

3D in the Browser with WebGL

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Just sayin'...



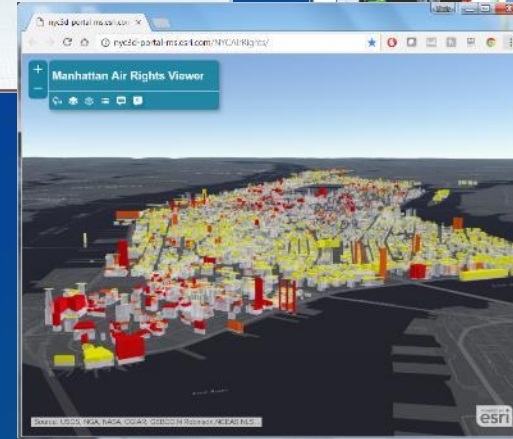
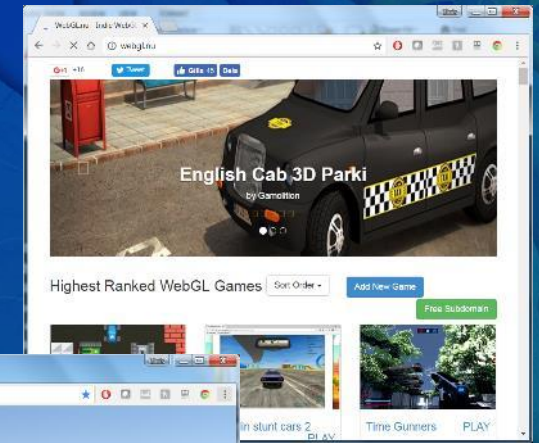
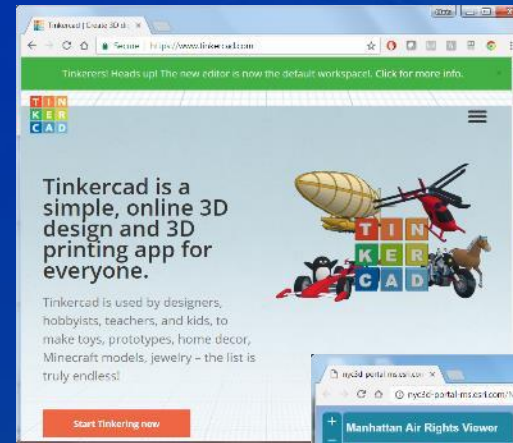
- This is not a programming class
- Goal is to help you learn about a technology area that impacts your ability to deliver maps and visualizations throughout large organizations and communities
- Some technology will be mentioned
- Some code examples will be shown

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 or 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 billions users – widely used from games to design tools to GIS
- Many different (geo)spatial flavors:
 - Three.js, Melown, CesiumJS, WorldWind, 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
 - Increasingly seeing glTF as a standard 3D model format for WebGL

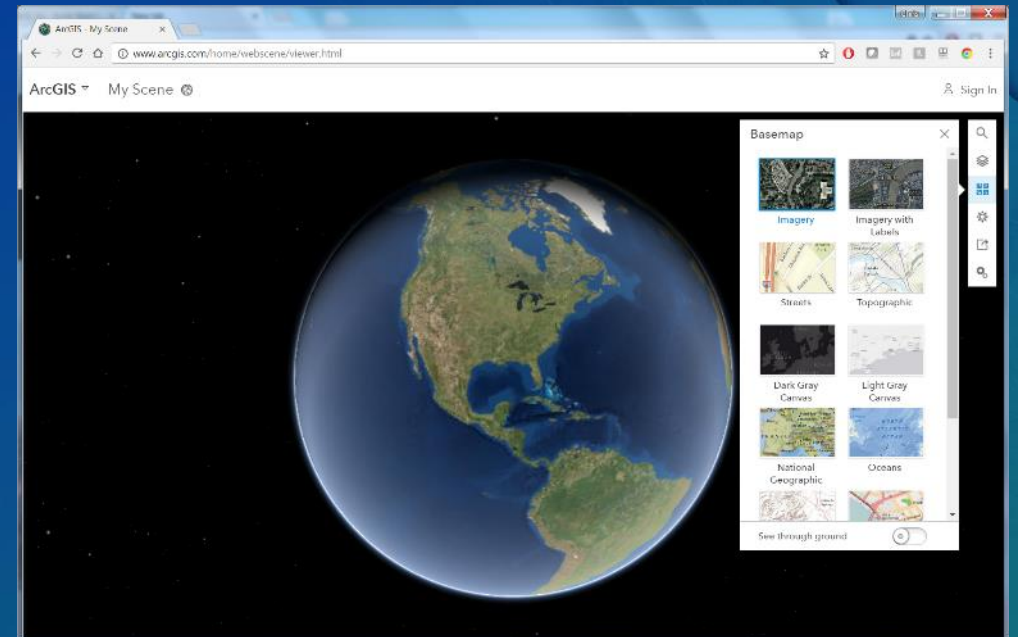
So what?

- 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 (+/-)



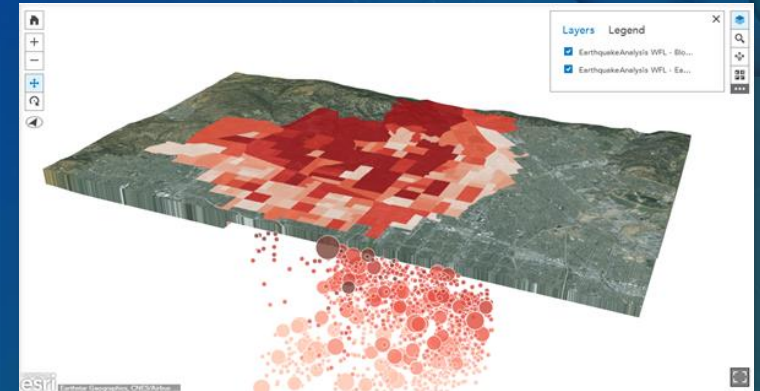
Why do some users need a WebGL globe?

