

Imagery Sources and Usage in ArcGIS

Miriam Schmidts Nicholas M. Giner July 13, 2017



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Imagery...

• ... is visible intelligence

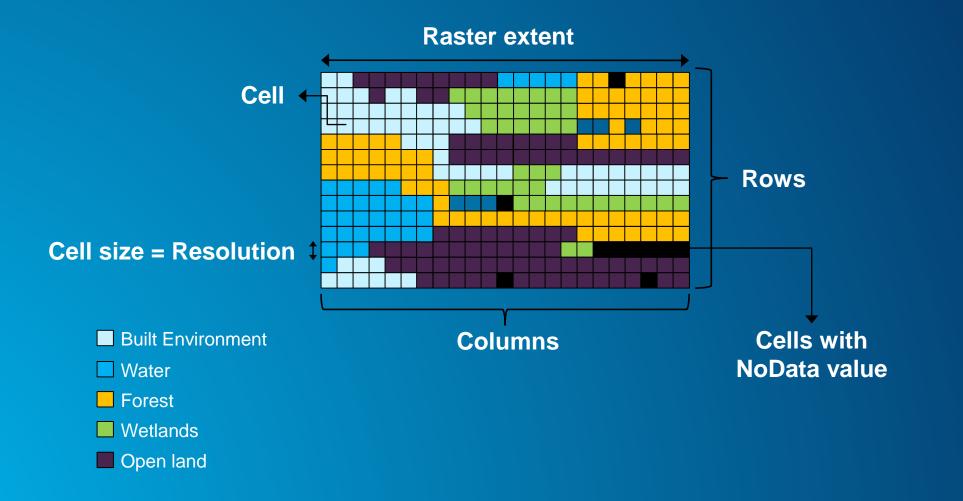




Agenda

- Imagery basics
- Sources of imagery
 - Platforms and sensors
 - Living Atlas
- Image usage
 - Image Storage
 - Image processing in ArcGIS Pro
 - Image Analysis techniques in ArcGIS Pro
- LAS Datasets
- Visualization

Image Anatomy



Spectral bands

• We know:

Sunlight consist of more wavelengths of electromagnetic radiation than the human eye can see

- e.g. sunburn

Bands: A specific range of wavelengths of electromagnetic radiation

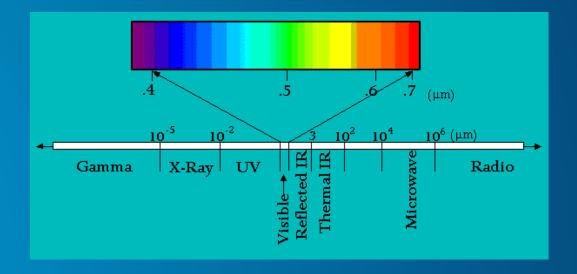
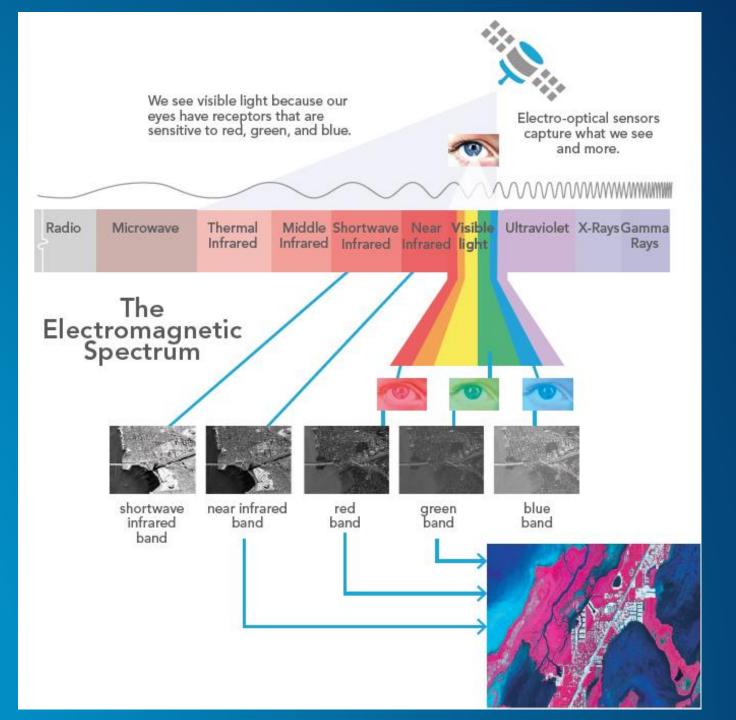


