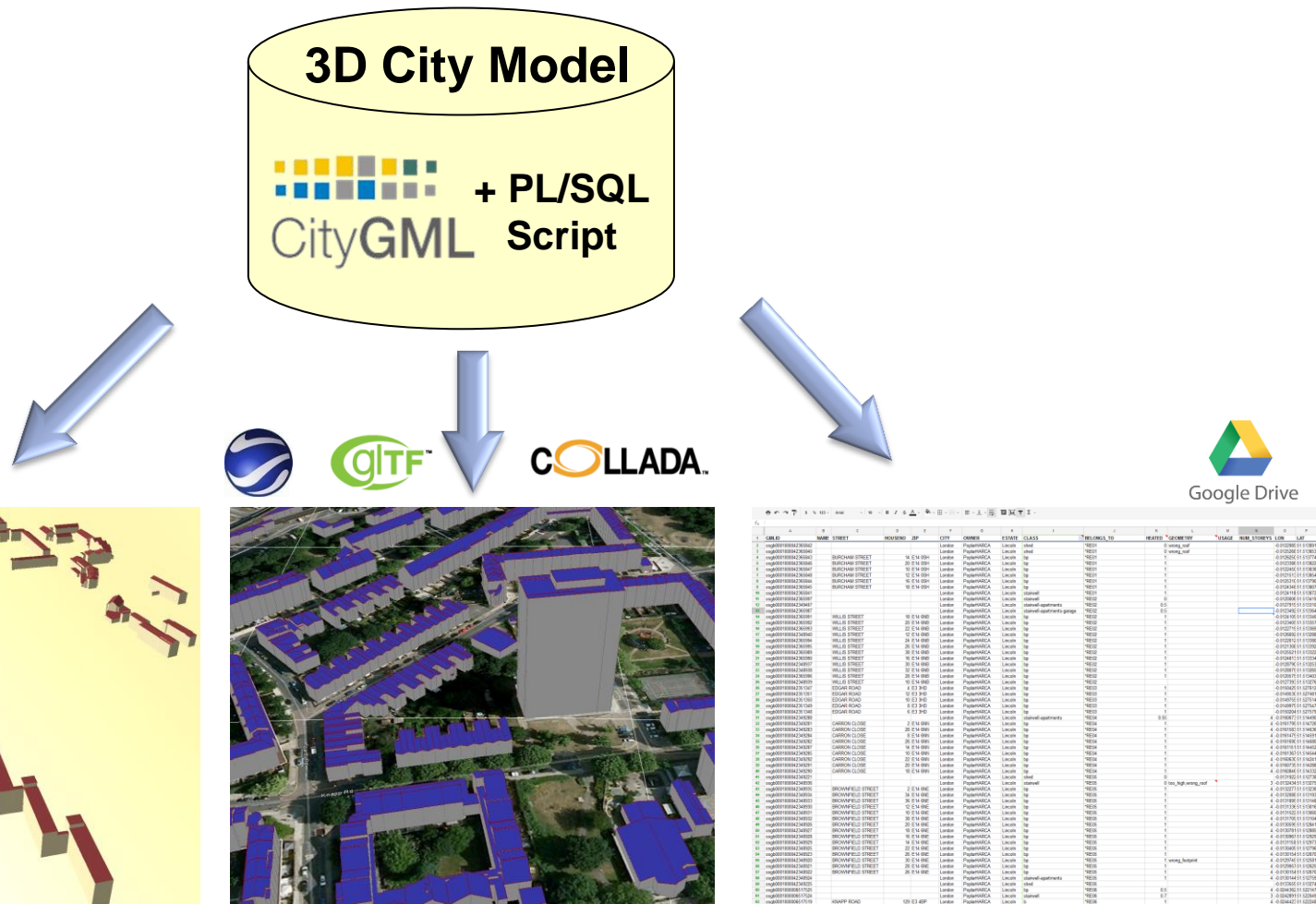
► Web Feature Service

- Implemented against the OGC WFS 2.0 interface
- Satisfies the *WFS Simple* conformance class

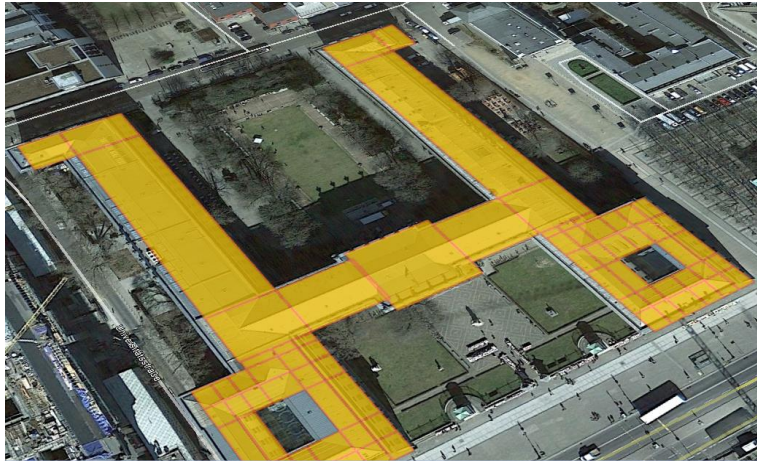
► 3DCityDB-Web-Map-Client (or called *3D Web Client*)

- Static web client for interactive 3D exploration and manipulation
- Cloud-based linking of 3D objects with thematic data

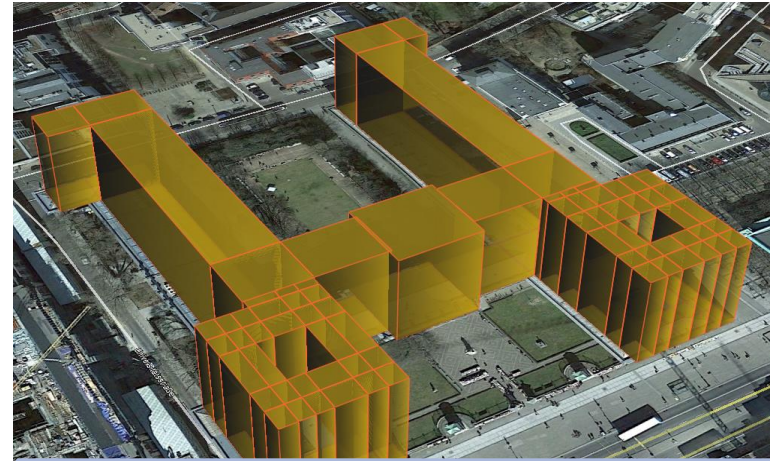
Output datasets from 3DCityDB



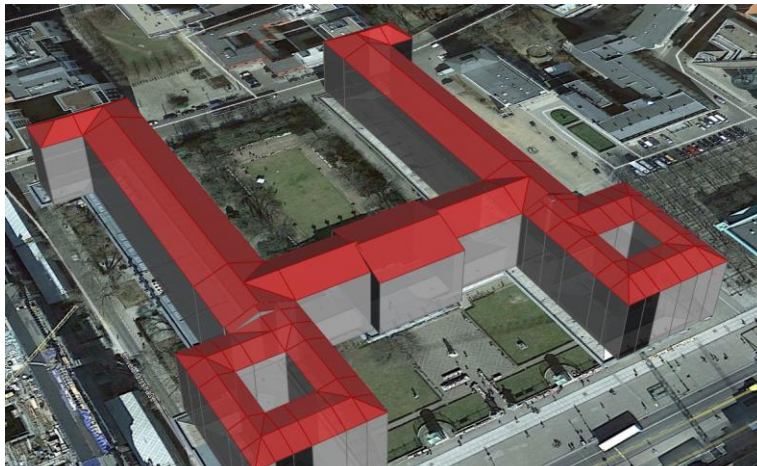
Different display forms of visualization models



LoD0 - Footprint



LoD1 - Extruded



COLLADA.



