Digital Cartography

3D Geovisualization

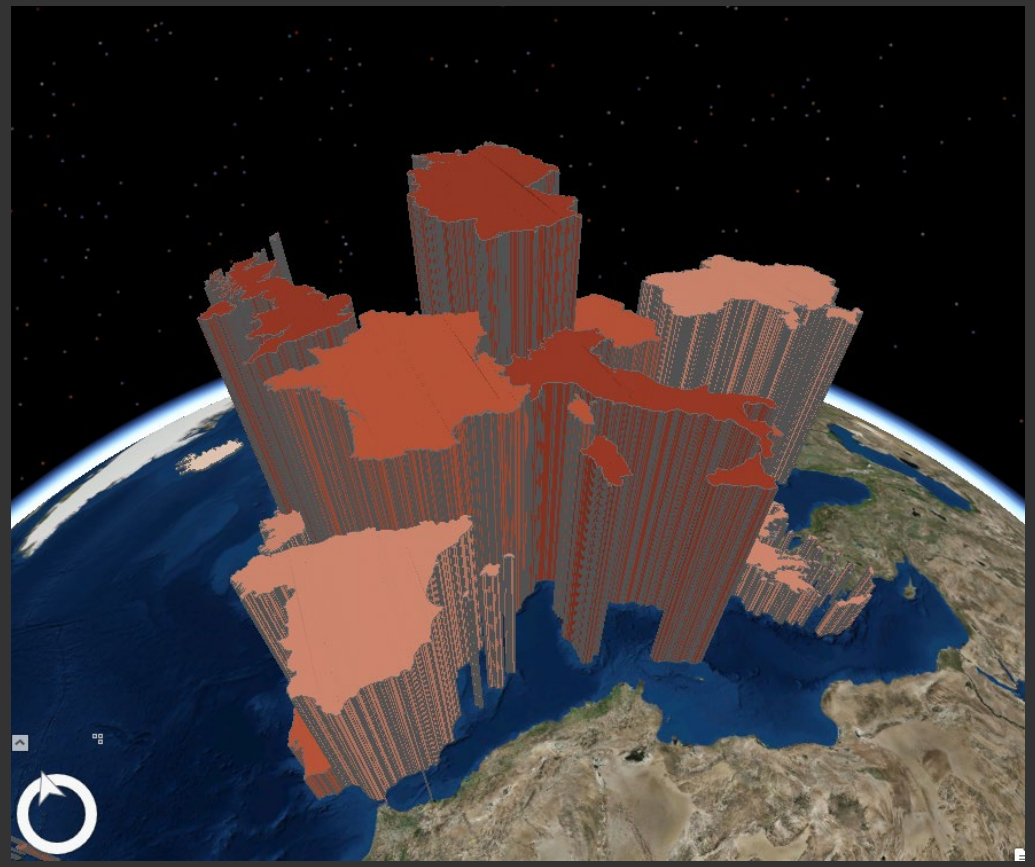
Image from NASA:
https://commons.wikimedia.org/wiki/File:Earth_Western_Hemisphere_transparent_background.png#filelinks

WV VIEW

AmericaView℠
Empowering Earth Observation Education
AmericaView.org - Est. 2003

3D Maps

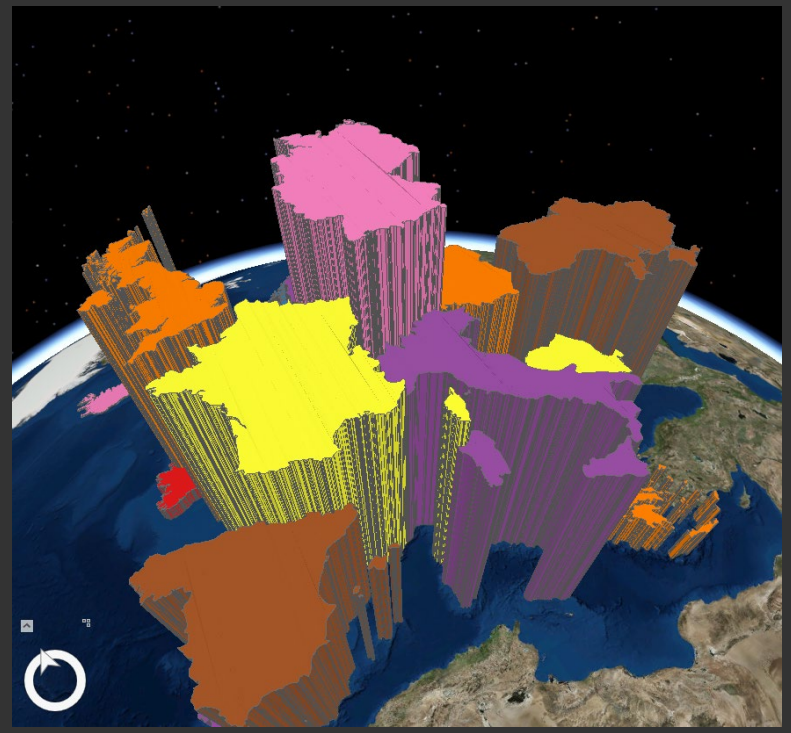
Prism Maps

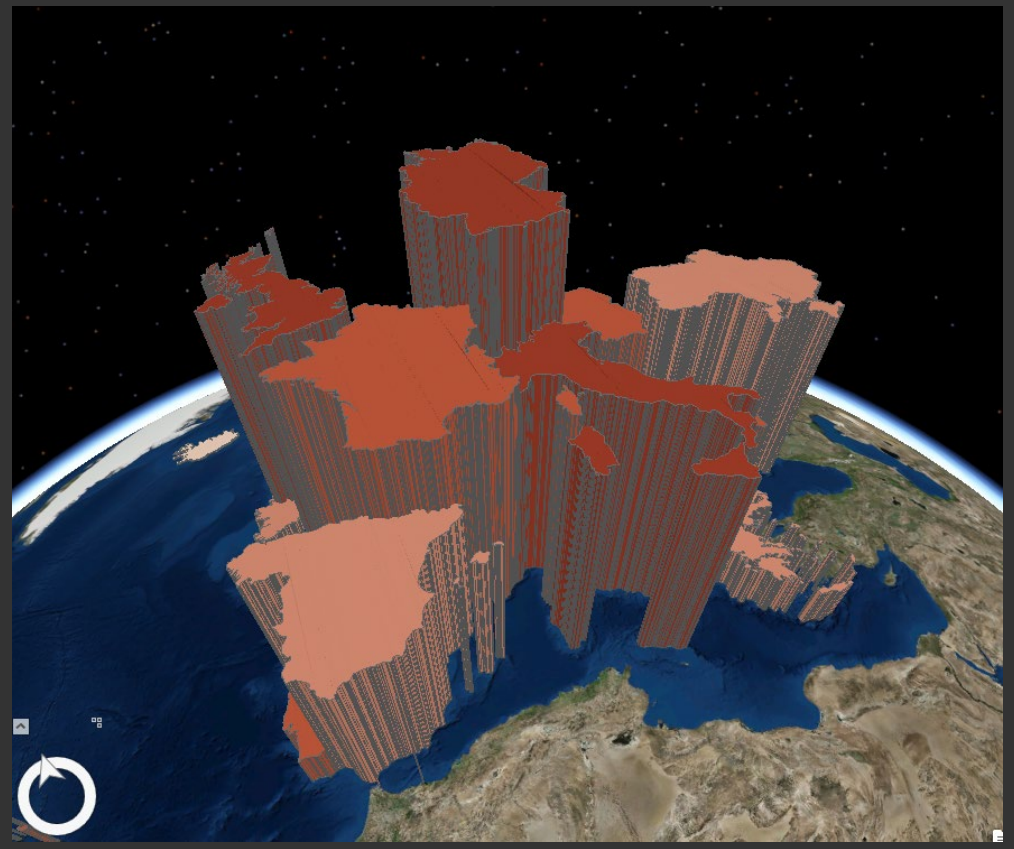


- Use perspective height to represent a quantity
- A thematic 3D map

Prism Maps

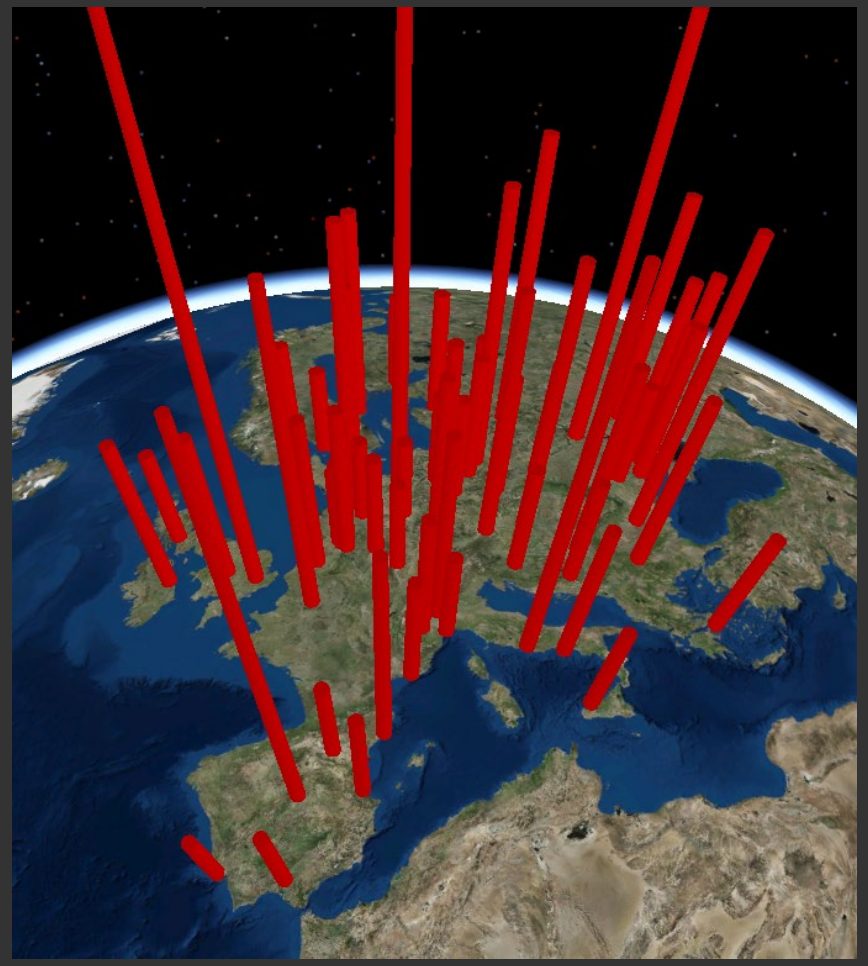
- Color for quantitative variable
- Color for qualitative variable





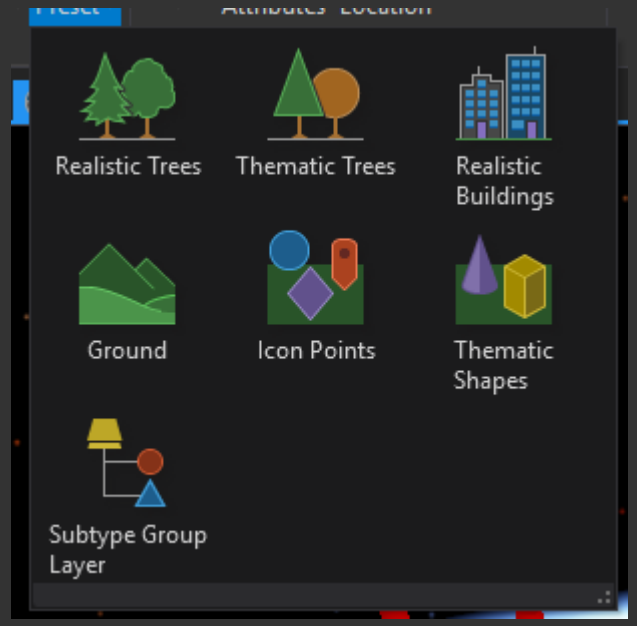
2D to 3D

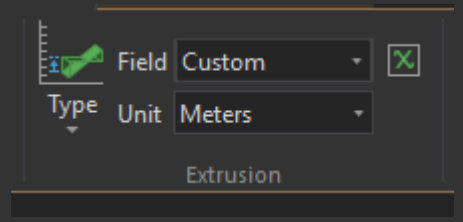
- Points → Lines
- Lines → Planes
- Polygons → Volumes



Make a Prism Map in ArcGIS Pro

- Use Scene as opposed to Map
- Make use of presets
- Use preset symbology: Thematic Shapes
- Apply extrusion for heights



