Lidar and GIS: Applications and Examples

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Outline

- Data structures, tools, and workflows
- Assessing lidar point coverage and sample density
- Creating raster DEMs and DSMs
- Data area delineation
- Estimating forest canopy density and height
- Floodplain delineation
- Feature Extraction for 3D City Modeling

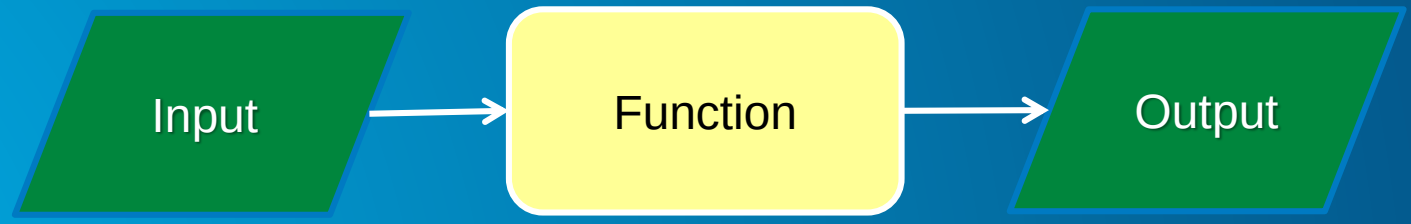
Big Picture

- Solutions for GIS end users
  - Not about lidar data production
- Operate on clean/classified lidar points
- Produce useful derivatives
- Perform analysis
- Handle large datasets
- Both file and database oriented solutions

Supporting Data structures and Tools

- **Vector features**
  - **points**
  - ***multipoints***
  - **lines**
  - **polygons**
- **Raster**
- **TIN**
- ***Terrain Dataset***

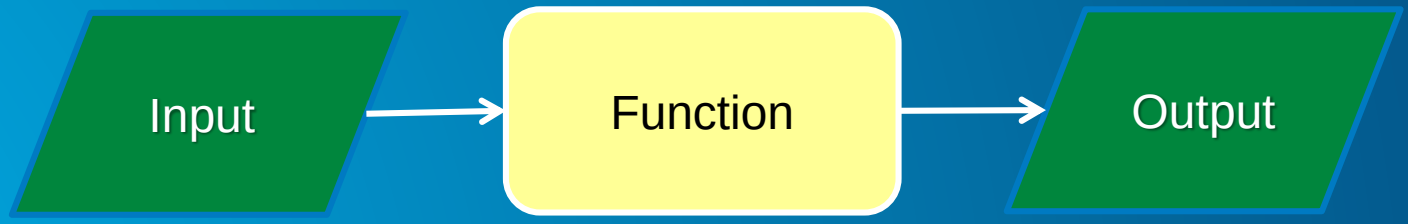
- **Point File Information**
- **LAS To Multipoint**
- **ASCII 3D To Feature Class**
- **Point To Raster**
- **Terrain To Raster**
- **Terrain To TIN**



Workflow

Supporting Data structures and Tools

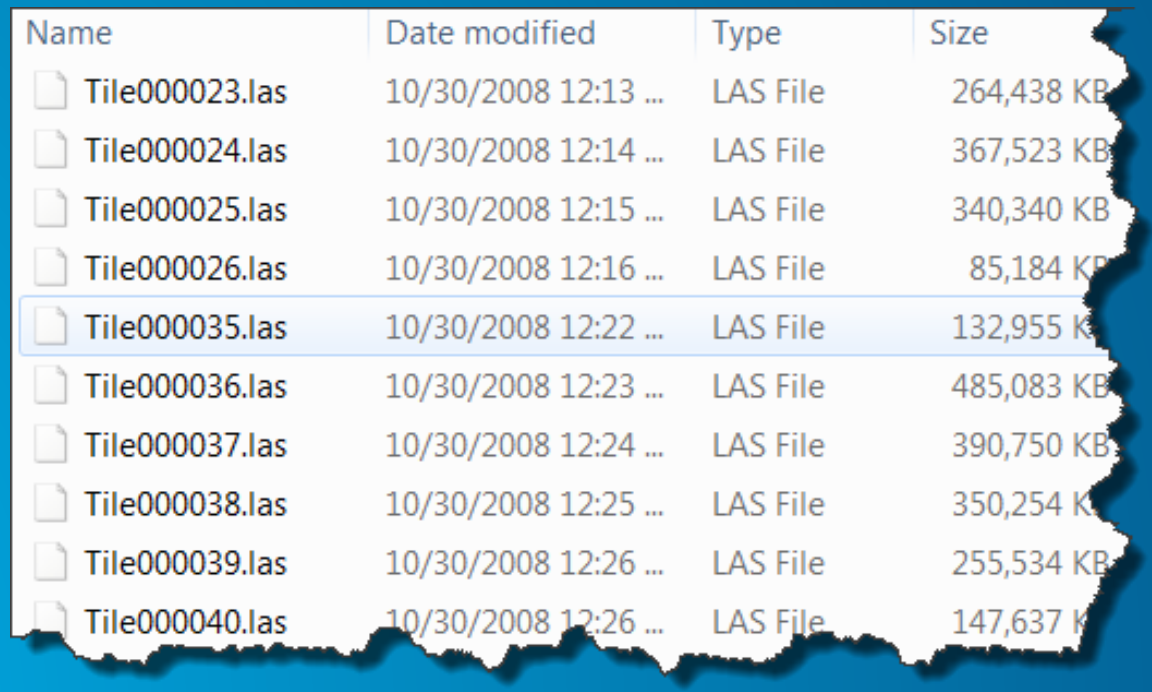
- LAS dataset
  - LAS Dataset Statistics
  - LAS Dataset To Raster
  - LAS Point Statistics As Raster
  - LAS Point Statistics By Area
  - LAS Dataset To TIN
  - Set LAS Class Codes Using Features
- LAS dataset…
  - Change LAS Class Codes
  - Classify LAS By Height
  - Classify LAS Ground
  - Extract LAS
  - Locate LAS Points By Proximity
- Mosaic dataset
  - Extensive collection of raster tools



Workflow

Lidar Point Coverage and Sample Density

- Basic QA/QC before loading data into geodatabase
- Verify xy and z extent
- Examine point spacing



