

Esri Southwest User Conference

November 13–15, 2013 | Salt Lake City, Utah



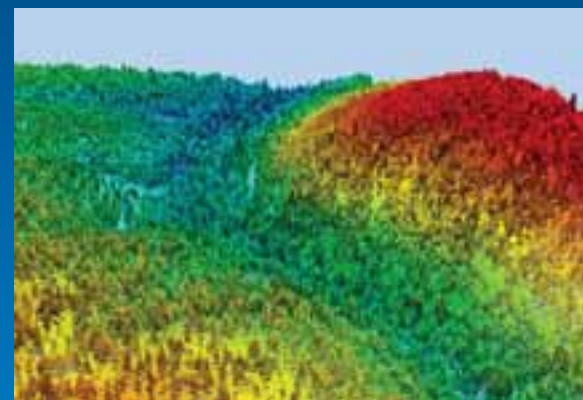
Managing Lidar Data using LAS Datasets

David Vaillancourt



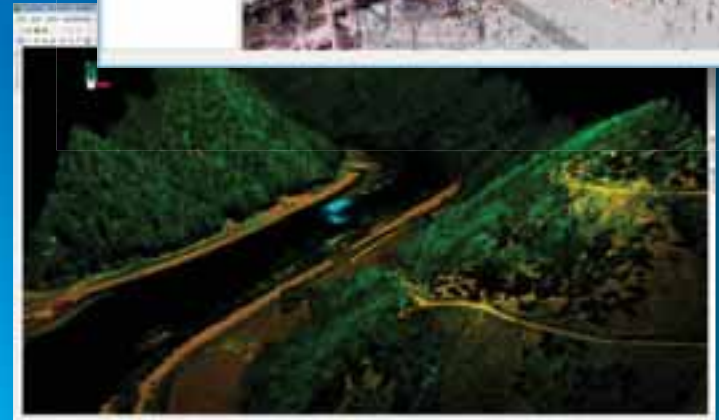
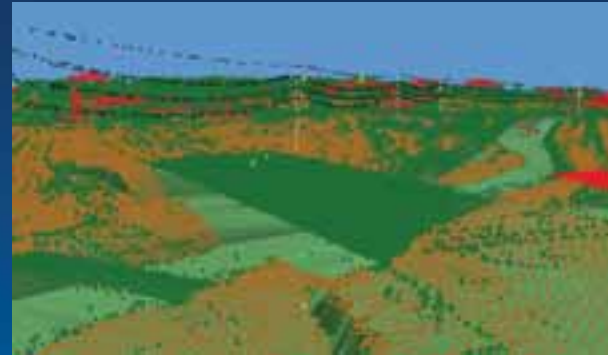
Workshop Agenda

- Lidar Concepts
- Managing Lidar with LAS Datasets
 - Creating, managing, understanding
- Sharing Lidar Data
 - Mosaic Datasets
 - Image Services