Image bands

Single Band

Multispectral



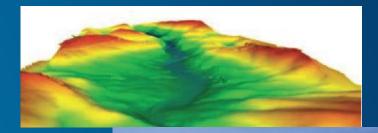
Types of Imagery: single band

- Grayscale imagery
- Digital Elevation Models (DEMs)



DEM

- 3D Imagery
 - Digitial Terrain Models (DTM) bare earth
 - Digital Surface Models (DSM) height of surface features



DTM

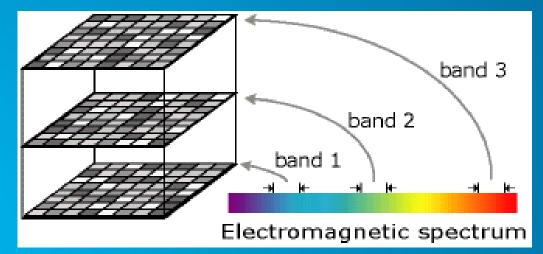


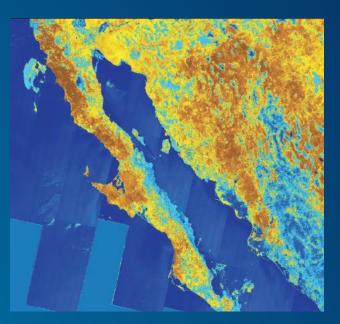
Multispectral Imagery

Multispectral

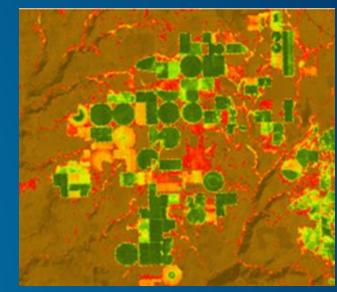


Color Infrared





NDMI

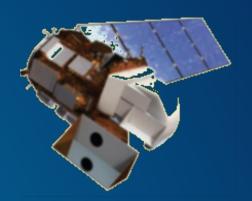


NDVI

Sensor Platforms

- Platforms
 - Satellites
 - Aircrafts
 - Drones (UAVs)
 - Ground based / handheld











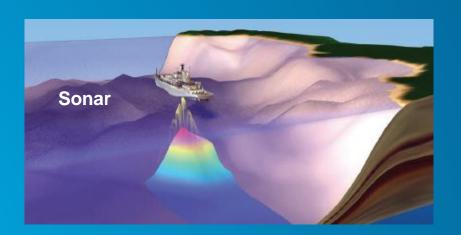


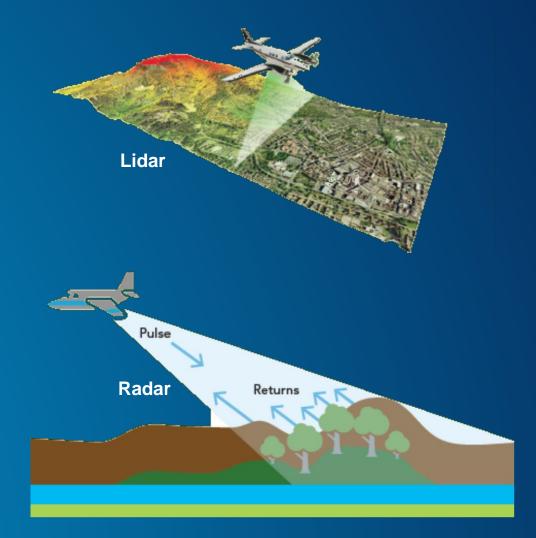


Sensors

Sensors

- Passive record reflected sunlight
 - Cameras
 - Spectrometers
- Active emit energy and record reflected radiation
 - Lidar
 - Radar
 - Sonar