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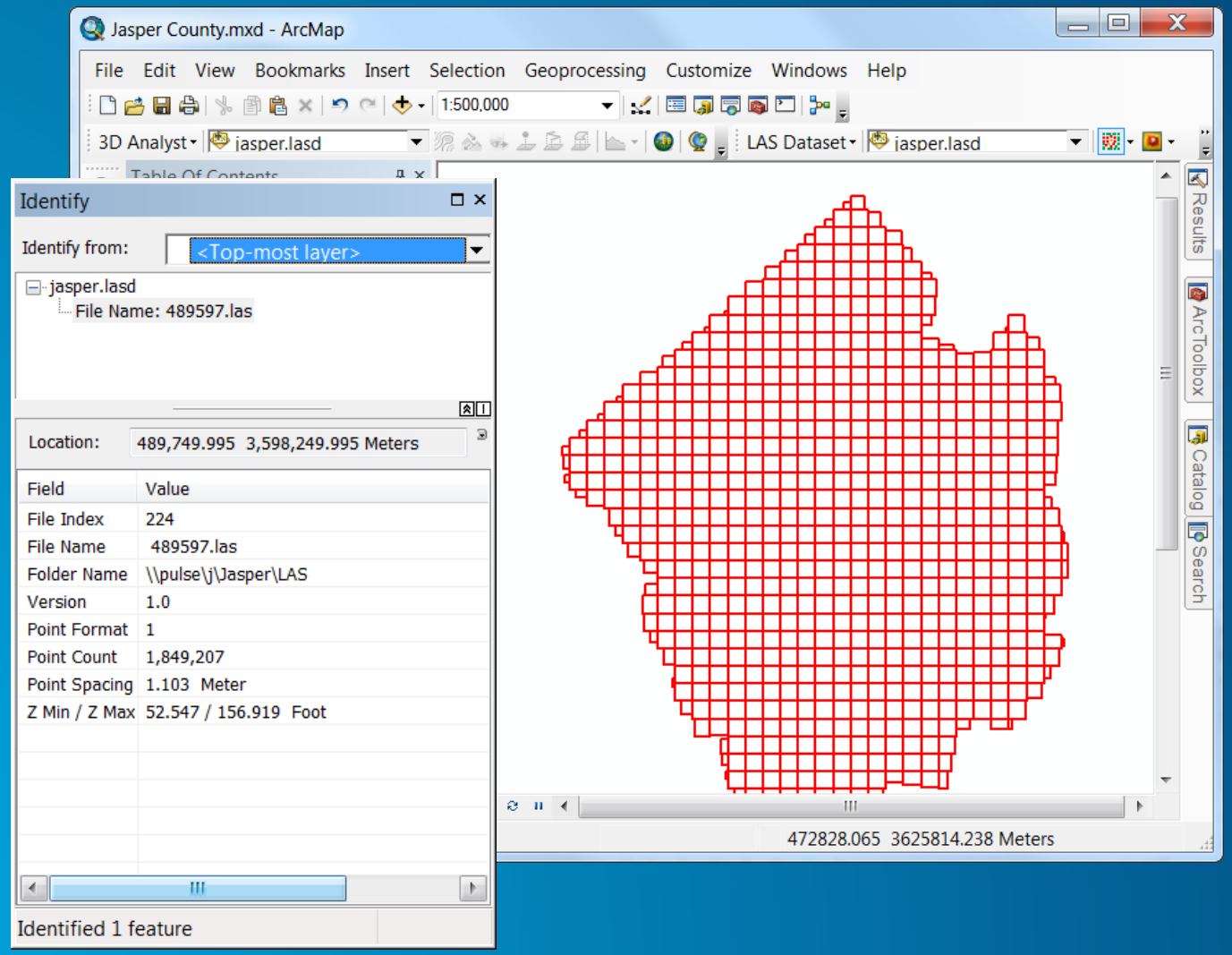
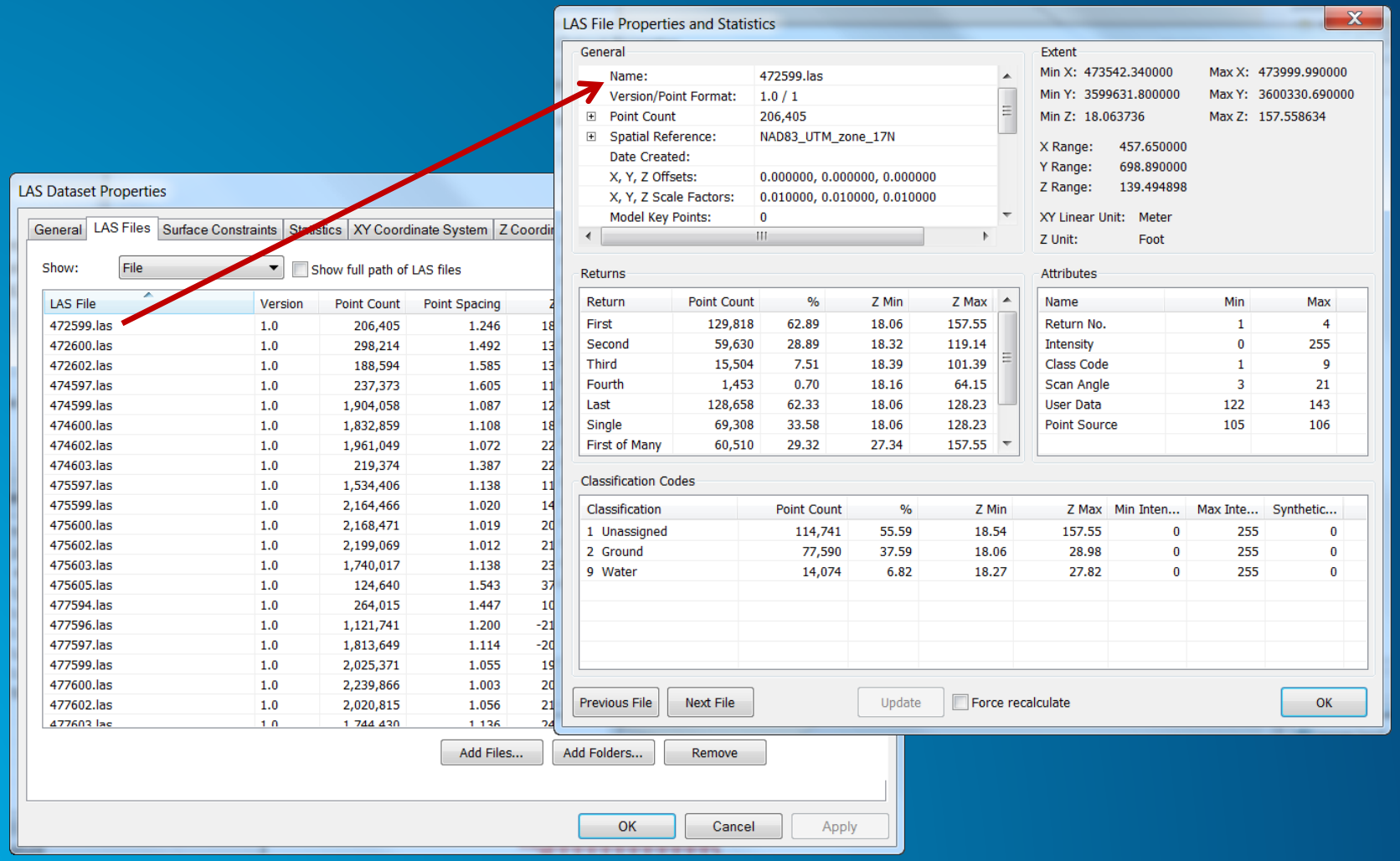
LAS Dataset Layer

