3D Analysis in ArcGIS Pro

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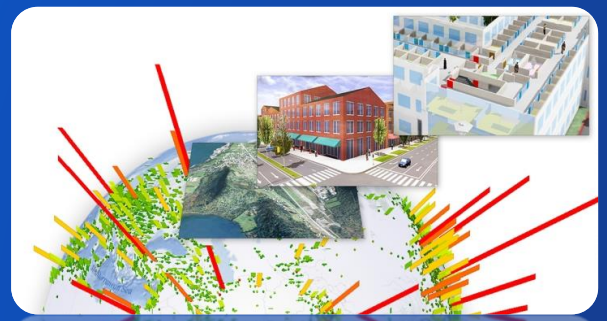
Workshop Overview

- What’s New Since ArcGIS Pro 2.2
- Scope of 3D Analysis
- 3D Data Types
- Analysis Capabilities
- Demos
- Q&A

What’s New in ArcGIS Pro

- 3D interpolation with Empirical Bayesian Kriging 3D (EBK3D) [2.3]
- Generate reports from statistical aggregations [2.3]
- Enhanced shading to emphasize depth characteristics of 3D data [2.4]
- Easily add multiple surfaces as separate elevation sources [2.4]
- Generate a profile view to interactively examine a 3D cross section [2.4]
- Interactively edit raster elevation data with the Pixel Editor [2.4]
- Interactively assess the cut-fill needed to level an elevation surface [2.4]
- Quality and performance enhancements for multiple tools [2.4]

Scope of 3D GIS

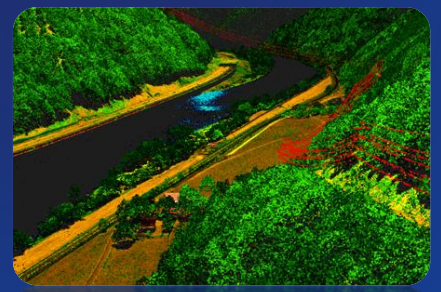


Multiscale 3D Models

ArcGIS for 3D Cities

Geodesign

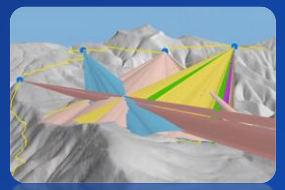
Desktop to Web



Point Clouds

Surface modeling

Integrated 3D



3D Analysis

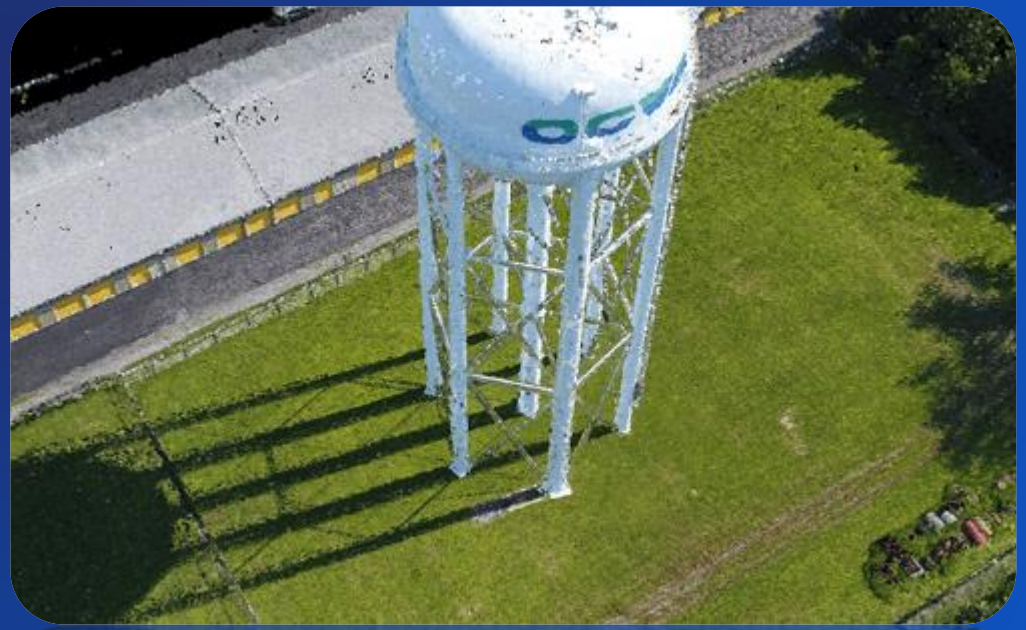
Building Information Modeling (BIM)

- **Revit models can be directly consumed in ArcGIS Pro**
- **Revit models can be interactively georeferenced**
- **Revit models organized into workspaces**
  - Construction disciplines are organized into “Building Discipline” dataset
  - Categories are organized into “Building” feature classes

CAD: Introduction to Using BIM Data from Revit in ArcGIS Pro, Thursday 11:15, Demo Theater 4

Drone 2 Map

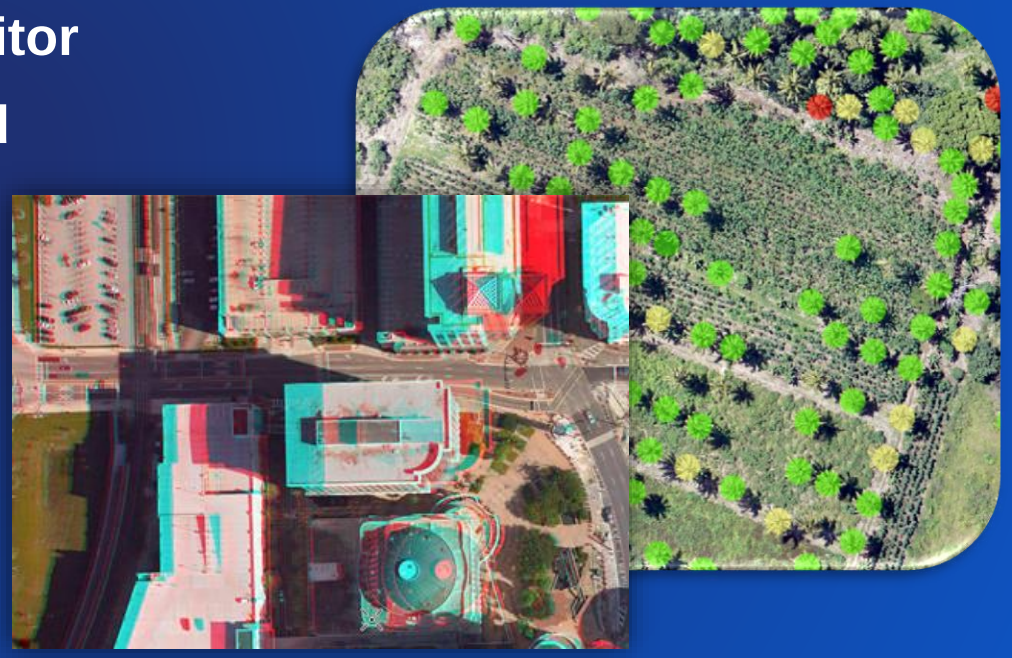
- **Use imagery from drones to generate high resolution 2D & 3D content**
- **Create an ArcGIS Pro project from Drone2Map to view:**
  - Photogrammetrically derived point clouds
  - 3D textured meshes
  - Contours
  - Flight path
  - Photo positions
- **Faster survey grade results (if collected properly)**



Drone2Map: Best Practices, Thursday 10:00, Room 8

Imagery Analyst

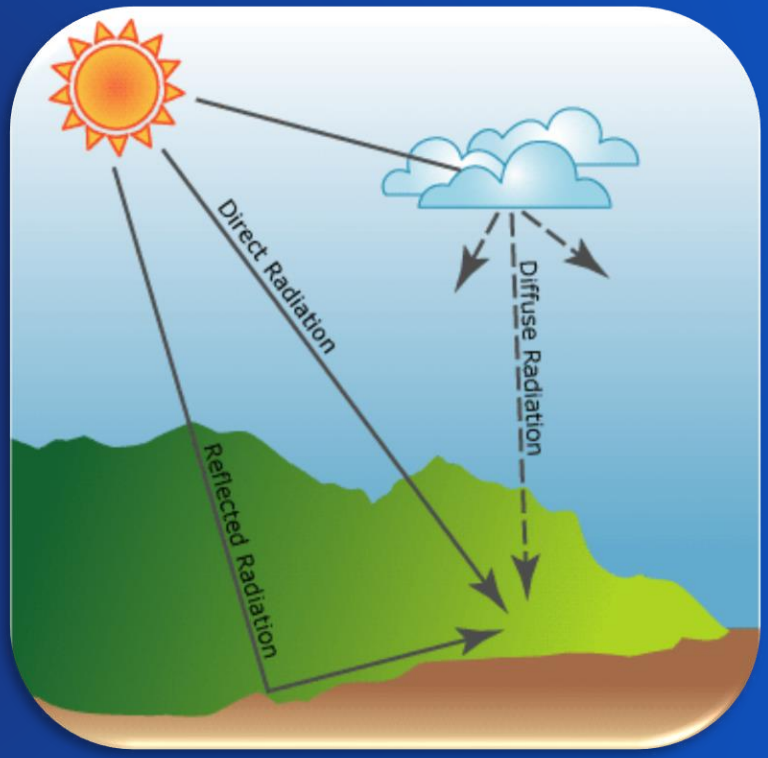
- Extract 3D features with stereo mapping
- Classify imagery with supervised methods and deep learning techniques
- Terrain modification capabilities in Pixel Editor
- Exploit robust raster functions & automated routines



ArcGIS Pro: Introduction to Image Analyst, Wednesday 2:30, Room 6D
ArcGIS Pro: Using Imagery & Deep Learning, Thursday 12:15, Demo Theater 2