LoD2 – Geometry only

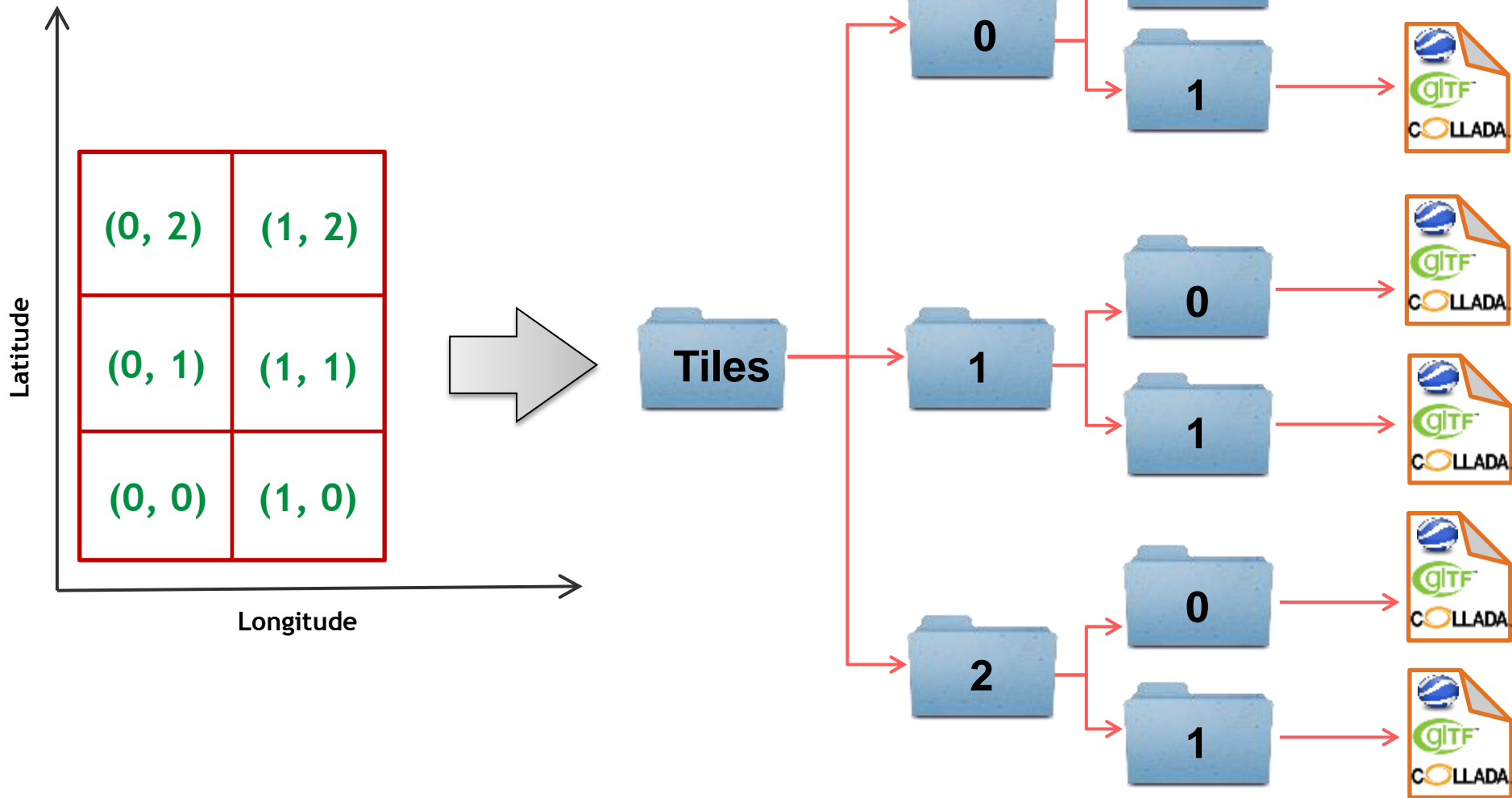


COLLADA.