Demo: Image Sources

Image Services

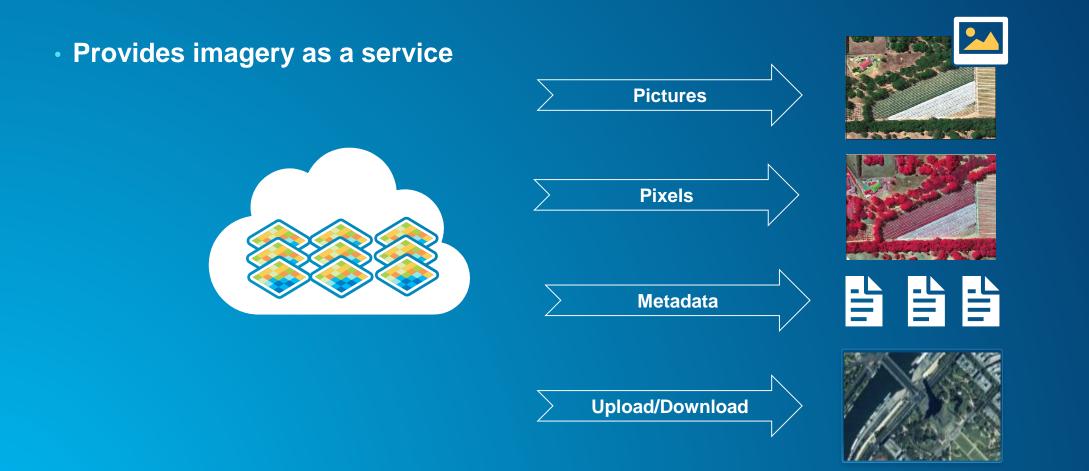
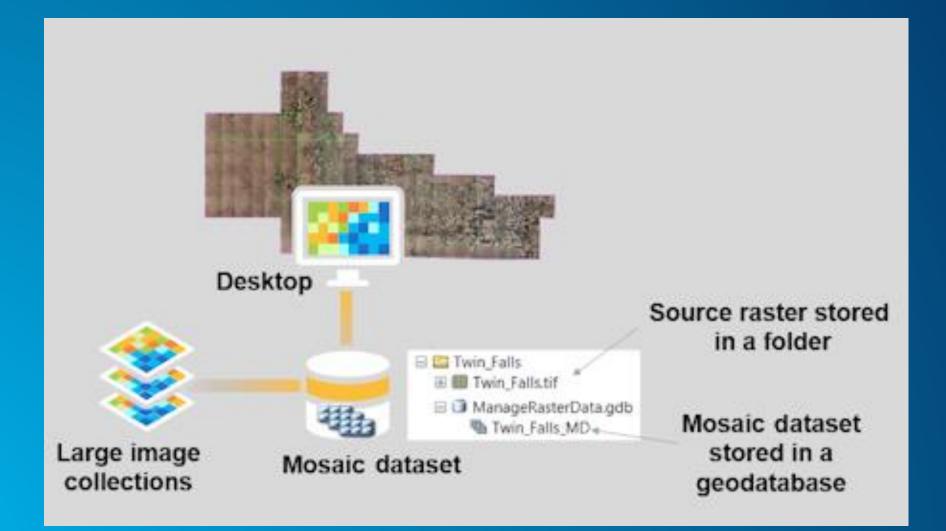
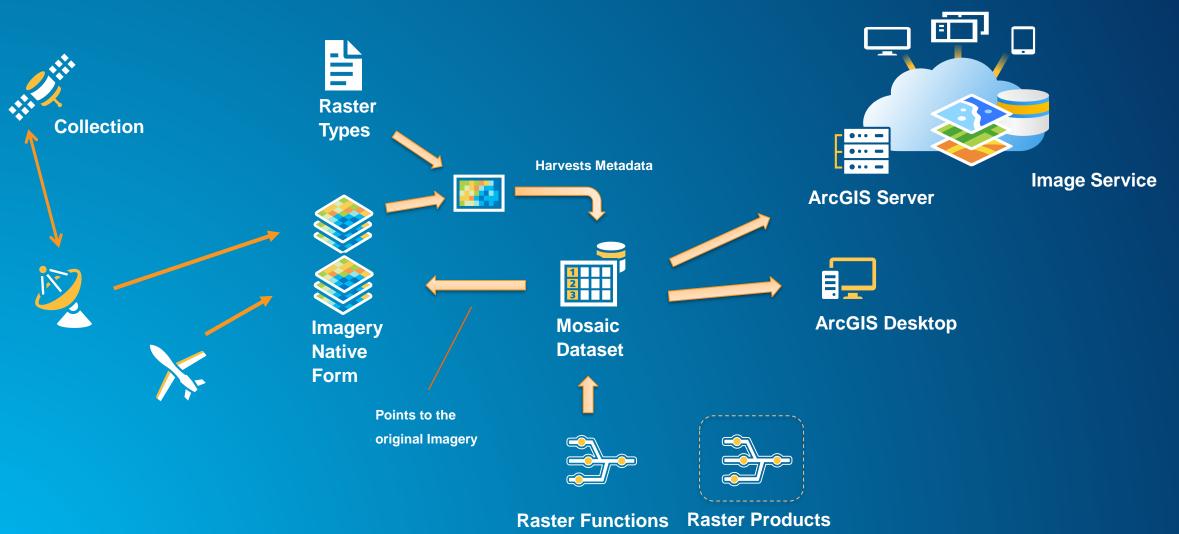