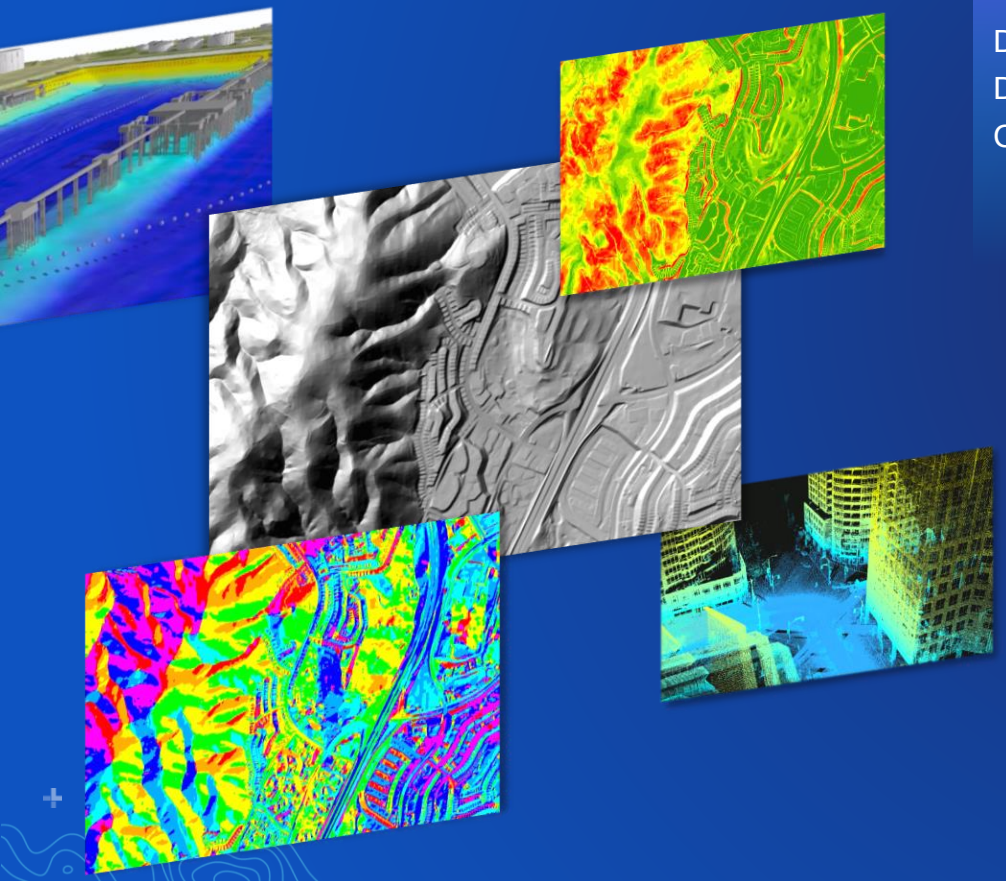
Spatial Analyst

- Surface derivatives
- Solar analysis tools
- Density estimation
- Cost distance analysis
- Image classification
- Hydrology and groundwater capabilities
- Robust math & statistical analysis



Spatial Analyst: An Introduction, Wednesday 2:30

3D Analyst



Area & Volume

Detect Change
Determine Cut/Fill
Calculate Surface Area & Volume

Overlay

3D Statistics
3D Proximity
3D Intersections
Visualization
Profile Graphs
Interpolate Features
Extrude Between Surfaces

Visibility

Line of Sight
Viewshed
Skyline
Shadow Modeling

Data Management

Data Conversion
Lidar QA/QC
Lidar Classification
Surface Interpolation
Import/Export Data

Surface Derivatives

Contours
Slope
Aspect
Hillshade
Statistics
Identify Outliers
Interpolate Geometry
Perform Math Operations

Overview of 3D Data Types

Surfaces & Vector Geometry

Storing XYZ Information

Vector Geometry

Points | Lines| Polygon

Point Cloud

Multipatch | Mesh

Surface Model

Triangulated Irregular Network

Raster

Understanding the 3D Mesh

- **Collection of triangles**
- **Support textures, colors, and transparency**
- **Represent many types of data:**
  - Discrete objects
  - Outer shell of a volume
  - Continuous measurements
    - Terrain with overhangs and enclosed spaces
    - Isosurface with multiple Z values at an XY

Multipatch Geometry

- **Supports textures & colors when stored in a geodatabase**
- **Supported as input for numerous automated analysis operations**
- **Single resolution dataset**
- **Created by:**
  - Editing in ArcGIS Pro
  - Deriving from surfaces
  - Importing from other 3D model formats
  - Symbolizing points, lines, and polygons with 3D properties

Indexed 3D Scene Layers (I3S)

- **Multi-resolution data type optimized for rapid display + cloud storage**
- **Open standard data format**
- **Supports the following 3D data types:**
  - 3D points
  - Point cloud
  - Discrete mesh (3D objects)
  - Integrated mesh

Constructing 3D Features

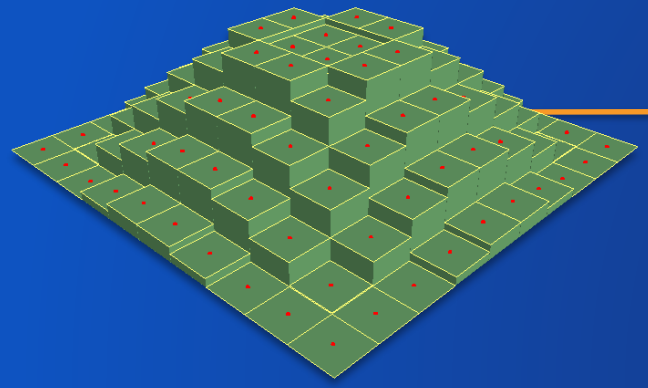
- Interactive digitization
- Symbolize points, lines and polygons:
  - Procedural rules to create complex models driven by feature attributes
  - Extrusion/base height properties to create walls from lines, volumes from polygons, and cylinders from points
  - Standard 3D marker symbols for points, tube symbols for lines
- Derive from spatial operations
- Import 3D models from a variety of data sources:
  - Collada
  - 3D Studio Max
  - OpenFlight
  - VRML/GeoVRML
  - Wavefront OBJ *(Pro only)*
  - SketchUp *(Desktop only)*

Understanding the Surface

Continuous data with one Z value for a given position in XY space.

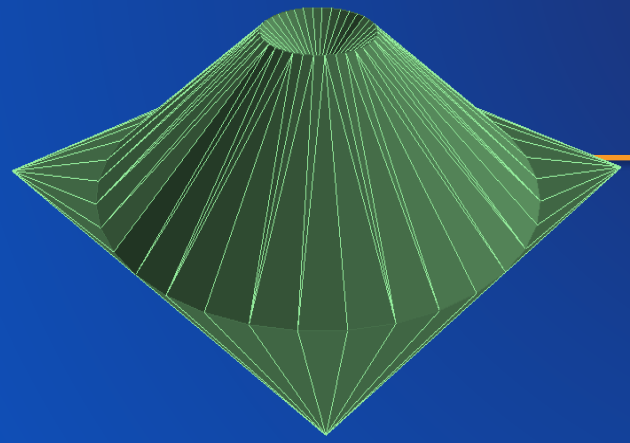
- **Temperature**
- **Gravitational fields**
- **Wind speeds**
- **Chemical concentrations**
- **Many diverse applications…**

Surface Data Models



Raster Surface

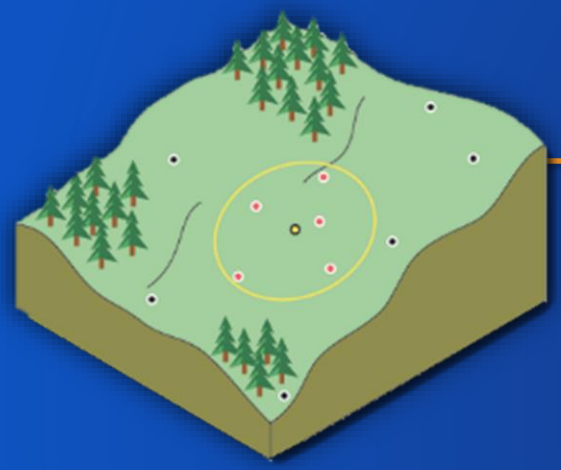
- Made by interpolation, generalize source measurements to cell size
- Fast to process, support robust math operations



TIN Based Surfaces

- Created by triangulation, maintain source measurements
- Support robust surface definitions & data

Distance Based Interpolators

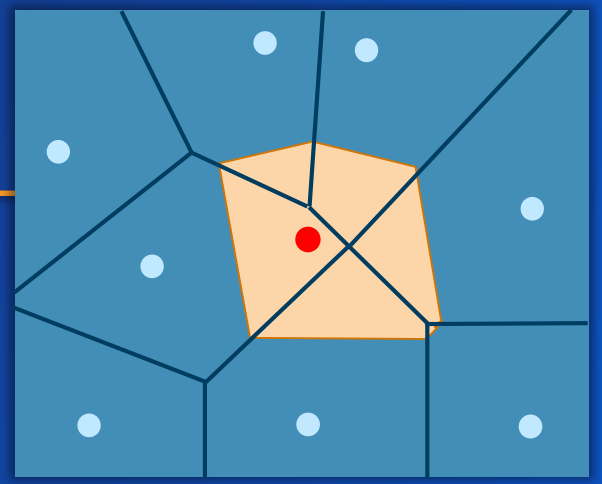


Inverse Distance Weighted (IDW)

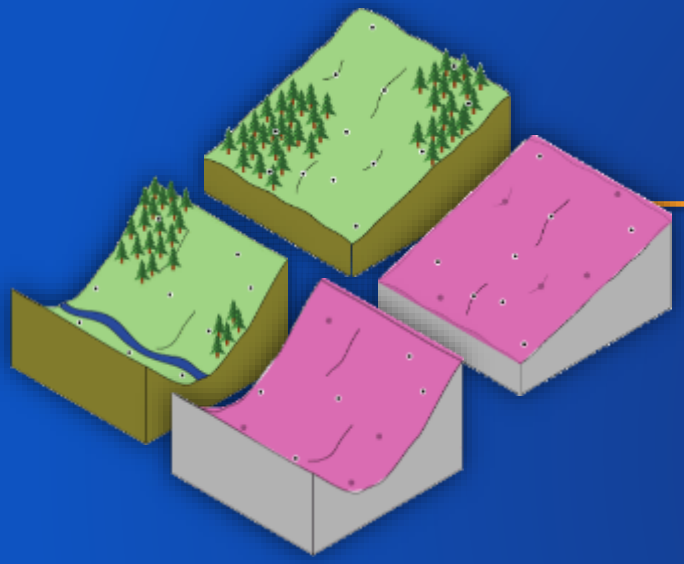
Consider using with evenly distributed source measurements that capture local surface variation.

Natural Neighbor

A better version of IDW, but takes longer to process due to its “smarter” method of applying weights. Consider using if you do not want your surface to exceed the min/max values in the sample measurements.