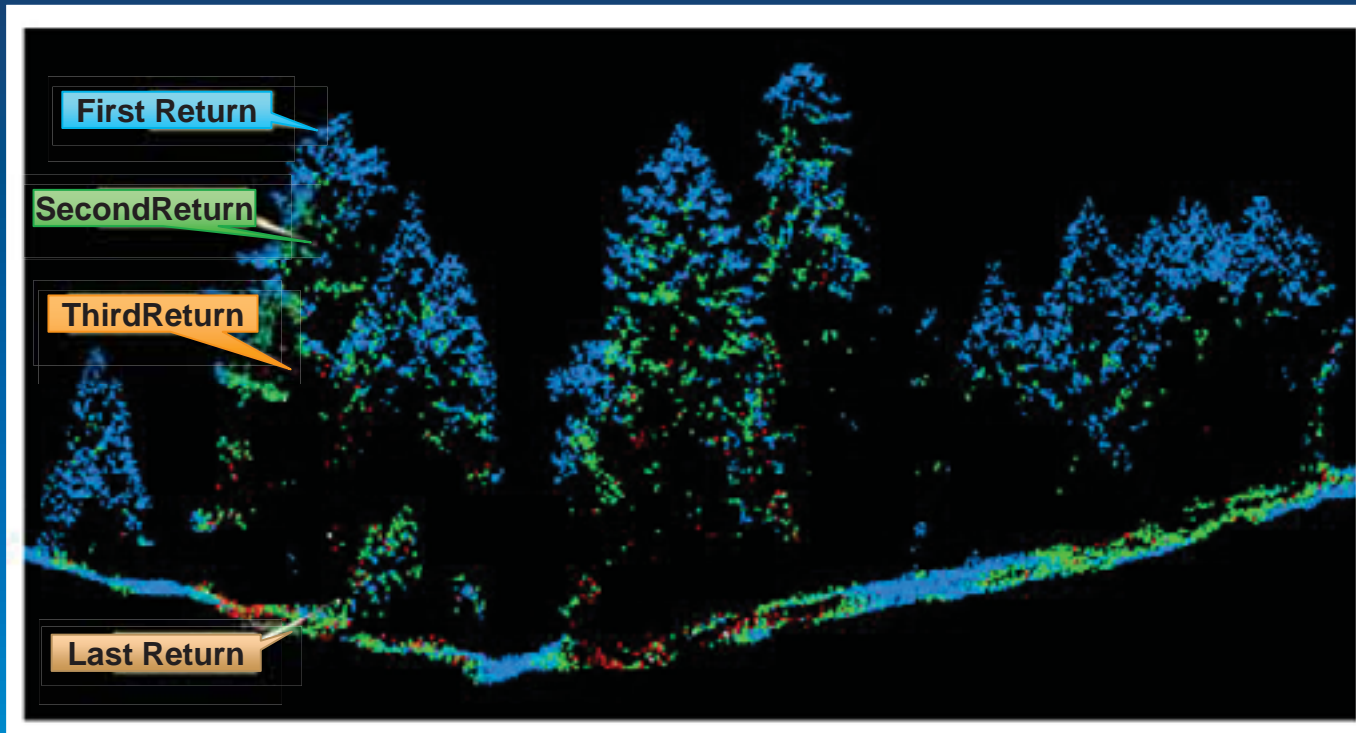
Types of Lidar

- **Airborne**
 - Captured from aircraft
 - Suitable for surface analysis
- **Terrestrial and Mobile**
 - Captured from the surface
 - Suitable for feature location and data validation