Image storage: Mosaic Dataset

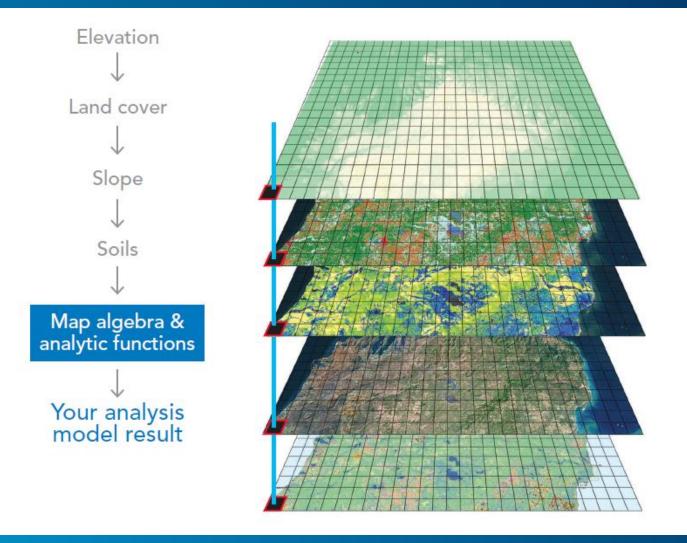


Imagery Workflow



Usage: Image Analysis

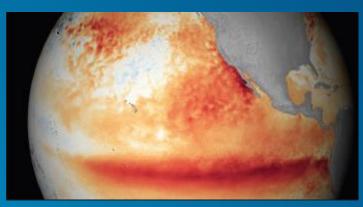
- Landcover classification
- Change detection
- Suitability Analysis
- Crop Health
- Visibility Analysis
- Hydrological Analysis



Imagery applications



Engineering and Construction



Climate and weather study



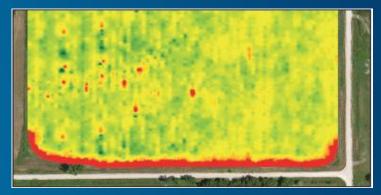
Humanitarian Aid



Forestry



Natural Disaster Management



Precision Agriculture

Raster Functions

- Apply an algorithm on-the-fly to an existing raster/image layer (raster dataset or mosaic dataset)
- Can be applied to a pixel or block of pixels (segment)
- Can be chained into Raster Function Chains

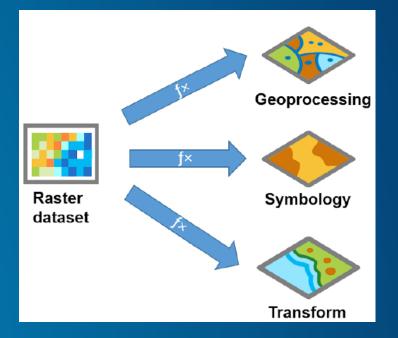
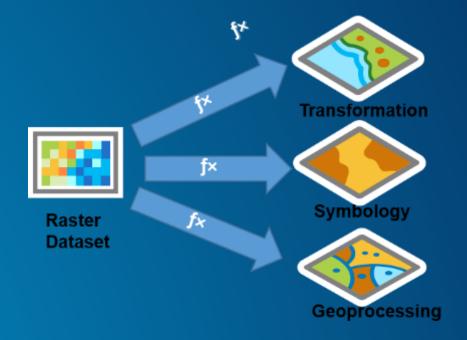