Trend Interpolators

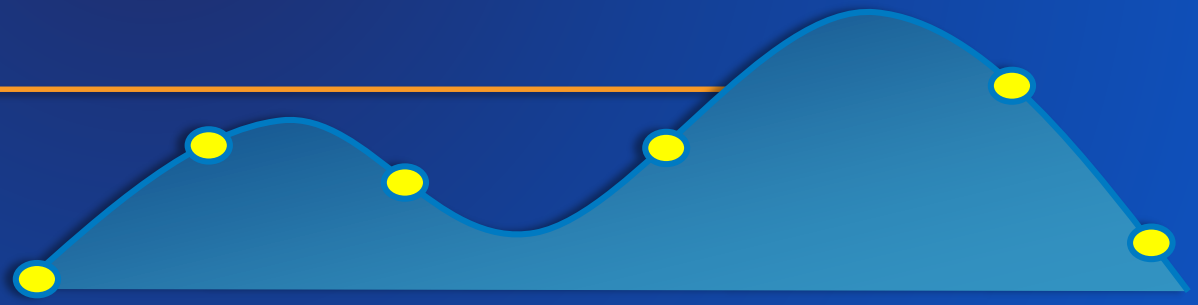


Trend

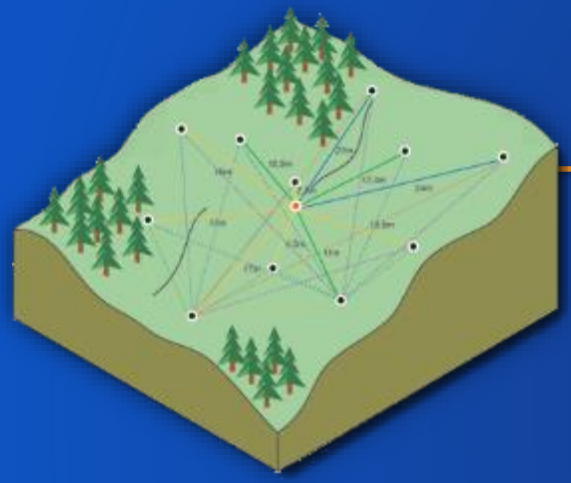
Useful for data with gradual variation (e.g. wind speed, temperature)

Spline

Predicts peaks and valleys that are not captured in the sample measurements

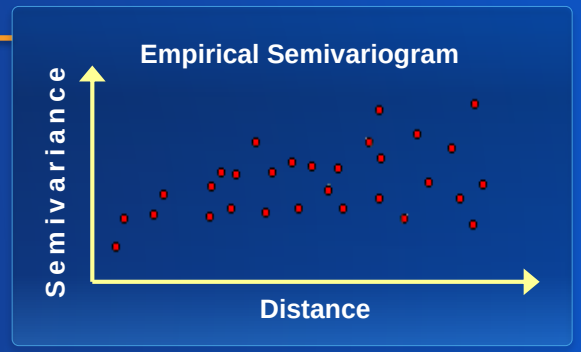


Geostatistical & Geomorphological Interpolation



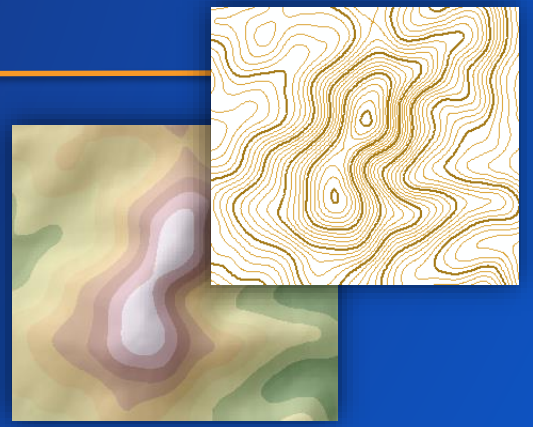
Kriging

Consider using with evenly distributed source measurements that capture local surface variation.



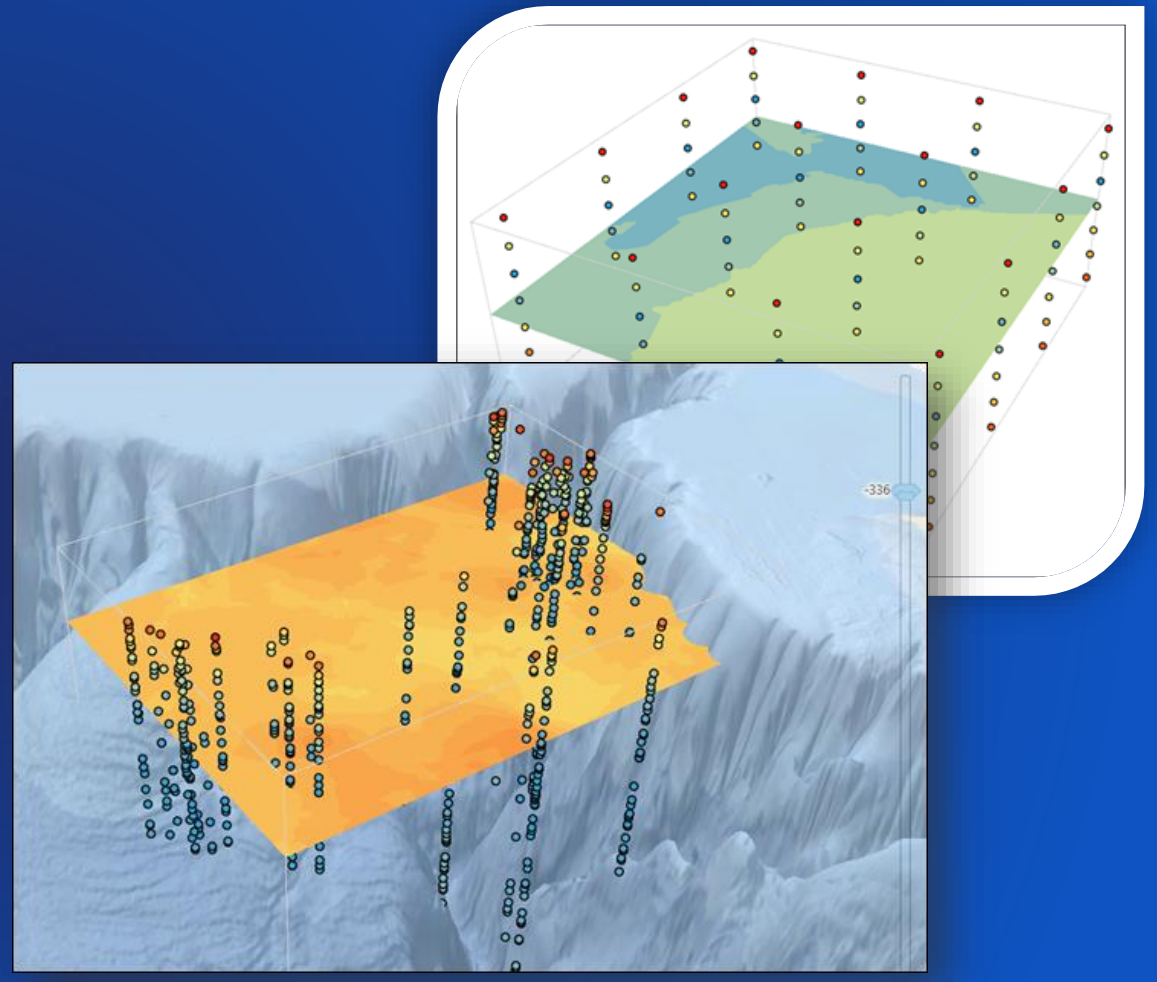
Topo To Raster

Creates hydrologically correct surface that eliminates local sinks, designed to work well with contour lines



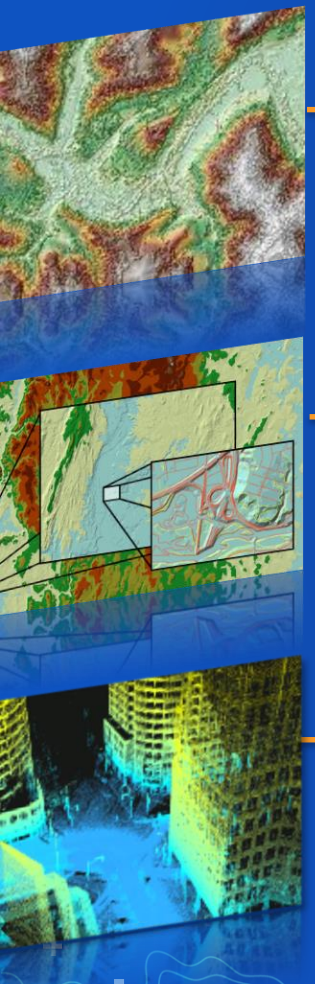
Empirical Bayesian Kriging 3D

- Predict subsurface geological properties
- Preview an iso-surface at any elevation
- Requires minimal interactive modeling
- Provides accurate results for moderately non-stationary data
- Dynamically view or export contours and raster dataset slices at any elevation
- Export regularly spaced prediction points



Using Living Atlas Data & ArcGIS Pro for 3D Interpolation, Thursday 2:30, Room 30C
Kriging: An Introduction to Concepts and Applications, Thursday 4:00, Room 15B

Triangulated Irregular Network (TIN) Surfaces



TIN

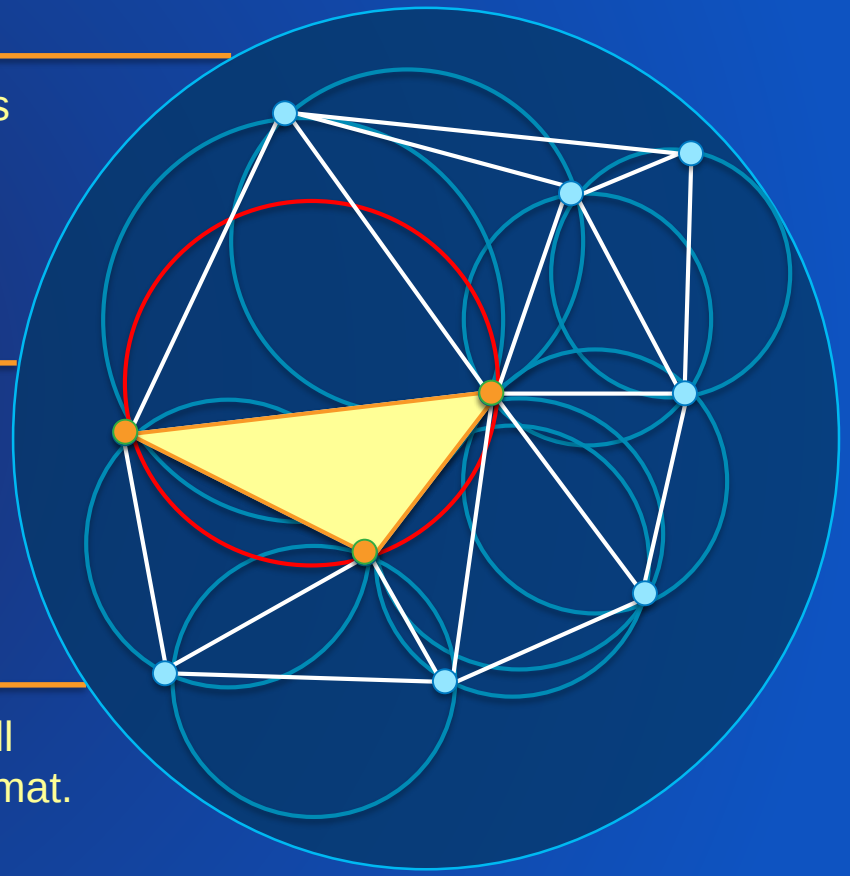
Well-suited for engineering applications and analysis of study areas that are not exceedingly large, provides interactive editing options.

Terrain

Multi-resolution, scalable, offers robust support for handling large amounts of data.