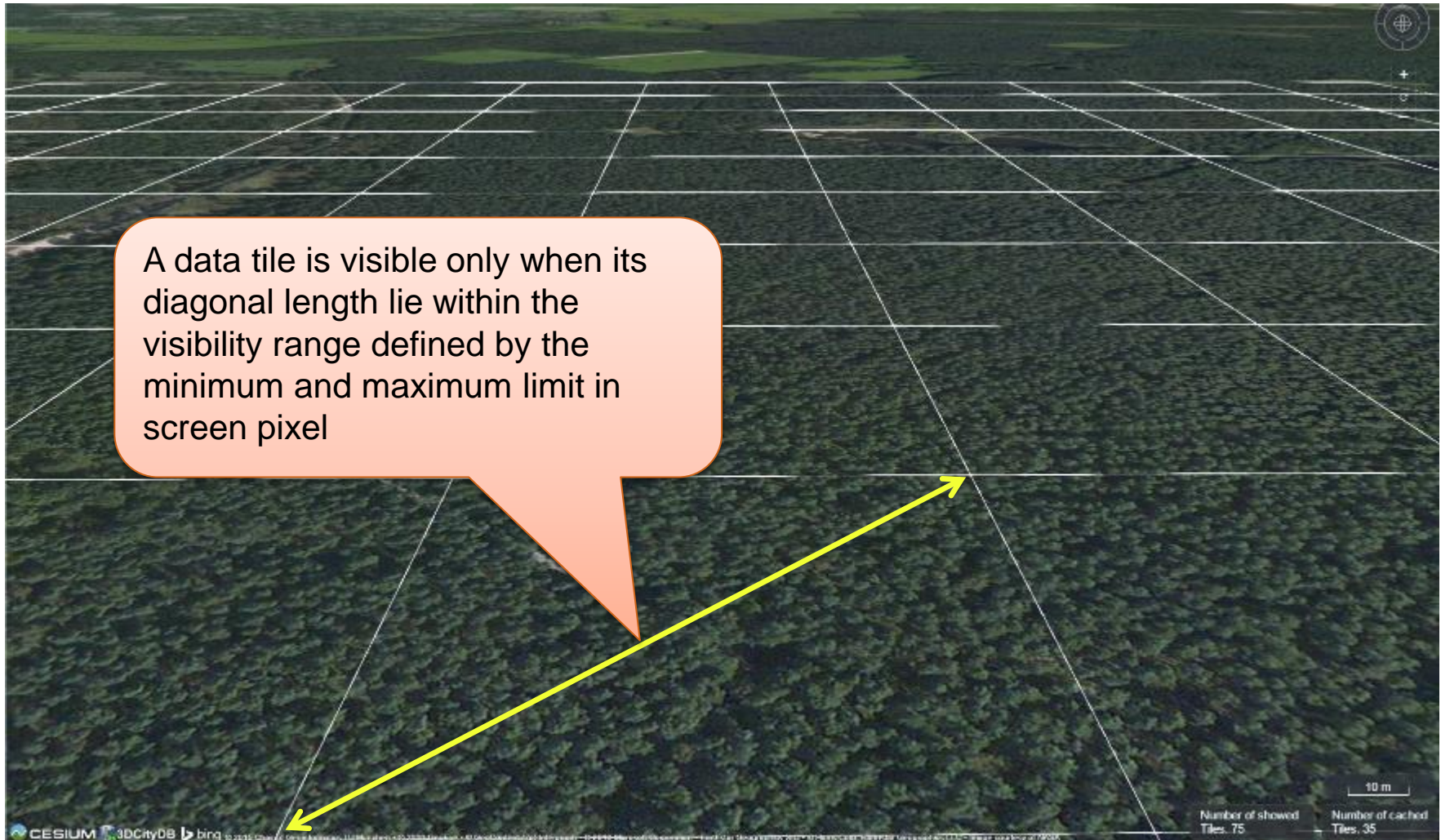


LoD2 – Geometry & Textures

A simple grid-based tiling strategy for the export of visualization models



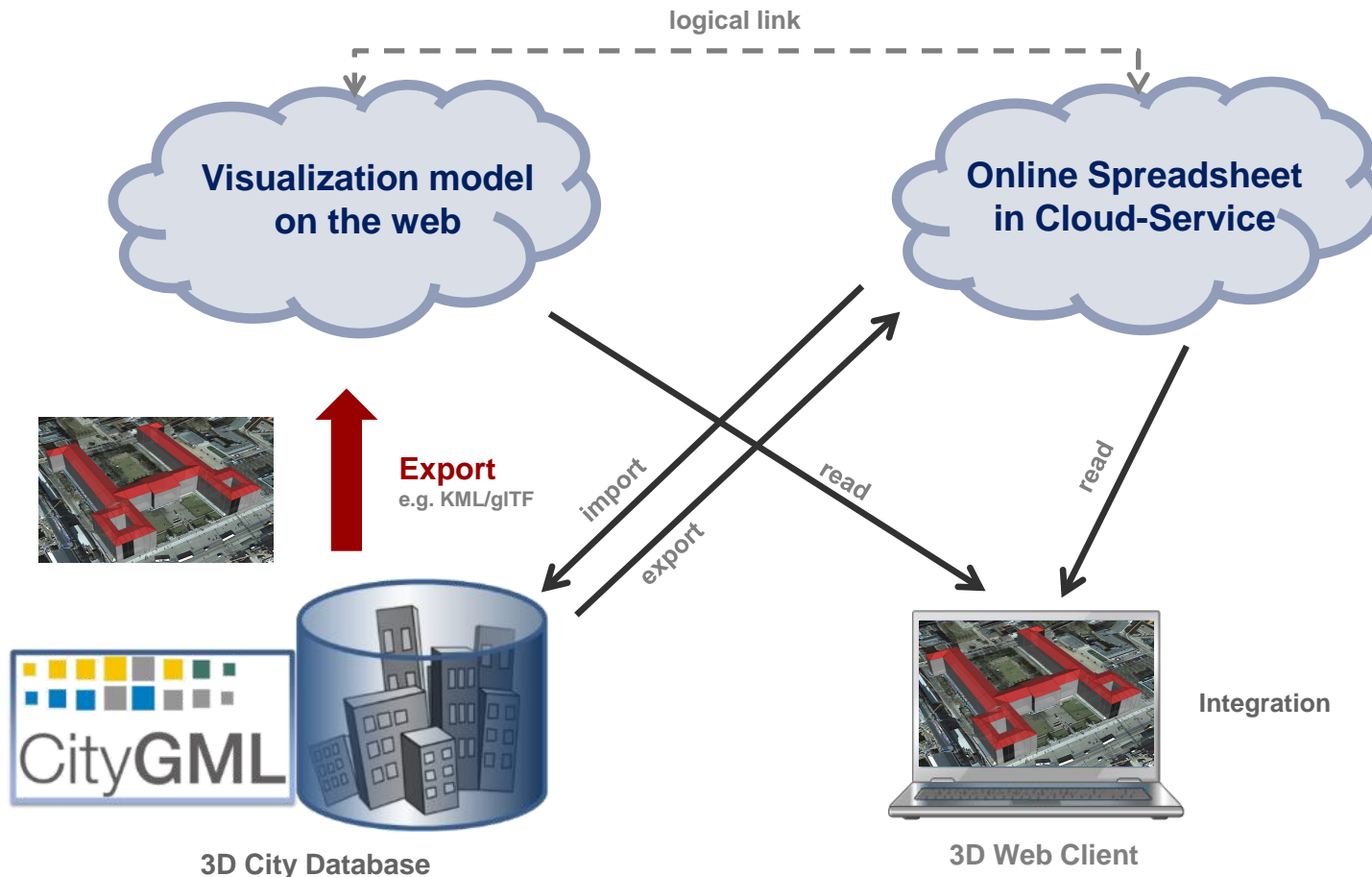
Efficient determination of which data tiles should be loaded