Image Processing: Raster functions

- Raster functions can:
 - Transform the data
 - Alter symbology properties
 - Replicate geoprocessing tools

Quality	Geoprocessing tool	Raster function
Has quick processing speed		X
Does not modify input data		X
Adjusts input parameters after processing		X
Can be used in process chain	X	x



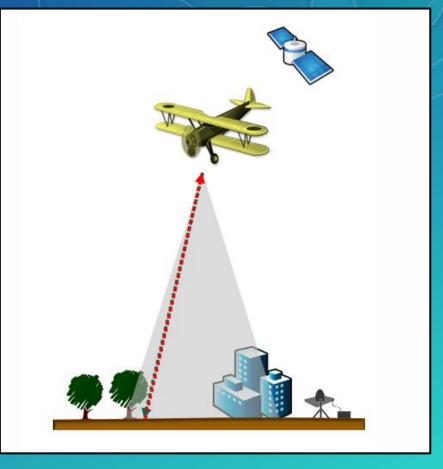
Demo: Image Analysis in ArcGIS Pro

LiDAR Background

LiDAR – Light Detection and Ranging

- Optical remote sensing technique using laser light to densely sample the Earth's surface, producing a point cloud of highly accurate x,y,z measurements
- Originated in the 1960s; Supported in ArcGIS since version 10.1
- Types of Point Clouds
 - Airborne scanned-based LiDAR
 - Airborne Geiger mode LiDAR
 - Mobile / Tripod-based LiDAR
 - Photogrammetric point clouds
- LiDAR point cloud attributes
 - x,y,z measurements
 - Intensity
 - Return number
 - Class code
 - RGB

- LAS is the default data structure for working with LiDAR point clouds
 - LAS is an industry-standard, binary file format developed by ASPRS
 - LAS/zLAS can be used individually now (~Pro 1.4)



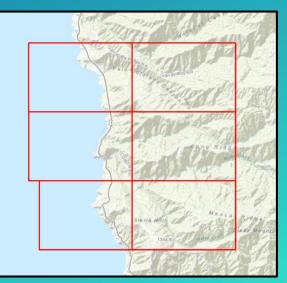
The LAS Dataset

LAS Dataset

- "Container" for storing reference to many LAS/zLAS files on disk
 - Pointer to the original LAS/zLAS files
 - Quick to create, small in file size, easy to update with additional LAS/zLAS files
- Quick display of LAS/zLAS data as point clouds or a dynamic TIN in 2D or 3D
- Excellent for QA/QC of LiDAR coverage (point density/spatial extent)
- Basis for generated products such as DEMs and DSMs or TINs
- Recommend Tiled LAS tool for large LAS files