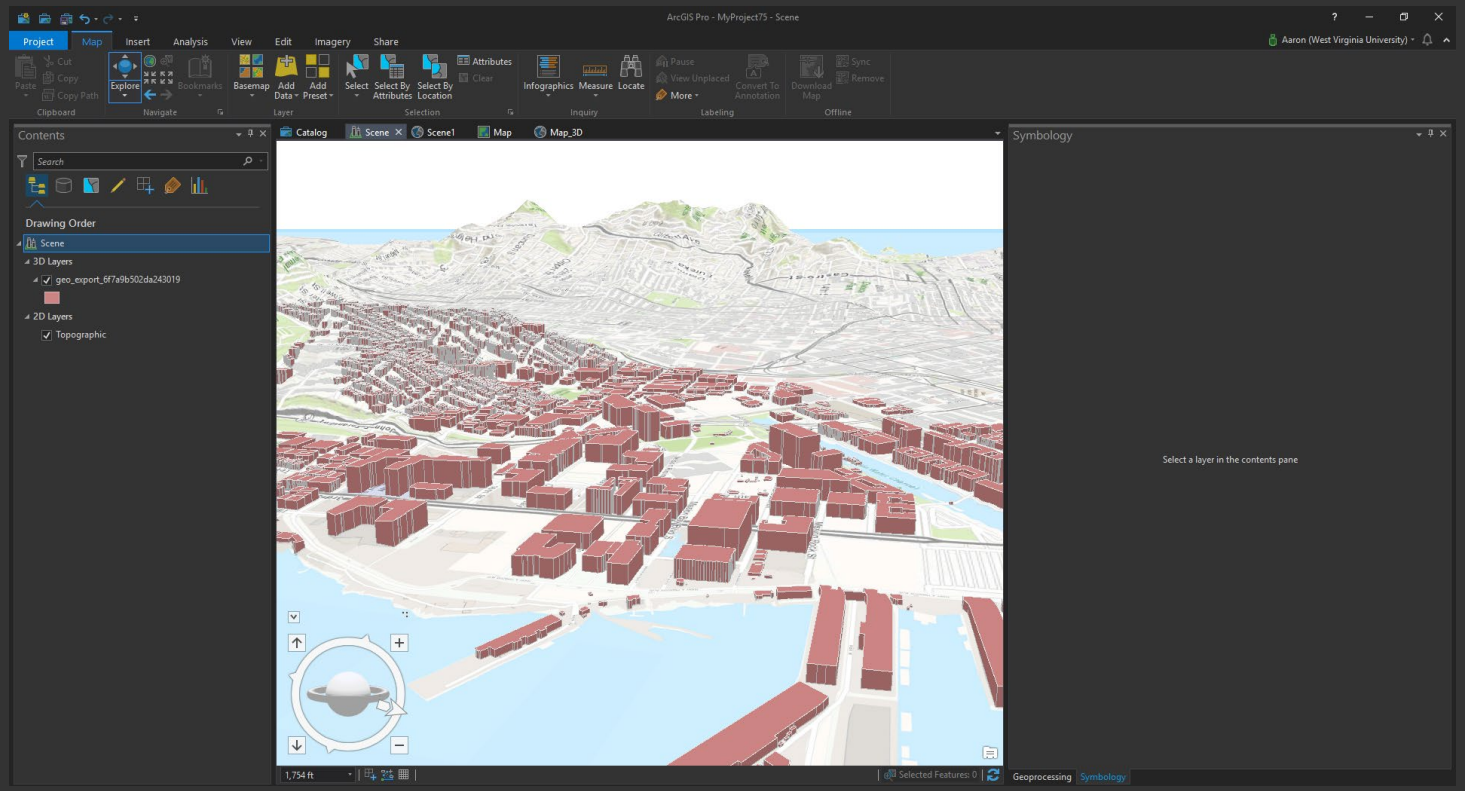


Other 3D Maps

- Can create 3D maps that are more photorealistic than thematic

3D Software Tools

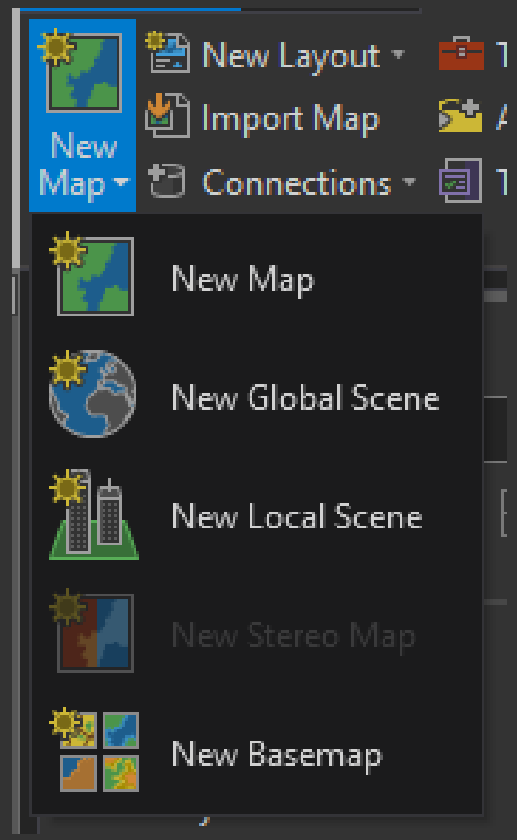
- ArcGIS Pro
  - Local Scenes
  - Global Scenes
- Google Earth
- Google Earth Pro
- Google SketchUp
- Gaming Engines



Data from: https://data.sfgov.org/Geographic-Locations-and-Boundaries/Building-Footprints/ynuv-fyni

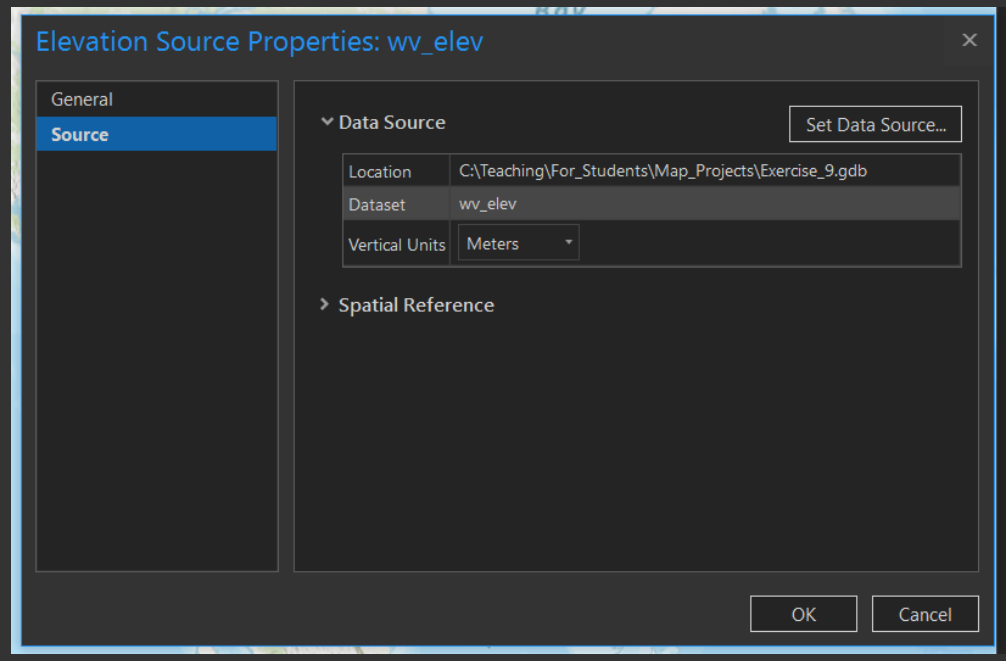
Creating 3D Scenes in ArcGIS Pro

- Work in a Local Scene or Global Scene
- Convert 2D layers to 3D layers
- Select base elevations
- Apply extrusion
- Change symbology
- Change lighting conditions



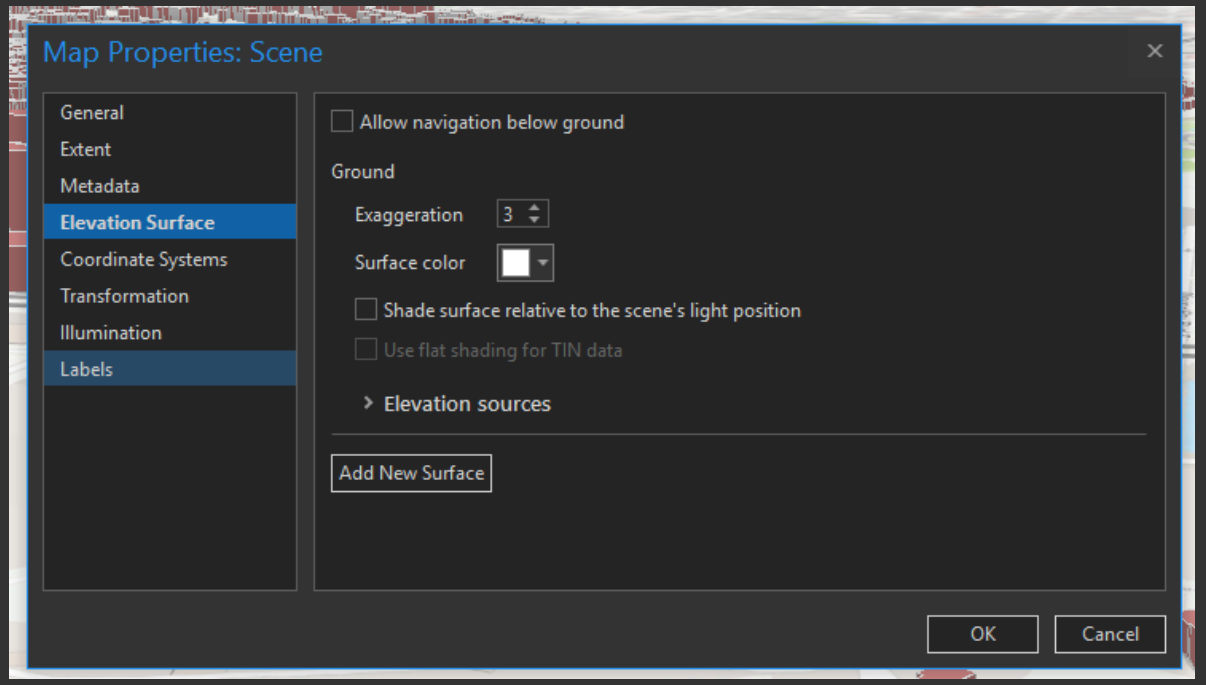
Assigning Base Heights

- Base heights from a DSM, DEM, or a TIN
- Can apply vertical exaggeration
- Can specify primary source, if multiple sources are provided
- Can specify units
- Default is the ESRI World Elevation web service



Vertical Exaggeration

- Sometimes elevation difference must be exaggerated to be noticeable



Data from: https://data.sfgov.org/Geographic-Locations-and-Boundaries/Building-Footprints/ynuv-fyni

Making a 3D Object

Extrusion = Extending a flat object to have a z-value

Block = a flat object that has been extruded to transform it into an object with a z-value

Offset = when extruded above the ground level

Data from: https://data.sfgov.org/Geographic-Locations-and-Boundaries/Building-Footprints/ynuv-fyni