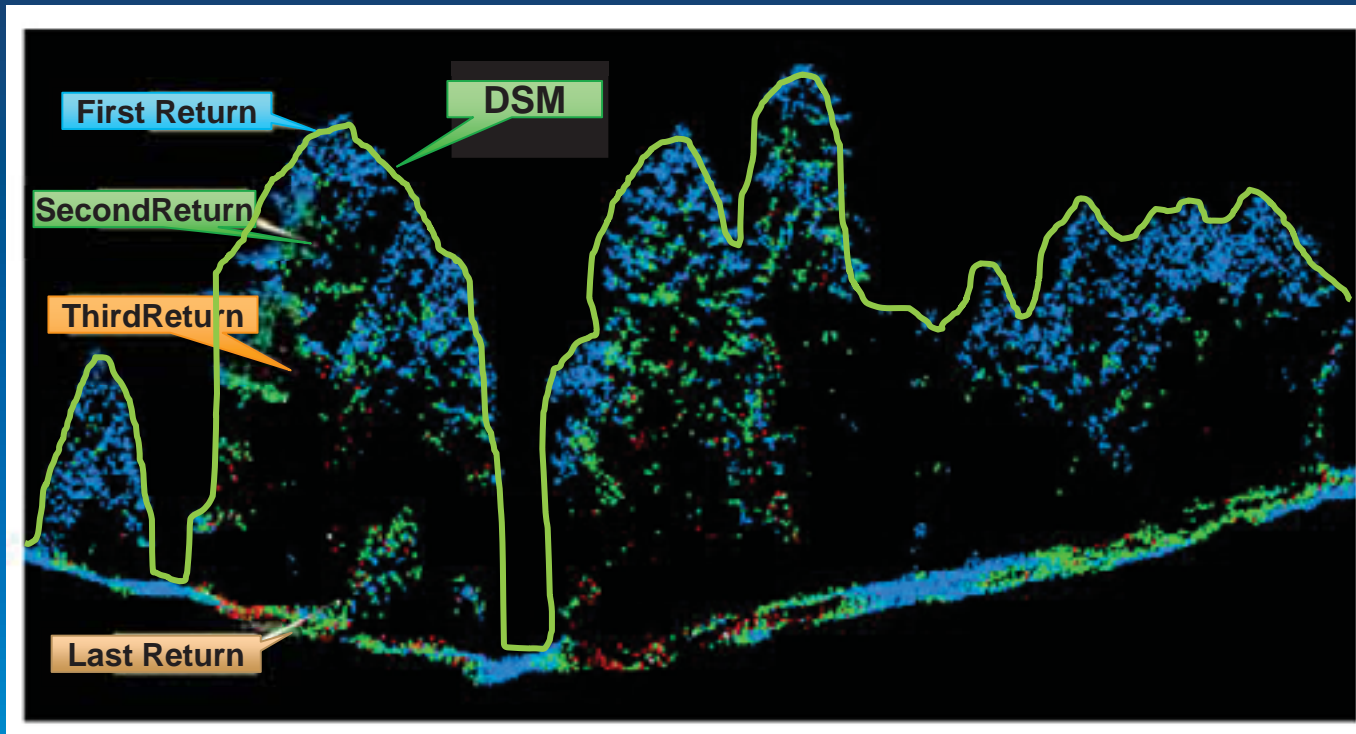
Lidar Data

- Very rich, but contains a lot of data not required for many applications