- Zero-plug-in version of a *Google Earth API app* is a *WebGL-based globe application*
- GIS market has significantly moved 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 and non-Cartesian CS
- Esri WebGL mapping capability
 - Always displays data in WGS84 GCS when in 'global 3D'
 - Can display any Cartesian or non-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 (late 2018 – global)



WebGL clients are part of the Web GIS infrastructure



3D as a core GIS capability anywhere in any environment

- GIS is 3D
- Web GIS services-based architecture
- New clients and experiences
- Workflow modernization
- Story-based product and tech concepts



Cross-platform

Open

Accessible

Enabling customers and partners through Open Standards

Open Software, Standards and Data enable organizational resiliency

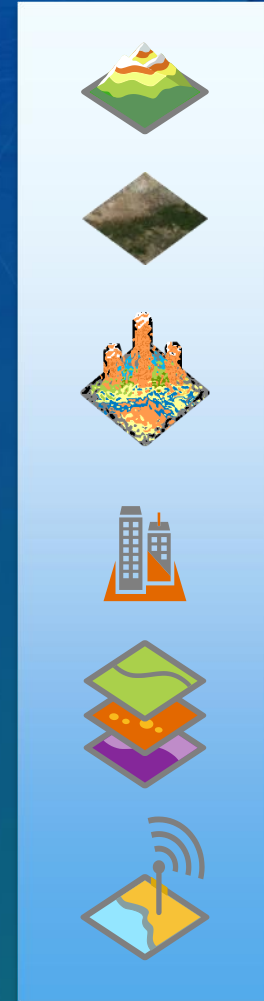
- Ensure access to data
- Guarantee interoperability
- Enable innovation
- Encourage usage and adoption



I3S	Scalable 3D scene content for visualization and distribution
LERC	Raster (imagery and elevation) compression technology for 2D and 2.5D
LEPCC	3D compression technology used for point clouds and other 3D rasterized data
GeoREST	Esri open REST APIs for access to any kind of GIS content and services

Web Scenes, Scene Layers

- Web Scene
 - Collection of layers, environment settings, slides, *animation*
 - Essential for 3D apps on any platform or experience
- Mobile Scene Package (*planned for 2018*)
 - Transportable, large 3D content packages
 - Used for mobile and publishing workflows
- Scene Layer
 - Scalable cache of graphics, styles, and attributes
 - 3D Objects, 3D Points, Integrated Meshes, Point clouds
 - *Future: LOD4/BIM (2018), 3D Lines, 3D Polygons*



I3S

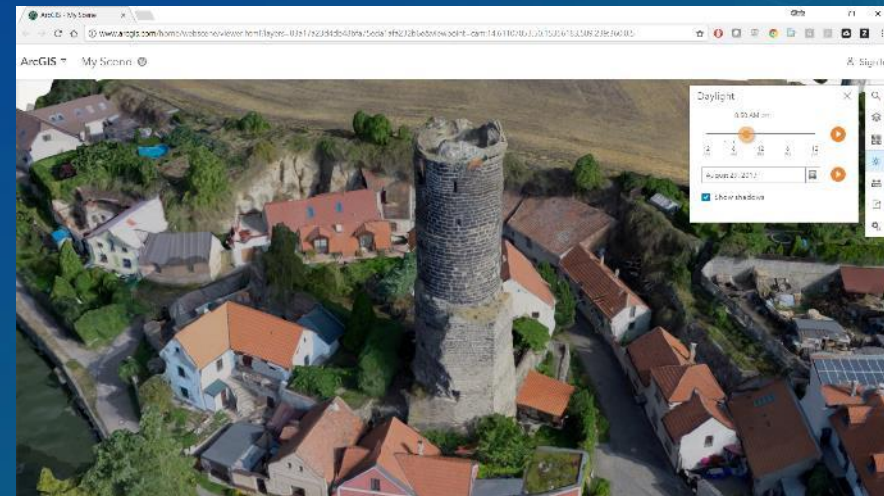
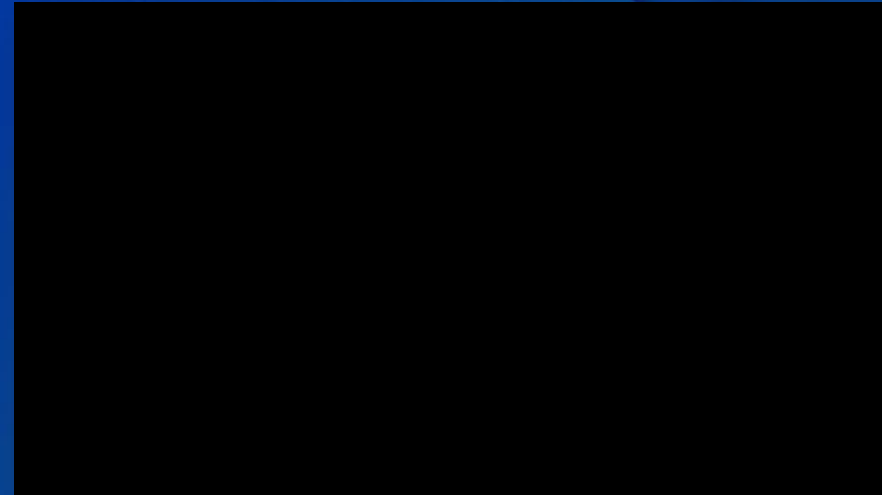
- Indexed 3D Scene (I3S) layer and Scene Layer Package specification
 - Open specification for 3D layers and packages of 3D content
 - Shared under Creative Commons licensing
 - Adopted in 2017 as an OGC® Community Standard
 - Describes a scalable scene cache with attributes and indexing
 - Multiple 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