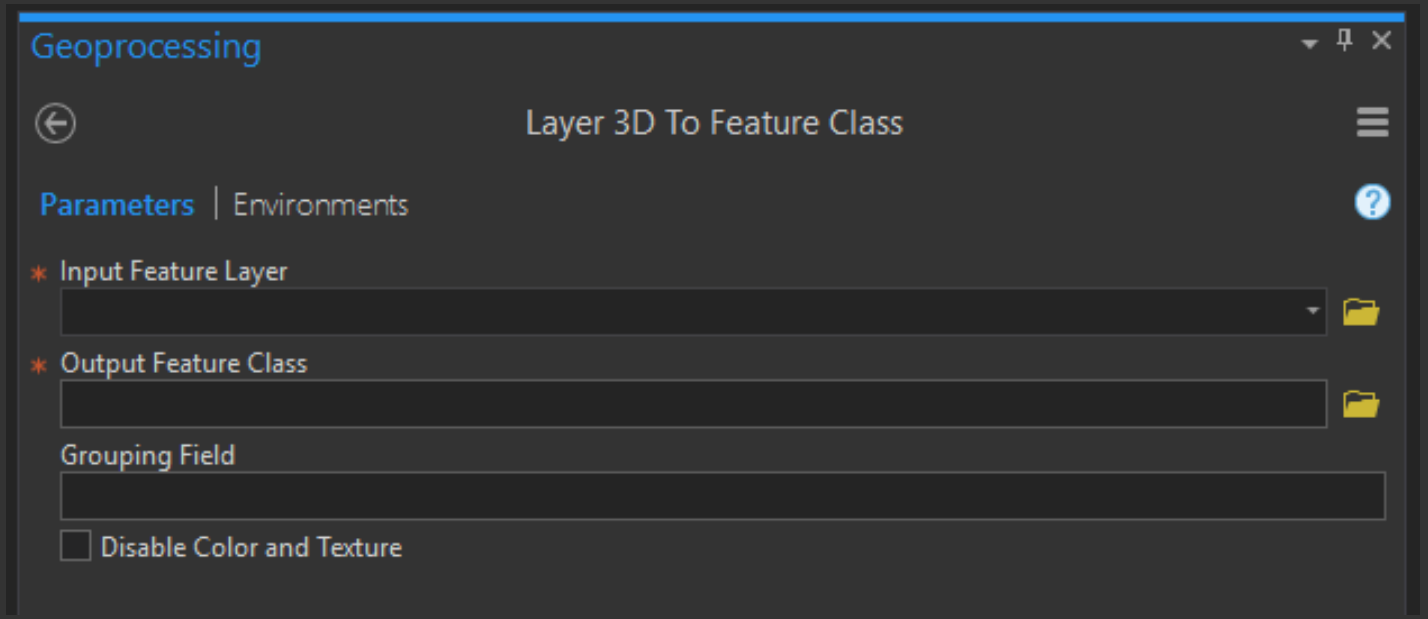
Types of Extrusion

Type	Description
None	Features are not extruded. This is the default.
Min Height	Add extrusion to each feature's minimum height. A z-value is calculated by adding the extrusion height to the minimum z-value of each feature. They are extruded to a flat top at that value. This option is not available for point features.
Max Height	Add extrusion to each feature's maximum height. A z-value is calculated by adding the extrusion height to the maximum z-value of each feature. They are extruded to a flat top at that value. This option is not available for point features.
Base Height	Add extrusion to each vertex of each feature's base height . A z-value is calculated for each vertex of the feature's base and each feature is extruded to those z-values. In the case of polygon features, top and base faces are created to connect to the extruded walls to construct a closed shape.
Absolute Height	Each feature is extruded to the specified z-value as a flat top, regardless of the z-values of each feature.

http://pro.arcgis.com/en/pro-app/help/mapping/layer-properties/extrude-features-to-3d-symbology.htm

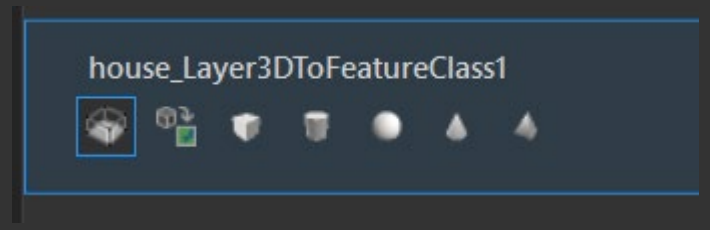
Layer 3D to Feature Class

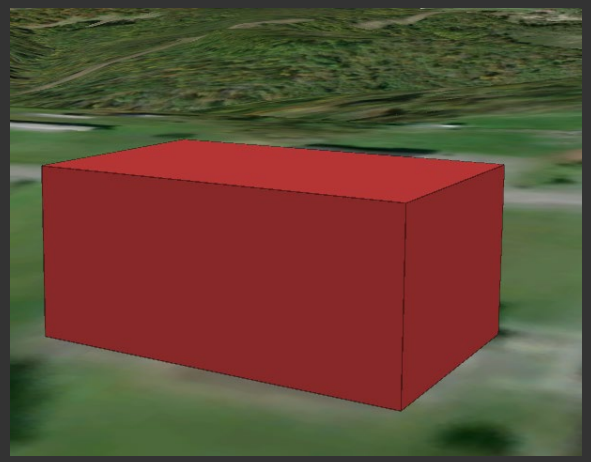
- Allows you to save a 2D layer that is being displayed in 3D to a true 3D layer
- Points → Lines
- Lines → Planes or Areas
- Polygons → Volumes

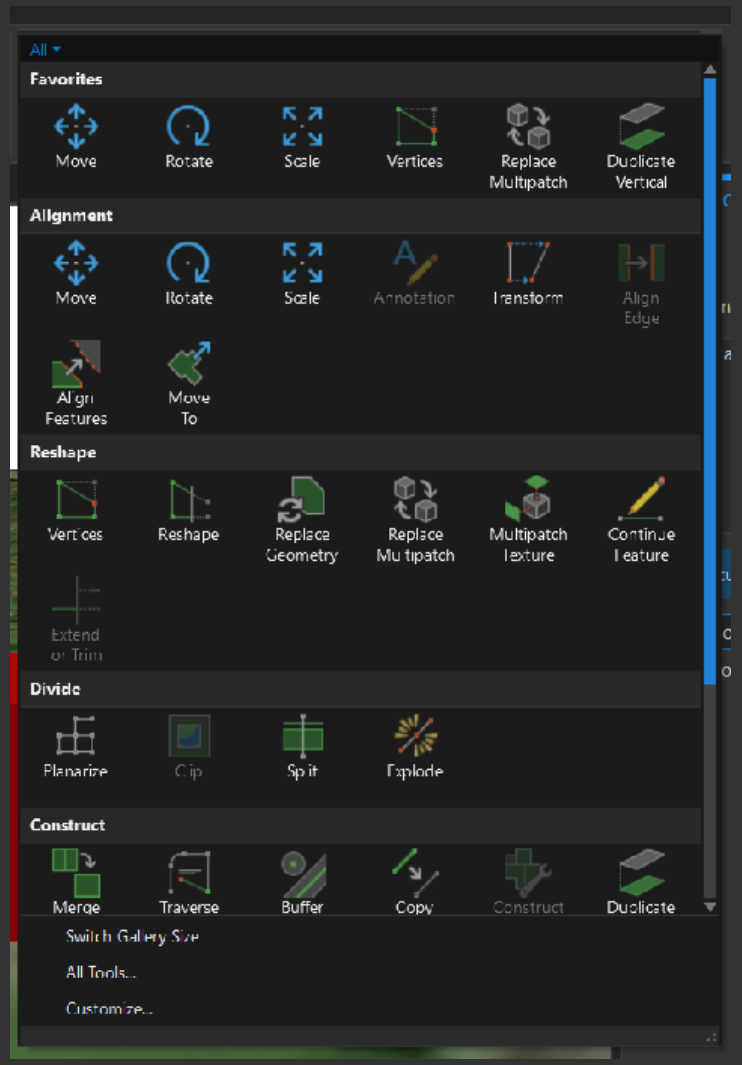


3D Features in ArcGIS

- Multipatch Feature = object that stores a collection of patches to represent the boundary of a 3D object as a single row in a database.
- Can edit in 3D environment
- Can apply textures