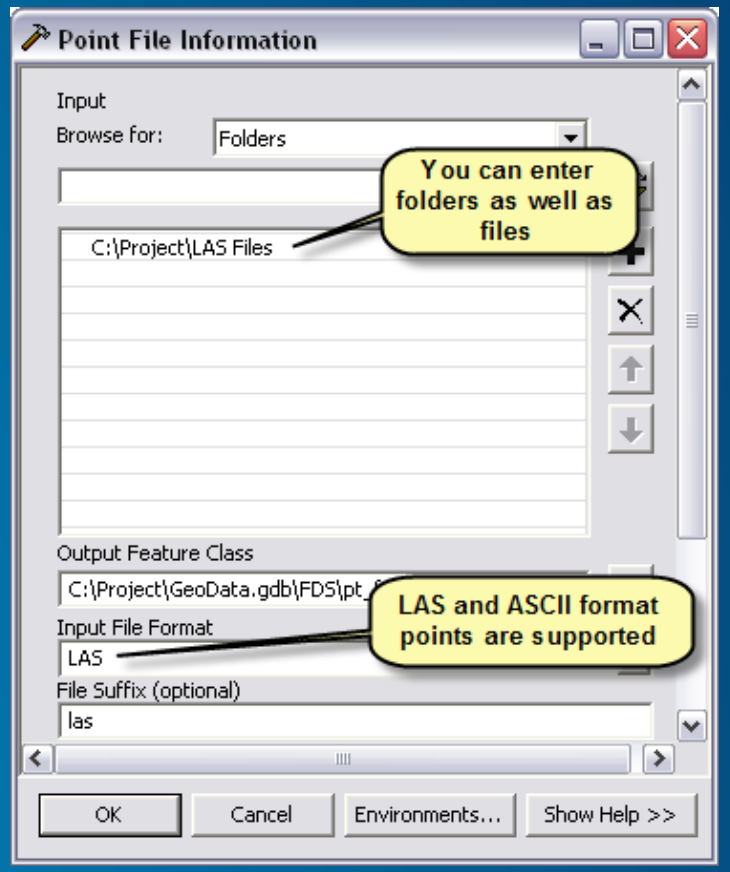


LAS Dataset Properties

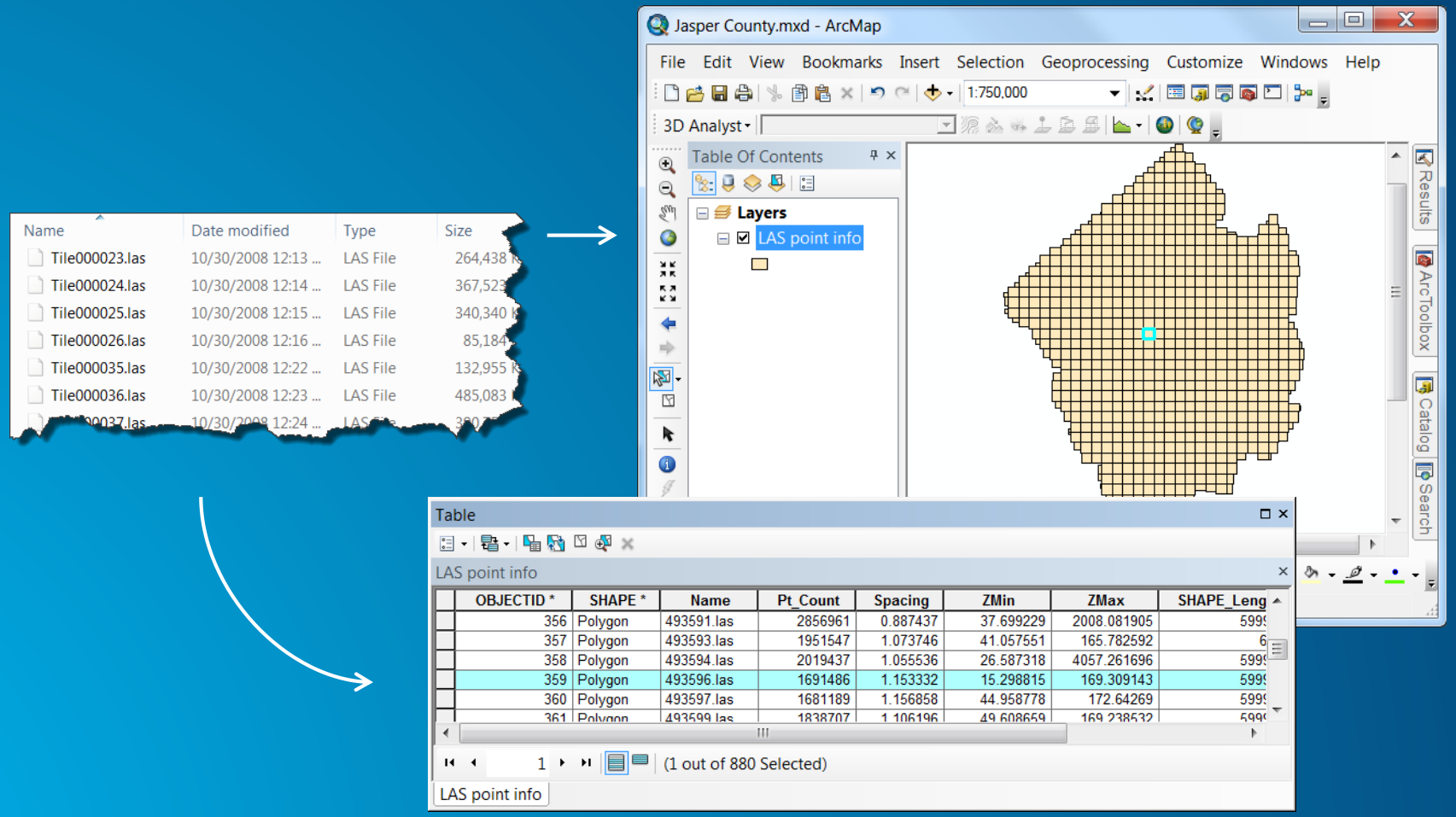


Point File Information Tool

- Inputs files (LAS and ASCII) and folders of files and outputs a polygon feature class.
- Each output record includes
  - Polygon of file's data extent
  - Source filename
  - Point count
  - Point spacing estimate
  - Z min
  - Z max