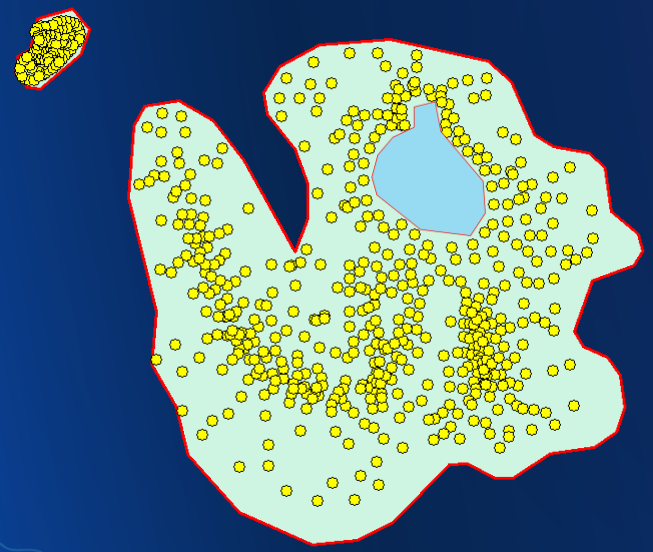
LAS Dataset

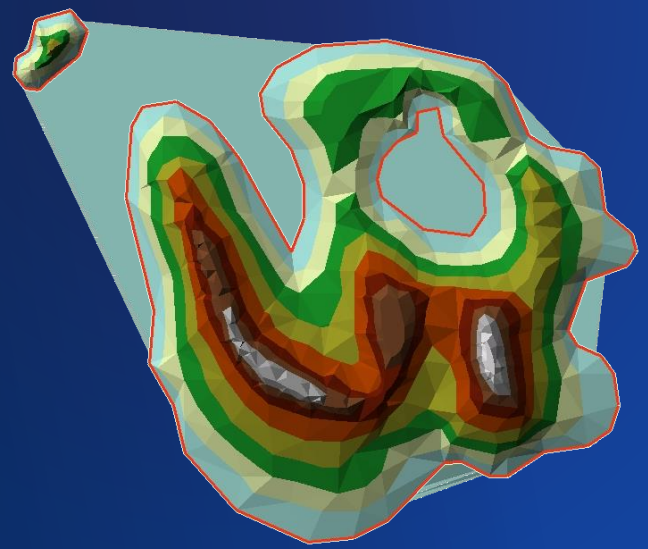
Rapidly visualize, filter, perform QA/QC and analyze lidar data. Well suited for aerial collections, supports compressed lidar in ZLAS format.



Surface Feature Types

- Mass points: Measurements used for triangulation
- Erase polygon: Interior areas of no data
- Replace polygon: Assigns a constant z value
- Clip polygon: Defines the interpolation zone

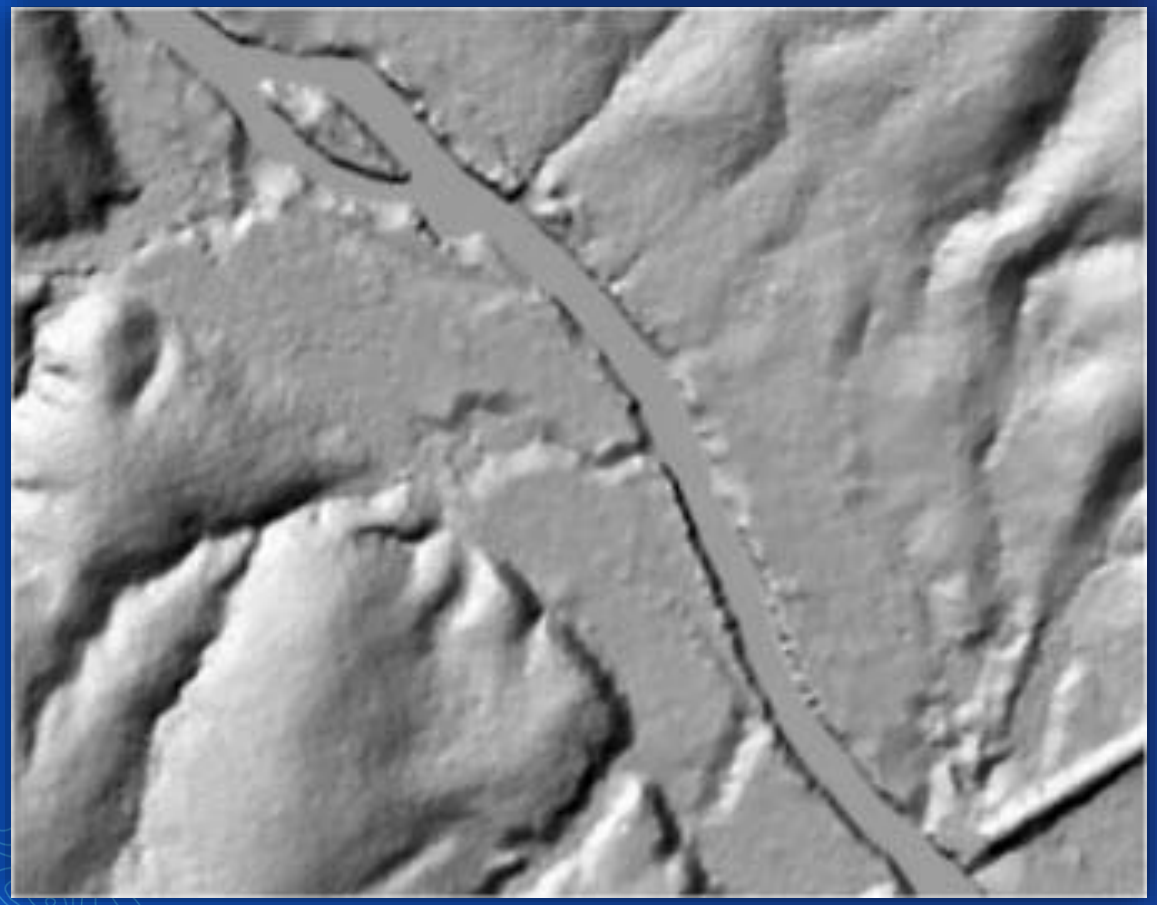


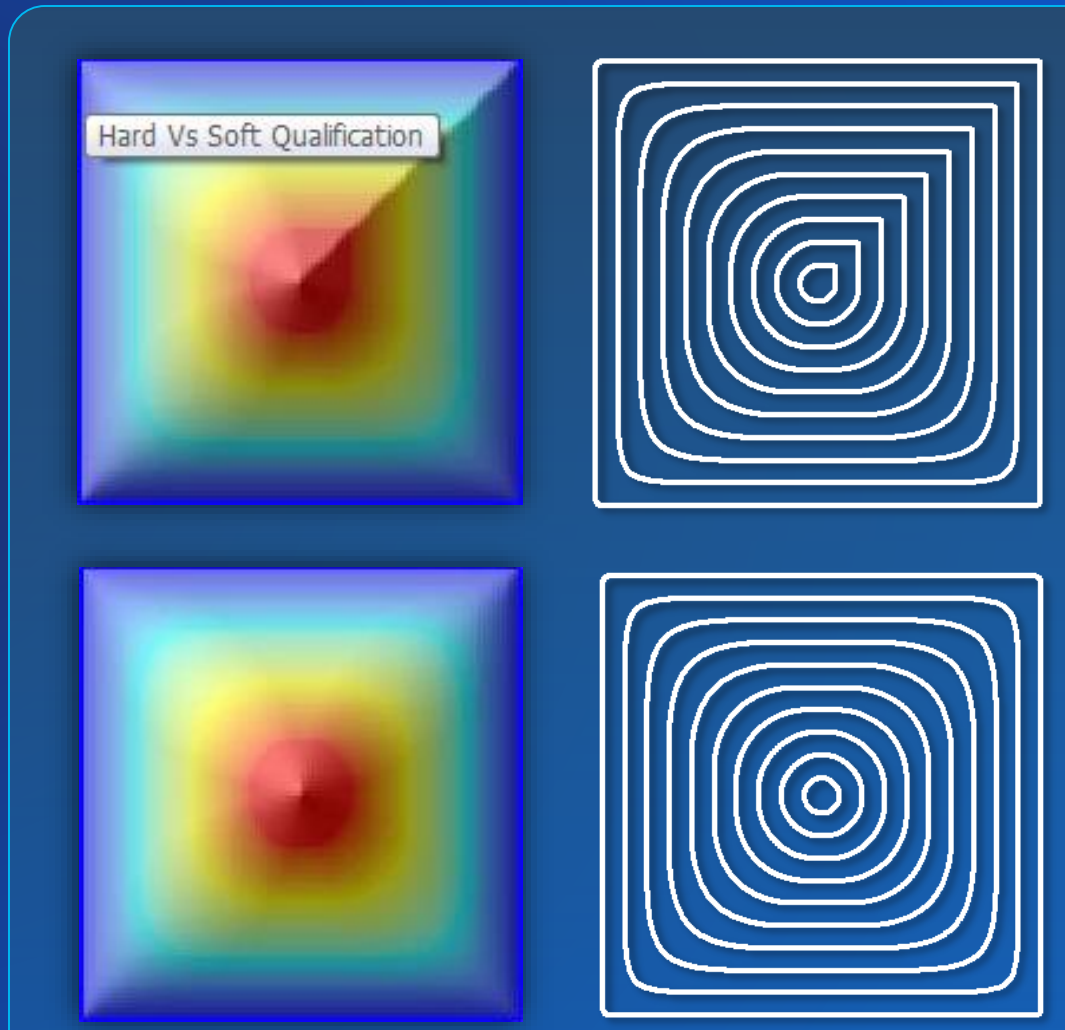


Also supports:

- Break lines
- Tag values

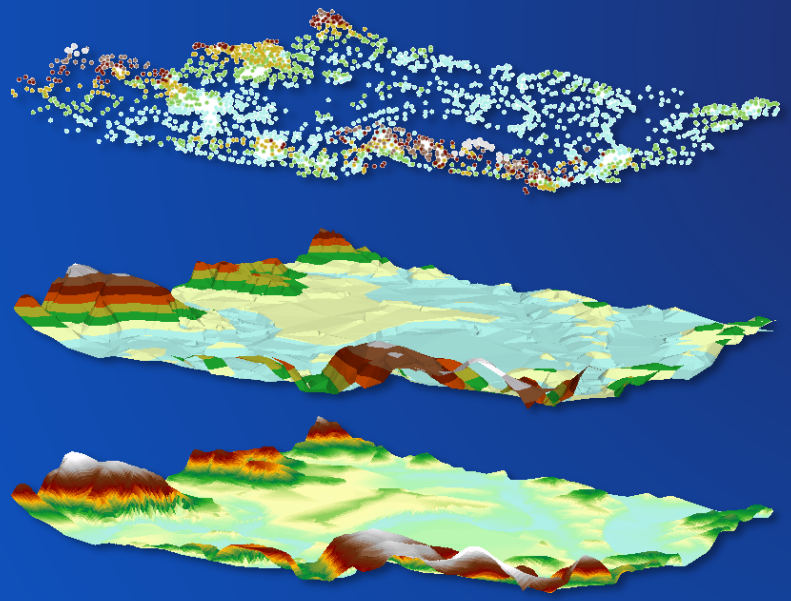
Hard & Soft Edges

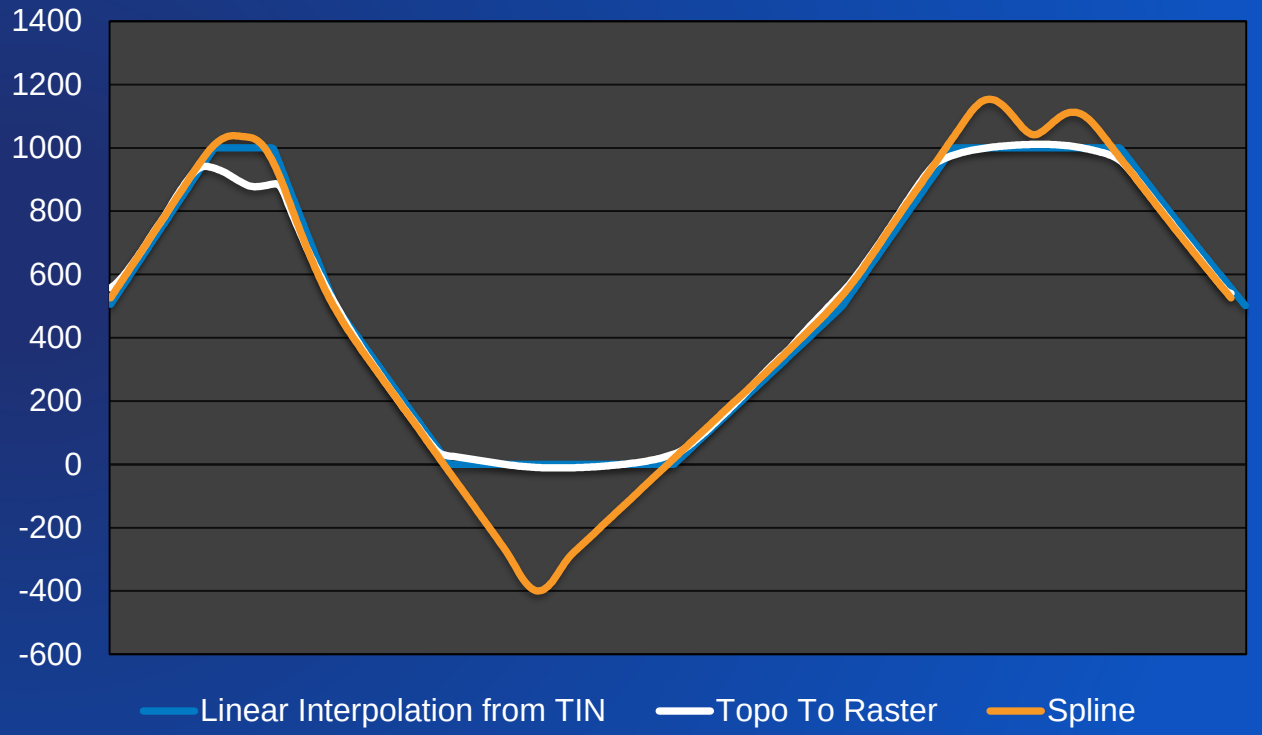




Choosing the Right Surface

- What is the nature of data being modeled?
- How is the data distributed?
- How will the data be used?

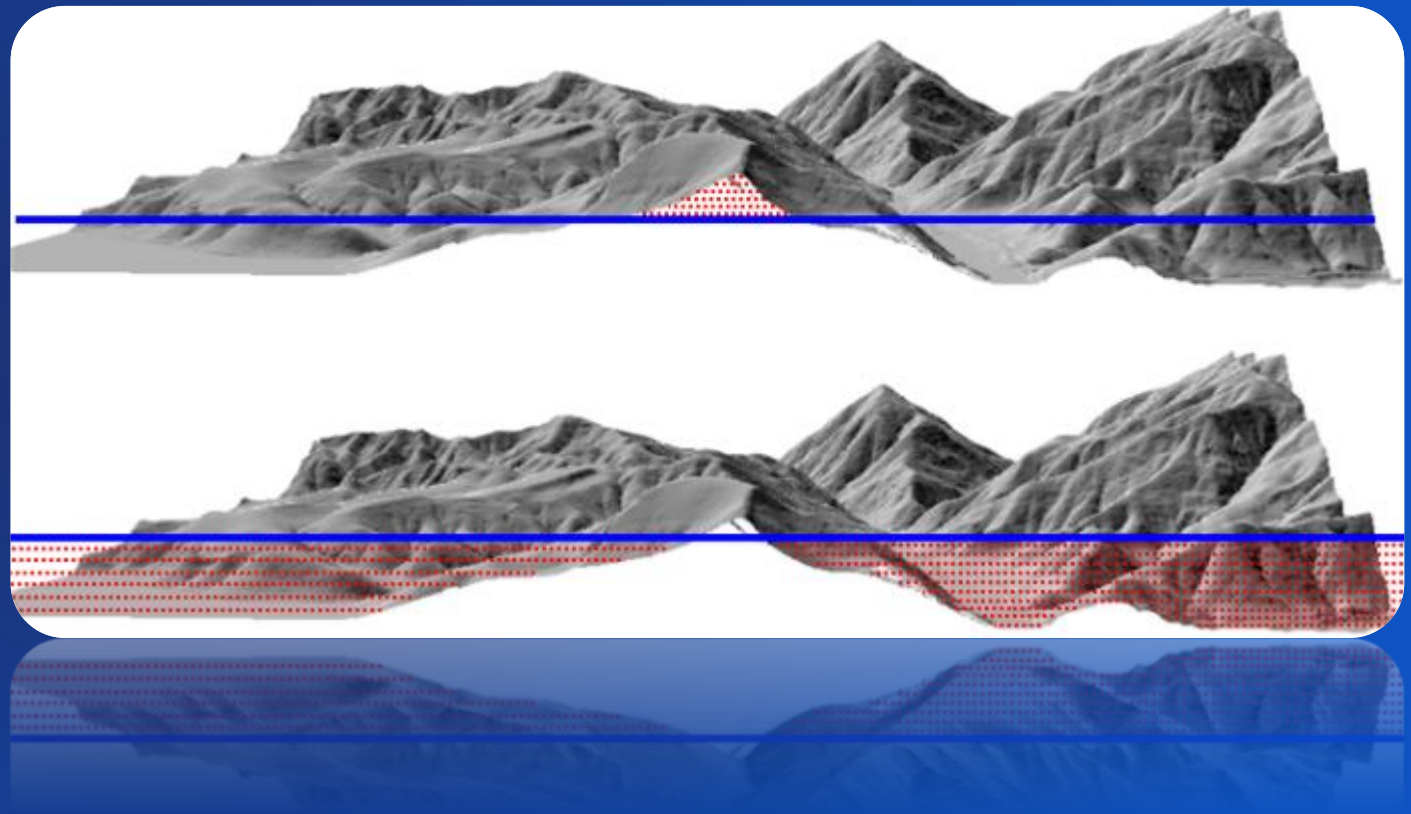




Overview of 3D Analysis

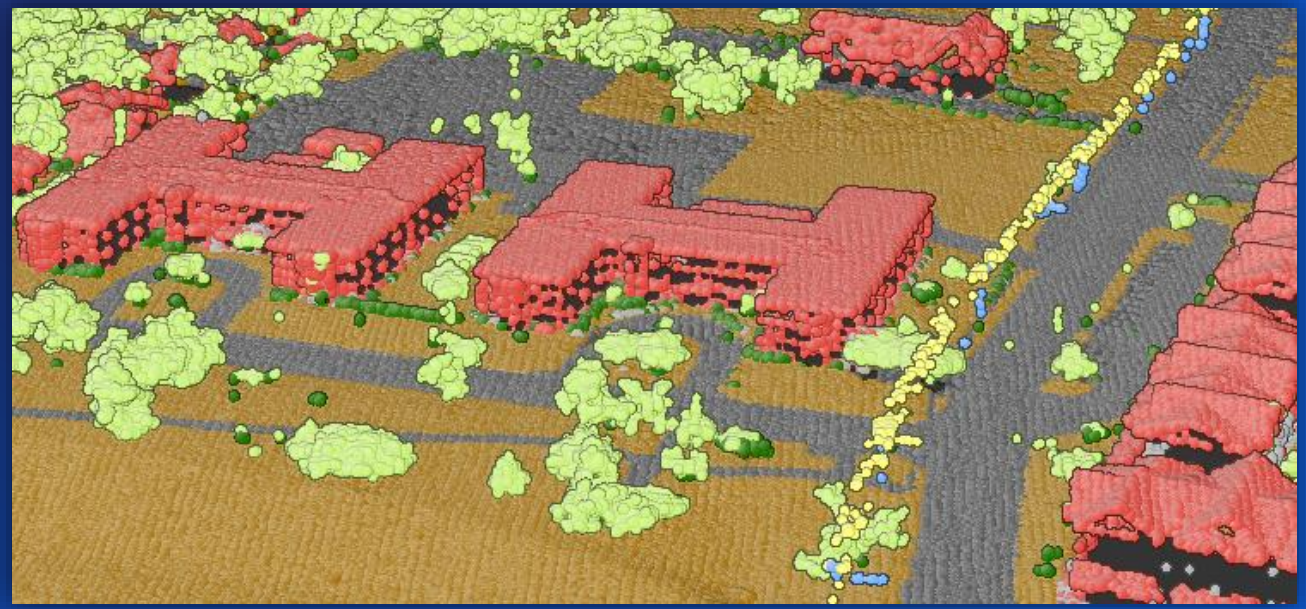
Surface Analysis

- Change detection
- Calculate area & volume
- Proximity analysis
- Robust mathematical operations
- Surface derivatives
  - Slope
  - Aspect
  - Curvature
  - Contour Lines



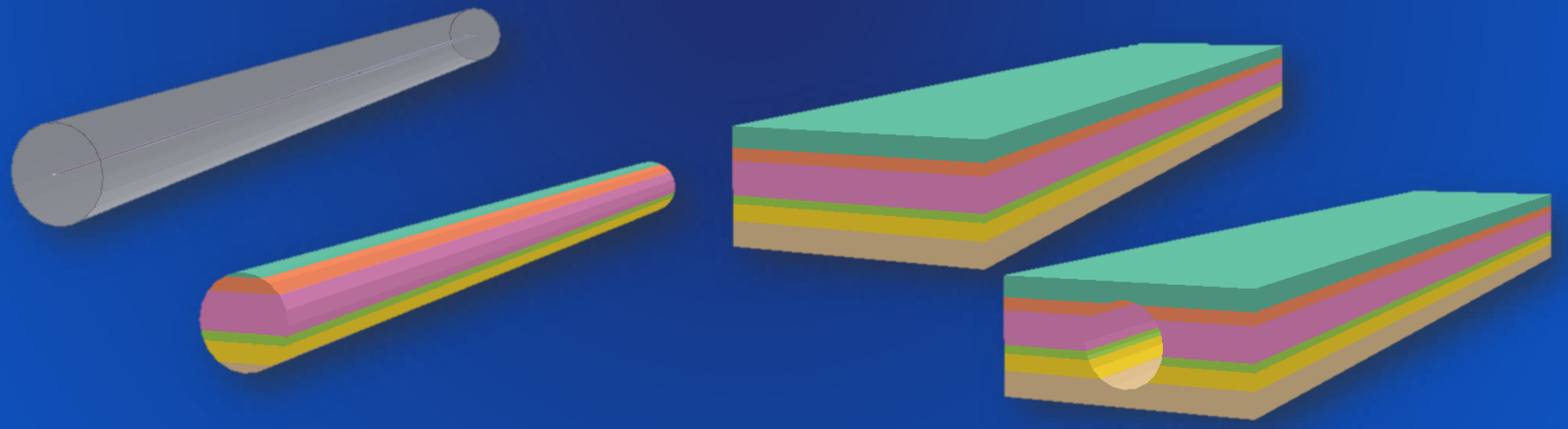
LAS Analysis

- Automated classification support:
  - Ground
  - Building
  - Noise
  - Overlap scans
  - Height above ground
  - Interactive editing
- Proximity analysis
- Point statistics
- Surface derivatives



