3D in the Browser with WebGL
Chris Andrews
Chris Andrews
- Lead Product Manager for 3D at Esri
- 9 years in 3D with GIS, AEC, Molecular Biology, Entertainment
- Joined Esri in 2014
- Primary focus areas
  - 3D across the ArcGIS platform
  - Evangelizing 3D with customers, partners, and the GIS community
  - ArcGIS Earth
Just sayin’…

• This is not a programming class

• Goal is to help you learn about a key technology area that impacts your ability to deliver maps and visualizations throughout large organizations and communities

• Some technology will be mentioned…
Key takeaways

- WebGL enables zero-plug-in mapping experiences in browsers
- Esri has geospatial WebGL capability for 3D (and 2D)
- With Esri WebGL tools, you can customize and integrate 3D (and 2D) maps into your workflows and applications
- Esri WebGL experiences allow you to take advantage of your investment in ArcGIS throughout your organization/community
What is WebGL?

• 3D API standard for web-based 3D
  - Since 2011
  - OpenGL in a browser
    - Chrome, Safari, Firefox, IE, Edge
    - iOS and Android mobile browser support (can vary)
  - Available to over 1 billion users – widely used from games to design tools to GIS

• Many different (geo)spatial flavors:
  - Three.js, CesiumJS, WebGLGlobe… and Esri (since ~2013)
How WebGL works

- JavaScript (ECMAScript) language package for drawing
  - JavaScript is ‘native’ to browsers
  - Allows direct declaration of drawing commands using primitives (triangles, lines, points) and 3D graphics capabilities captured in shaders and memory buffers
  - 3D and 2D
  - Uses graphics hardware (GPU)
  - No native file formats, language… it’s a capability
  - Can be combined with other JS capabilities to create dynamic, rich web apps
So what?

- WebGL enables you to have really great browser-based mapping apps with no plug-in

**Upside**
- No plug-in, lightweight
- Broad community support
- Open standards-based

**Downside**
- Greater variation in per-platform support
- Browser security limitations
- JavaScript programming (+/-)
Why WebGL globe?

- Zero-plug-in version of a *Google Earth API app* is a *WebGL-based globe application*
- GIS market is moving rapidly to 3D
- Globe-based visualization is critical for communication and analysis in Federal Government domains
What about coordinate systems?

- Esri customers can create services in WGS84, WMA, and other Cartesian CS

- Esri WebGL mapping capability
  - Always displays data in WGS84 GCS when in ‘global 3D’
  - Can display any Cartesian CS in ‘local 3D’
  - Can display 2D web maps

- Can switch back and forth between 2D and 3D (with customization)
- Can navigate underground only in ‘local’ scenes today (future – global)
WebGL clients are part of the Web GIS infrastructure.
Esri users are adopting 3D

• Users are
  - Collecting and processing new types of data
  - Visualizing new projects and underground information
  - Analyzing behavior and aesthetics of natural phenomena and new development
  - Communicating to stakeholders
3D as a core GIS capability anywhere in any environment

- Combine 2D and 3D in the same web GIS architecture
- Reuse dynamic services across clients
- Securely collect, manage, curate 3D data
- Conduct analysis across real-time and historical data
- Create tailored experiences for different types of users
Building an open platform with 3D

- Indexed 3D Scene (I3S) layers
- LERC for raster terrain and imagery
- KML
- WMS/WMTS
Web Scenes, Scene Layers

- **Web Scene**
  - Vehicle for cross-platform 3D capability
  - Collection of layers, environment settings, slides, *animation*
  - Essential for 3D apps on any platform or experience

- **Scene Layer**
  - Scalable cache of graphics, styles, and attributes
  - 3D Objects, 3D Points, Integrated Meshes, Point clouds

- **Reuse, Share, Extend**
Indexed 3D Scene (I3S) layer specification
- Open specification for 3D layers
- Shared under Creative Commons licensing
- Currently in process with OGC for consideration as a Community Standard
- Describes a scalable scene cache with attributes and indexing
- Multiple levels of detail
- Can be streamed over the internet
- Can be used locally on disk as a package
- Opportunity for future layer types to accommodate new data types
- Open for feedback and modification
3rd party adoption of I3S

• Integrated mesh
  - VRICON, Pix4D, and Bentley sharing packages or services in I3S format
  - Supports Drone2Map

• Additional partners coming soon

• Expanding list of layer types and layer capability
Esri JavaScript stack

- Widgets
  - Web AppBuilder
  - Scene Viewer (3D)
  - Map Viewer (2D)
- Core platform widgets
  - ArcGIS API for JavaScript (2D & 3D)
- GeoREST APIs