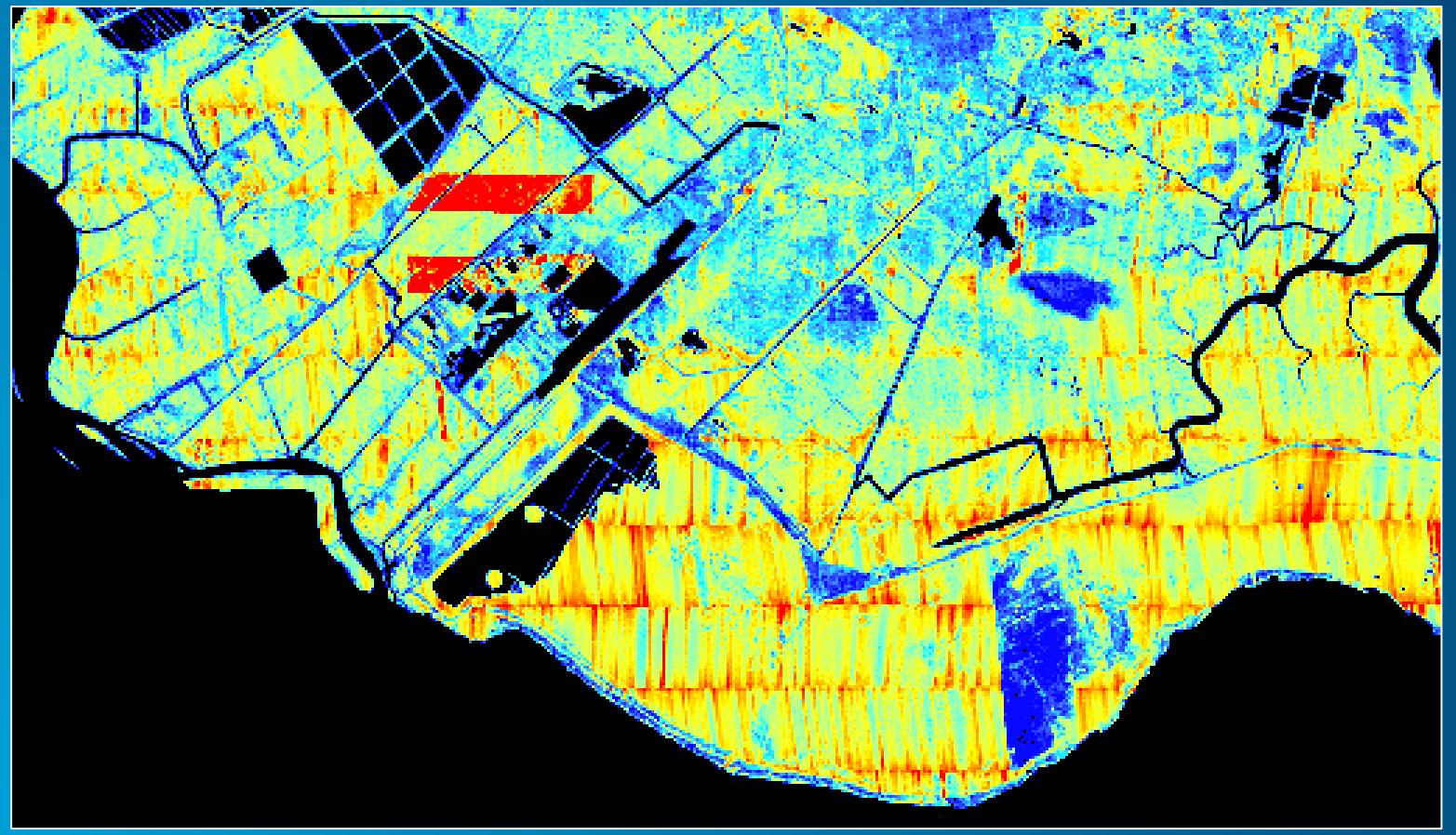


Point File Information Tool



LAS Point Statistics As Raster Tool

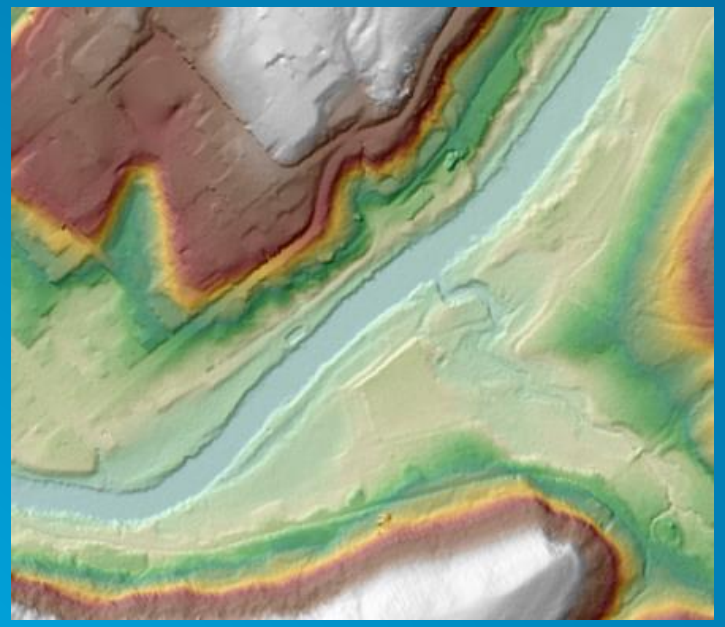
Pulse/sample density



Demo

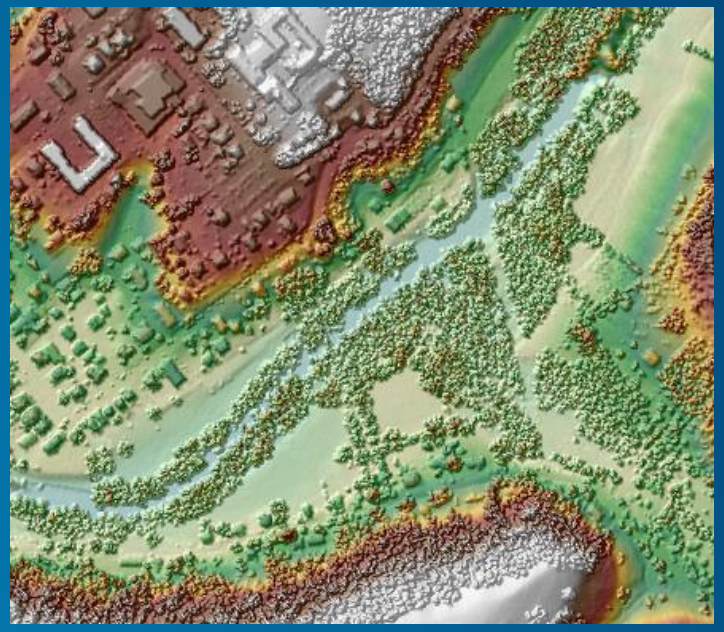
Creating Raster DEMs and DSMs

Digital Elevation Model



Bare earth surface made using only ground hits.