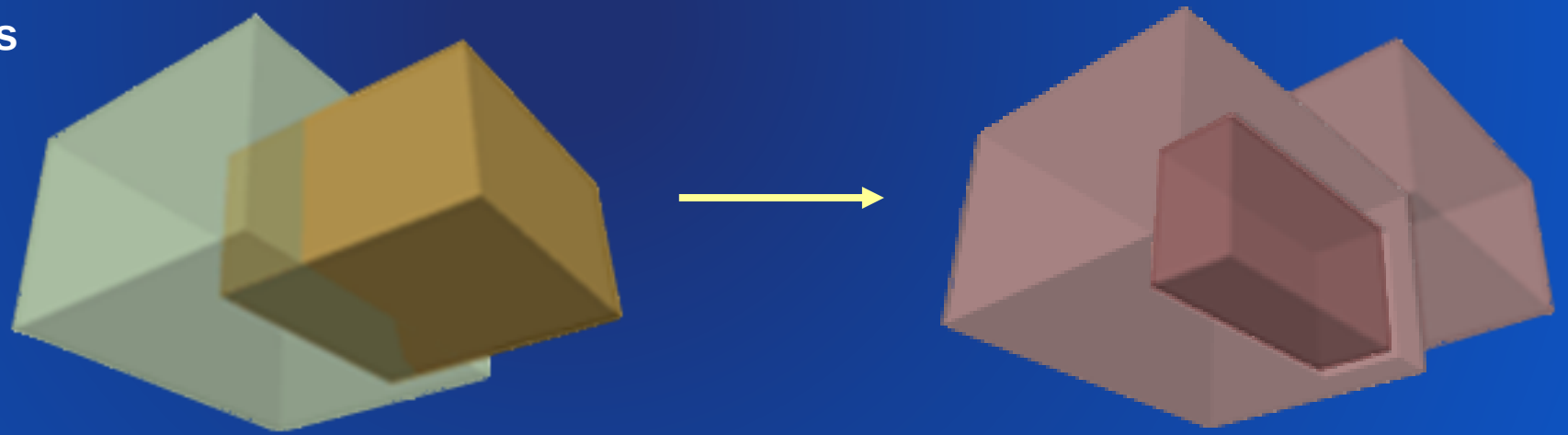
Proximity Analysis

- Create 3D buffers
- Identify closest objects
- Find intersection of 3D lines with surfaces & multipatch shapes
- Construct the minimum bounding volume encompassing a cluster of points



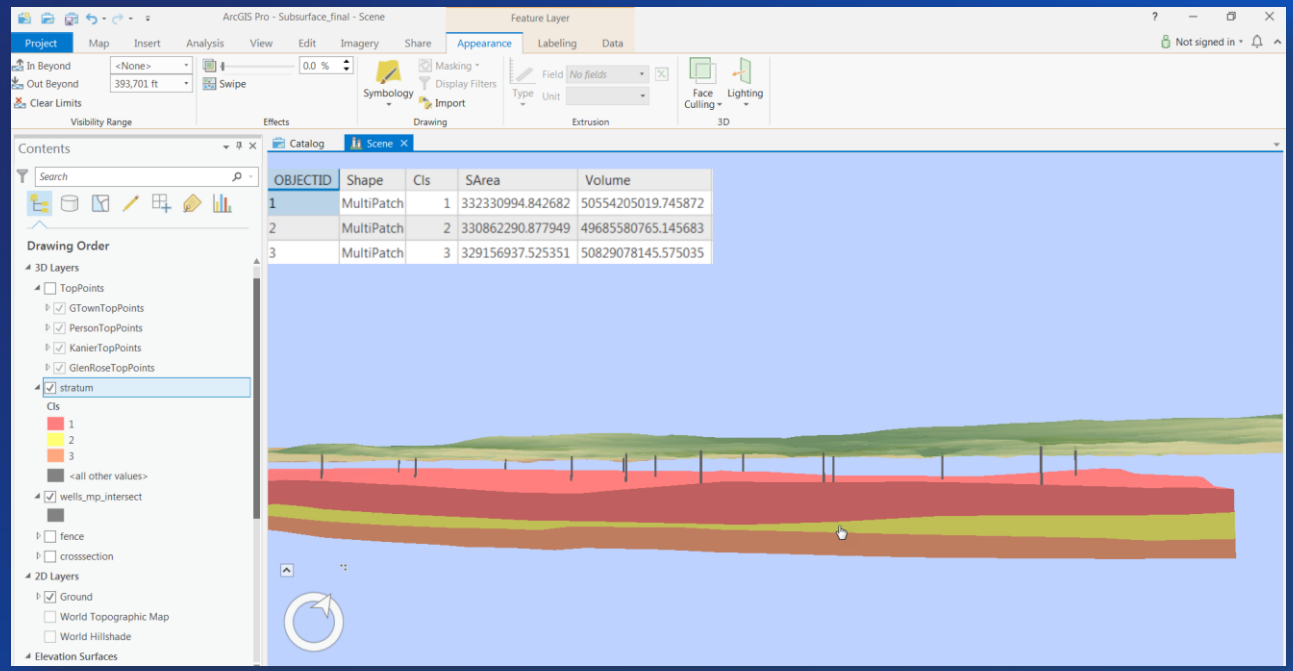
Volumetric Overlay Analysis

- Identify features that are inside volumetric enclosures
- Perform geometric operations:
  - Difference between volumes
  - Overlap of volumes
  - Union of volumes



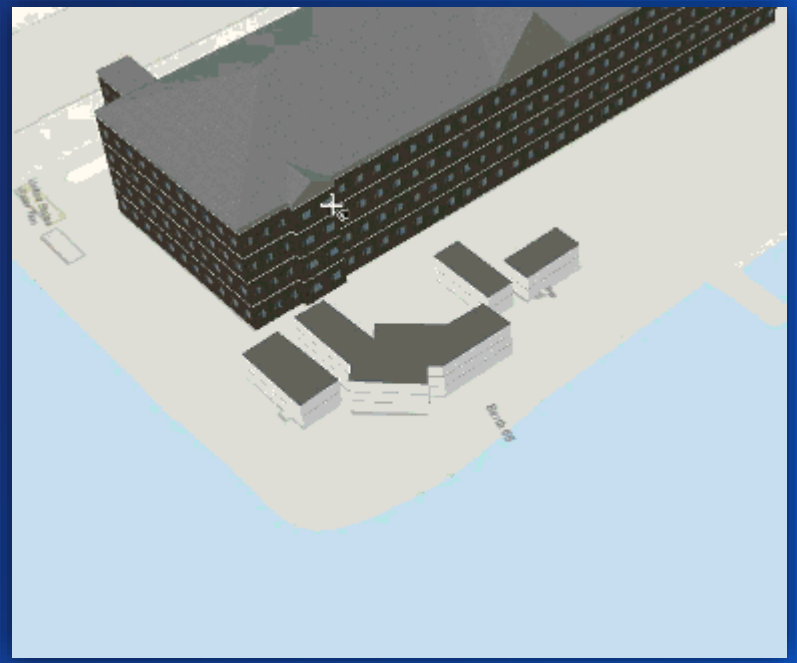
Subsurface GIS

- Construct 3D models
  - Interpolate surfaces
  - Construct fence diagrams & volumetric shells of geologic strata
  - Visualize infrastructure assets
- Analyze spatial properties
  - Compute volume & area
  - Find intersection of wells, tunnels, & boreholes with geologic strata
- Communicate results
  - Create charts & reports
  - Share on multiple platforms



Viewshed

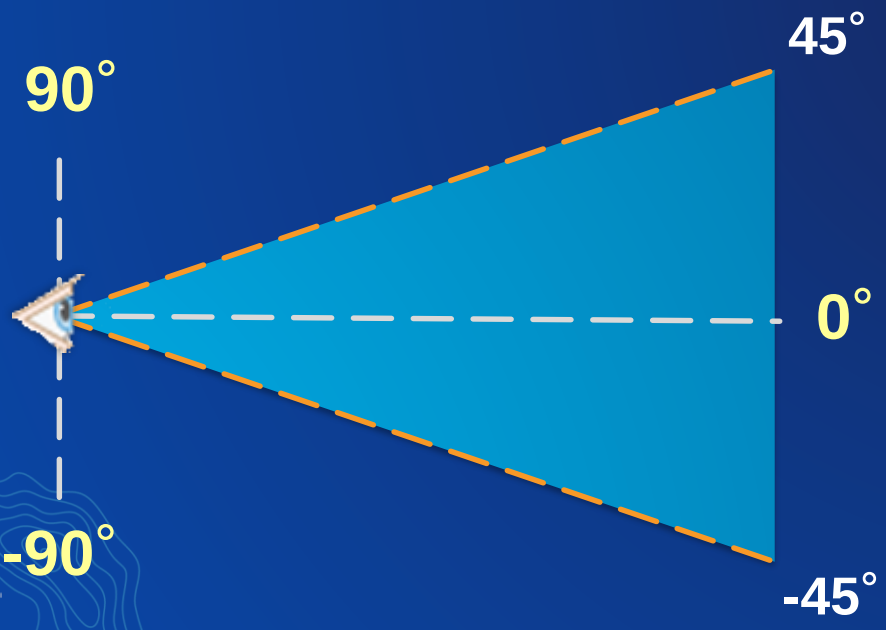
- Identifies what can be seen from an observer over a vast tract of space
- Automated viewshed supports target offset
- Interactive viewshed supports real-time changes to scene/observer