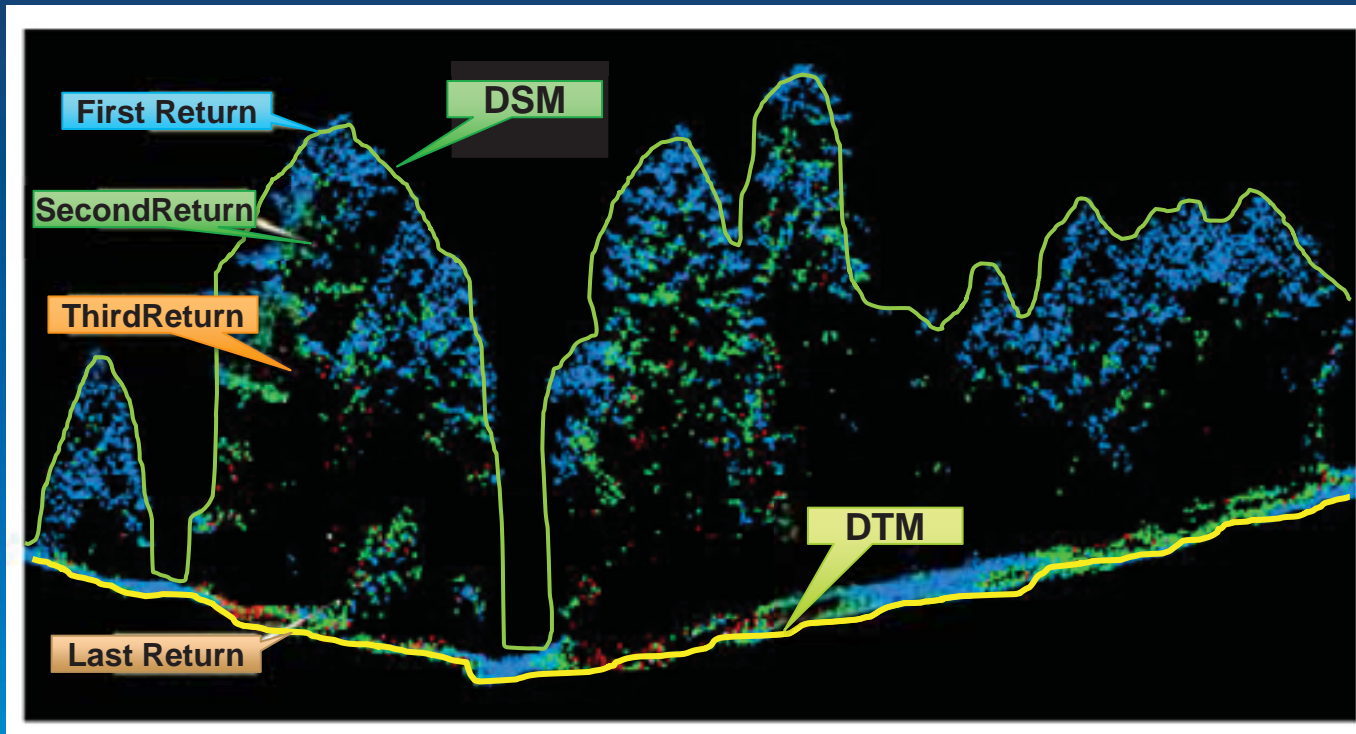
Lidar Data

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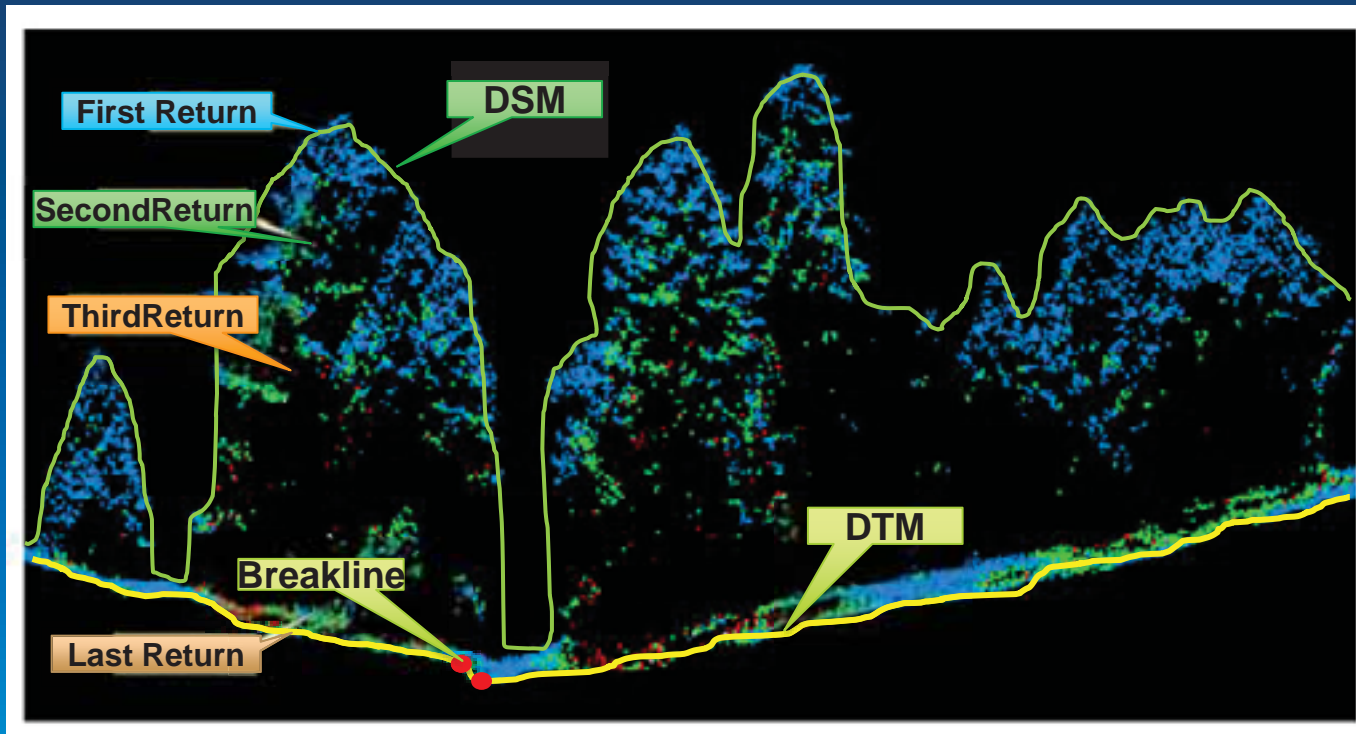
Lidar Data