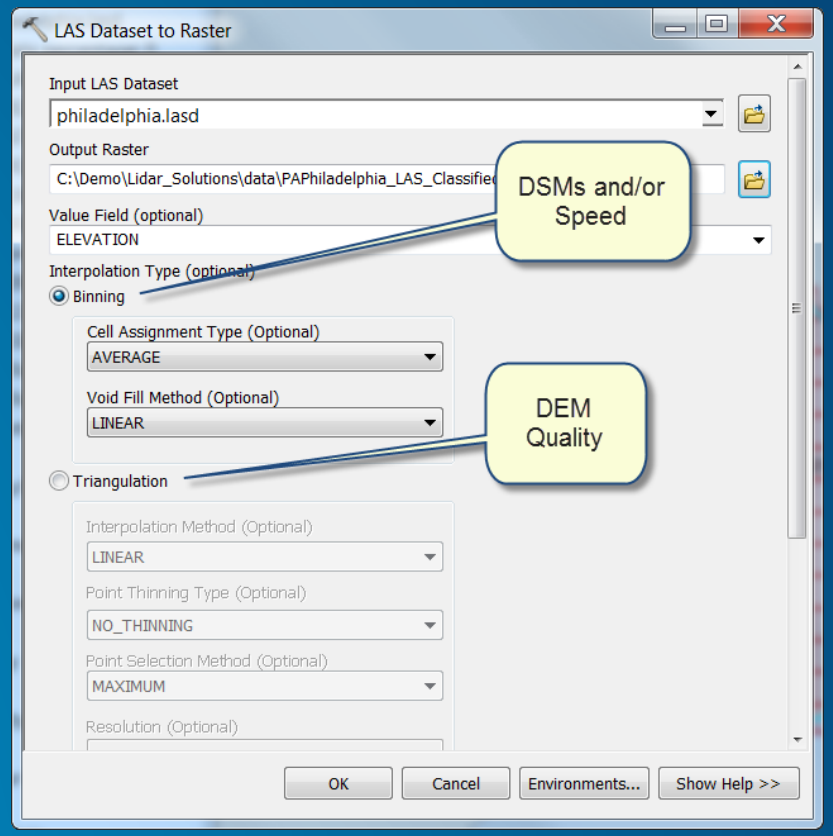
Digital Surface Model



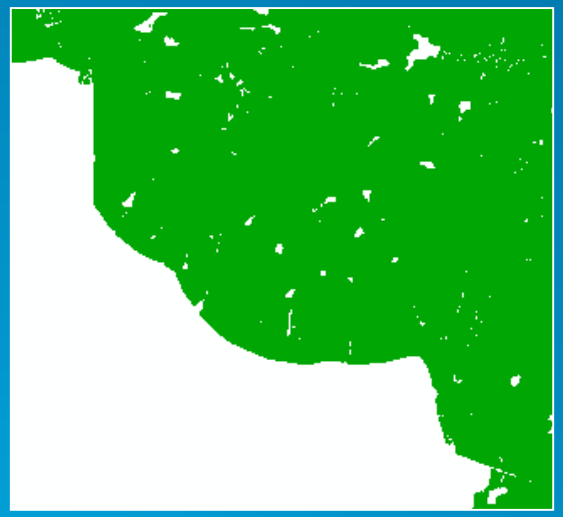
Includes ground, trees, and buildings made using first returns.

LAS Dataset To Raster

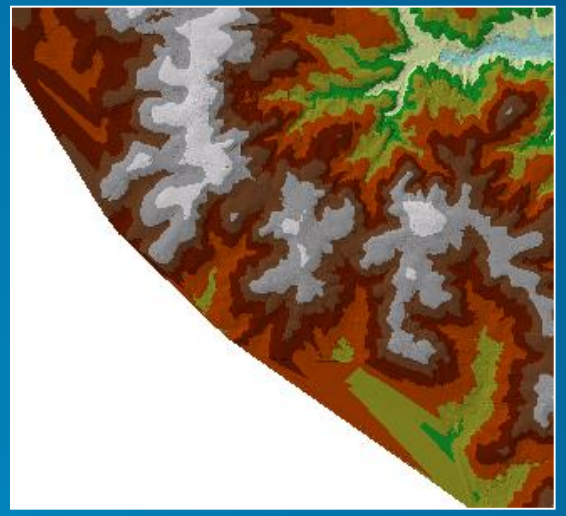
- **Binning**
  - Fast
  - Reasonable for DSMs
  - Void filling options
  - Honors replace and clip constraint types
- **Triangulation**
  - True interpolation
  - Always fills voids
  - Appropriate for DEMs
  - Honors all constraint types



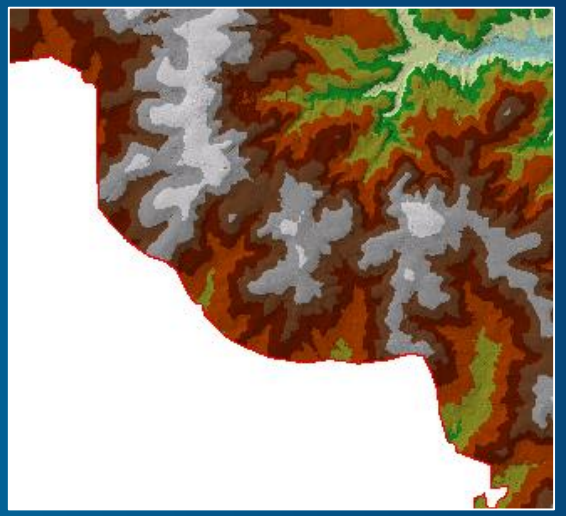
Data Area Delineation



Dense collection of source measurement points (green)