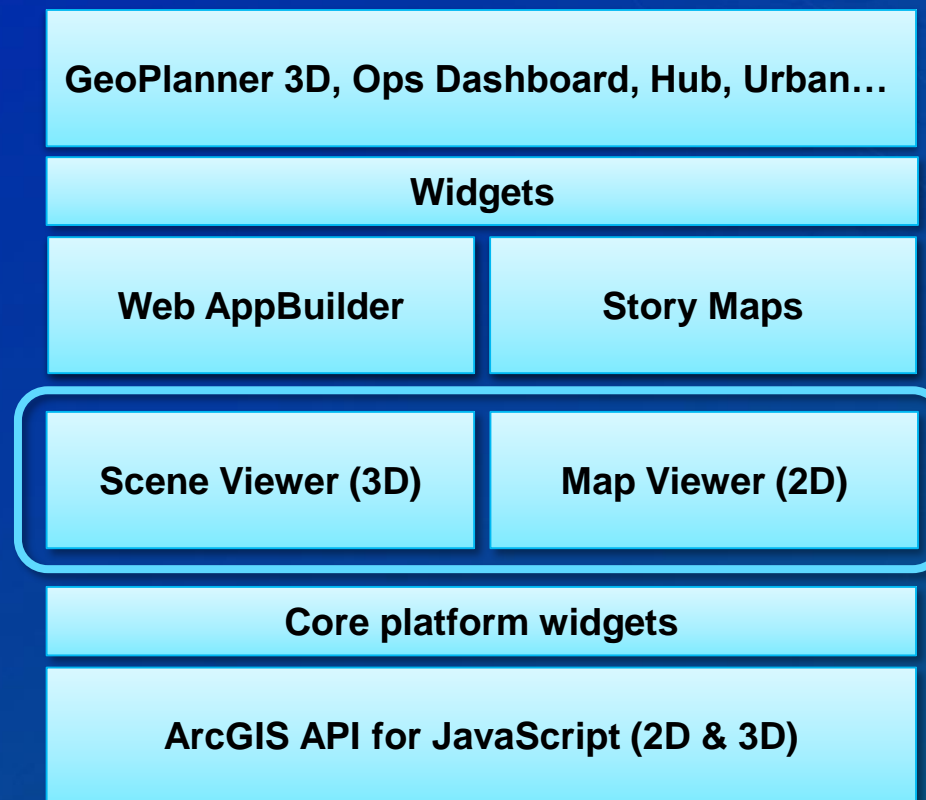
- Integrated mesh
 - VRICON, Melown, Pix4D, and Bentley sharing packages or services in I3S format
 - Supports Drone2Map
 - Safe Software FME (*in beta*)

- Expanding list of layer types and layer capability



Melown

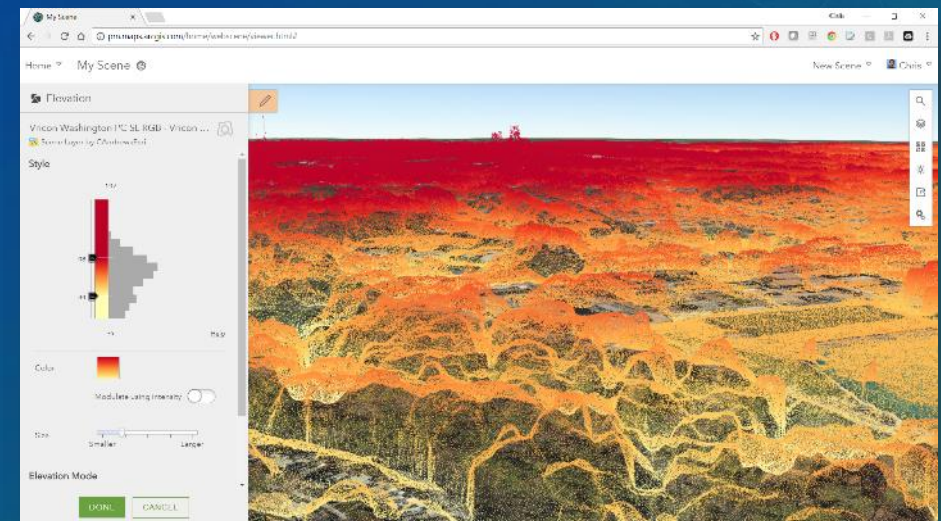
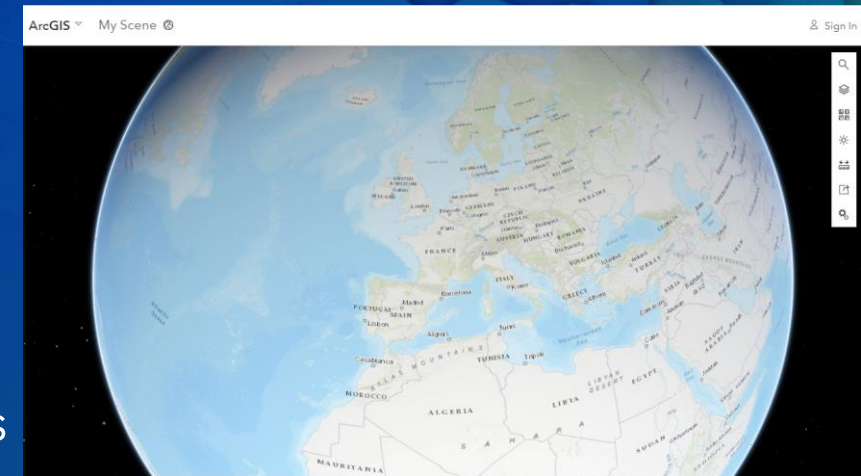
Esri JavaScript stack