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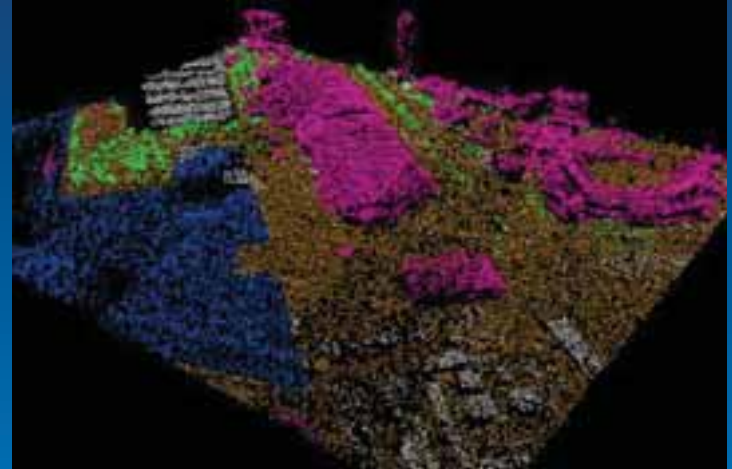
Lidar Data

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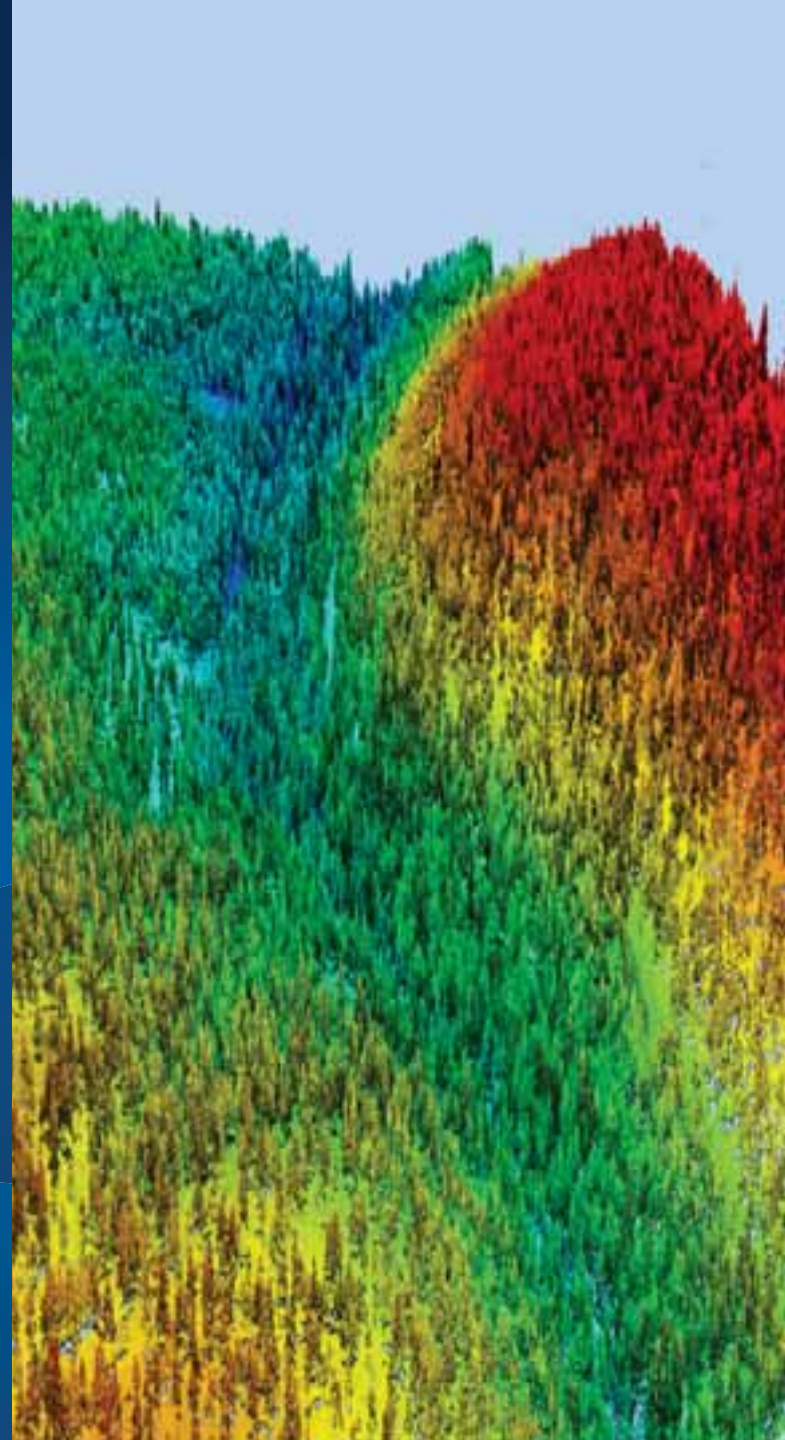
Key Lidar Functionality