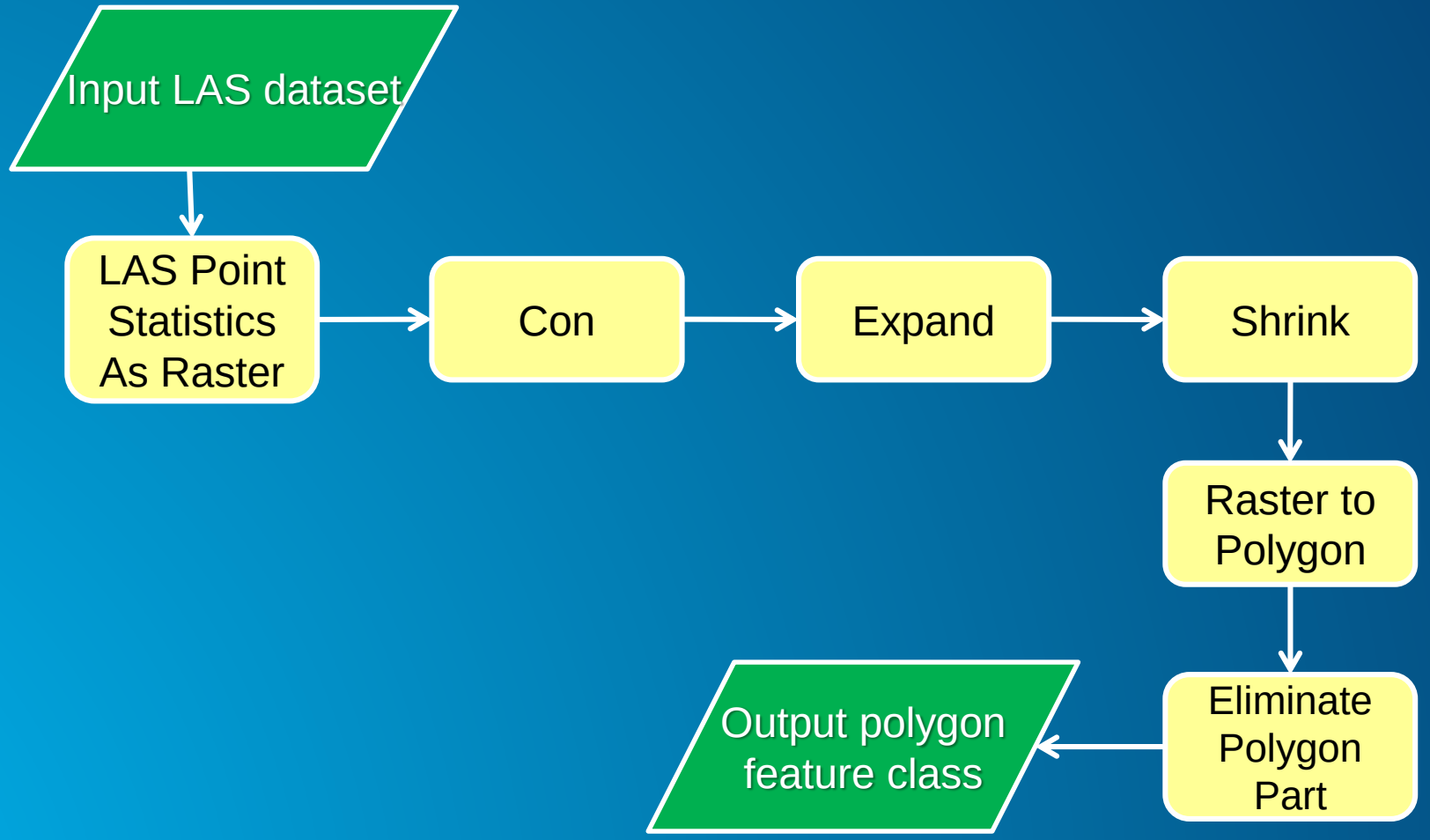


Triangulation of those points without a boundary constraint



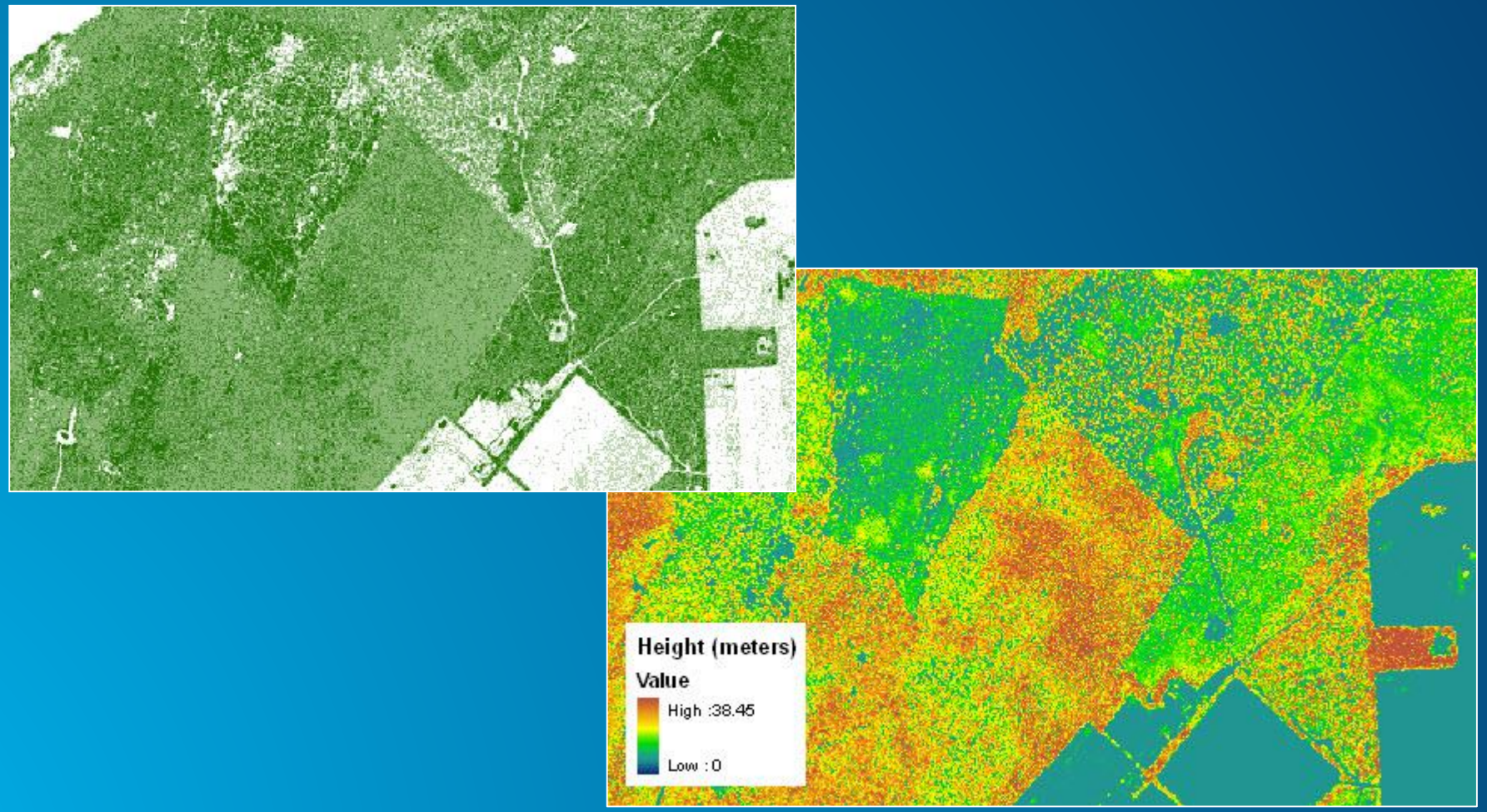
Constraint applied

Workflow to Calculate a Data Area Polygon



Demo

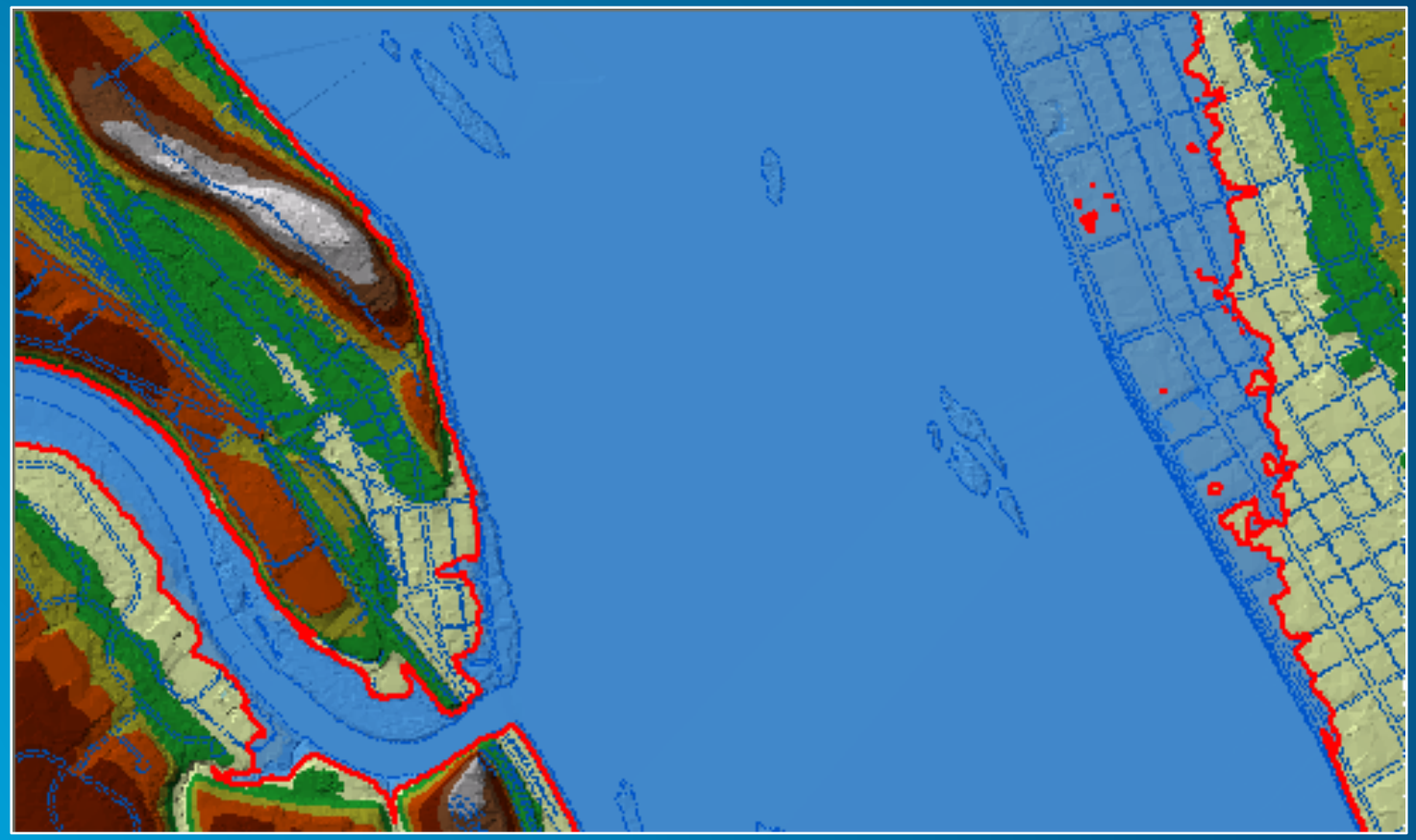
Estimating Forest Canopy Density and Height



