Creating a 3D Virtual City using ArcGIS

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Overview

- Planning for your Virtual City
- Creating and Importing 3D Data
- Authoring the 3D View
- Serving the 3D View
What is a 3D Virtual City?

• A GIS based representation of an urban environment

• What do people want to do with them?
  – Data visualization
  – Animation and simulation
  – Development/scenario planning
  – Emergency services
  – Threat analysis
  – Facilities and asset management
What is a 3D Virtual City?

- What is it composed of
  - Buildings
  - Other structures
  - Street furniture
  - Vegetation
  - Thematic data
Outline

• Planning
  – What is the intent
  – What features do you need
  – Data collection

• Creating and Importing 3D data
  – Basemap
  – Buildings
  – Street Furniture
  – Utilities
  – Vegetation
  – Thematic Data
Planning

• What is the intent of your virtual city
  – Realism
  – Interactivity
  – Analysis

• What features do you need
  – Your needs
  – Your wants
  – Your dreams
Planning

• Data Collection
  – What can you get?
  – Usable formats
    • GIS Data
    • 3D Models
    • CAD/BIM
    • Tabular data
  – What can you create?
    • Manual creation
    • Random generation
    • Programmatic creation
Creating and Importing Data

- Identifying your basemap layers
  - Aerial Imagery
  - Elevation Data
  - Transportation

http://resources.esri.com
Creating and Importing Data
Creating and Importing Data
Creating and Importing Data

- Creating Simple Buildings
  - Generate footprint
    - Image interpretation
    - Terrain interpretation
    - Heads-up digitization
  - Set a height attribute
    - Model from elevation data
    - Interpret from oblique photos
    - Manually set

- Create “Wedding Caked” Buildings
Creating and Importing Data
Creating and Importing Data
Creating and Importing Data

- **Importing Buildings – Model Placement**
  - Place a model as a graphic
    - Quick, easy, in 3D
    - Can’t be analyzed
  - Place a model as a point
    - Can be converted
    - Can be adjusted
  - Referencing in the native software
    - Import directly

Companies supplying photogrammetric data

*Model complexity can impact performance*
Creating and Importing Data

- Importing Buildings – Multipatch Conversion
  - What is a multipatch
  - Why convert to Multipatch?
    - Apply textures
    - Use in analysis
    - Performance
  - How to convert to Multipatch
    - Import 3D File
    - Layer 3D to Feature Class
  - Shapefile versus Geodatabase
Creating and Importing Data
Creating and Importing Data

Generating building textures programmatically

Material Properties File → Material Properties Table Generator → Building Properties Table Generator → Building Properties Table → Texture Images

Material Properties Table

Building Footprints Feature Class

Building Properties Table

Textures Textured Buildings Feature Class Generator
Demo
Creating and Importing Data

- **Street Furniture and other features**
  - Best represented by a 3D Symbol
    - Large set provided with Globe
    - Import from other formats
  - At what distance is it meaningful?
  - Use it, place it, where you need it.
  - Can be placed manually or randomly

KML can also be used to augment the view, and is supported as a special layer type, but does not provide analysis capabilities.
Creating and Importing Data

• **Vegetation**
  – Best represented by 3D Symbols
    • Cross Symbols
    • Complex Models
  – Can be placed manually or randomly
  • GP Tool Create Random Points
  – For appearance, rotate randomly
    • Calculate Field - INT(359 * Rnd)

More advanced options like Lenne3D
Demo
Outline: Authoring and Serving the 3D View

• Authoring the 3D View
  – Globe Data Caching
  – Texture Management
  – Using Multiple Representations
  – Demo

• Publishing to ArcGIS Server
  – Demo

• Questions
Globe Data Caching

• Mechanism for managing large amounts of data
• To improve display performance, ArcGlobe keeps a cache of tiles for each layer
• Two types of caches
  – Memory Cache
    • For immediate use
  – Disk Cache
    • Tiles are stored on disk for later use

• Tiles are swapped between disk cache and memory cache based on available resources and the current view
Memory Cache

- Refers to assigning an amount of the computer's RAM for use by ArcGlobe
- Memory can be assigned by data type
- Significant improvement in performance with proper settings
Disk Cache

- Tiles are stored on disk for fast retrieval
- Layer disk cache is temporary unless the ArcGlobe document or a layer file is saved
- Raster data has multiple levels of detail
- Feature data in ArcGlobe has only one level of detail
- Two methods of generating the cache:
  - **On-demand**: tiles are created and stored as needed
  - **Explicit**: cache all areas
    - **Partial**: generate cache for specified level of detail
    - **Full**: all levels of detail

- **Tip**: For best performance generate full caches for your 3D objects (buildings etc.)
Texture Management

• Textures on 3D objects can be memory intensive
• Data can take longer to display
• Navigation can be sluggish
• Performance degradation depends upon available physical memory as well as memory cache settings
• Three texture-management options are available:
  – Disable textures
  – Apply DXT compression
  – Downscale textures
Texture Management

- **Layer Properties → GlobeDisplay**

<table>
<thead>
<tr>
<th>Globe General</th>
<th>Source</th>
<th>Selection</th>
<th>Globe Display</th>
<th>Display</th>
<th>Symbology</th>
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<tbody>
<tr>
<td>Floating layers</td>
<td>See-through position (+ is above globe surface):</td>
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<td>Image</td>
<td>Texturing mode:</td>
<td>Smooth</td>
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<td>Features</td>
<td>Scale 3D symbols with distance</td>
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<td>Rasterize feature layer</td>
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<td>Convert symbol point unit to:</td>
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<td>Meters</td>
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<td>Rendering</td>
<td>Enable rendering with compressed textures</td>
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<td>Material texture resolution:</td>
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<td>Minimum transparency threshold:</td>
<td>Low</td>
<td>High</td>
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<tr>
<td>Disable material textures</td>
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<td>Only generate the level of detail specific to the current view during navigation</td>
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- **DXT compression**
- **Texture downscaling**
- **Disable textures**
Texture Management

Full Textures

Downscaled Textures

Disabled Textures
Using Multiple Representations

- Feature data in ArcGlobe has only one level of detail
- If you have a large number of features then
  - Create multiple representations of your data
    - Use GP tools in ArcToolbox (example: MultiPatch Footprint)
    - Use texture management techniques
  - Use different visibility ranges

Far (less detail)  Near (more detail)
Using Multiple Representations

Example: Multiple representations for buildings

- Aggregated building footprints
- Individual building footprints
- Extruded footprints
- Buildings without textures
- Buildings with downscaled textures
- Buildings with full resolution textures
Using Multiple Representations

- Aggregated Footprints
- Individual Footprints
- Extruded Footprints
- Disabled Textures
- Downscaled Textures
- Full Textures
Using Multiple Representations

• For detailed information on which GP tools to use and how to optimize your ArcGlobe document please see:

Demo
Publishing to ArcGIS Server

- Publish the ArcGlobe document as a GlobeService
- Supports Local-area (LAN) and Web-based access
- Consume in ArcGIS Explorer, ArcGlobe, Globe Control
- All ArcGlobe supported data types can be served
- Supports Identify, Search and Find features
- Animation is also supported
Publishing to ArcGIS Server
Demo
Questions?
Related Technical Workshops

- 3D Analyst – An Introduction
- 3D Analyst - Visualization with ArcGlobe
- 3D Analyst Geoprocessing
- Getting Started with ArcGIS Server
- Animations in ArcGIS