- **Surface analysis**
 - First-return, Bare-earth
- **Feature extraction**
 - Digitizing, Point classification
- **Background information**
 - Measuring, Data validation
- **Sharing**
 - Serving
 - Zip-and-ship



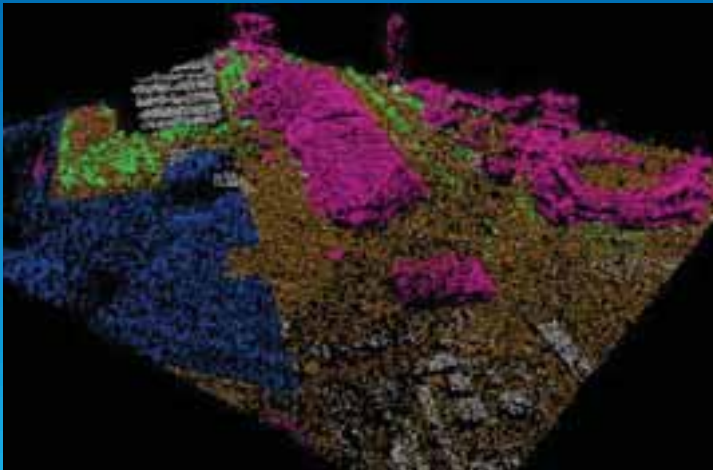
Topic

LAS Datasets



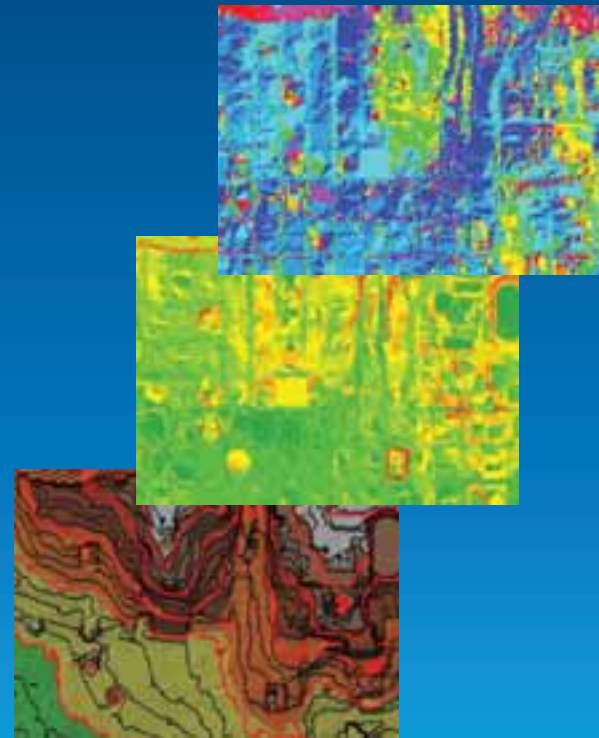
LAS Dataset

- Data type (new @ 10.1)
- File based – not in a GDB
- Stores references to LAS files on disk
- Optionally reference breakline data
- Treats a collection of LAS files as one logical dataset