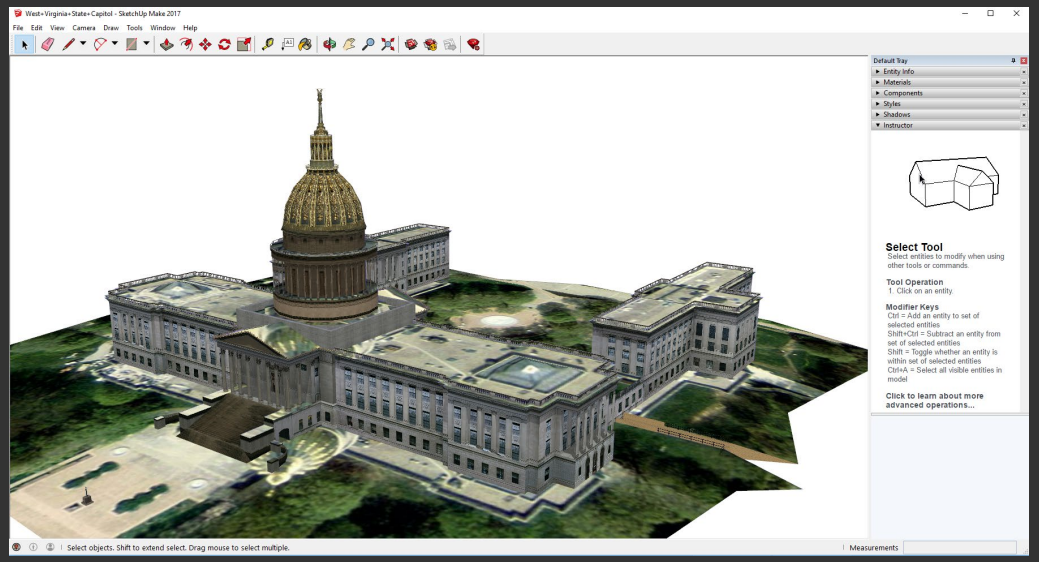


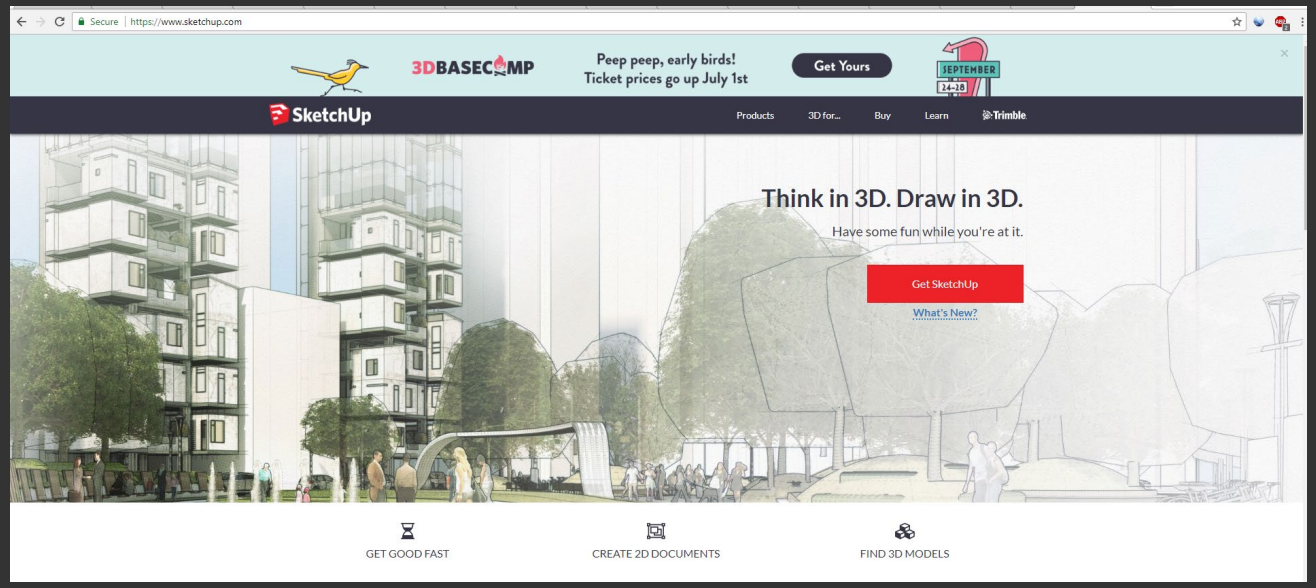




Google SketchUp

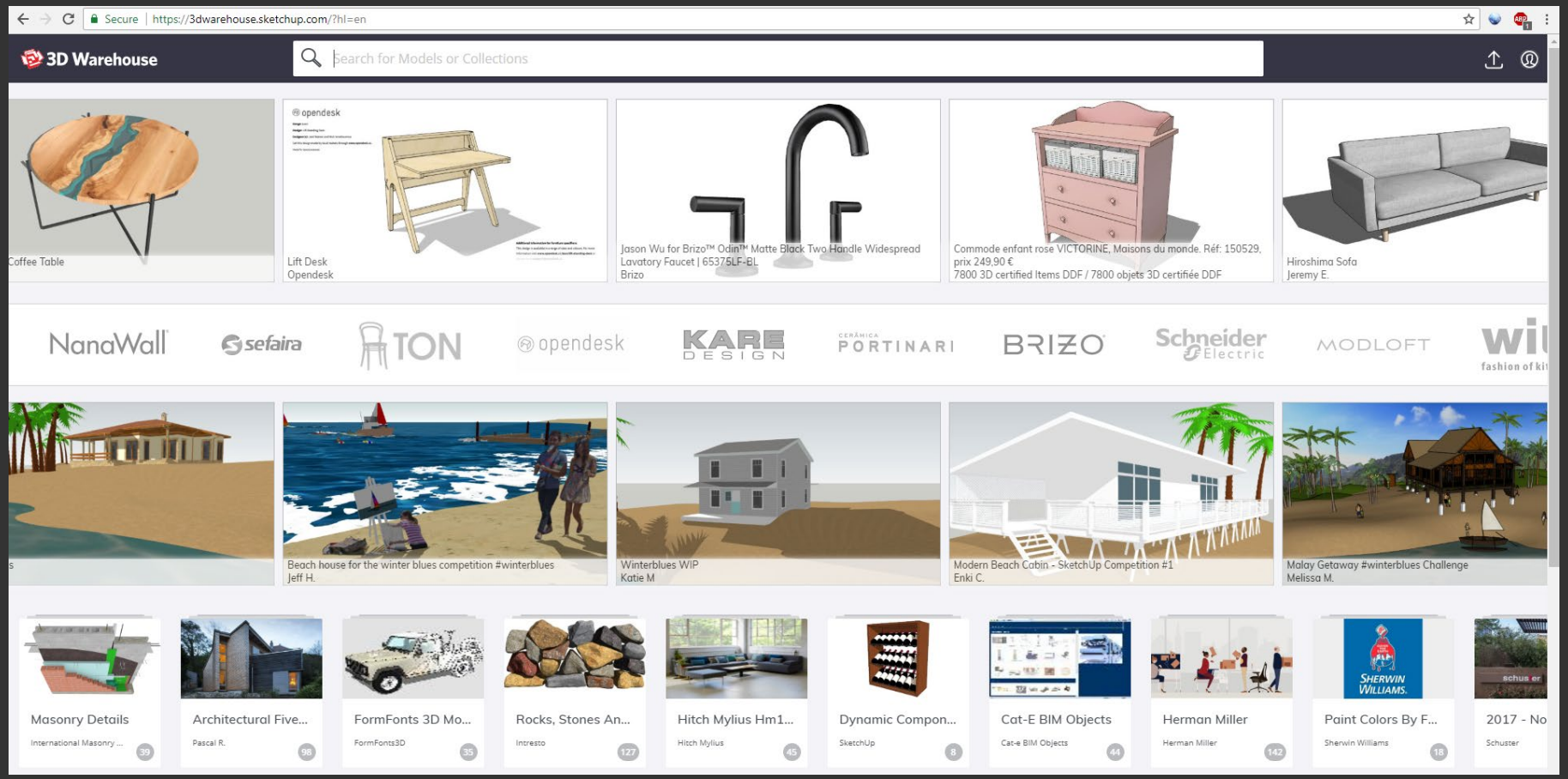
- A free version of SketchUp is available at: http://www.sketchup.com/
- You can also purchase a professional version with advanced functionality





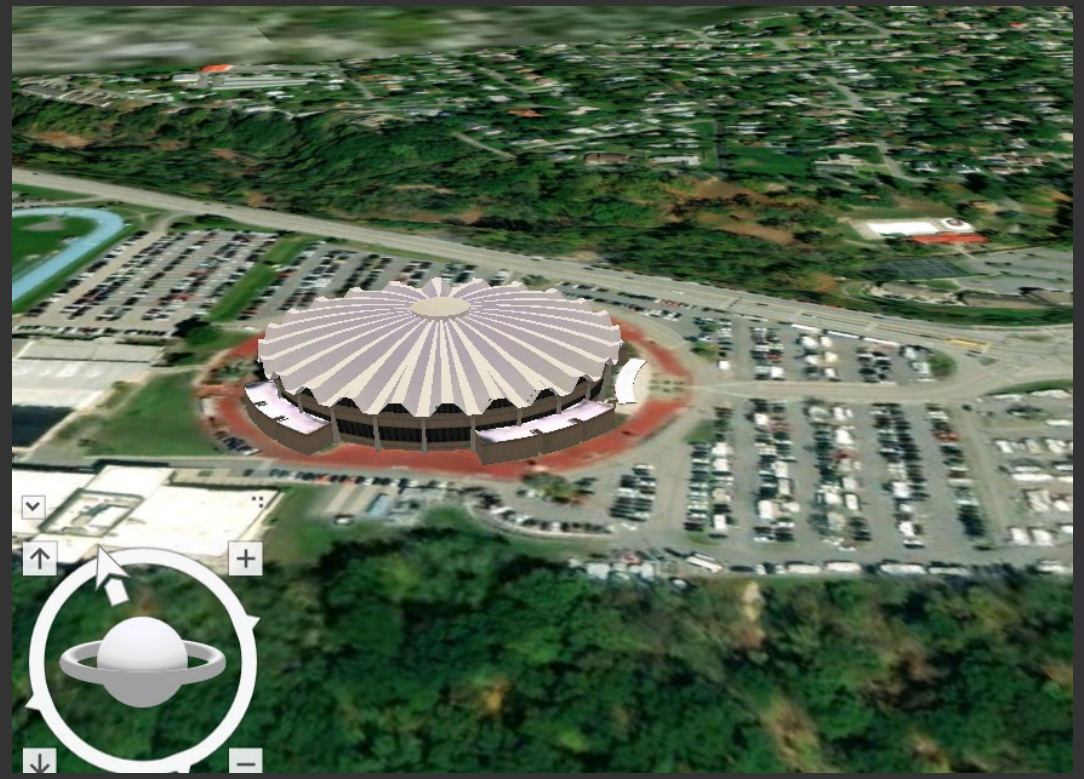
https://3dwarehouse.sketchup.com/model/f6a3329def694b72164596d8946fe6d6/West-Virginia-State-Capitol

3D Warehouse



https://3dwarehouse.sketchup.com/?hl=en

Add 3D Models

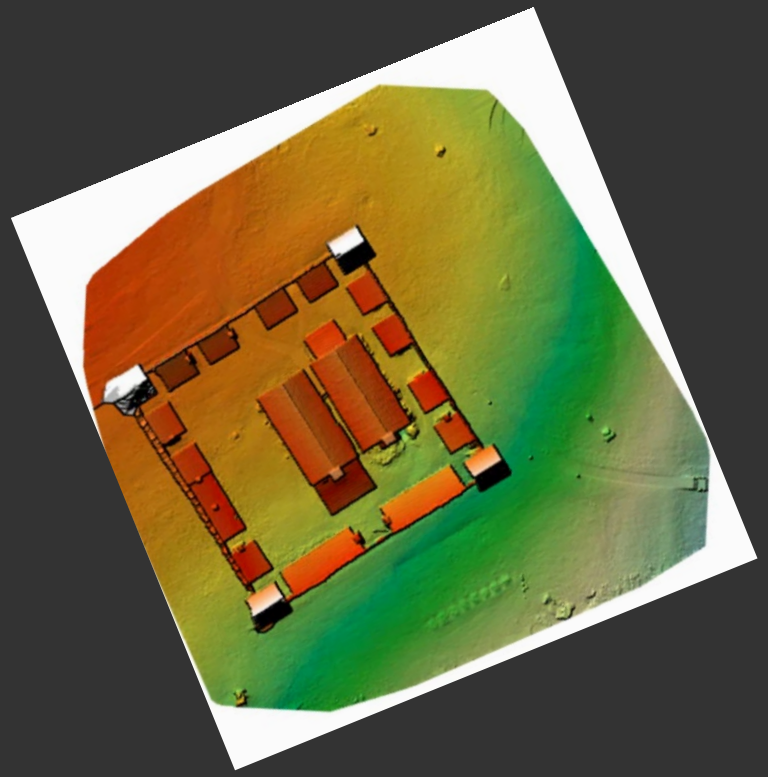


- KML files can be added to a scene
- Can replace features with 3D models (not compatible with KML)

Model from:
https://3dwarehouse.sketchup.com/model/eecb0e633525673aaeac66d23562cbc1/WVU-Coliseum

Models from SfM

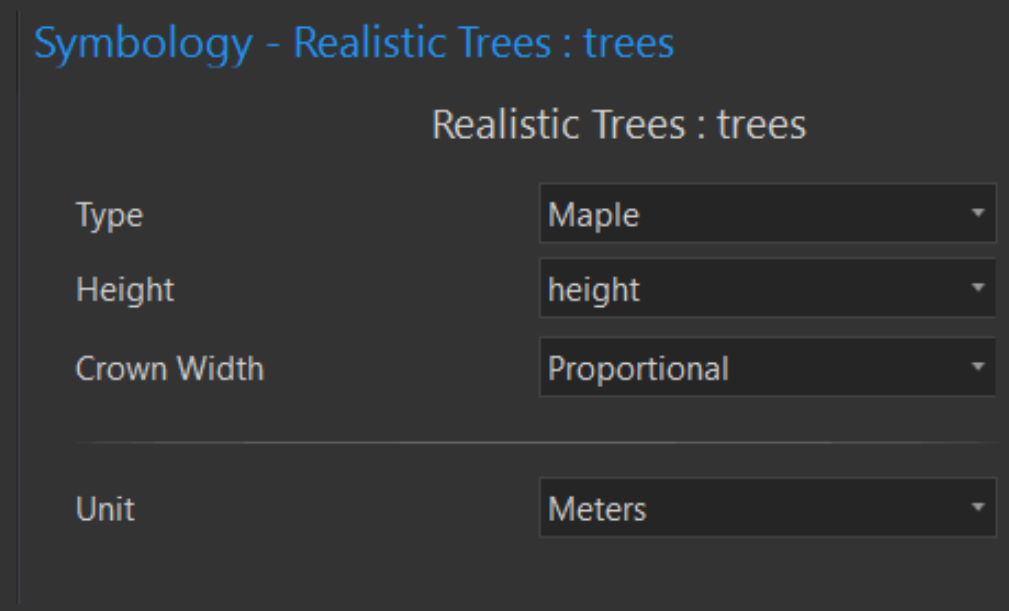
- Drone-based Structure from Motion data can also be used to make 3D scenes and 3D objects