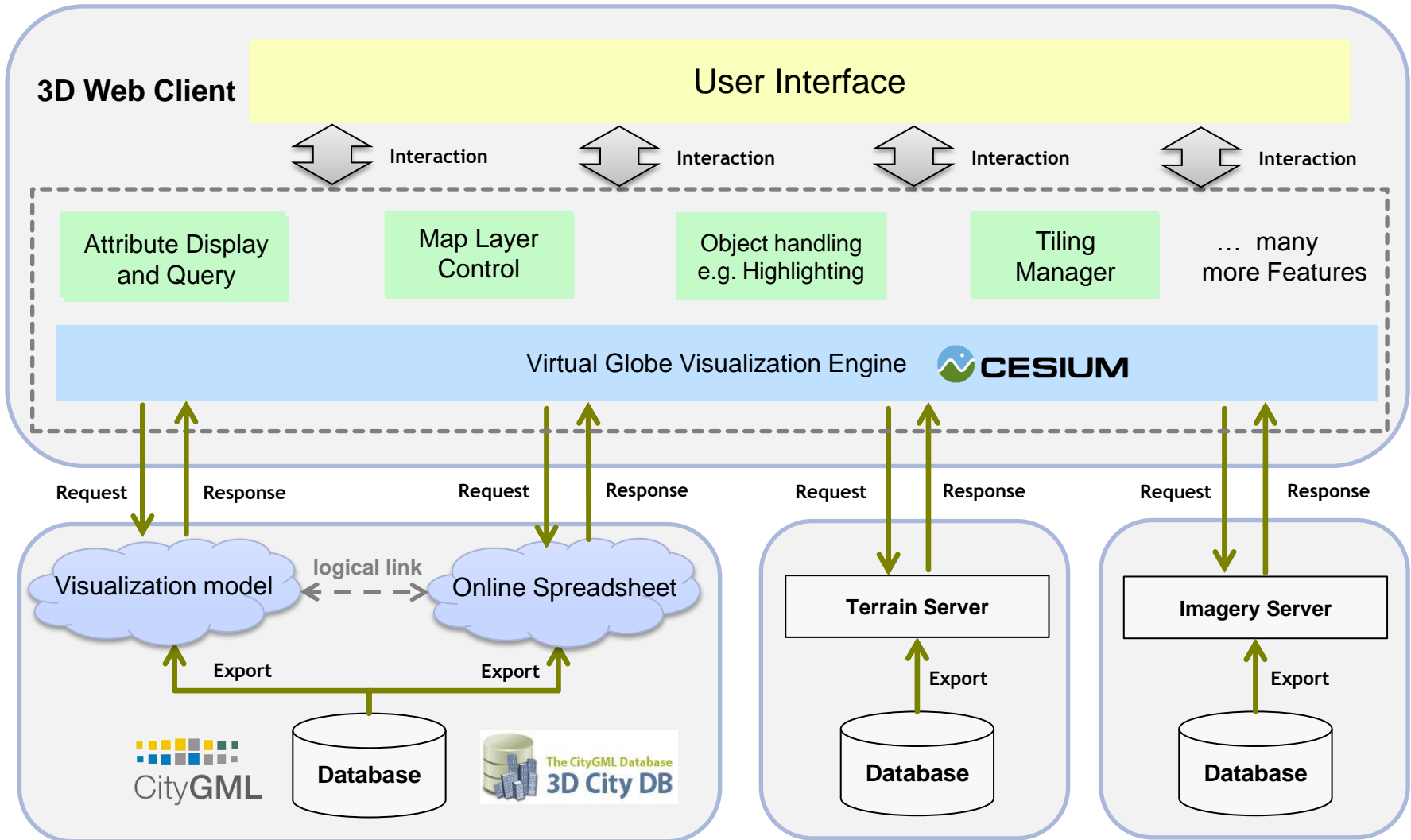
**We need to find a way for
interactive 3D visualization and
exploration of 3D city models on
the web...**



General concept: Coupling of Cloud Service and 3DCityDB



System Architecture of the 3D Web Client



The screenshot shows a 3D city model interface. A central 3D model of a city block is displayed, with a specific building highlighted in green. A red speech bubble points to this building, containing the text "Attribute Information of the selected City Object". To the left of the model is a "Toolbox for Controlling and Management of the Data Layers", which includes options to show or hide various layers (NYC_Buildings, NYC_Streets, NYC_Lots), add or remove layers, and manage the scene. A red speech bubble points to this toolbox. On the right side, a panel titled "uuid_f1ff198c-1dcb-4cf9-8c60-710173fe2fed" displays a table of attribute information for the selected building. A red speech bubble points to this panel. At the bottom, a "Status Indicator" shows the number of shown tiles (72) and the number of cached tiles (45). The interface also includes a timeline at the bottom and a search bar at the top right.

Attribute Information of the selected City Object

Toolbox for Controlling and Management of the Data Layers

Status Indicator

uuid_f1ff198c-1dcb-4cf9-8c60-710173fe2fed	
GMLID	uuid_f1ff198c-1dcb-4cf9-8c60-710173fe2fed
NAME	Flatiron Building
STREET	BROADWAY
HOUSE_NUMBER	1
ZIP_CODE	10010
BUILDING_MEASURED_HEIGHT	91.528392
BUILDING_MEASURED_HEIGHT_UNIT	m
BOROUGH_BLOCK_LOT_NUMBER	1008510001
BUILDING_IDENTIFICATION_NUMBER	1016278
DOITT_ID	507159
GROUND_ELEVATION	12.8016
BUILDING_VOLUME	92246.5917684584
PLUTO_BUILDING_CLASS	O3
PLUTO_BUILDING_AREA	17042.96978496
PLUTO_COMMERCIAL_AREA	17042.96978496
PLUTO_RESIDENTIAL_AREA	0
PLUTO_OFFICE_AREA	16211.58048
PLUTO_RETAIL_AREA	831.38930496
PLUTO_GARAGE_AREA	0
PLUTO_STORAGE_AREA	0
PLUTO_FACTORY_AREA	0
PLUTO_OTHER_AREA	0
PLUTO_NUMBER_OF_FLOORS	21
PLUTO_UNITS_RESIDENTIAL	0
PLUTO_YEAR_BUILT	1903
PLUTO_YEAR_ALTERED_1	1990
PLUTO_YEAR_ALTERED_2	0
PLUTO_BUILT_FLOOR_AREA_RATIO	21.21
PLUTO_CONDOMINIUM_NUMBER	0
CENTROID	40.7141 72.9806 97.4052

Number of showed Tiles: 72

Number of cached Tiles: 45



3D City Database

The Open Source CityGML Database

<http://www.3dcitydb.org/> 3dcitydb@tum.de

Visit our GitHub Page for more details:
<https://github.com/3dcitydb>

Repositories

People 10

Teams 1

Filters ▾

Find a repository...

3dcitydb-web-map

JavaScript ★ 18 🍴 8

Cesium-based 3D viewer and JavaScript API for the 3D City Database

Updated just now

importer-exporter

Java ★ 11 🍴 17

Java-based tool for loading and extracting 3D city model data from the 3D City Database

Updated 16 hours ago

plugin-spreadsheet-generator

Java ★ 1 🍴 0

Plugin for the Importer/Exporter to export feature attributes as spreadsheets

Updated 16 days ago

web-feature-service

Java ★ 5 🍴 3

OGC Web Feature Service 2.0 interface for the 3D City Database

Updated 24 days ago

3dcitydb

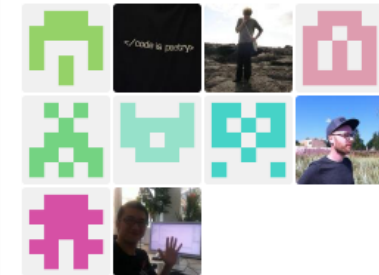
PLSQL ★ 33 🍴 13

3D City Database - The Open Source CityGML Database

Updated 24 days ago

People

10 >



Learn more about 3DCityDB

► <http://www.3dcitydb.org/3dcitydb/documentation/>

The CityGML Database
3D City DB

News Features Demos Software Downloads Partners 3DCityDB in Action

Publications

Documentation
The document below provides the new documentation for the **3D City Database 3.3**, the **Importer/Exporter**, and the new **3D Web Viewer**. The documentation has been extended and completely revised from the previous documents.