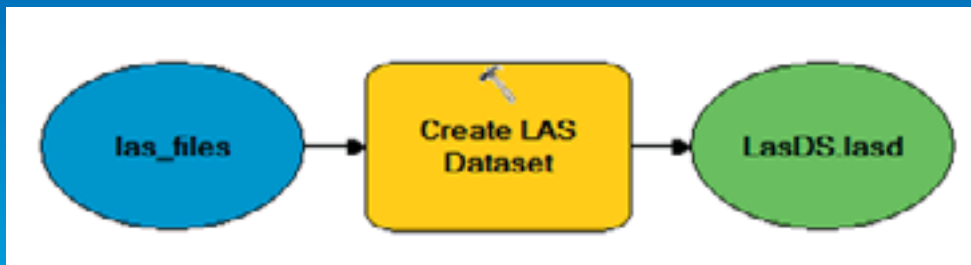
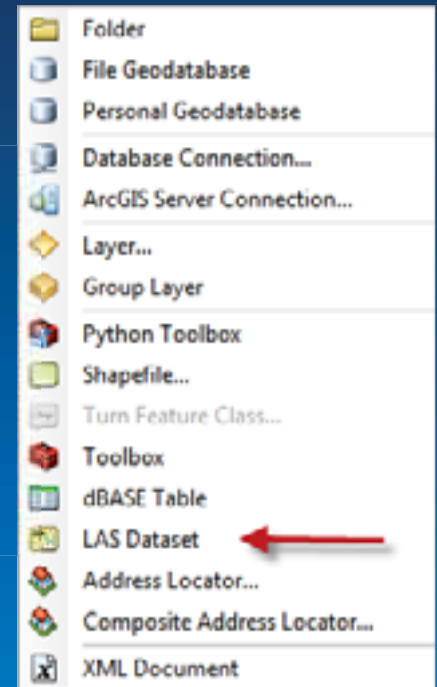
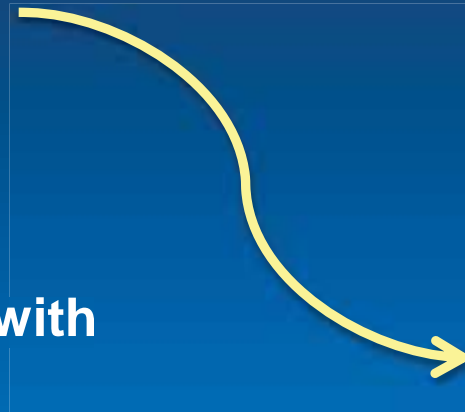
LAS Dataset Strengths

- **Scalability**
 - Works directly on LAS files
- **Data Integration**
 - Point cloud and breakline support
 - Storage efficient
- **Data Management**
 - I/O efficient
 - Edit LAS classifications



LAS Dataset – Creation

- Interactively via Catalog
 - File folder context menu
- Using scripts and models with geoprocessing tools



LAS Dataset – Dataset based

- LAS Dataset Properties: LAS Dataset Statistics

LAS Dataset Properties

General LAS Files Surface Constraints **Statistics** XY Coordinate System Z Coordinate System

Show: File Show full path of LAS files

LAS File	Version	Point Count	Point Spacing	Z Min	Z Max	Statistics
4512-01.las	1.0	2,020,084	3.245	590.420	2842.830	[+]
4512-02.las	1.0	1,666,465	3.542	603.330	2589.330	[+]
4513-01.las	1.0	1,940,772	3.294	601.670	843.000	[+]
4513-02.las	1.0	1,080,166	4.211	650.080	838.830	[+]
4513-03.las	1.0	1,816,176	3.382	612.000	830.750	[+]
4513-04.las	1.0	1,278,076	3.947	610.920	813.500	[+]
4514-01.las	1.0	2,041,337	3.225	567.000	823.330	[+]
4514-02.las	1.0	1,376,597	3.812	629.830	895.920	[+]
4514-03.las	1.0	1,951,863	3.283	564.000	869.250	[+]
4514-04.las	1.0	1,108,822	4.185	675.670	897.420	[+]
4522-01.las	1.0	1,846,979	3.337	596.330	2310.330	[+]
4522-02.las	1.0	1,238,635	3.870	571.330	841.330	[+]
4523-01.las	1.0	1,366,594	3.825	614.670	839.580	[+]
4523-02.las	1.0	1,429,072	3.713	600.670	834.670	[+]
4523-03.las	1.0	1,457,039	3.715	611.750	847.250	[+]
4523-04.las	1.0	1,403,807	3.747	580.170	1519.750	[+]
4524-01.las	1.0	1,702,973	3.474	703.420	875.000	[+]