Data and models created by Rachael Taylor

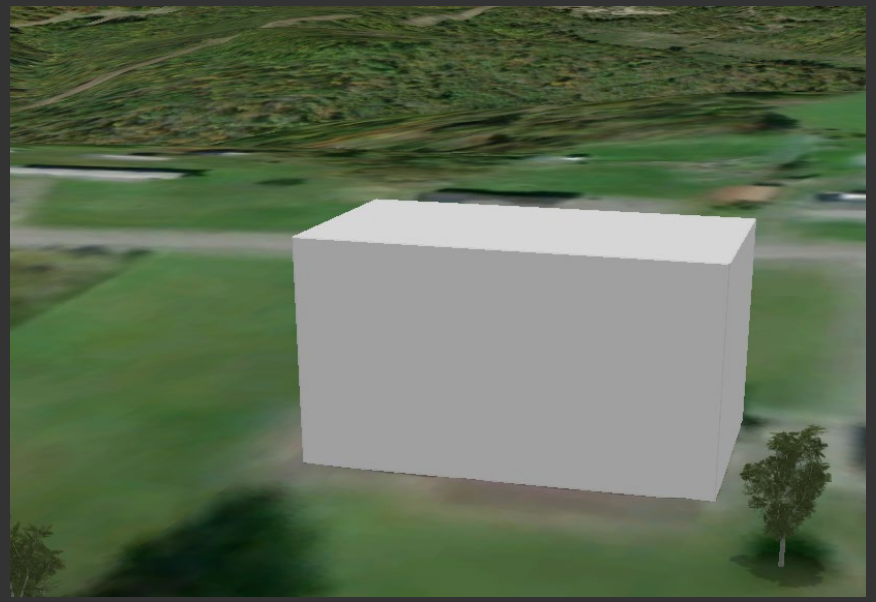
3D Symbology

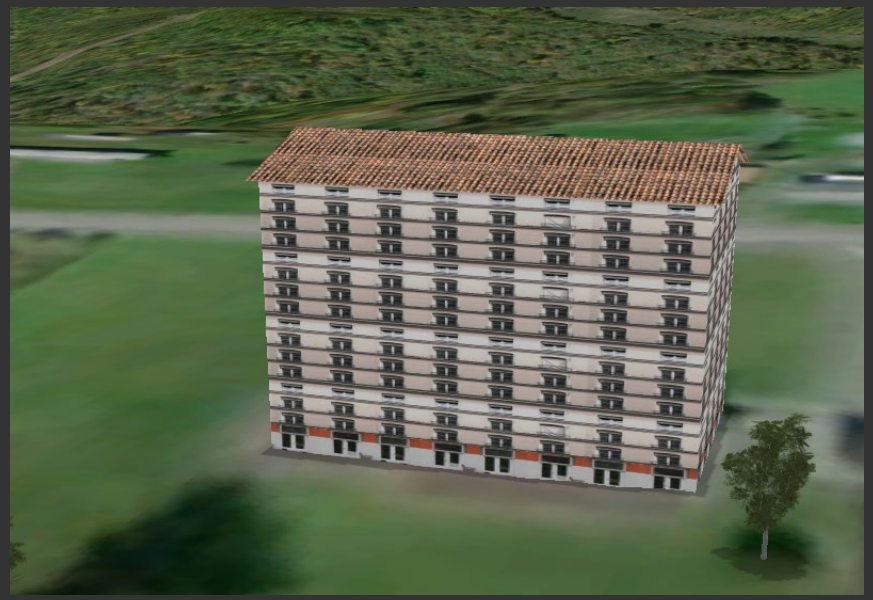
- Use preset symbols or 3D symbols



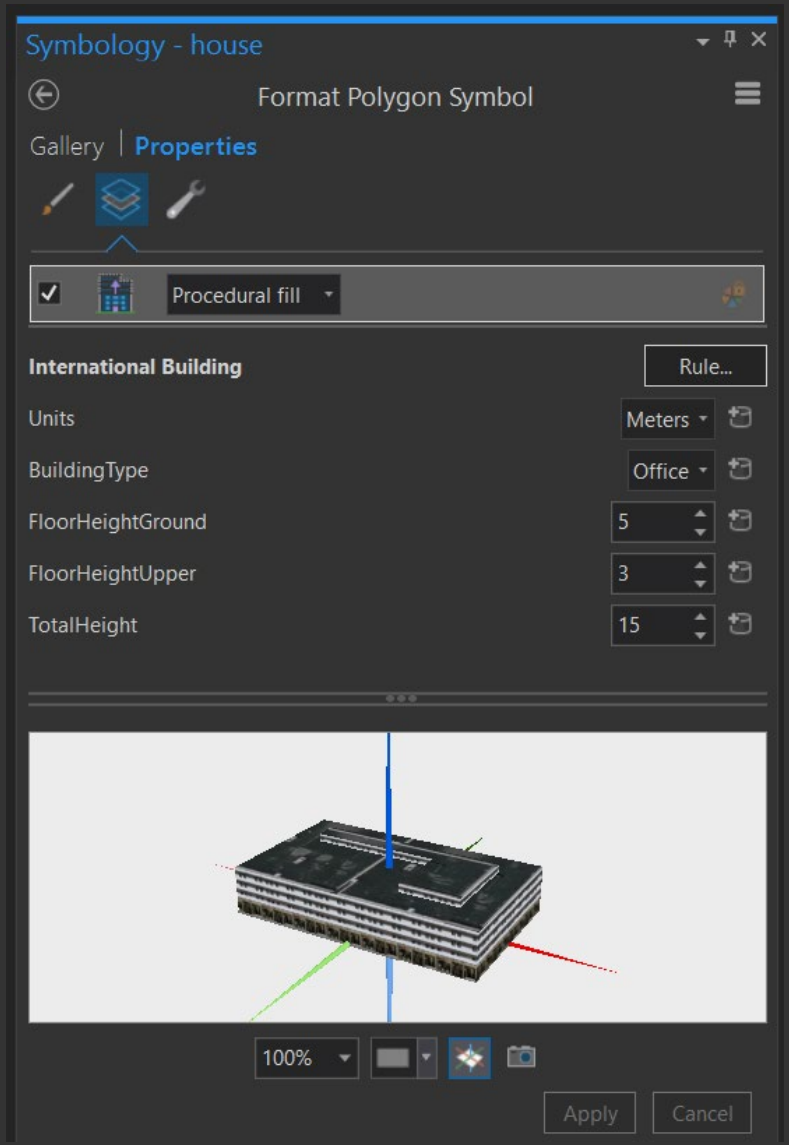
3D Symbology

- Use 3D symbology
- Can be applied to 2D features
- Can specify height

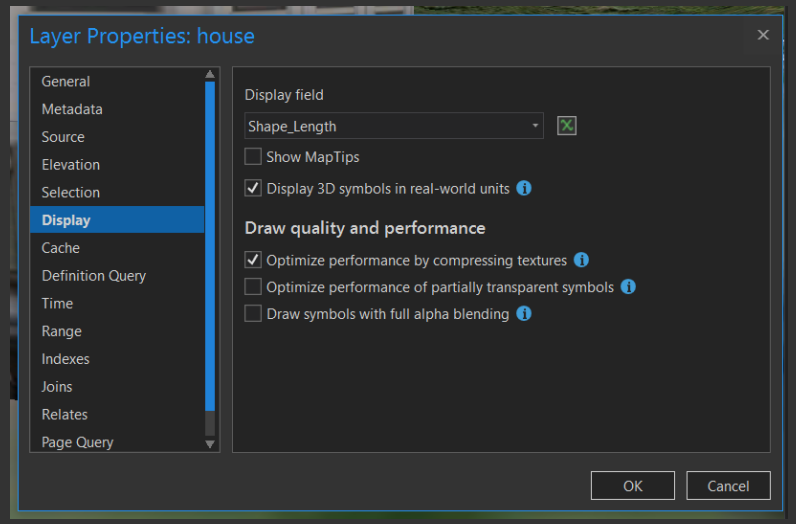


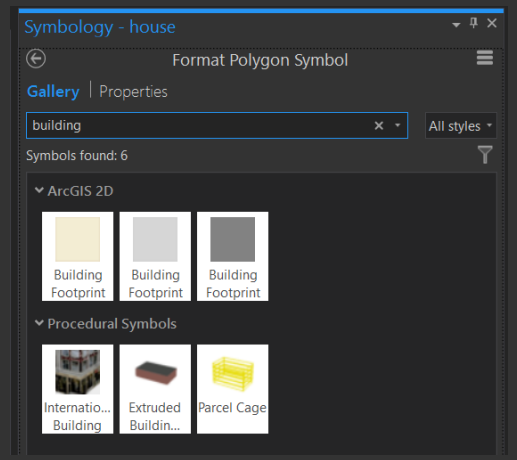


3D Symbology



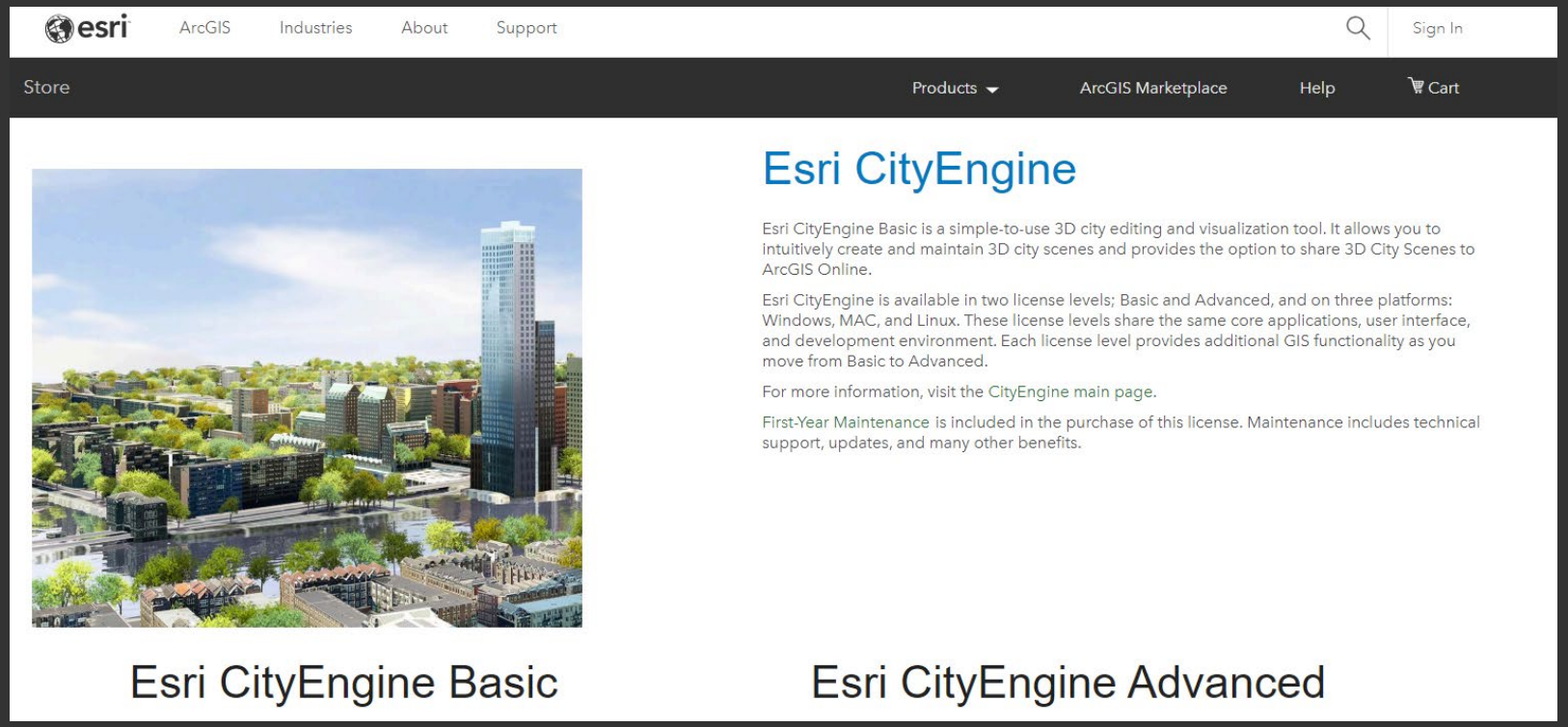
- Use 3D symbology
- Make use of procedural symbols from CityEngine
- Create your own procedural symbols in CityEngine





CityEngine

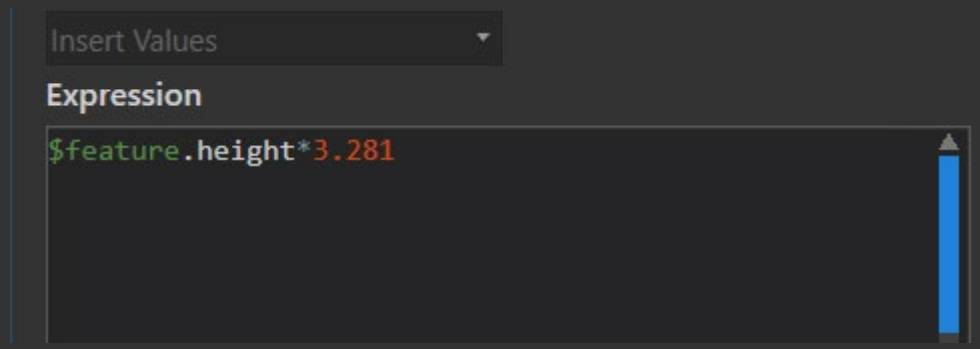
- A powerful rule-based 3D visualization program designed for quickly modeling 3D cities
- By ESRI