* Widgets can be 2D, 3D, or both

Scene Viewer capabilities

- Load web scenes and scene layers
- Save web scene for reuse
- Add and configure data in web interface
 - Smart 3D mapping for point data, polygons, point clouds
 - Group layers
- Change environment settings
 - Basemap, Time of day,
- Create and use slides
- Navigation
- 3D measurement
- Mobile (April 2018 update in Online)



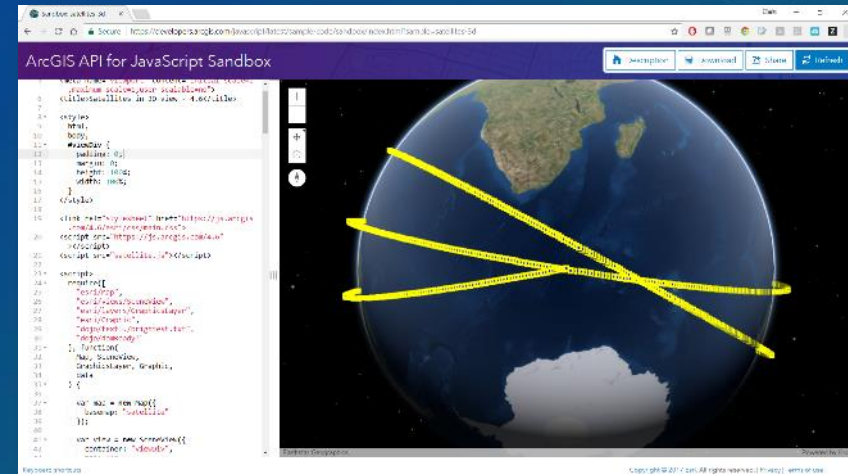
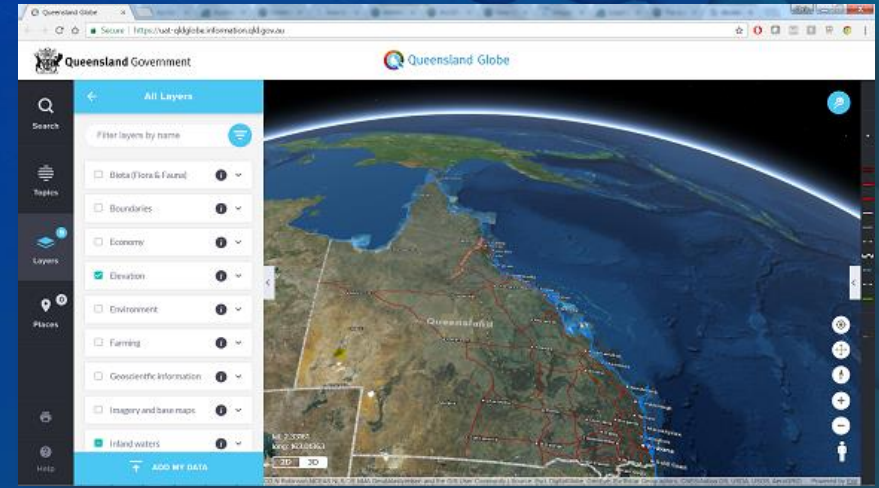
Web AppBuilder and Story Maps

- Story Maps
 - Combine 2D and 3D with narrative
- Web AppBuilder
 - Use either 3D or 2D
 - Create custom templates with branding/logos
 - Create custom widgets
 - Move to 4.x JS API planned for 2D late 2018 (enables more widgets)



Examples of JavaScript API 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
- ...





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 use the “Portal Information Model” in
ArcGIS Enterprise or ArcGIS Online

Play with the Sandbox

- Sample code
- Examples
- Editable
- Try it out!
- No account required

The screenshot displays the ArcGIS API for JavaScript Sandbox interface. The browser address bar shows the URL: <https://developers.arcgis.com/javascript/latest/sample-code/sandbox/index.html?sample=visualization-point-styles>. The page title is "ArcGIS API for JavaScript Sandbox".

The interface is split into two main sections:

- Code Editor:** Shows the HTML and JavaScript code for the visualization. The code includes a meta tag for the page title, a link to the ArcGIS CSS, and a script tag for the ArcGIS API. The CSS defines the styling for the map container and the city labels. The JavaScript code uses the ArcGIS API to load a WebScene and a FeatureLayer, and then applies a custom point style to the city labels.
- Map View:** Displays a 3D city map of Lyon, France, with various point markers representing different types of locations. A legend on the right side of the map lists the types: Museum, Restaurant, Church, Hotel, and Park. The map includes navigation controls (zoom in, zoom out, pan, etc.) and a toolbar at the bottom with options like "Set callout lines on icons", "Declutter view", "Improve icon perspective", and "Align icon to building height".