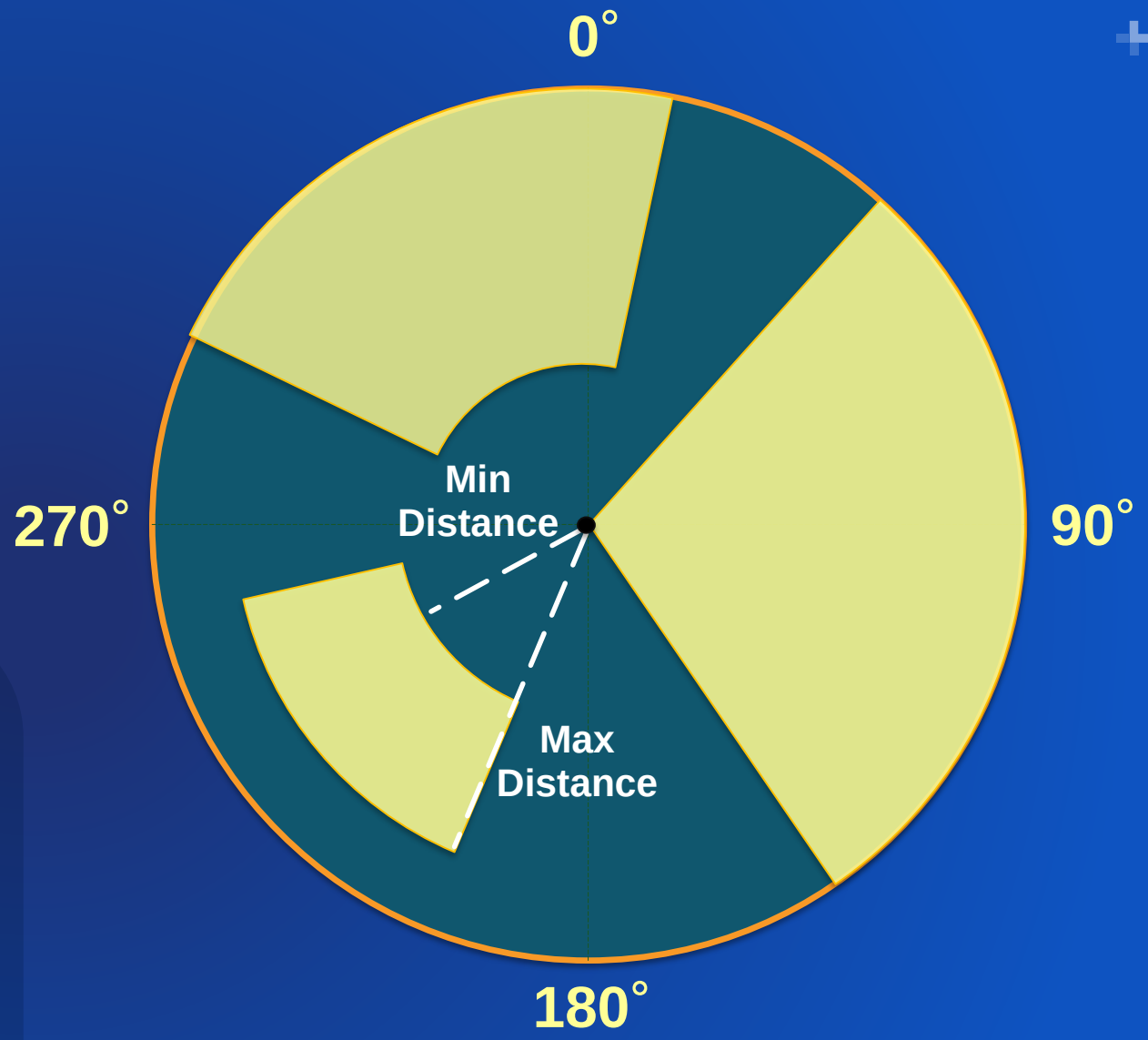


Controlling the Observer

Viewshed frustum defined by:

- Azimuth & vertical angle range
- Visible distance range
- Observer and target offset





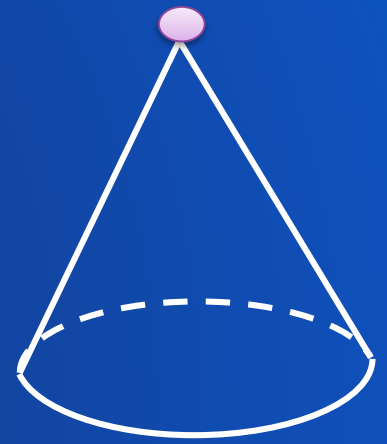
Examples of Observer Profiles

Spherical Observer

Azimuth ::: 0˚ to 360˚
Vertical Angle ::: -90˚ to 90˚
Distance ::: 0 to 100 meters

Conical Observer

Azimuth ::: 0˚ to 360˚
Vertical Angle ::: -60˚ to -90˚
Distance ::: 0 to 12 meters

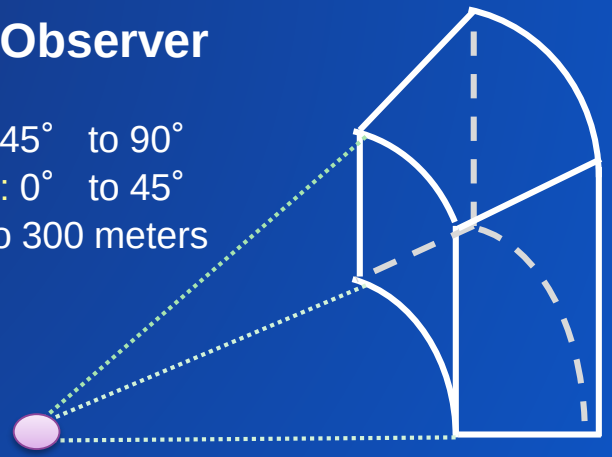


Hemispherical Observer

Azimuth ::: 0˚ to 360˚
Vertical Angle ::: 0˚ to 90˚
Distance ::: 45 to 100 meters

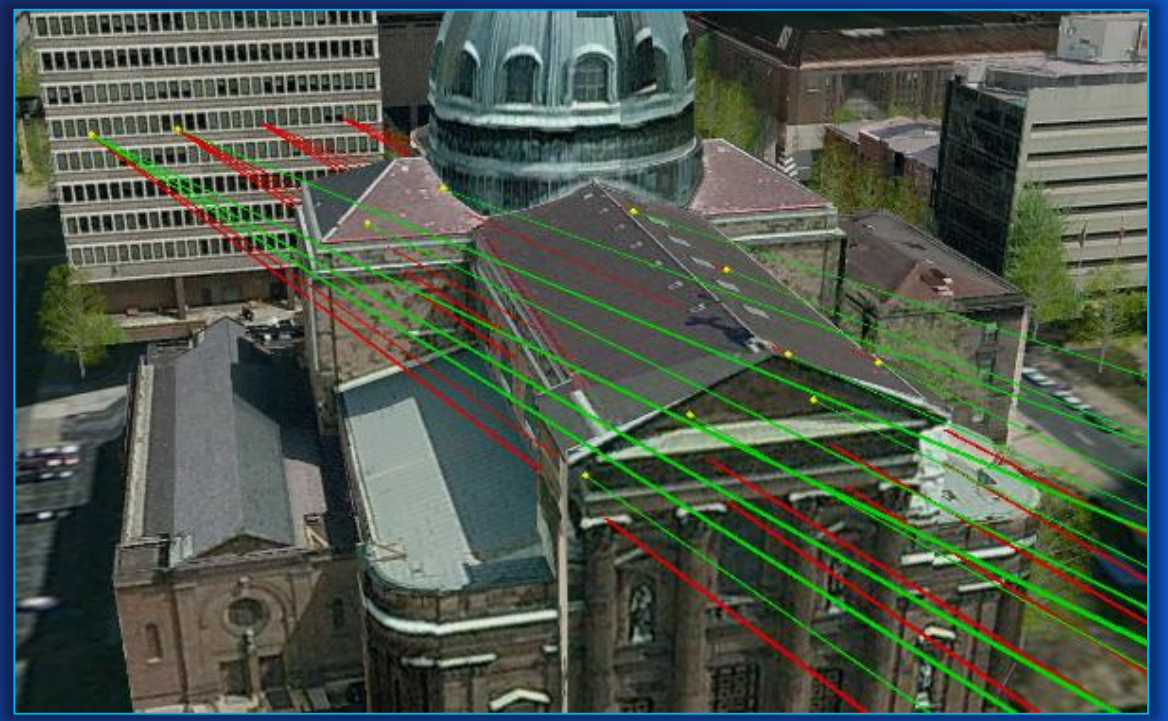
Distance Offset Observer

Azimuth ::: 45˚ to 90˚
Vertical Angle ::: 0˚ to 45˚
Distance ::: 250 to 300 meters



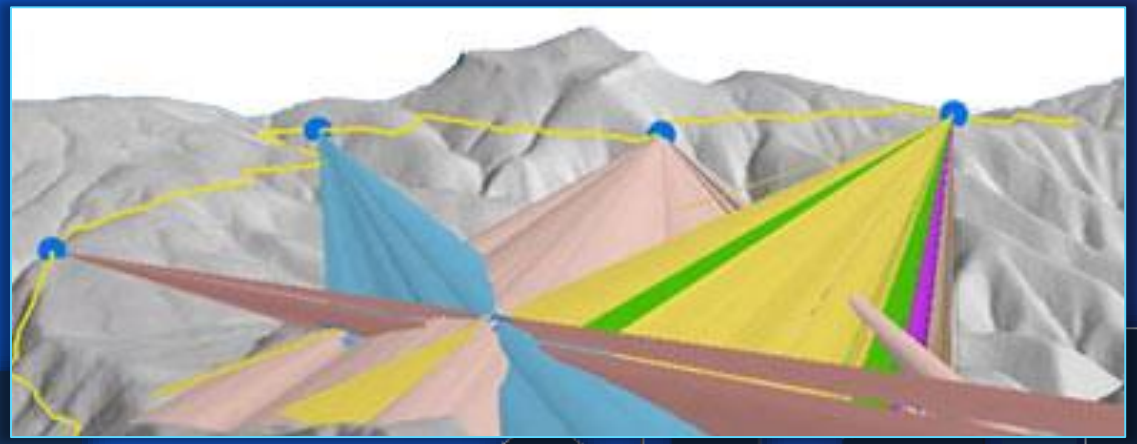
Sightline Analysis

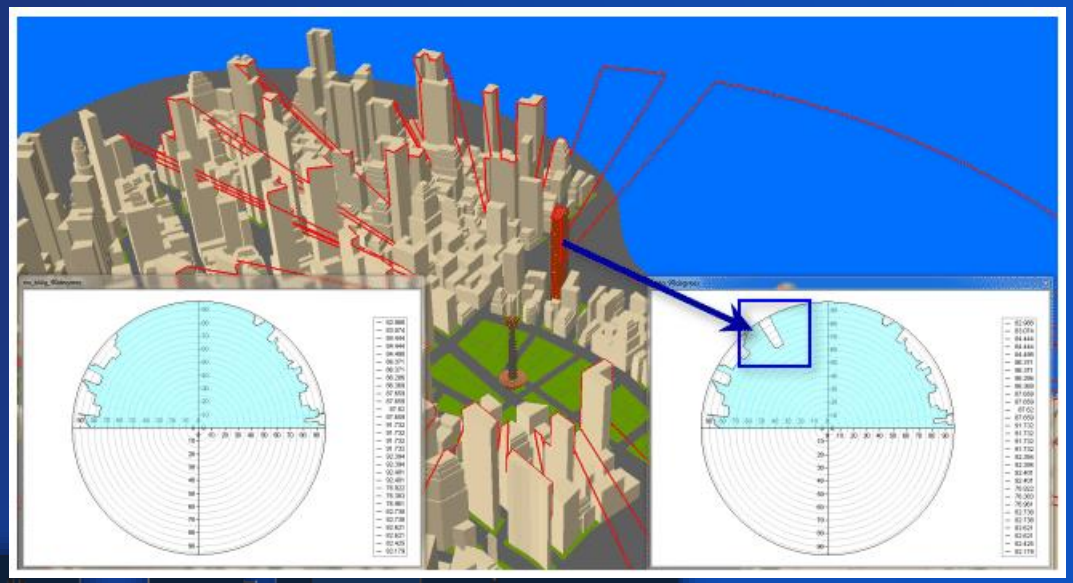
- Visibility along 2-vertex line in 3D space
- Identify obstruction point
- Interactively generate and manipulate a sightline for exploratory analysis