Canopy Density and Height

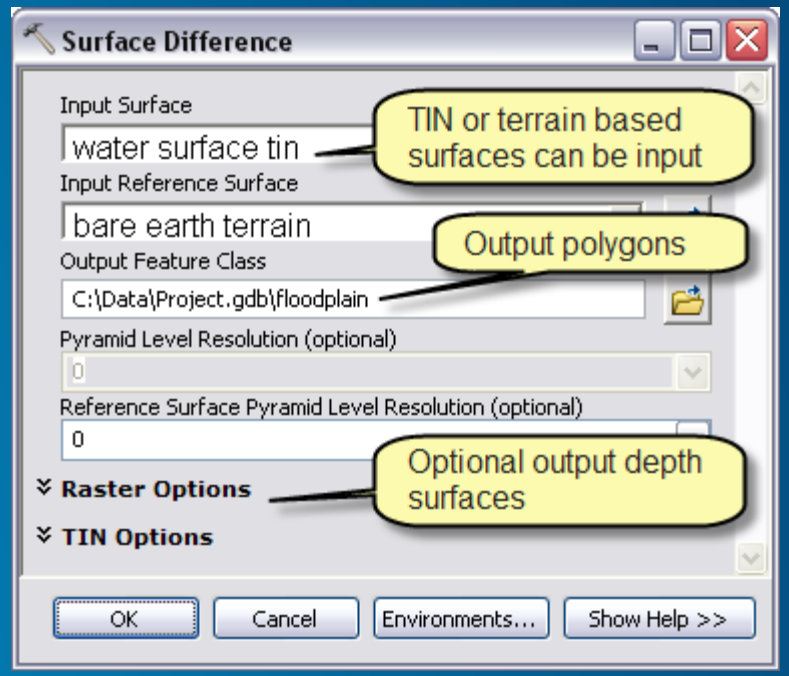
- Density is the ratio of vegetation hits to total hits within a unit area (i.e., raster cell).
  - LAS Point Statistics As Raster to make ‘count’ grids
  - Add ground and non-ground to make a ‘total’ grid.
  - Use Divide to get the ratio between non-ground and total.
- Height is the difference between DSM and DEM
  - Sometimes referred to as normalized DEM (nDSM) or Canopy Height Model (CHM)
  - LAS Dataset to Raster or Terrain to Raster followed by Minus.

Floodplain Delineation



Surface Difference Tool

- Subtract lidar based ground surface from modeled (e.g., HEC-RAS) water surface
- Output polygons used to delineate floodplain
- Optional output of depth surface(s)



Demo

Roof-Form Extraction for Procedural Building Modeling

- Extract information about roof shape and height from lidar-derived surfaces
- Symbolize buildings in 3D using procedural rules
- Review output against LAS dataset

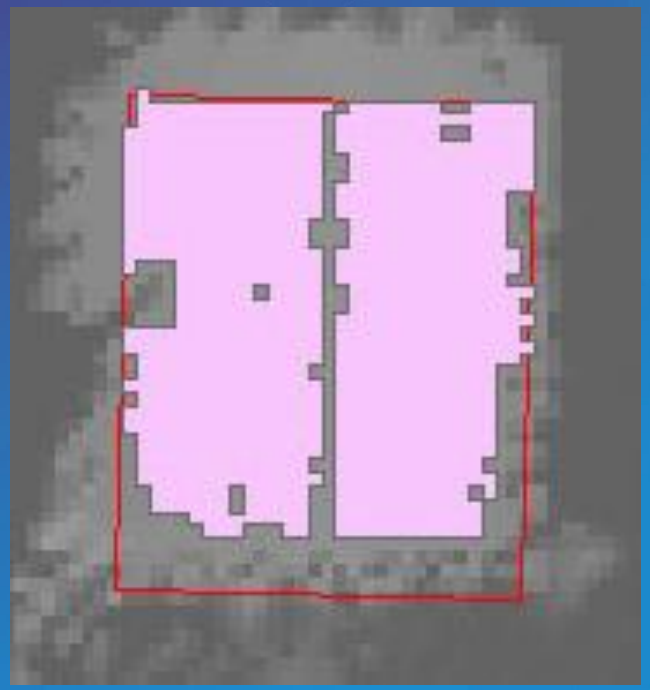
Automated Roof-Form Attribute Extraction