At the bottom of the page, there is a footer with the text: "Source: USGS, NGA, NASA, CGIAR, GEBCO, Robinson, NCEAS, NLS, OS, NIMA, Geodatasystem and L... Powered by Esri. Copyright © 2018 Esri. All rights reserved. | Privacy | Terms of use".

WebGL capabilities looking ahead

Sooner

Mobile support

Masking based on attributes and location

More interactive analysis

3D Editing

Underground navigation in global scenes

Identification/popups on all scene layers

Changing symbology on scene layers

Time and range widgets

Later

Animation

Imagery time selector capability

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esri

**THE
SCIENCE
OF
WHERE**

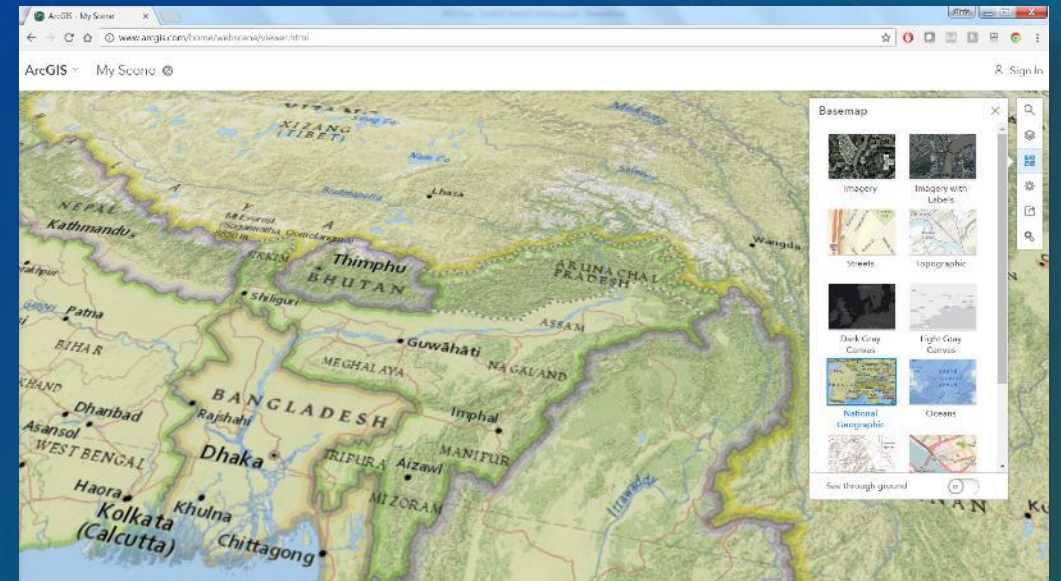
Esri provided content for WebGL applications

- 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
 - Now updated with high accuracy AIRBUS data
- Basemaps
 - New imagery basemap capability reduces color change across scales!
- 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, WMS, Dynamic tiled services