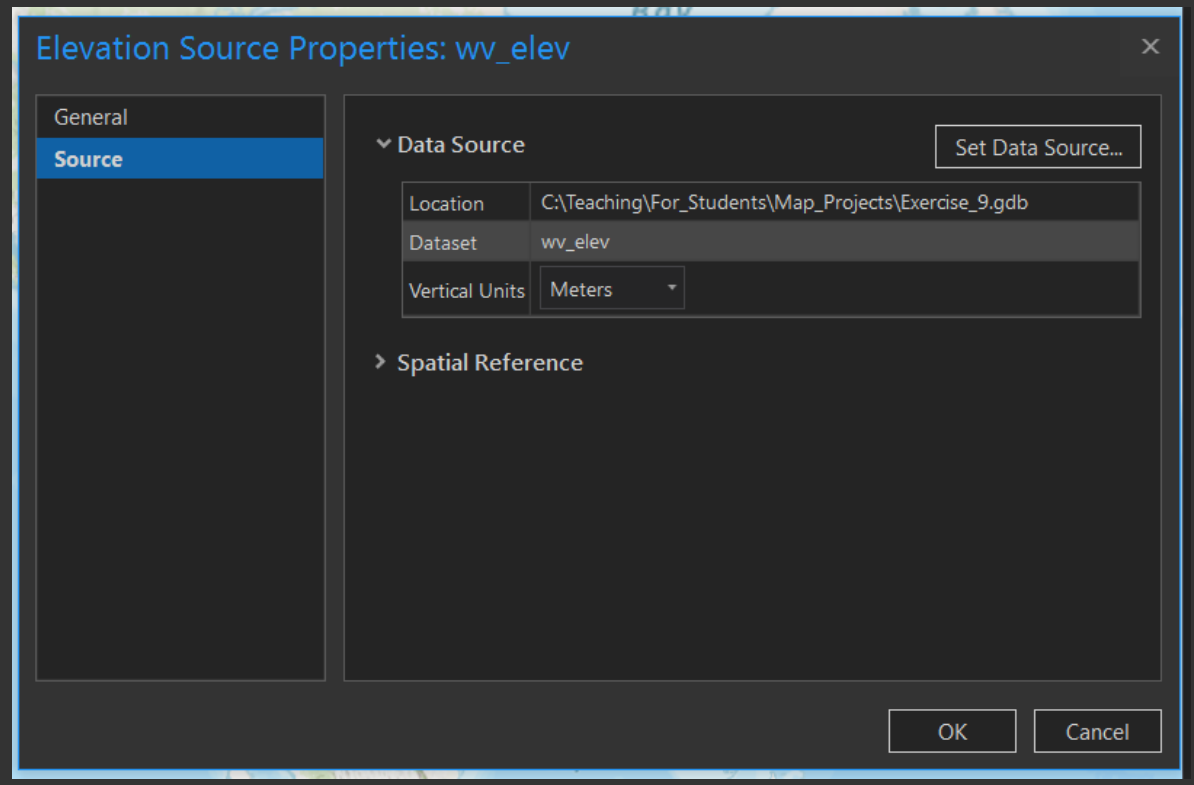


https://www.esri.com/en-us/store/city-engine

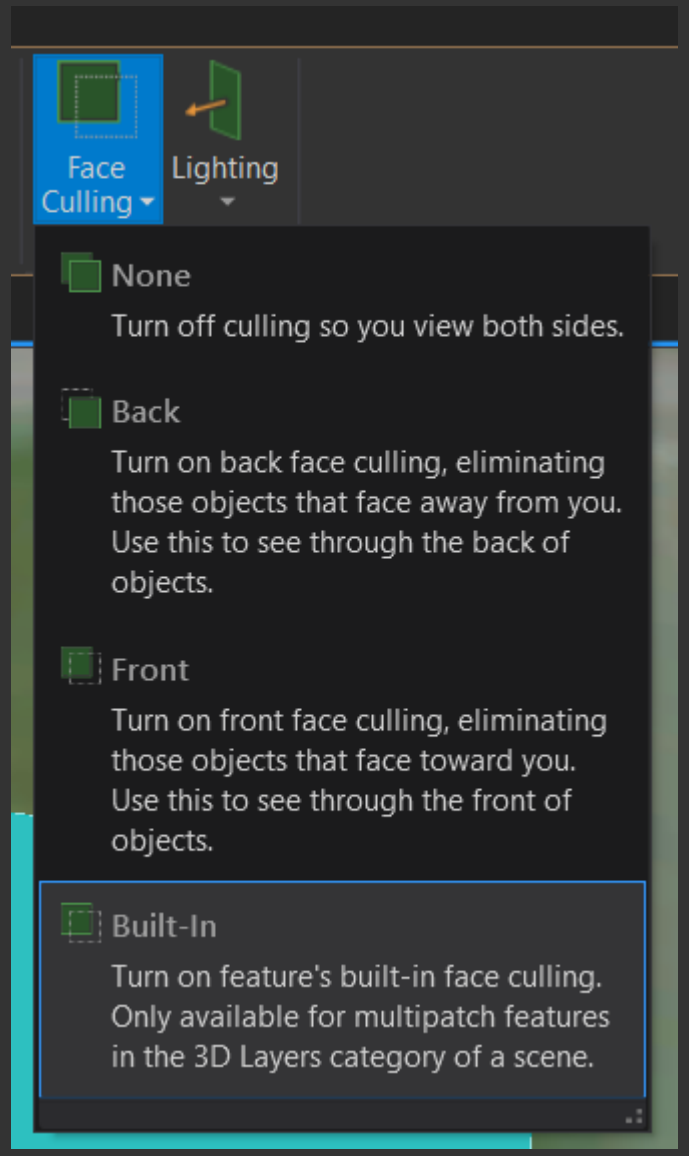
Dealing with Scale Issues

- May need to alter units if scales are different
- Example: feet vs. meters





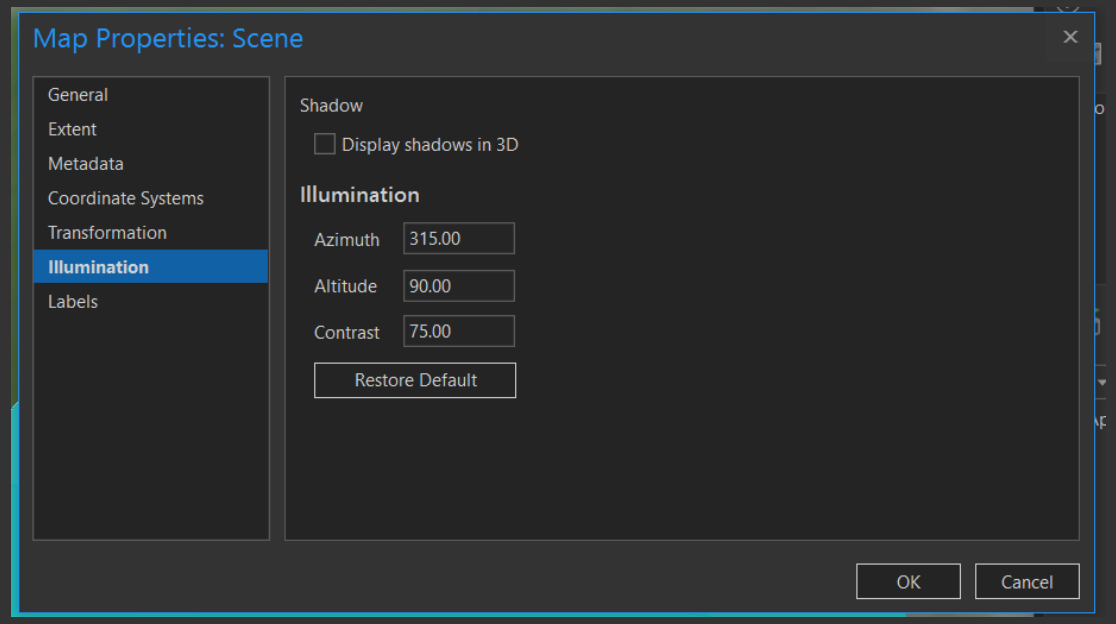
Face Culling

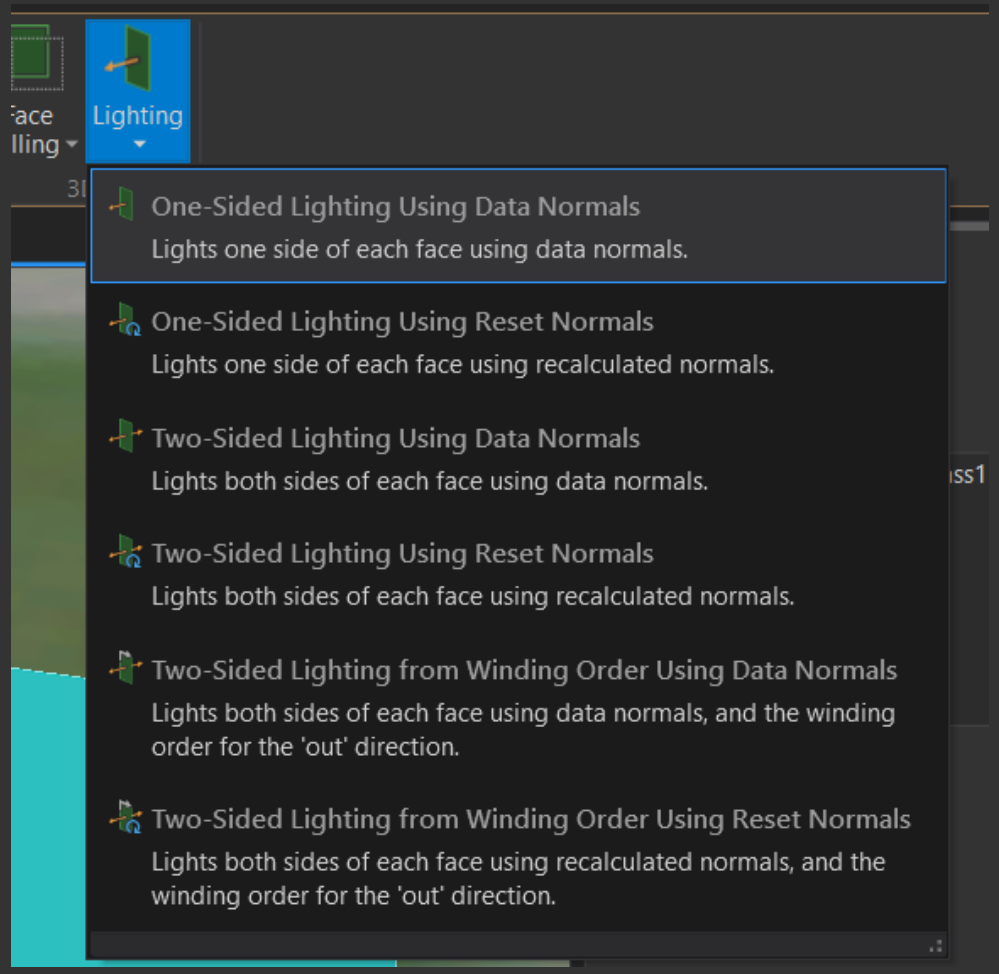


- Control face visibility

Lighting and Shadow

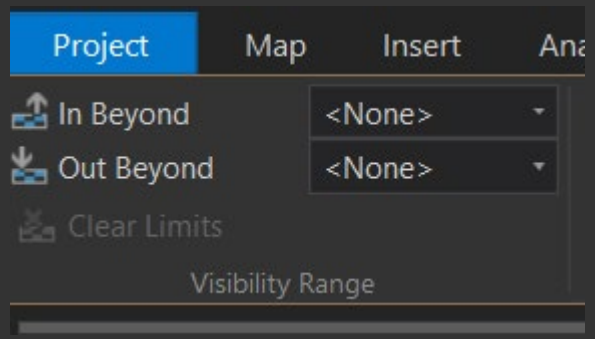
- Can control lighting
- Can control modeling of shadows
- Can set Sun position