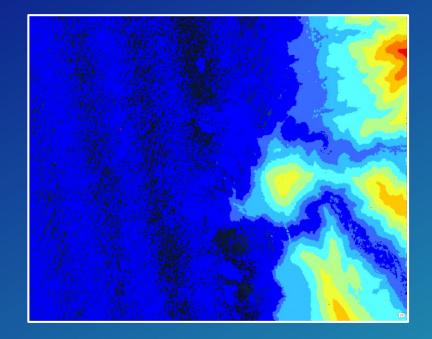




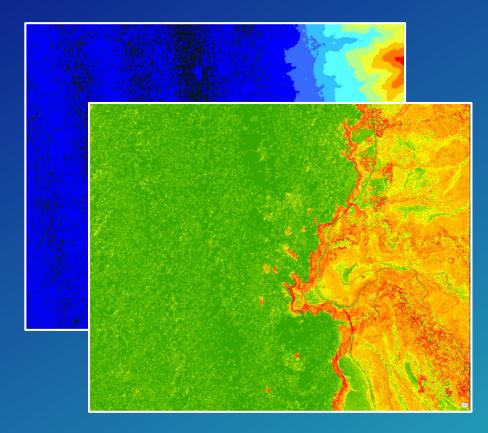


Symbolize points

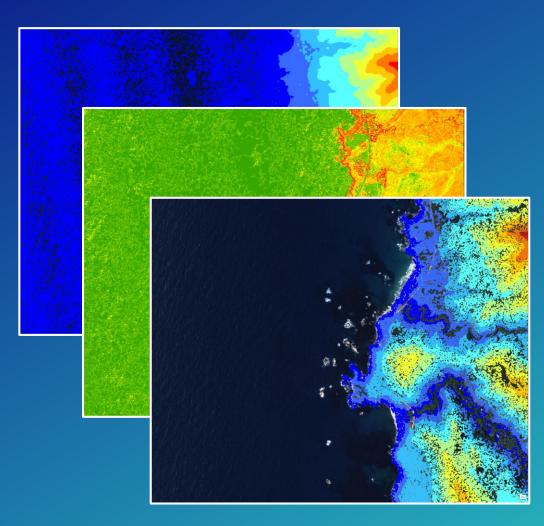
LAS Dataset		- ×
LAS Dataset 🛛 🖗 LAS Dataset ArcMap 🔻	1982 ·	• 📴 • Filters • 🗇 🖈 🏠 🐺 🖾 🖾