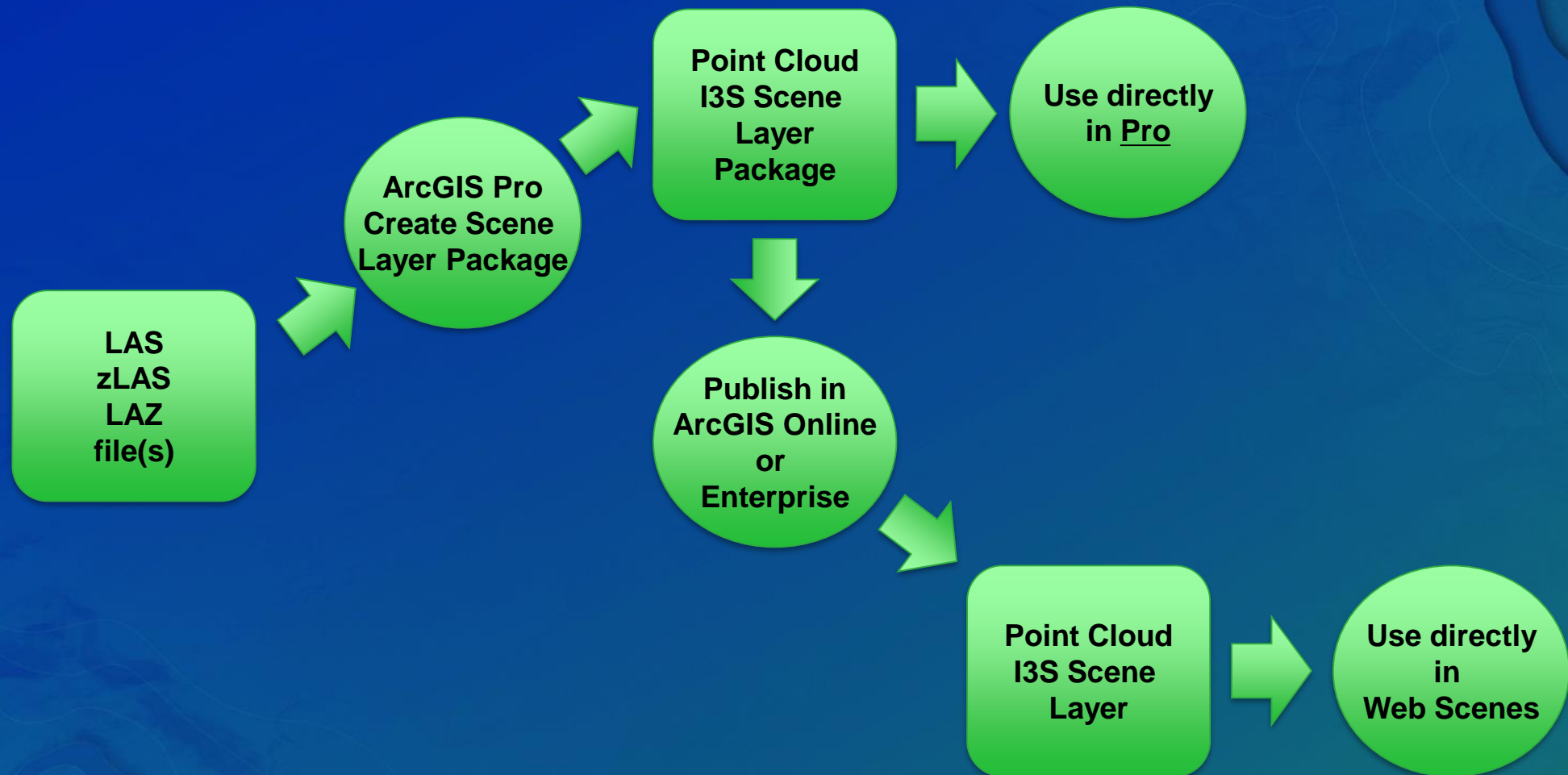


3D data types for Esri WebGL globe applications

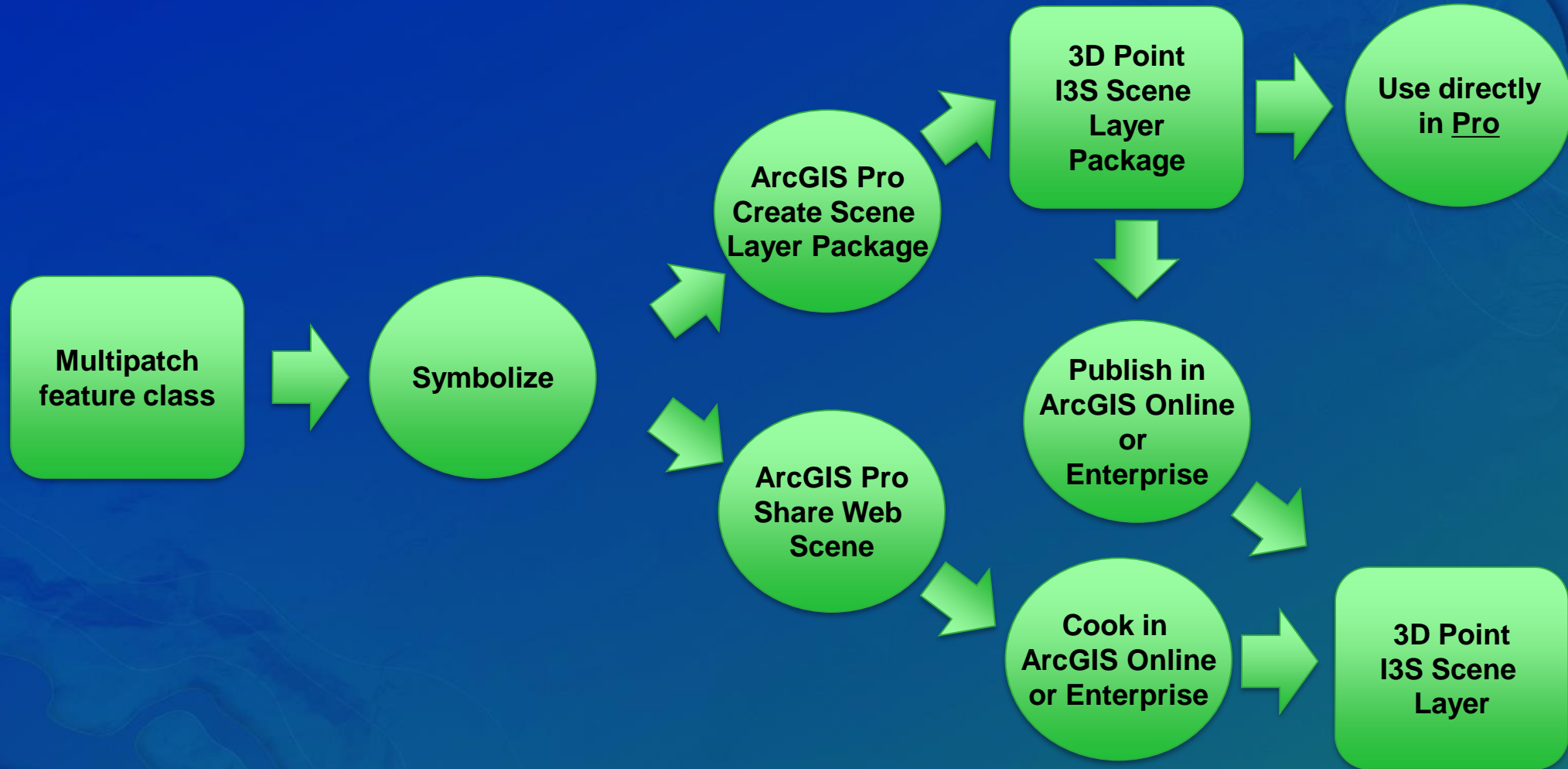
- I3S scene layers (no feature limits)
 - 3D Objects - From Multipatch feature classes; Buildings, infrastructure, analytical shapes
 - 3D Points - Trees, tourism locations, city centroids
 - Point clouds - LAS (future LAZ, zLAS)
 - Integrated mesh - Provided by partners, Drone2Map
- LERC Cached Tiled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