3DCityDB_Documentation_v3.3.docx (53.9 MB)
3DCityDB_Documentation_v3.3.pdf (47.9 MB)

Documentation for previous releases
The documentation for the previous release **3D City Database 3.0** can be downloaded using the hyperlinks below. Please scroll down to see all available downloads for all older releases.

3DCityDB_Documentation_v3.docx (32 MB)
3DCityDB_Documentation_v3.pdf (13.2 MB)

The **documentation for the old version** (3D City Database 2.0) can still be downloaded using the hyperlinks below. It covers all releases 2.x.x.

3DCityDB-Documentation-v2_0.doc (12,2 MB)
3DCityDB-Documentation-v2_0.pdf (5,8 MB)

The document below contains the **addendum** to the 3D City Database Documentation 2.0.1, coming with the

Downloads

- Documentation
- 3D City Database
- Importer/Exporter
- Importer/Exporter Plugins
- Web Feature Service
- 3DCityDB-Web-Map-Client
- citygml4j

Software Licensing
Our software is open source and released under the terms of **Apache**.

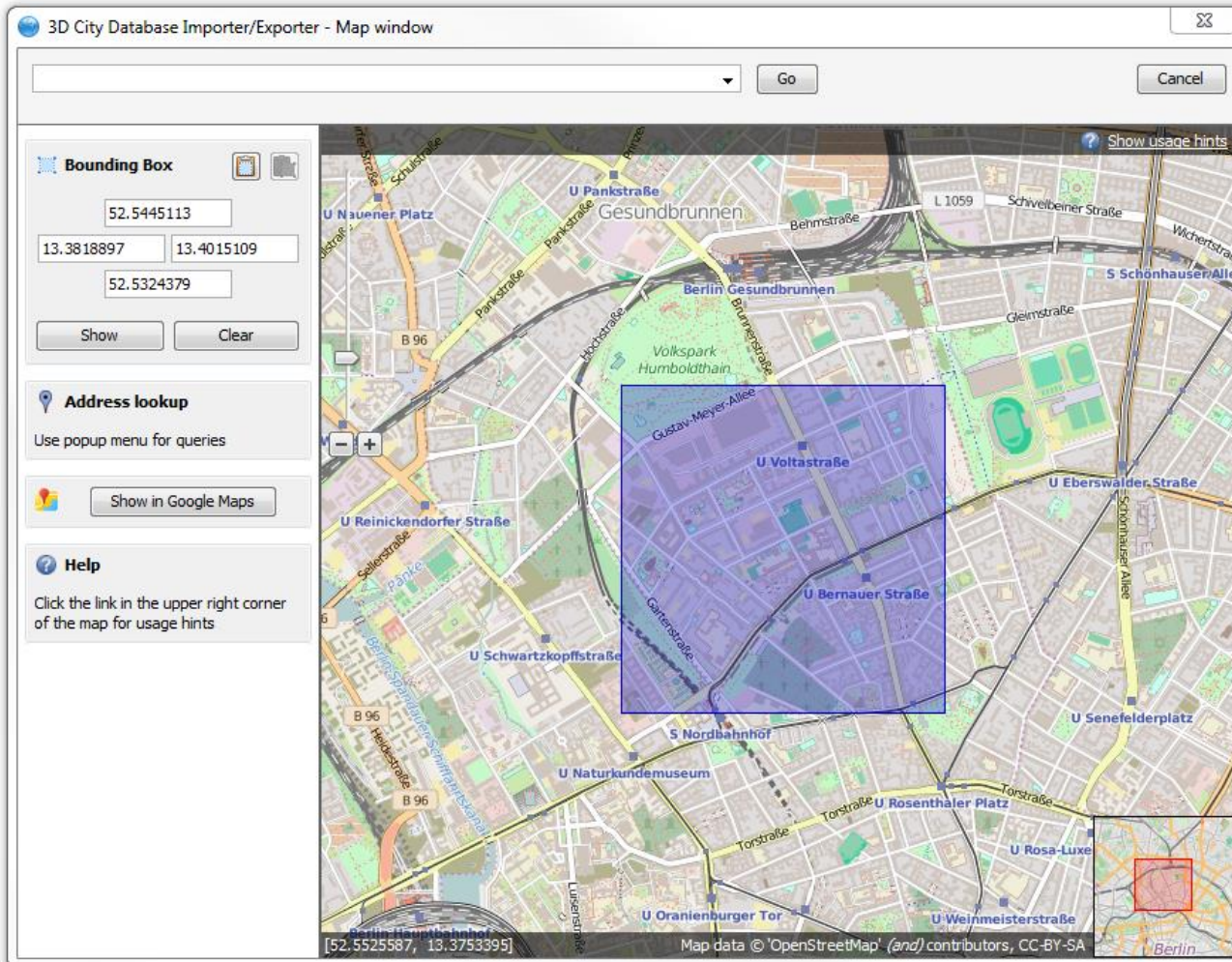
Software Project Page
Visit our **GitHub Page** for details, further material, the GitHub repository and for reporting bugs.

Chair of Geoinformatics | Technische Universität München



Practical Exercise

Course Data (1)