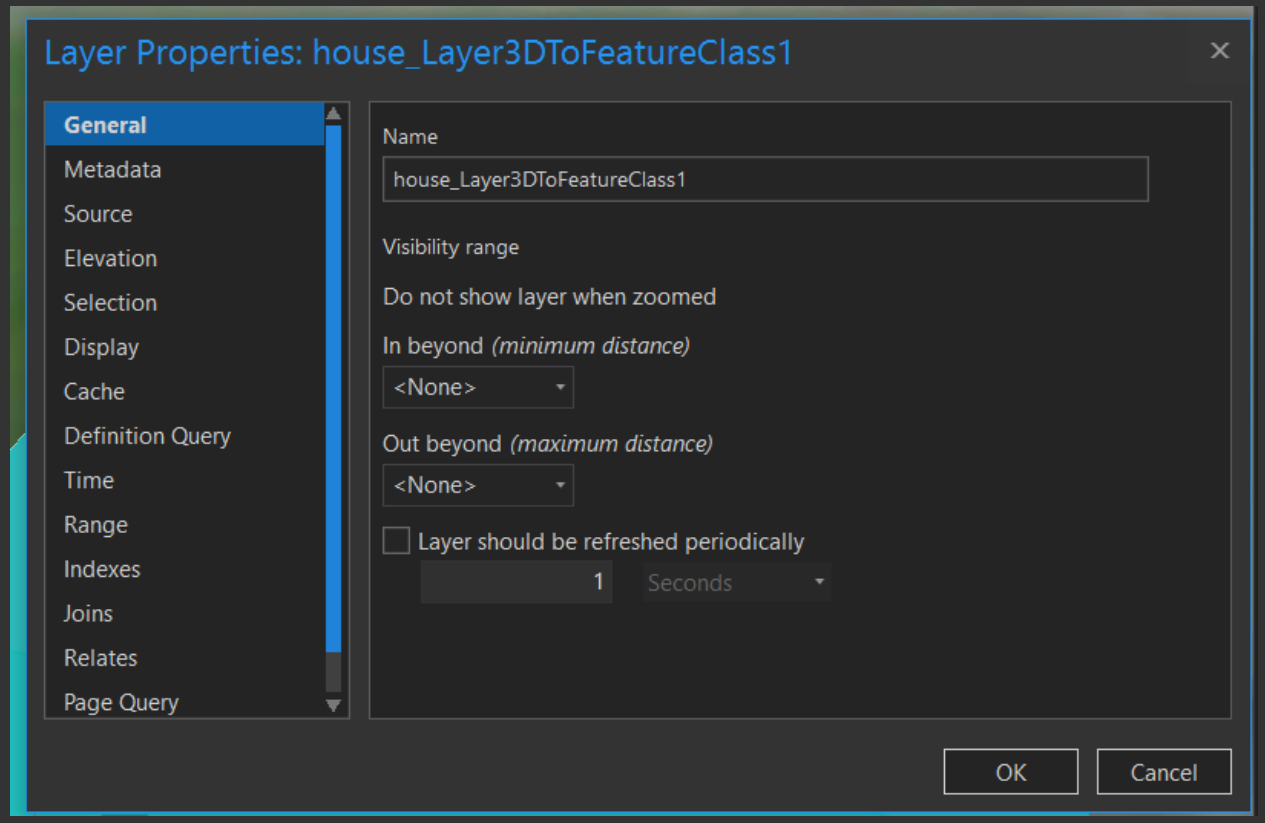




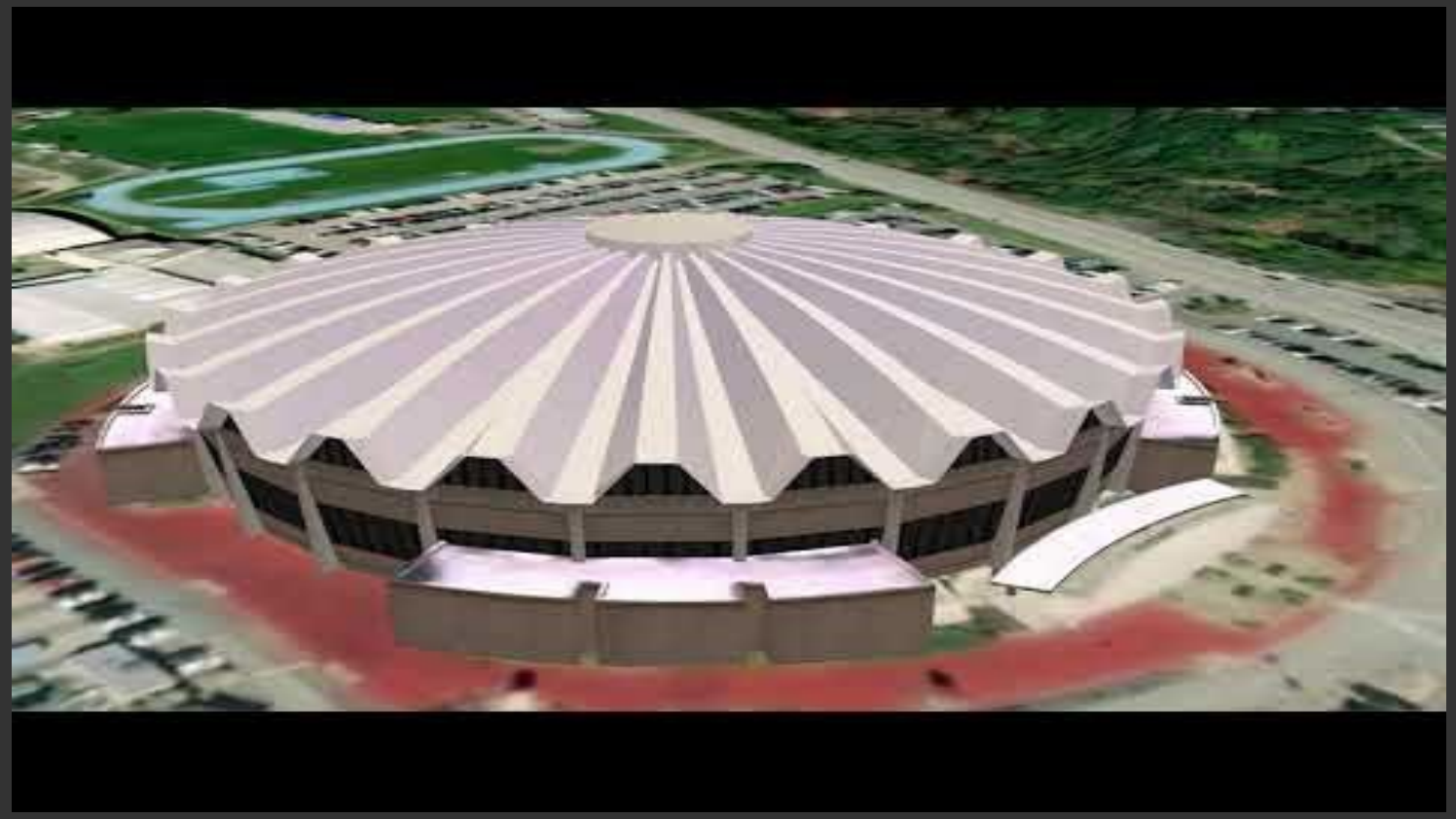
Using Scale

- Can change layer symbology and visibility based on scale





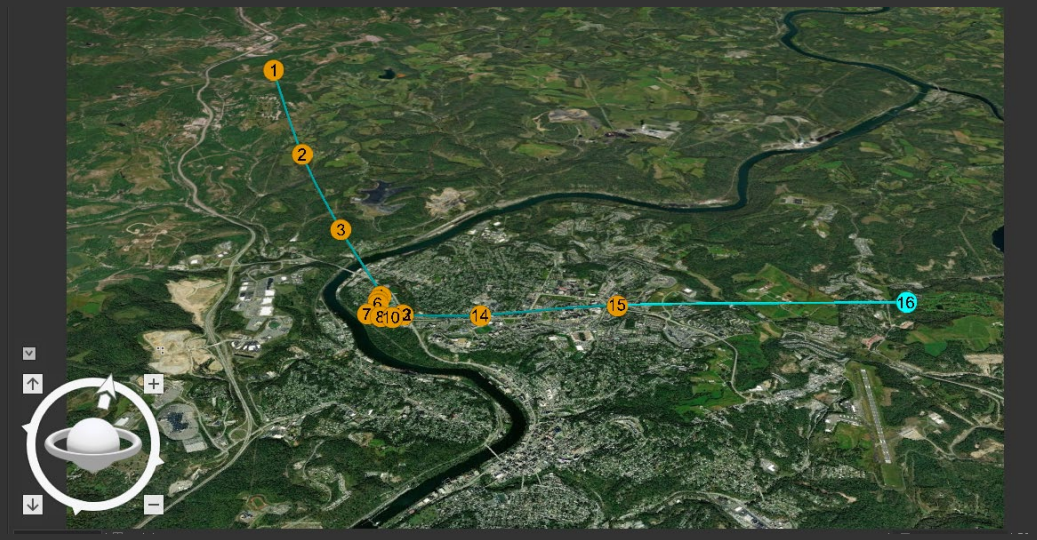
Creating Video Fly-Through in ArcGIS Pro

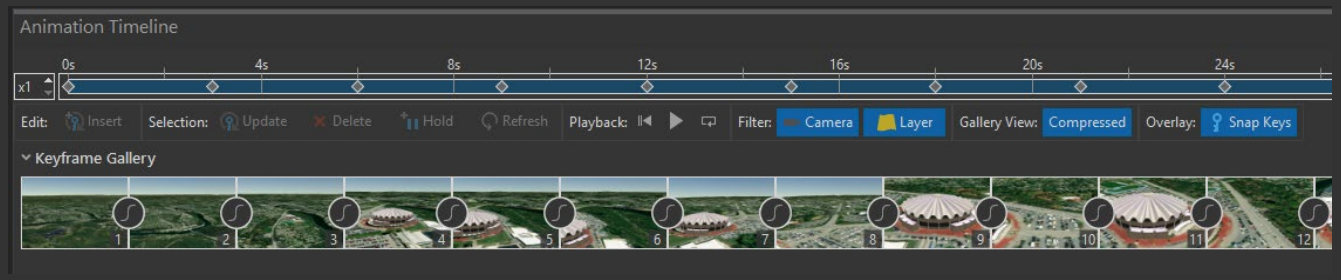


3D model from:
https://3dwarehouse.sketchup.com/model/eecb0e633525673aaeac66d23562cbc1/WVU-Coliseum

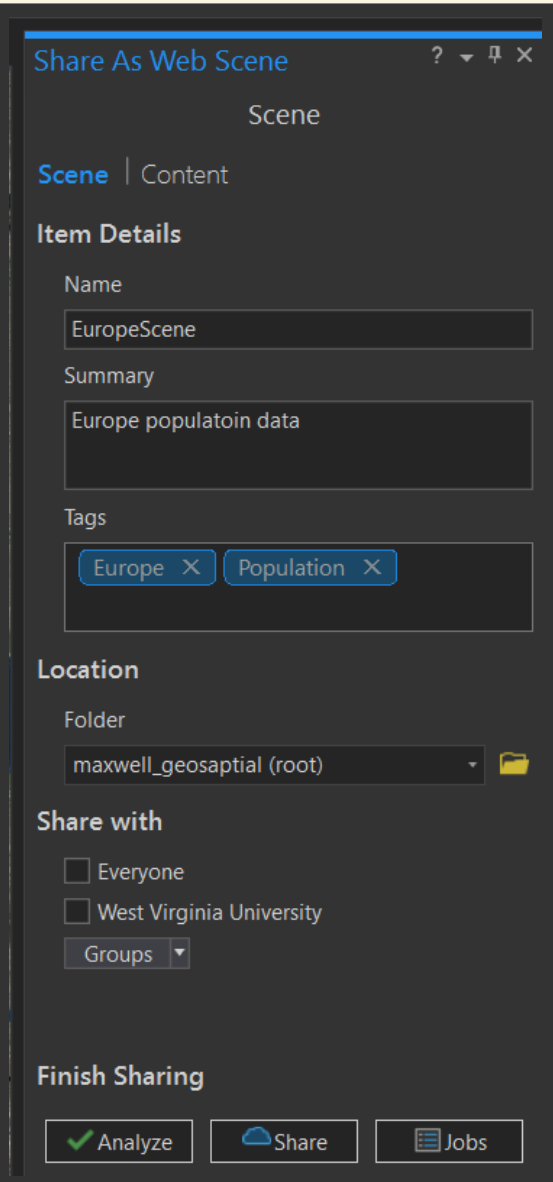
Creating Video Fly-Through in ArcGIS Pro

- Add keyframes to control motion
- Set speed between keyframes
- Create keyframes from bookmarks
- Add titles, text, images, watermarks, copyrights, logos, etc.
- Render movie to video files





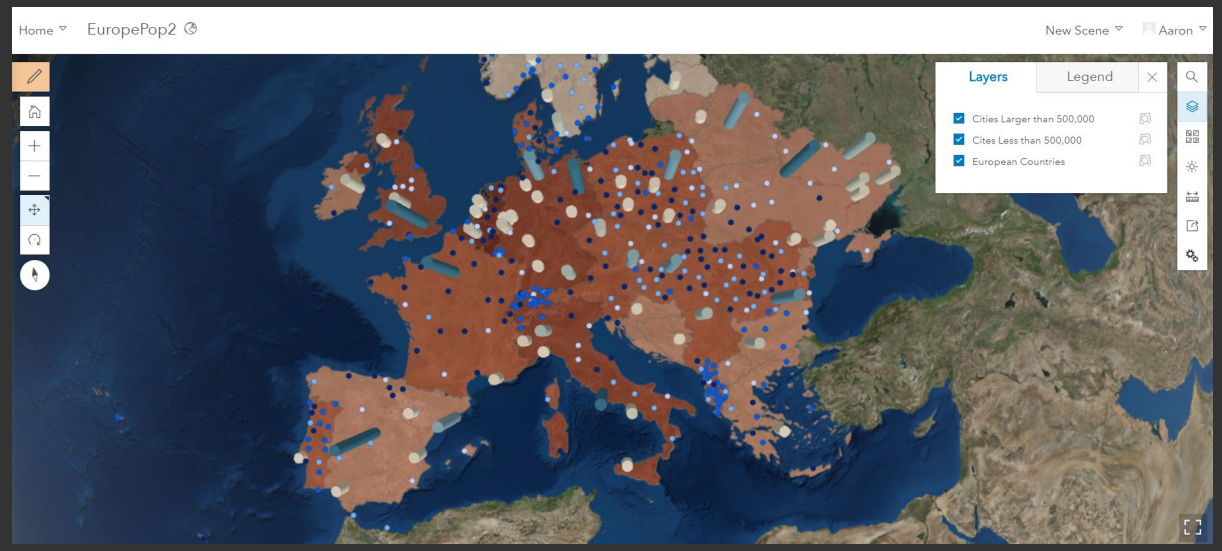
Scenes on the Web



- Can share scene as a web scene
- Need valid ArcGIS Online account with publishing privileges
- Will be published to your ArcGIS Online content
- Data will be published as hosted feature layers
- Additional editing can be performed in ArcGIS Online
- Apps can be generated
- Recommend that all layers use WGS84 or Web Mercator