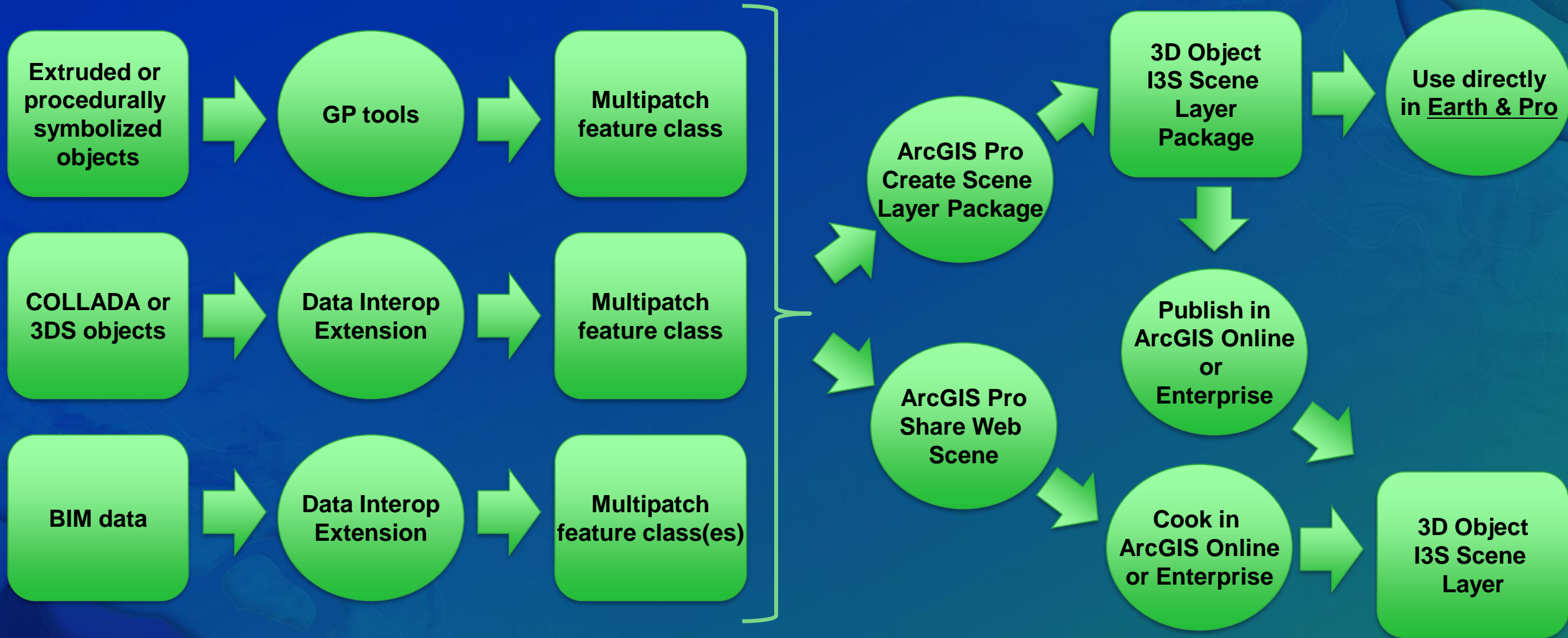
Creating Point Cloud Scene Layers



3D Point Scene Layers



3D Object Scene Layers

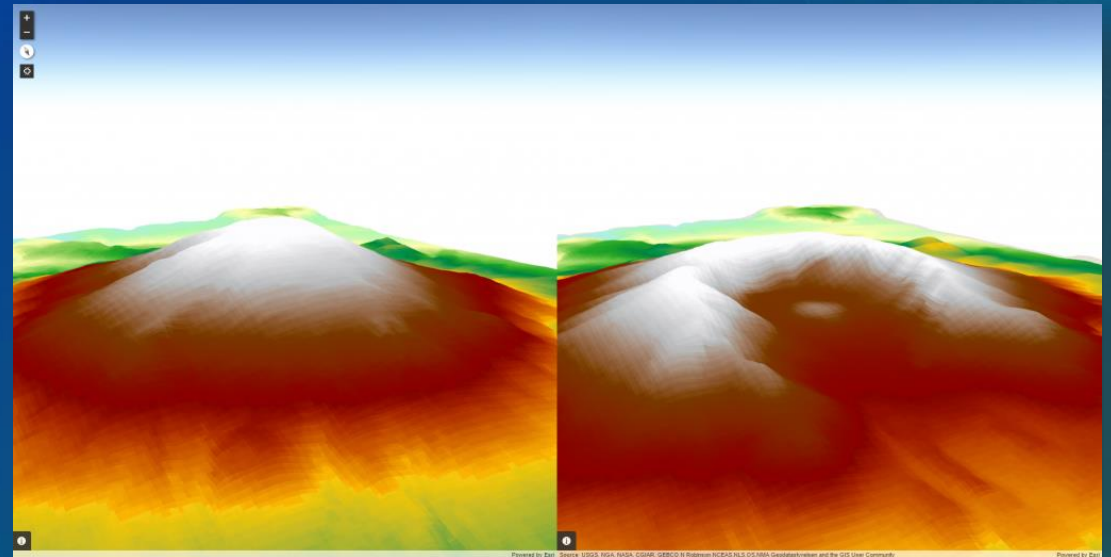


Imagery and Elevation raster layers

Publish image services to Enterprise with ArcMap

Upload tile packages to Online from Pro

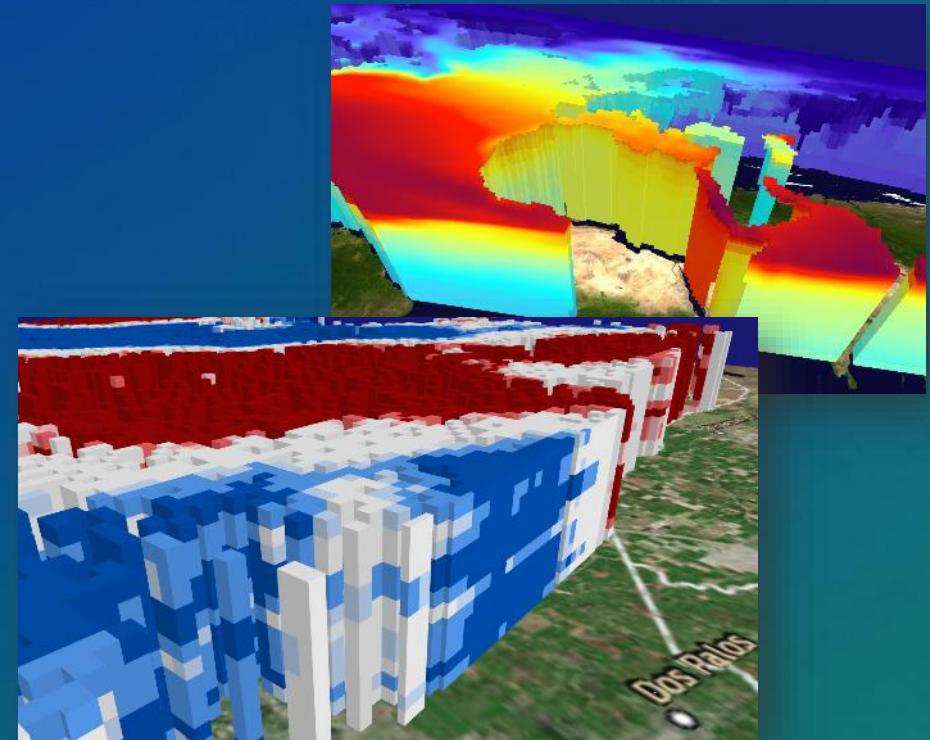