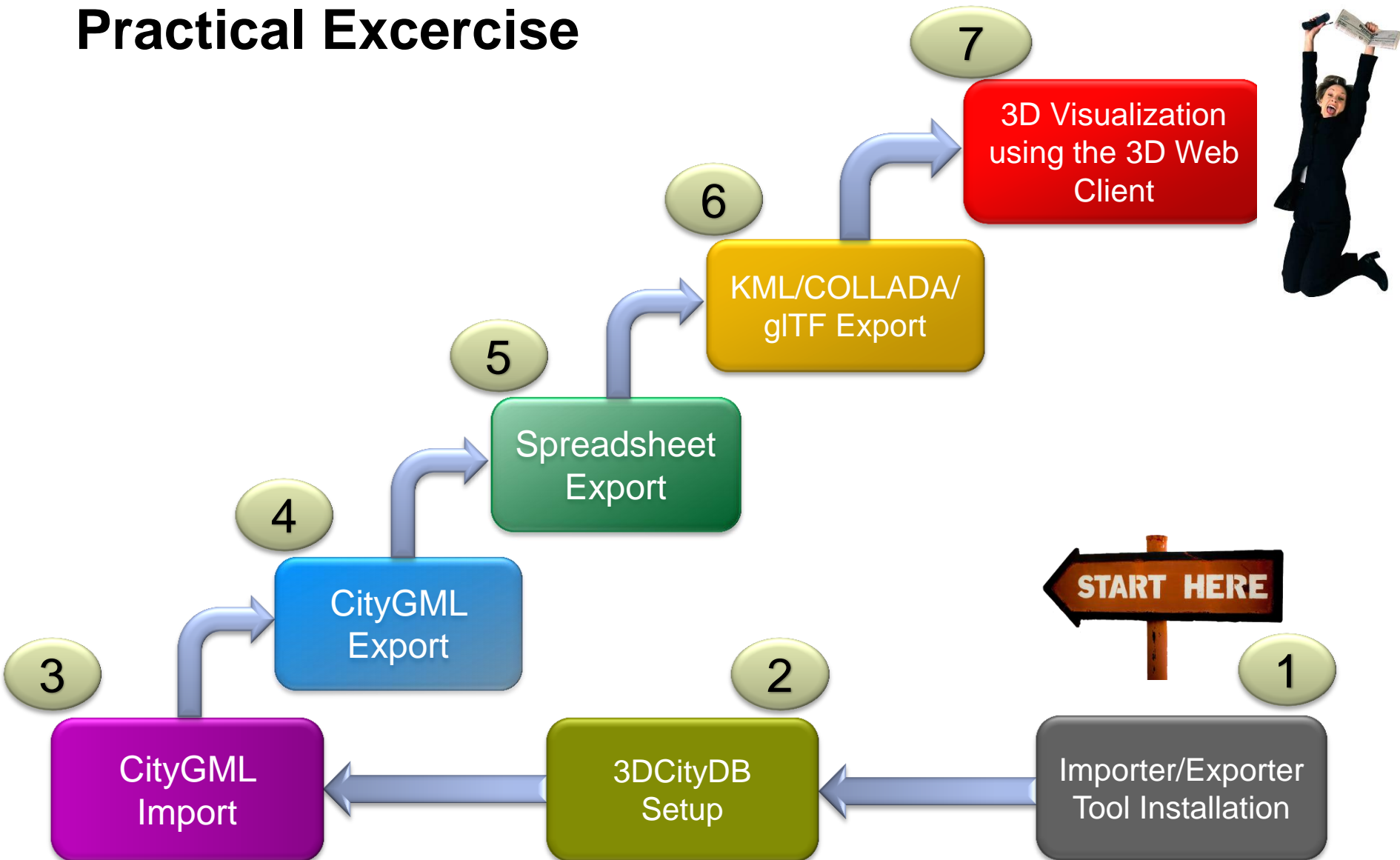


- ▶ **City**
 - Berlin
- ▶ **Format**
 - CityGML (.gml)
- ▶ **Spatial Reference**
 - SRID: 25833
- ▶ **Feature Type**
 - Building
- ▶ **Number of Buildings**
 - 954

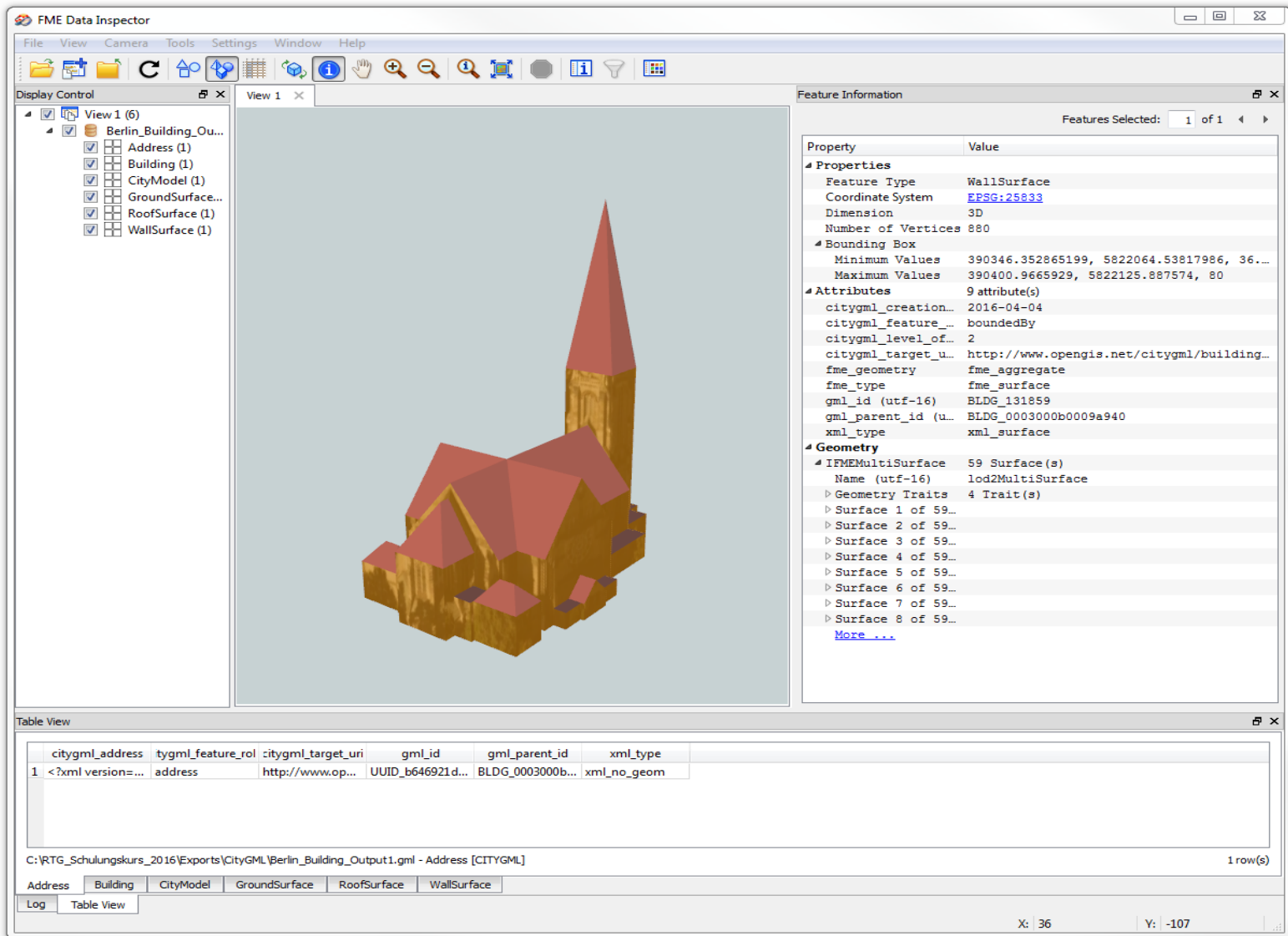
Course Data (2)



