Working with CityGML and ArcGIS
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Agenda

1. Introduction to ArcGIS for 3D Cities
2. Concepts of CityGML
3. CityGML I/O Tools
4. 3D Data Quality Assurance
3D Across the Platform

Desktop  Web  Device

ArcGIS

Web GIS

Portal

Server

Online Content and Services
Applications of 3D
The 3D Cities Information Model
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Why ArcGIS for 3D Cities?
Driving the platform’s 3D capabilities

GIS Professionals
Urban Planners
Citizens, Decision Makers
Businesses

- Manage & Maintain
- Evaluate & Improve
- Understand & Share
- Decide & Market
What is ArcGIS for 3D Cities?
Ready-to-use Workflows, Tools and Sample Data for Urban Management

- Create 3D City Base Layers
- Build a 3D Campus Map
- Visualize New Developments
- Understand Zoning
- Perform Solar Analysis
- Manage Public Safety

3D Cities Information Model: Themes

**Built Environment**
- Created and actively managed by people
  - Structures, utilities, transportation networks, installations

**Legal Environment**
- Defines restrictions on land use
  - Land use zones, property ownership boundaries, regulations

**Natural Environment**
- Naturally occurring features on, above, or below the earth’s surface
  - Land cover, subsurface geology, atmosphere/climate/weather
CityGML – A 3D City Exchange Format

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Data model and exchange format for virtual 3D City Models

Modeling of all relevant parts of a virtual city according to
- Semantics
- Geometry (and Topology)
- Appearance

Various thematic modules
- Buildings, CityFurniture, Relief, Transportation, Vegetation, WaterBody, …

Level of Details (LoD)

Application Domain Extension

CityGML 1.0.0 is OGC Standard since 2008
- Current version is 2.0.0
Comparing CityGML and the 3DCIM

3DCIM
- Procedural Creation
- Scalable Visuals
- Analytics
- Data Maintenance
- Interoperability

CityGML
- Open Infrastructure
- Exchange Format
- Common Semantics
- ADEs
CityGML I/O Tools

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CityGML and ArcGIS for 3D Cities

- 3D City Information Model (3DCIM)
  - Data Model for Geodatabases with Data Management Tools
- CityGML Import and Export Tools
  - Import CityGML files into Geodatabase
  - Export from Geodatabase to CityGML files
CityGML Import and Export Principles

- **ETL Tools**
  - Ready to use
  - Customizable
- **Lossless import and export (round trips)**
- **CityGML version 1.0 and 2.0**
  - All Level of Details (0-4)
  - Multiple representations
  - Textures
- **System requirements**
  - ArcGIS 10.2.2
  - Data Interoperability Extension or FME® Desktop 2014
Supported CityGML Feature Classes

- **Building, BuildingPart**
  - Roof-, Wall-, GroundSurface
  - Room
  - BuildingFurniture
  - IntBuildingInstallation
  - BuildingInstallation
  - Opening, Window, Door
  - FloorSurface
  - InteriorWallSurface

- **PlantCover**

- **SolitaryVegetationObject**

- **CityFurniture**

- **TrafficArea**

- **Address**

- **LandUse**

- **WaterBody & Surface**

3D Cities Information Model in File GDB

*Note: ADEs are in scope for the next release.*
Example Mapping for Building

Building

LoD1

<<includes>>

GroundSurface

LoD2

<<includes>>

WallSurface

RoofSurface, ...

<<includes>>

Ext.Installation, ..

LoD3

<<includes>>

InteriorWall

InteriorInst.

LoD4

<<includes>>

Room, ...

Solid

BuildingShell

Level: 1..4

<<aggregated to>>

BuildingShellPart

BuildingInteriorStruct.

BuildingInst.

BuildingInteriorSpace
3D Data Quality Assurance

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3D Data Quality Assurance

- Data Quality is Key for
  - Interoperability
  - Analysis
  - Visualization

- Quality Measurements
  - Geometry (precision, accuracy, closeness…)
  - Semantics (meaning, content, …)
  - …
Common 3D Data Issues

- Orientation
- Closed Volume
- Missing Textures
Specific CityGML Quality Issues

- Schema
- Semantics
  - Misinterpretation of Concepts (e.g. Level of Details)
  - Different Attribute Storage Patterns (e.g. Generic Attributes and Features)
- Geometry
  - GML geometry characteristics
- Conformance Requirements

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10.3.9 Conformance requirements
- Base requirements
  1. If a building only consists of one (homogeneous) part, it shall be represented by the element Building. However, if a building is composed of individual structural segments, it shall be modelled as a Building element having one or more additional BuildingPart elements. Only the geometry and non-spatial properties of the main part of the building should be represented within the aggregating Building element.
OGC Data Quality Interoperability Experiment (09/2014 – 03/2015)

OpenGIS Project Document 14-043

• OGC, SIG3D and EuroSDR
  - Define data quality requirements for CityGML data specification
  - Provide recommended implementation guidance for 3D data
  - Provide a suite of essential quality checking tools

• Types of Issues
  - Schema Errors
  - Geometric Errors (part of this presentation)
  - Semantic Errors
  - Conformance Requirements

• Final Report is outstanding
CityGML I/O Tools (upcoming Release enhancements)

- Additional ETL Tools
  - Issue Detection and Reporting
  - (Repairing)
- Purpose
  - Check CityGML files before importing data into 3DCIM
Set of Issues to Detect

- Schema Validation
- Self-Intersections in 2D
- Non-Planar Surfaces
- Invalid Solid Boundaries
- Invalid Solid Voids
- Missing Texture Coordinates
- Missing Vertex Normals
Live Demonstration
Validation Tools for CityGML
Get the 3D Cities & CityGML tools!

• GitHub:
  - https://github.com/Esri/3d-cities-template

• Learn more about 3D Cities:

• Type less:
  - http://esriurl.com/3DCities
Thank you…
Any Questions? Ideas? Comments?

Please fill out the session survey.
Understanding our world.