- Classify areas of like slope & aspect in DSM

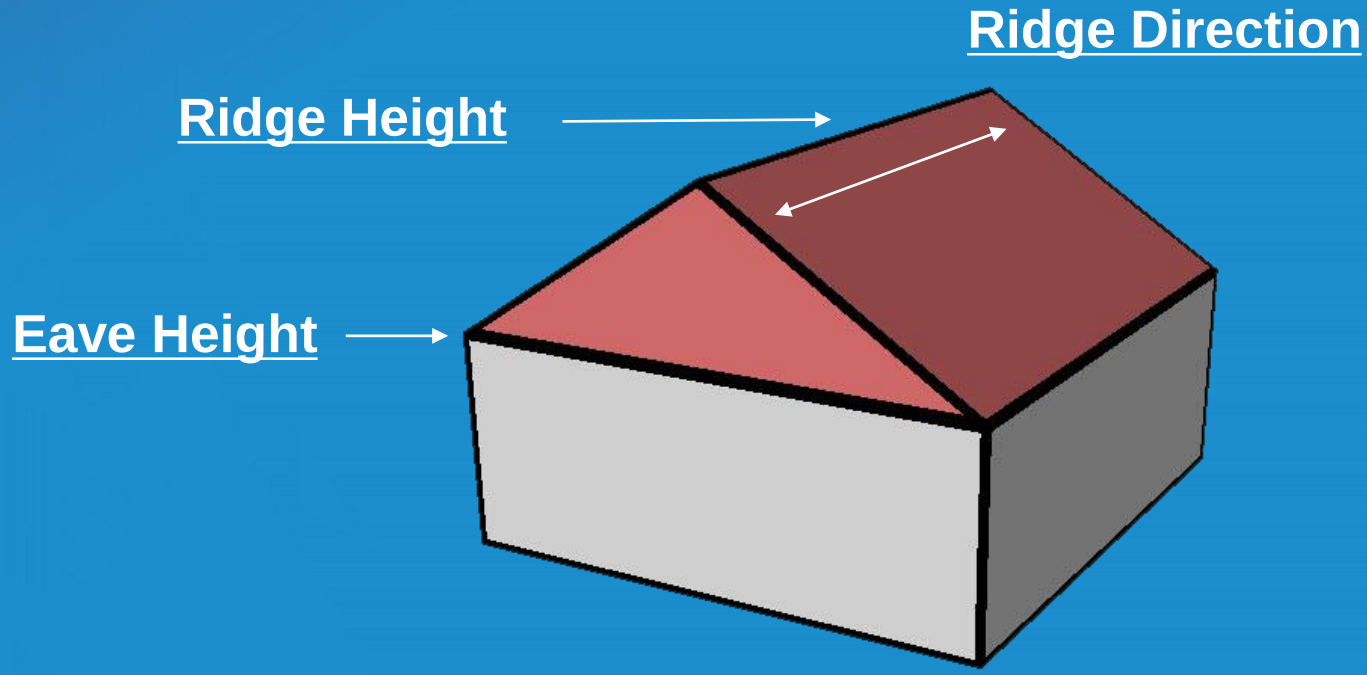
- Create roof-plane polygons

- Extract attributes

Procedural Modeling



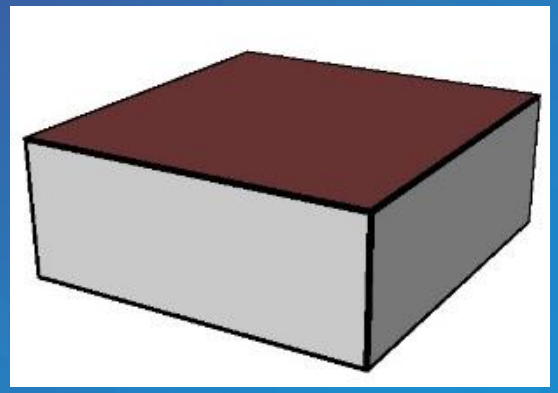
- Ridge Height = Highest point
- Eave Height = Lowest point
- Ridge Direction = Perpendicular to roof slope
- Roof form = Dependent on plane types found in footprint



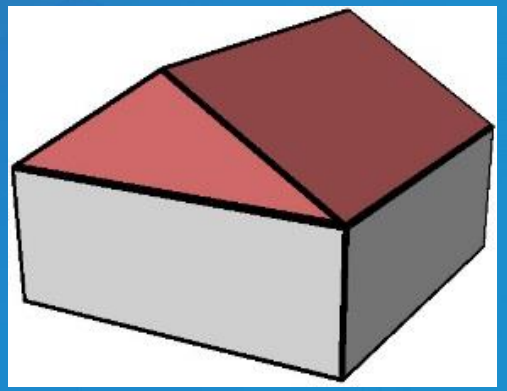
Roof Form: Gable

Procedural Modeling

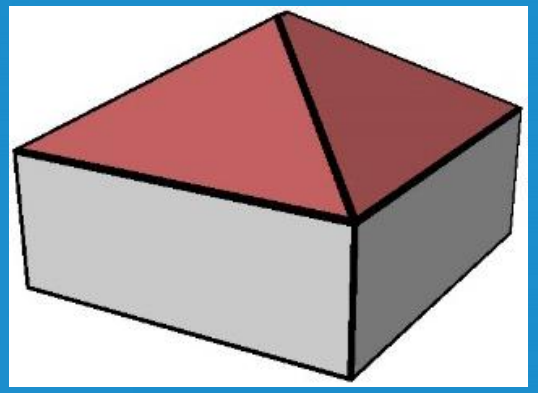
- Roof types automatically classified



Flat



Gable



Hip

- Other types supported:
  - Shed
  - Dome
  - Vault
  - Mansard

Reviewing Output

- Compare procedural symbols directly against lidar
  - Manual changes update on-the-fly

Demo

Do It Yourself!

- ‘Schematic City’ workflow in ArcGIS for Local Government Solutions
  - Task-based workflow for ArcGIS Pro
  - Includes other workflows for 3D tree creation, and 3D city analysis
- ArcGIS for 3D Cities: An Introduction
  - Wednesday and Thursday 1:30 - 2:45
- http://solutions.arcgis.com/local-government/help/local-government-scenes/

Questions?

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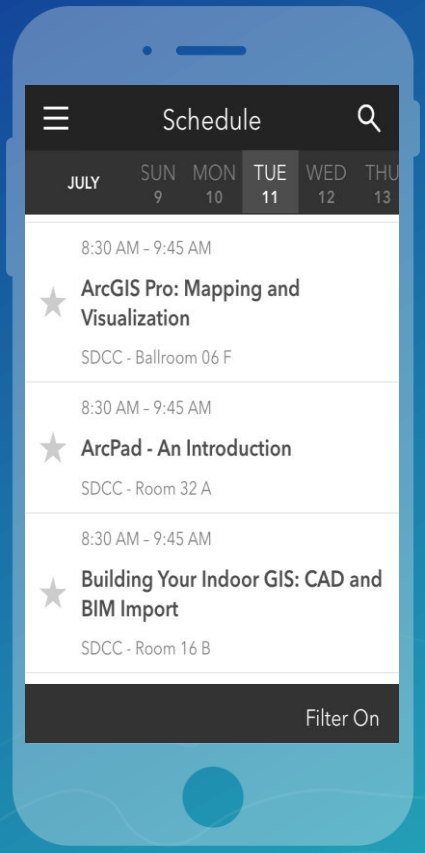
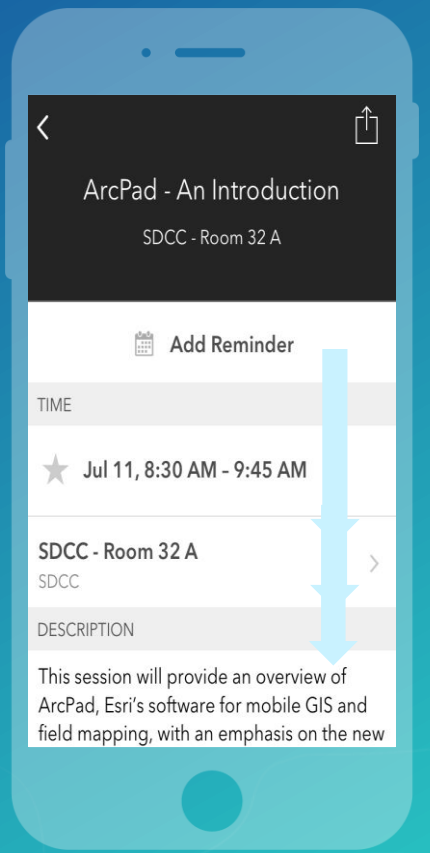
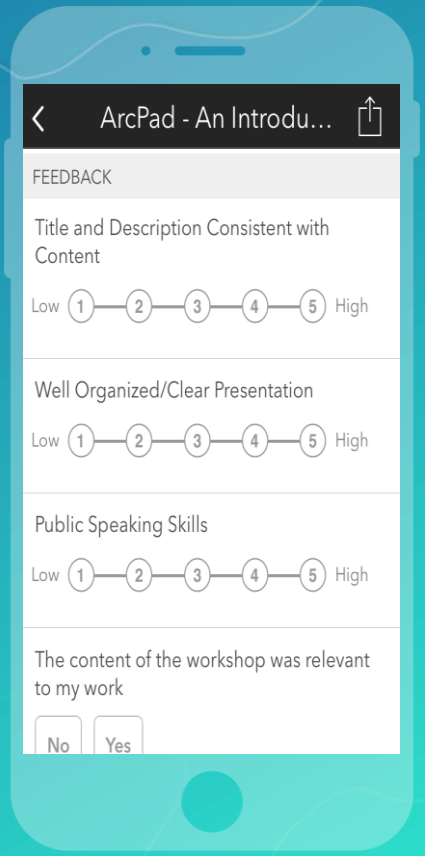
Select the session you attended



Scroll down to find the survey



Complete Answers and Select "Submit"

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