Practical Exercise



Practical Exercise – Example Results (1)



The screenshot shows the FME Data Inspector interface. The main view displays a 3D model of a building with a red roof and yellow walls. The left pane shows the 'Display Control' tree with the following structure:

- View 1 (6)
 - Berlin_Building_Ou...
 - Address (1)
 - Building (1)
 - CityModel (1)
 - GroundSurface...
 - RoofSurface (1)
 - WallSurface (1)

The right pane shows the 'Feature Information' for the selected feature. The 'Properties' section includes:

- Feature Type: WallSurface
- Coordinate System: EPSG:25833
- Dimension: 3D
- Number of Vertices: 880

The 'Attributes' section includes:

- citygml_creation_: 2016-04-04
- citygml_feature_: boundedBy
- citygml_level_of_: 2
- citygml_target_u_: http://www.opengis.net/citygml/building...
- fme_geometry: fme_aggregate
- fme_type: fme_surface
- gml_id (utf-16): BLDG_131859
- gml_parent_id (u...): BLDG_0003000b0009a940
- xml_type: xml_surface

The 'Geometry' section includes:

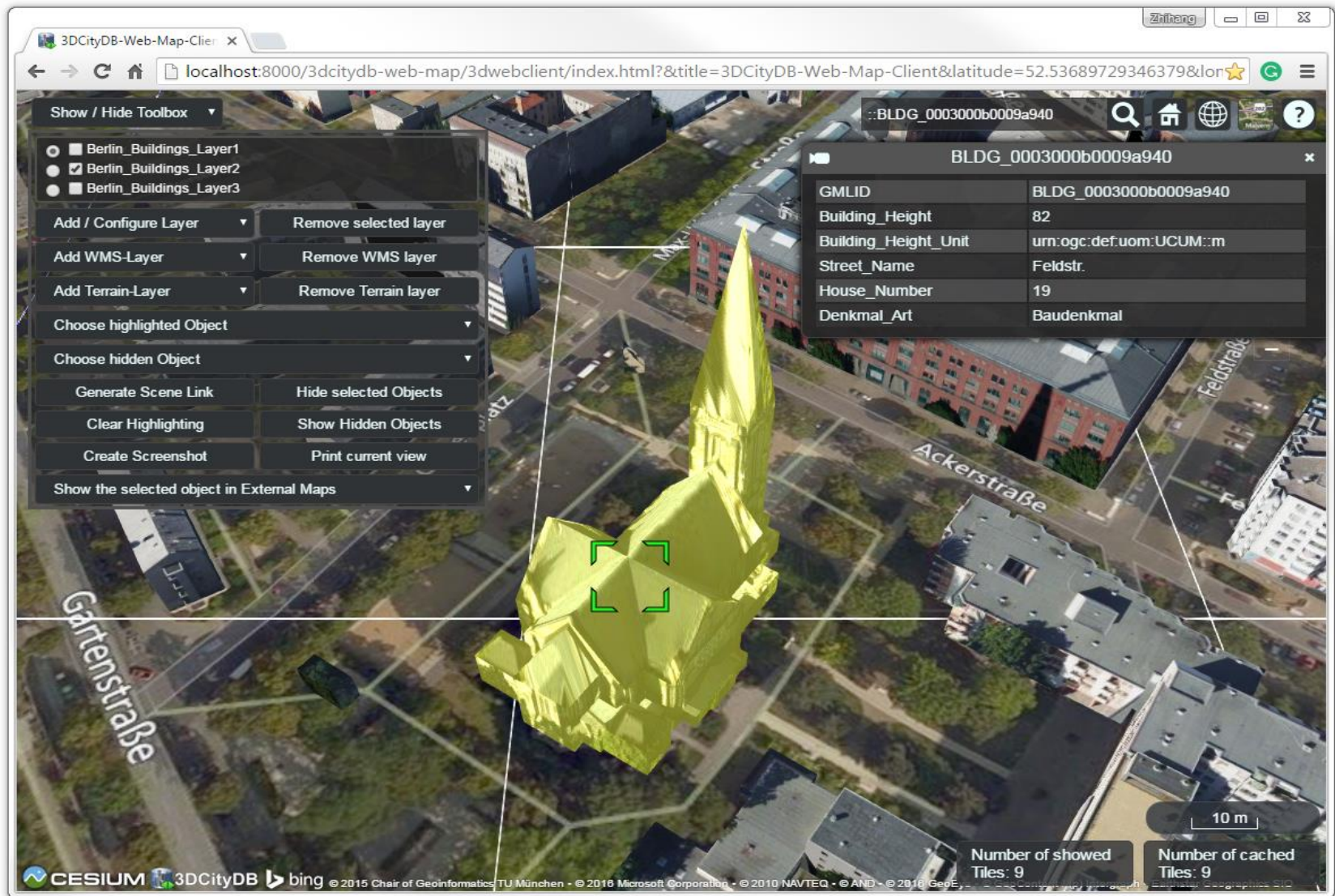
- IFMEMultiSurface: 59 Surface(s)
- Name (utf-16): lod2MultiSurface
- Geometry Traits: 4 Trait(s)
- Surface 1 of 59...
- Surface 2 of 59...
- Surface 3 of 59...
- Surface 4 of 59...
- Surface 5 of 59...
- Surface 6 of 59...
- Surface 7 of 59...
- Surface 8 of 59...

The bottom pane shows the 'Table View' with the following data:

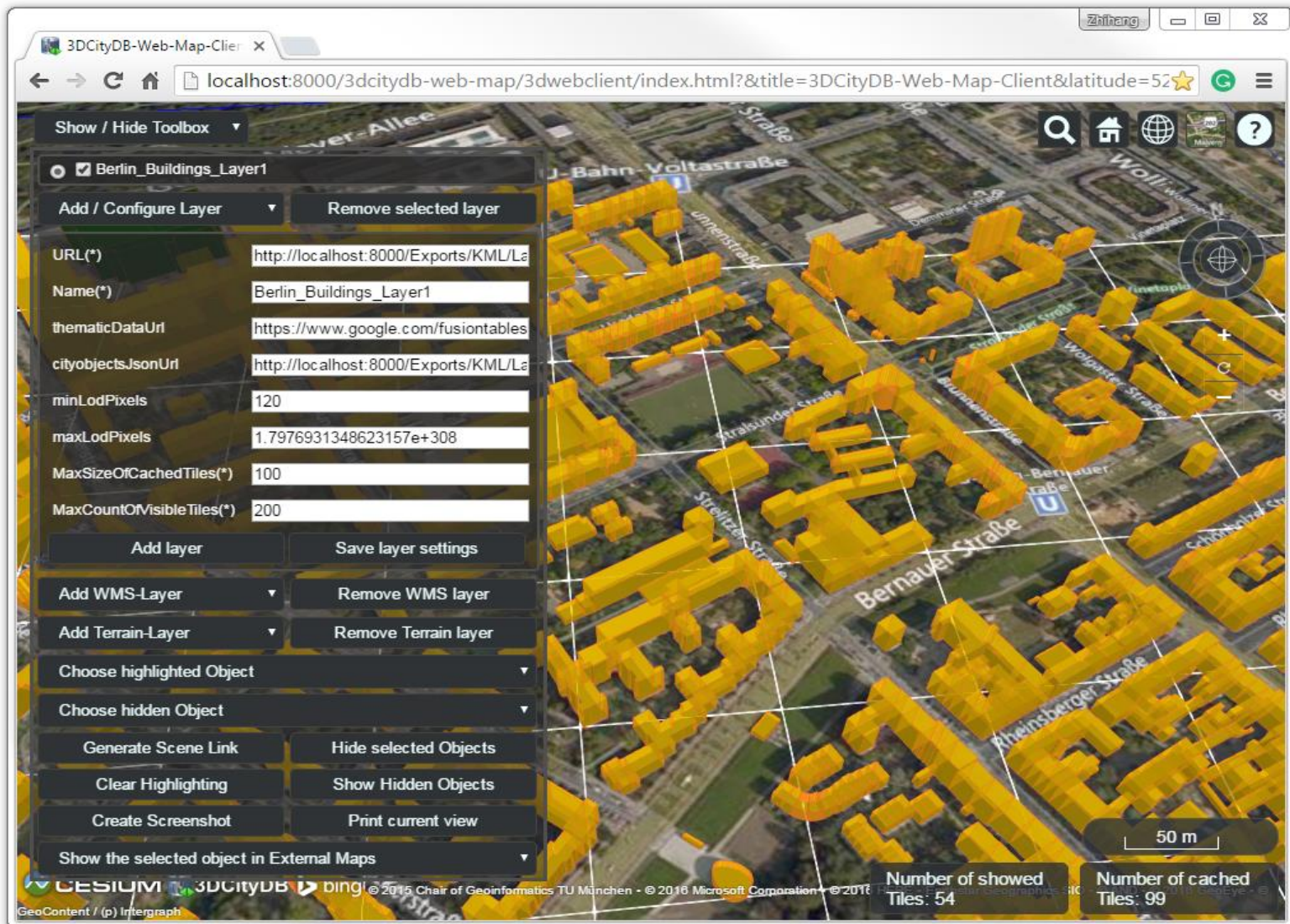
citygml_address	tygml_feature_rol	citygml_target_uri	gml_id	gml_parent_id	xml_type
1	<?xml version=...	address	http://www.op...	UUID_b646921d...	BLDG_0003000b...

The status bar at the bottom indicates the current location: X: 36, Y: -107.

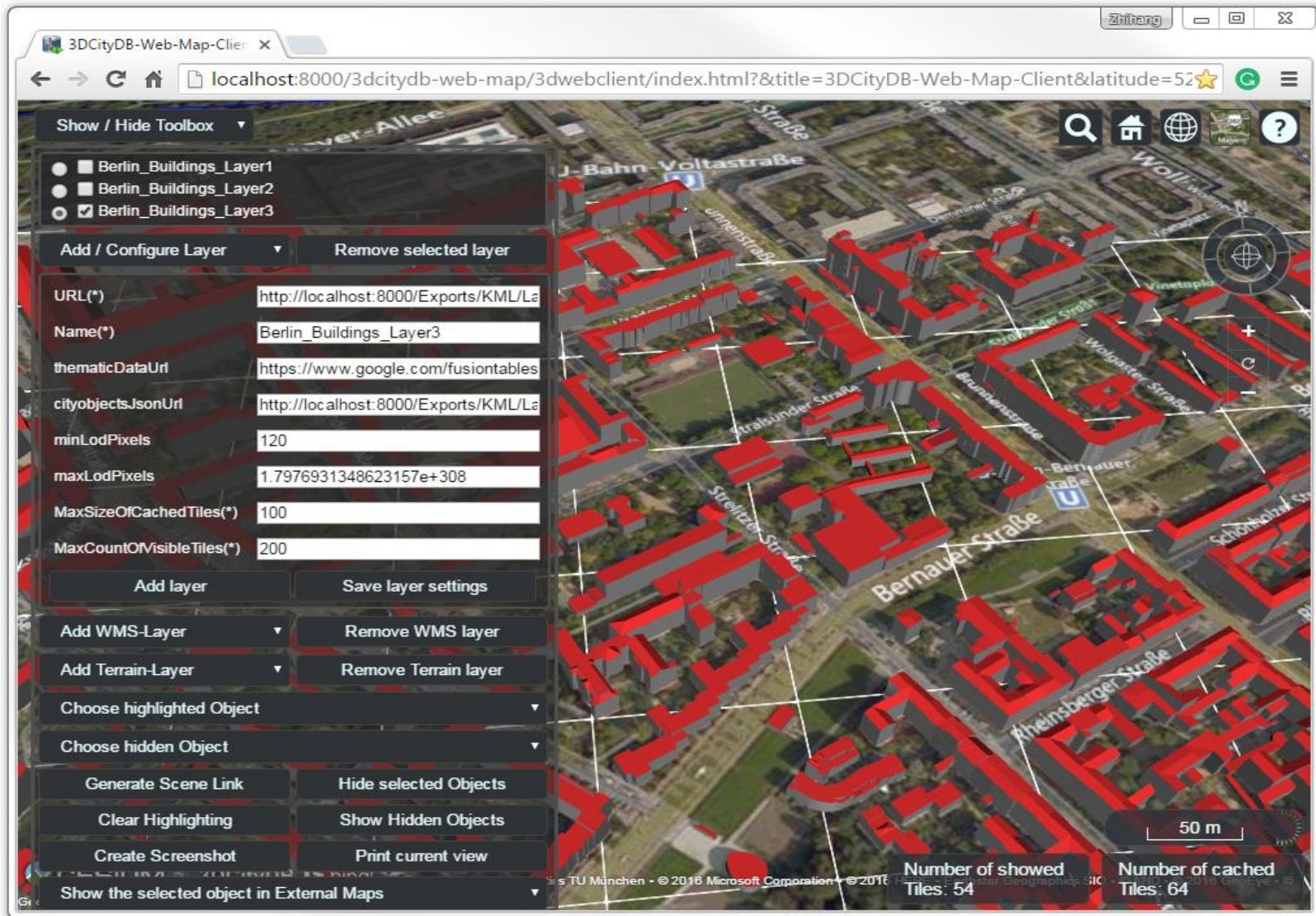
Practical Exercise – Example Results (2)



Practical Exercise – Example Results (3)



Practical Exercise – Example Results (4)



Let's start the practical exercise now!

Please download the tutorial using the following link:

https://www.gis.bgu.tum.de/fileadmin/w00bov/www/Dokumente/Projekte/3DCityDB/3DCityDB_V3.3_Hands-On_Tutorial.pdf