*Widgets can be 2D, 3D, or both*
(Web) Scene Viewer capabilities

- Load web scene
- Add and configure data in web interface
  - Smart 3D mapping for point data
  - Group layers
- Change environment settings
  - Basemap
  - Time of day
- Create and use ‘slides’
- Navigation
Web AppBuilder and Story Maps

- **Story Maps**
  - Combine 2D and 3D with narrative

- **Web AppBuilder**
  - Use either 3D or 2D
  - Create custom templates with branding/logos
  - Create custom widgets
Examples of JavaScript customizations

- 2D/3D toggle
- Custom measurement tools
- Custom layer lists
- Change extrusion or color symbology
- Create custom add data dialog
- Use 2D overview map on 3D scene
- Multiple viewports in a scene
- On canvas popups
- Terrain inspection tool
- ...

![Image of map interface with layers and popups]
Demoing the JavaScript stack
To access the ArcGIS API for JavaScript, create or access I3S scene layers from Esri, or use Web AppBuilder, or Story Maps you must be using ArcGIS Enterprise or ArcGIS Online
WebGL capabilities looking ahead

Sooner
- Filtering and query on attributes
- Measurement and interactive analysis
- 3D Editing
- Underground navigation in global scenes
- Identification/popups on all scene layers
- Changing symbology on scene layers
- Time and range widgets
- Mobile support

Later
- Animation
- Imagery time selector capability
Esri provided content for WebGL applications

- Living Atlas – Umbrella for most publicly-shared Esri content
- World Elevation Service
  - Curated public and licensed content
  - Varying resolution down to 3m or better in some places
- Basemaps
- Sample building content (PLM Modelworks and others)
Using existing data in Esri WebGL applications

- Feature services (2K feature limit)
  - Extrusion for polygons
  - Billboard or draped 2D symbols for points
  - 3D model symbols for points
  - Some extrusion for lines
- Custom basemaps
  - Vector tile basemaps
- Tiled image services
New data types for Esri WebGL globe applications

• I3S scene layers (no feature limits)
  - 3D Objects – From Multipatch feature classes; Buildings, infrastructure, analytical shapes
  - 3D Points – Trees, tourism locations, city centroids
  - Point clouds – LAS (future LAZ, zLAS)
  - Integrated mesh – Provided by partners, Drone2Map

• LERC Cached Tiled Raster Elevation
Types of scene layers
Creating Point Cloud Scene Layers

1. LAS file(s)
2. ArcGIS Pro Create Scene Layer Package
3. Point Cloud I3S Scene Layer Package
4. Use directly in Pro
5. Publish in ArcGIS Online or Enterprise
6. Point Cloud I3S Scene Layer
7. Use directly in Web Scenes in Online*
3D Point Scene Layers

- Multipatch feature class
- Symbolize
- ArcGIS Pro Create Scene Layer Package
- ArcGIS Pro Share Web Scene
- Publish in ArcGIS Online or Enterprise
- Cook in ArcGIS Online or Enterprise
- 3D Point I3S Scene Layer Package
- Use directly in Pro
- 3D Point I3S Scene Layer
3D Object Scene Layers

Extruded or procedurally symbolized objects → GP tools → Multipatch feature class

COLLADA or 3DS objects → Data Interop Extension → Multipatch feature class(es)

BIM data → Data Interop Extension → Multipatch feature class(es)

ArcGIS Pro Create Scene Layer Package

3D Object I3S Scene Layer Package → Use directly in Earth & Pro

ArcGIS Pro Share Web Scene

Publish in ArcGIS Online or Enterprise

Cook in ArcGIS Online or Enterprise

3D Object I3S Scene Layer
Imagery and Elevation raster layers

Publish image services to Enterprise with ArcMap
Upload tile packages to Online from Pro
Details available in blogs and docs

Future data types for Esri WebGL globe applications

- Additional I3S scene layers (no feature limits)
  - 3D lines
  - 3D polygons
- NetCDF and other scientific data formats
- Voxels
- CDB
- KML

Timing is TBD on all of these
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For more information

- Try the scene viewer
- ArcGIS API for JavaScript docs
- Web AppBuilder for ArcGIS docs
- Esri Story Maps pages
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<tr>
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<td>10:45 AM – 5:15 PM</td>
</tr>
<tr>
<td><strong>GIS Solutions Expo, Hall B</strong></td>
<td><strong>GIS Solutions Expo, Hall B</strong></td>
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<tr>
<td>5:15 PM – 6:30 PM</td>
<td>6:30 PM – 9:30 PM</td>
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<td><strong>Expo Social, Hall B</strong></td>
<td><strong>Networking Reception, Smithsonian National Air and Space Museum</strong></td>
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