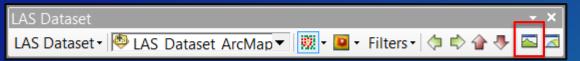


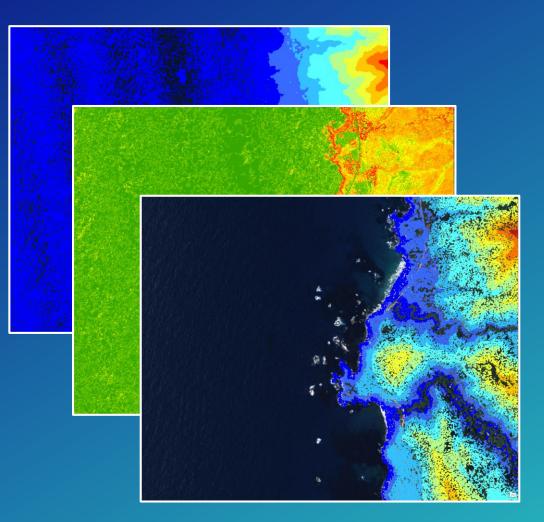


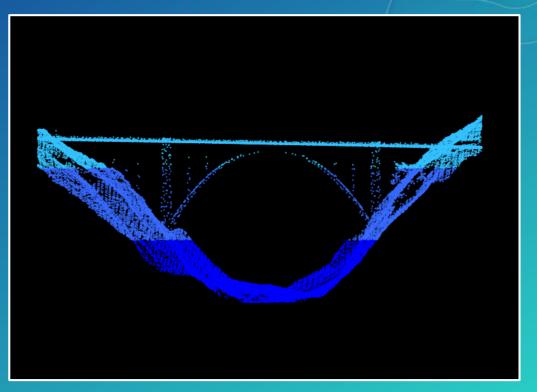




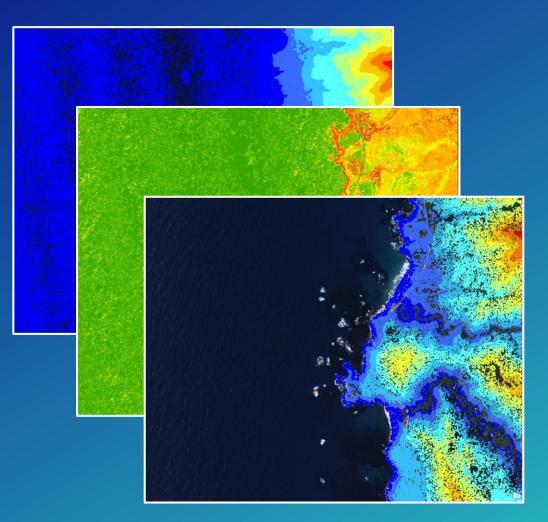
LiDAR point profile

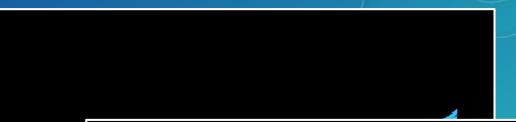


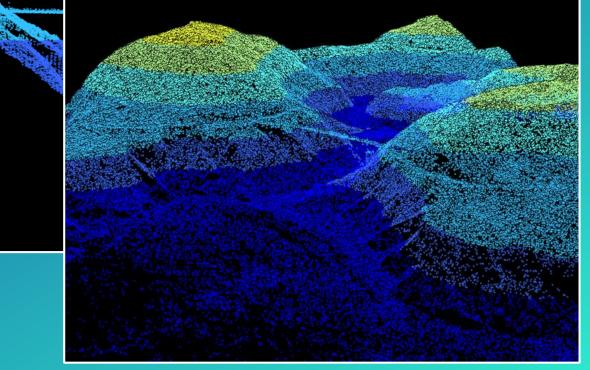












□ ■ 3D Sample Tools Sonversion ASCII Text To LAS LAS Dataset To Point IAS Dataset To Tiled Rasters LAS File Extent As Polygon [™] LAZ To zLAS Mosaic To LAS Dataset Terrain To Tiled Rasters [™] TIN To LandXML TIN to Multipatch [™] zLAS To LAZ 🖃 🗞 Feature Analysis Adjust Multipatch Z Cast Shadows On Raster Contour Multipatch Screate Sun Sightlines Screate Sun Skymap Cross Section Lines Cross Section Polygons Second Simplify 3D Line 🖃 🗞 Lidar Analysis LAS Building Multipatch LAS Building Polygon LAS Overlap Areas LAS Point Statistics By Area Locate LAS Points By Proximity Sample Z From LAS

- 🖃 🦠 Lidar Classification Classify LAS By Height Classify LAS Ground Points Classify LAS Model Key Points Classify LAS Noise Classify LAS Overlap Points Classify LAS Rooftop Points 🖃 🗞 Lidar Management Check LAS Colorize LAS Convert LAS Version Create PRJ for LAS S Delete PRJ For LAS EzLAS Optimizer LAS File Information 3 LAS Reporter 🔨 LAS To LAS Rearrange LAS Points Reference LAS Subset Split LAS File Thin LAS 🗆 🛸 TIN Closest TIN Node Create Fence Diagram Extract TIN Integrate TINs 🔨 Set TIN Node Z
- 🖃 🖏 TIN
 - 🔨 Closest TIN Node
 - 🔨 Create Fence Diagram
 - 🔨 Extract TIN
 - 🔨 Integrate TINs
 - 🔨 Set TIN Node Z
- 🖃 🗞 Vegetation Analysis
 - 🔨 Canopy Peaks
 - 🔨 LAS Height Metrics As Raster
 - 🔨 Tree Crown Extent
 - 🔨 Tree Crown Radius

https://www.arcgis.com/home/ item.html?id=fe221371b77940 749ff96e90f2de3d10

Working with LiDAR in ArcGIS Pro

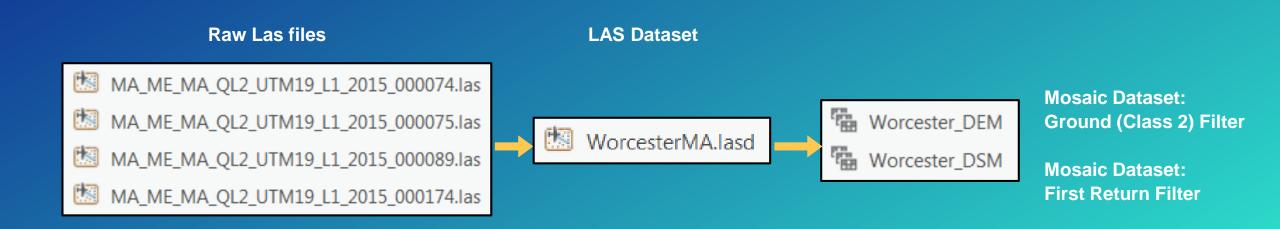
LAS dataset point symbology LAS dataset filter - 9 💼 🕤 T 🔿 T 👎 ArcGIS Pro - ImageryandUsage_UC2017 - BigSur LAS Dataset Layer Classification Analysis Project Map Insert View Edit Imagery Share Appearance Data 🐴 In Beyond 🖻 + 0.0 % File Extent Full Resolution 5 <None> <Auto> 🖶 Swipe 1 Display Limit 📥 Out Beyond 800,000 <None> LAS Surface Symbology Density Min Max Clear Limits Points -Constraints Point Thinning Visibility Range Effects Drawing Filters 🗟 🗟 🕤 • 🗟 • 🔻 ArcGIS Pro - ImageryandUsage_UC2017 - BigSur -9 LAS Dataset La Project Analysis View Edit Imagery Map Insert Share Appearance Data (K) 🛺 Add Files **∕**••• 😼 Remove Files Add Surface Line Of Surface Surface Surface Locate Export Statistics Sight Ŧ Outliers Information Aspect Contour Slope Management Analysis ArcGIS Pro - ImageryandUsage_UC2017 - BigSur -9 Ē. Project Map Analysis Imagery View Edit Share Insert Clear Classification Code No Change 1 Model Key • Withheld • Select Apply Automated Overlap - Synthetic -Changes ы Interactive Edit Selection