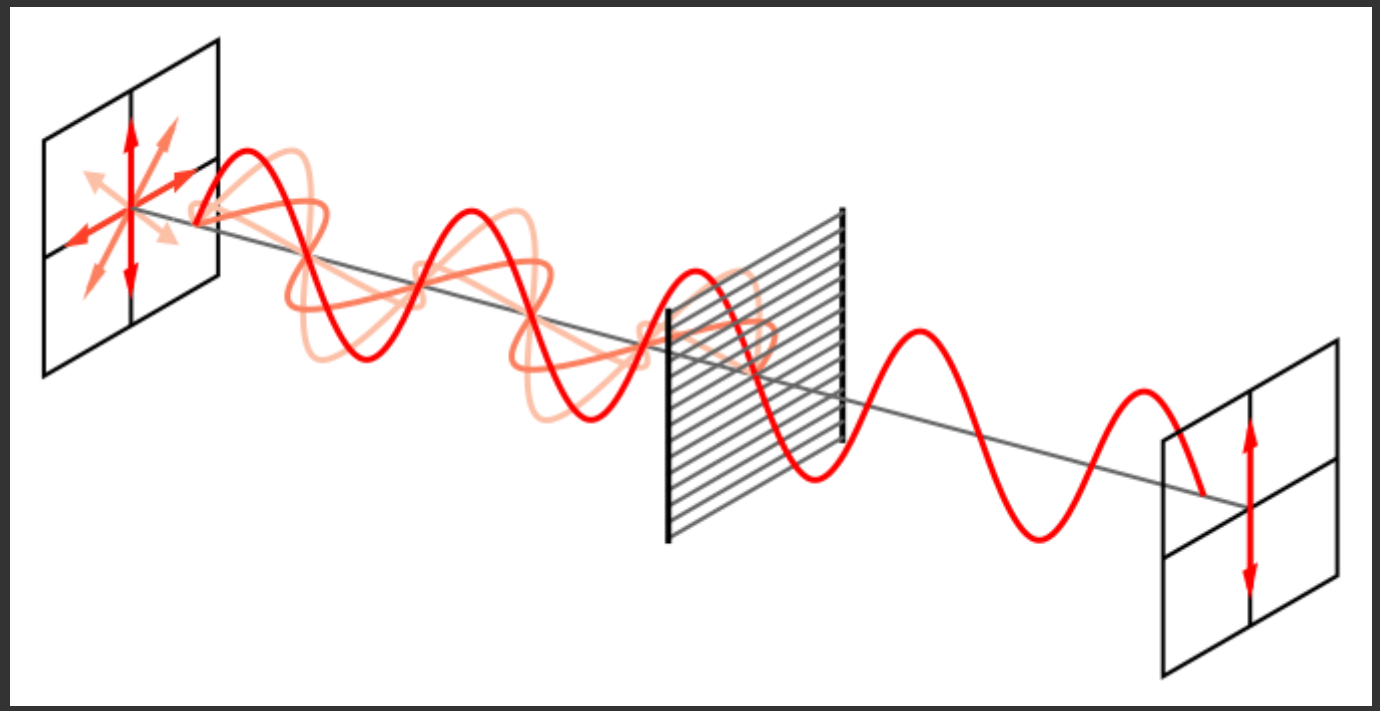
Scenes on the Web

- Can edit symbology of points
- Editing polygons is limited
- Can change visibility scales
- Can add additional layers
- Should edit pop-ups in ArcGIS Pro



Stereo Projection

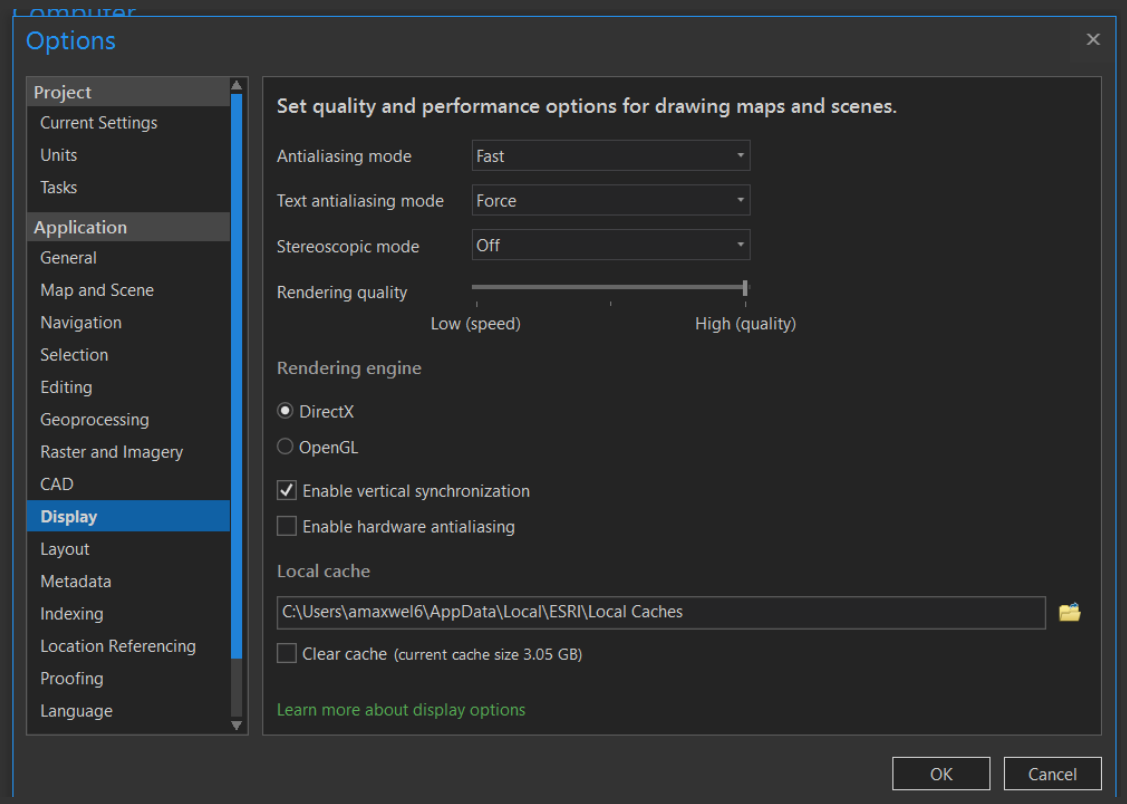
- Need access to stereo viewing



https://commons.wikimedia.org/wiki/File:Wire-grid-polarizer.svg

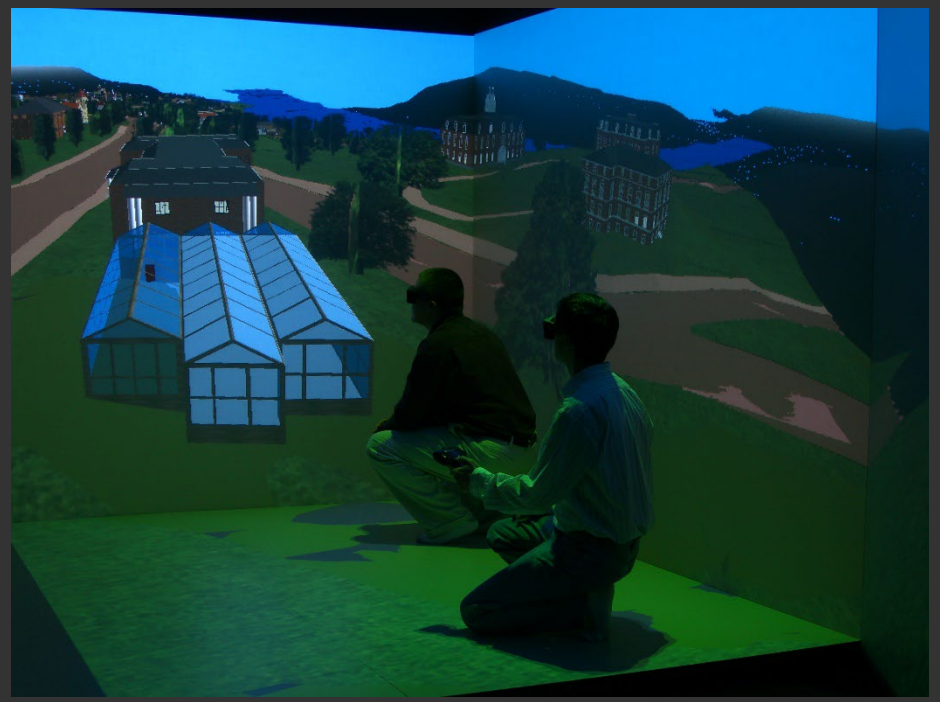
Stereo Projection

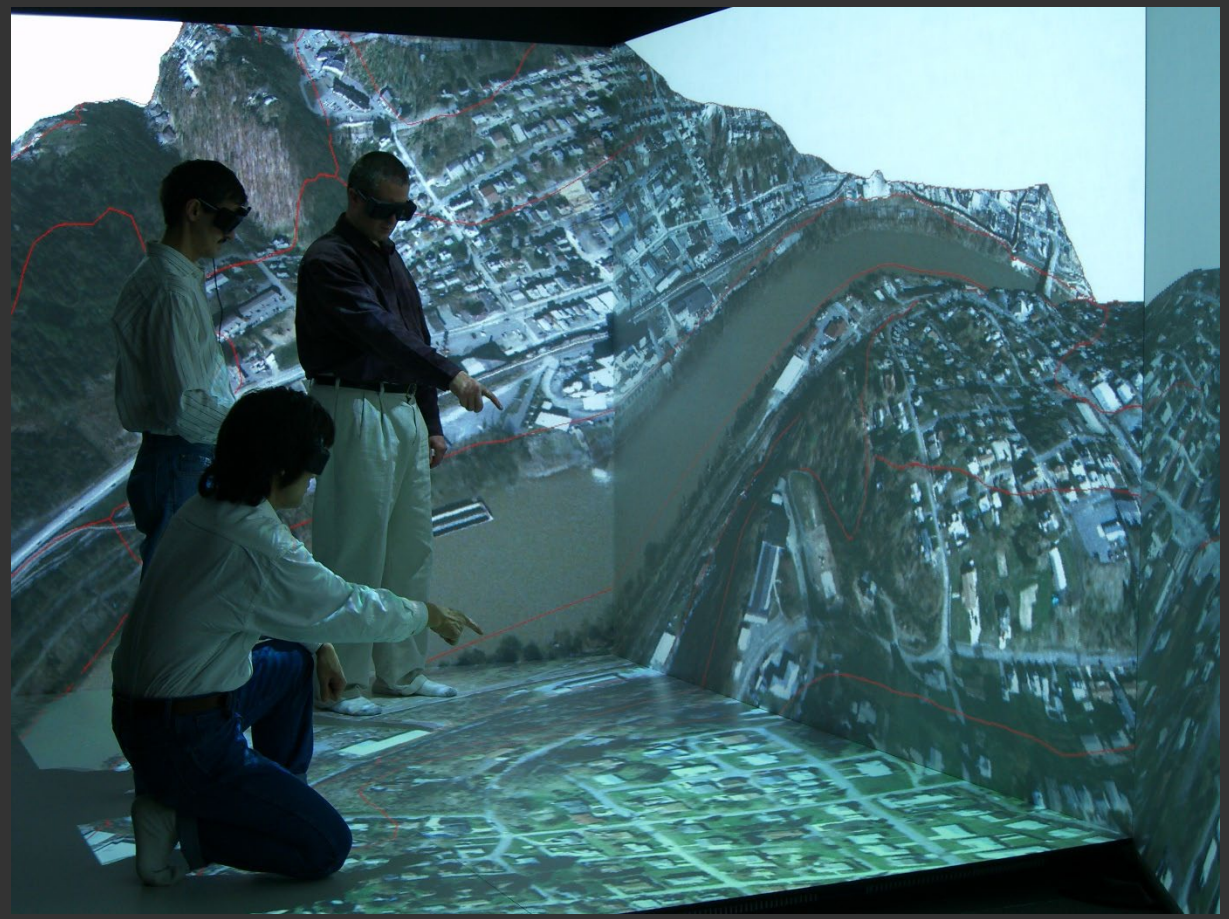
- ArcGIS Pro allows for stereo viewing with required hardware



The CAVE

Need access to stereo viewing





Virtual Reality Goggles

https://commons.wikimedia.org/wiki/File:Oculus_Rift_Crescent_Bay_Prototype_(16383004719).jpg

https://commons.wikimedia.org/wiki/File:Oculus_Rift_Crescent_Bay_Prototype_(16568187562).jpg

This is the end of this lecture module.

Please return to the West Virginia View Webpage for additional content.