Skyline Analysis

- Segment the horizon by its contributing features
- Create closed volumes bounded by the skyline





Atmospheric Refraction

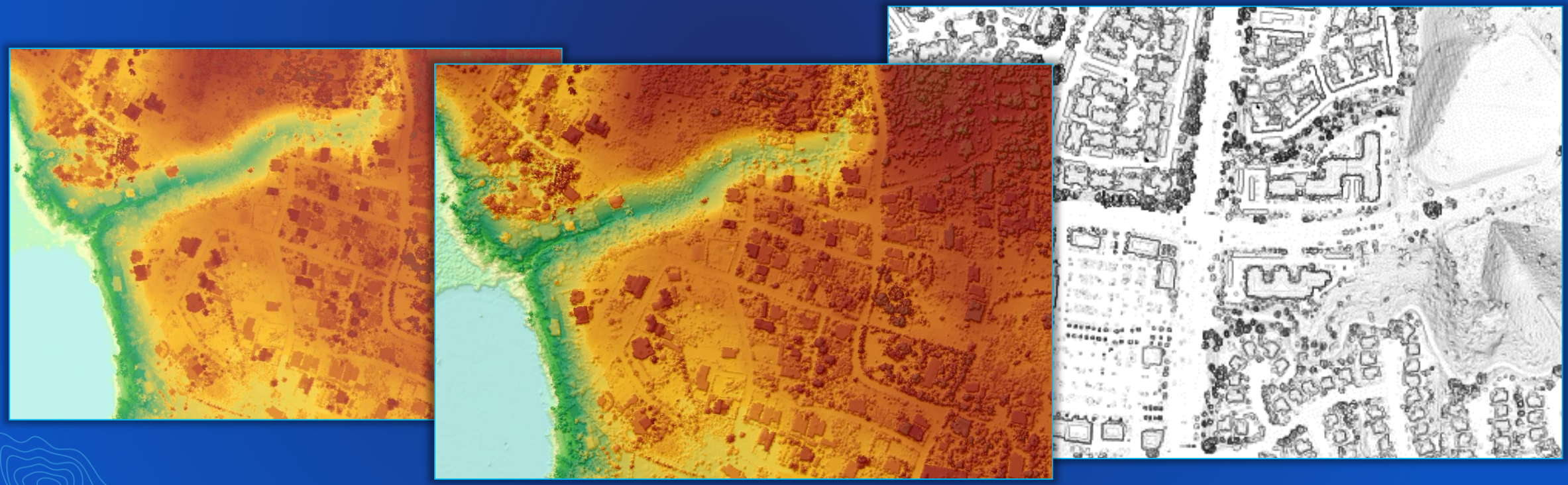
- Bending of light passing through the atmosphere
- Influenced by variations in air pressure, density, humidity, temperature & elevation
- Refraction coefficient supported in:
  - Line of Sight
  - Skyline
  - Viewshed
  - Solar Radiation

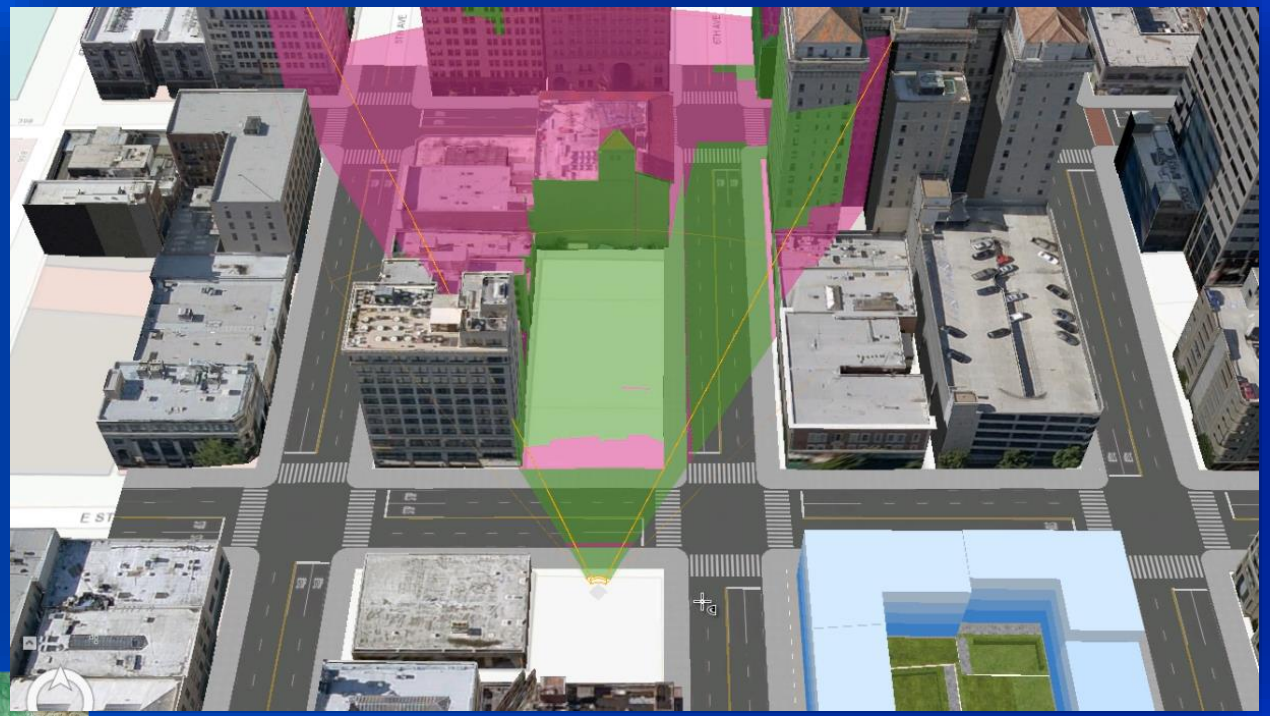
Sun Shadow Analysis

- **Create closed volumes modeling shadow cast from sunlight**
- **Determine shadow frequency on surface**
  - Right-to-light studies
  - Urban heat island estimation

Hillshade

- Accentuates sharp features by simulating impact of a localized illumination source
- Multi-directional hillshade provides a planimetric view





3D Analysis

Using Interactive & Automated Tools

Please Share Your Feedback in the App

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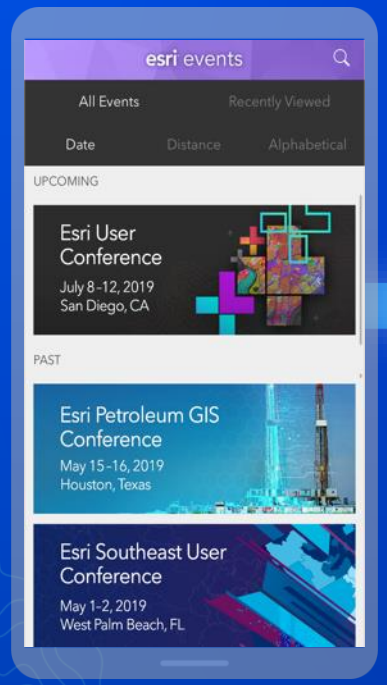
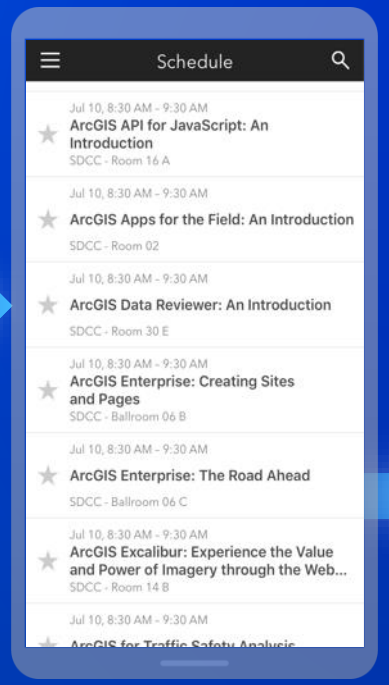
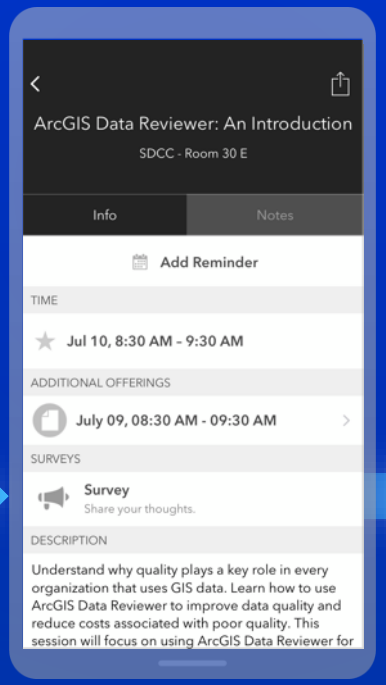


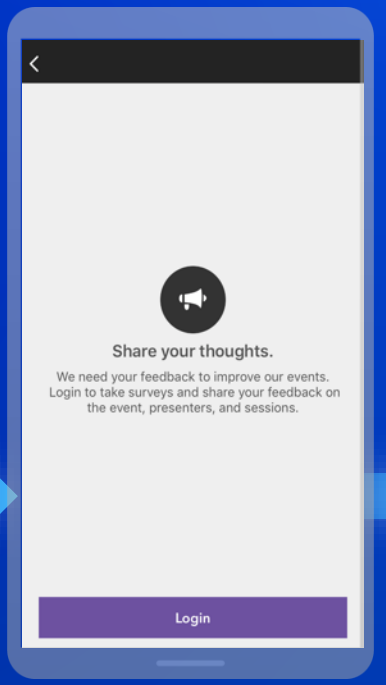
Select the session you attended



Scroll down to “Survey”



Log in to access the survey



Complete the survey and select “Submit”