Demo #1:

- Find LiDAR data on USGS EarthExplorer
- Create and explore a LAS Dataset

Working with LiDAR in a Mosaic Dataset

- LAS datasets can be directly read into the Mosaic Dataset
 - Use Raster functions or other tools (i.e. Viewshed, Contour, Profile)
 - Used as a DEM
 - Used to orthorectify imagery
 - Used in applications that support rasters but not LAS files or LAS datasets

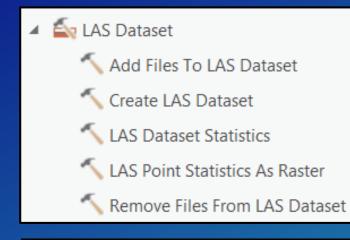


Demo #2:

- Add LiDAR data to a Mosaic Dataset
- Use Raster functions on a Mosaic Dataset to create
 - a Normalized Difference Surface Model (nDSM)

LiDAR and Geoprocessing in ArcGIS Pro

Data Management Tools



🔨 Make LAS Dataset Layer

3D Analyst Tools

- 🔺 🎪 LAS Dataset
 - 🔨 Change LAS Class Codes
 - 🔨 Classify LAS Building
 - 🔨 Classify LAS By Height
 - 🔨 Classify LAS Ground
 - 🔨 Classify LAS Noise
 - 🔨 Classify LAS Overlap
 - 🔨 Extract LAS
 - 🔨 LAS Point Statistics By Area
 - 🔨 Locate LAS Points By Proximity
 - Net LAS Class Codes Using Features
 - 🔨 Tile LAS

🔨 LAS Building Multipatch

Conversion Tools

🔨 LAS To Multipoint

🔨 LAS Dataset To TIN

🔨 LAS Dataset To Raster

Demo #3:

- Extract height values to building footprints from LiDAR
- Apply a Rule Package to create textured, realistic 3D buildings



Appendix

Considerations for working with a LAS dataset

This table summarizes several factors that you should consider before building a LAS dataset.

Consideration	Recommendation	
Coordinate system	 Data recommended to be delivered and consumed in a projected coordinate system. If no spatial reference is present or if the LAS file has an incorrect spatial reference, add an accompanying projection file (.prj) file with a LAS file 	
	referenced by the LAS dataset.	
Height measurements	• Use orthometric heights.	
Lidar data types supported	 Use classified lidar data. Surface constraint data can be photogrammetrically derived breaklines or GPS points. 	
Data storage	 Store the data locally. Limit 1 to 2 million data points per every LAS file. 	
	• Limit file size to 25 to 50 MB, and no larger than 100 MB.	
Version	 Tiled LAS with version 1.1 or later to access predefined classification codes. ArcGIS supports LAS versions 1.0, 1.1, 1.2, 1.3, and 1.4 (point record formats 0-5). 	

Appendix

Advantage	Description
Dynamic mosaicking	Stores multiple collections and projects: • Projections • Formats • Resolution
Elevation data storage	 Topographic data Bathymetric data Raster data Point data
On-the-fly processing	Processes image as accessed: • Stretch, extract bands • Clip, mask • Reproject, orthorectify, pan-sharpen • Shaded relief, slope, aspect
Data access	 As raster As source data As data shared internally and online