Details available in blogs and docs

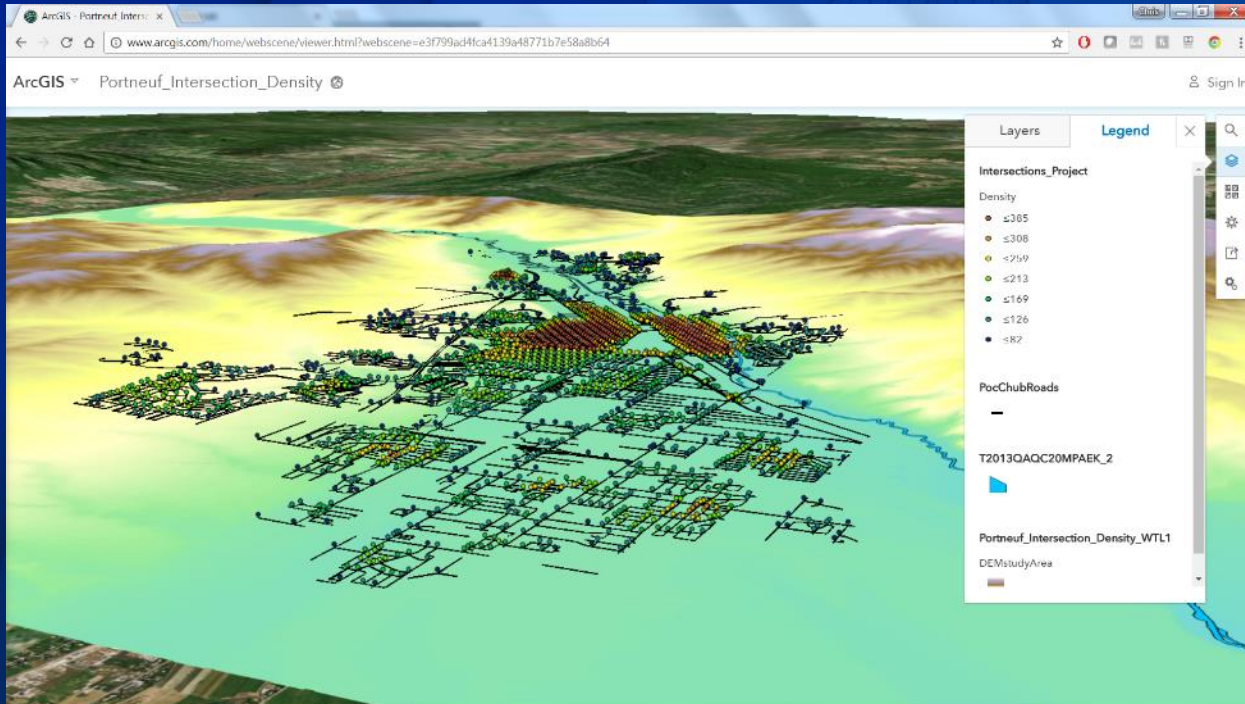


Future data types for Esri WebGL globe applications

- 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





Demo

For more information

- [Try the scene viewer](#)
- [ArcGIS API for JavaScript docs](#)
- [Web AppBuilder for ArcGIS docs](#)
- [Esri Story Maps pages](#)