Add Remove

OK Cancel Apply

LAS Dataset – File based

- LAS Dataset Properties: LAS File Statistics

The screenshot shows the 'LAS Dataset Properties' dialog box with the 'Statistics' tab selected. The dialog is divided into several sections: Returns, Attributes, Classification Codes, and Classification Flags. The Returns table shows data for First, Second, Last, Single, First of Many, and Last of Many returns. The Attributes table lists Return No., Intensity, Class Code, Scan Angle, User Data, and Point Source. The Classification Codes table shows three classes: 1 Undersified, 2 Ground, and 7 Low Point (noise). The Classification Flags section includes a table for Name and Point Count, and buttons for Check Status, Update, and Force recalculate. A message at the bottom states '0 file(s) have outdated or no statistics'.

Returns

Return	Point Count	%	Z Min	Z Max
First	23,186,358	75.34	567.00	2842.83
Second	7,589,412	24.66	-178.50	868.33
Last	23,168,198	75.28	-178.50	897.42
Single	17,047,489	55.39	567.00	897.42
First of Many	6,138,869	19.95	577.92	2842.83
Last of Many	6,120,709	19.89	-178.50	864.50

Attributes

Name	Min	Max
Return No.	1	2
Intensity	0	255
Class Code	1	7
Scan Angle	0	0
User Data	0	0
Point Source	1	11

Classification Codes

Classification	Point Count	%	Z Min	Z Max	Min Int...	Max Int...	Synthe...
1 Undersified	14,501,112	47.38	568.67	2842.83	0	255	0
2 Ground	12,422,648	40.37	567.00	785.17	0	255	0
7 Low Point (noise)	3,772,010	12.25	-178.50	2297.42	0	255	0

Classification Flags

Name	Point Count
Model Key	0
...	...

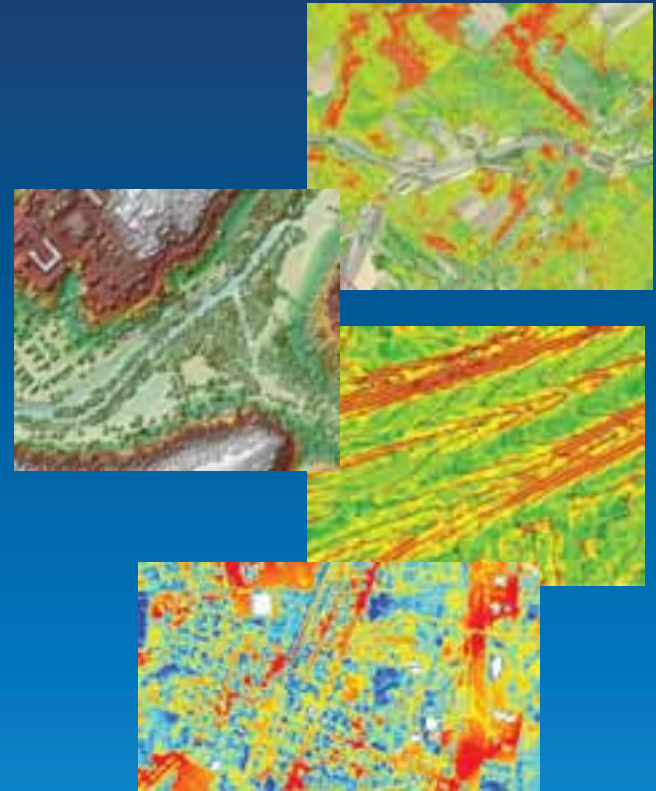
Check Status Update Force recalculate

0 file(s) have outdated or no statistics

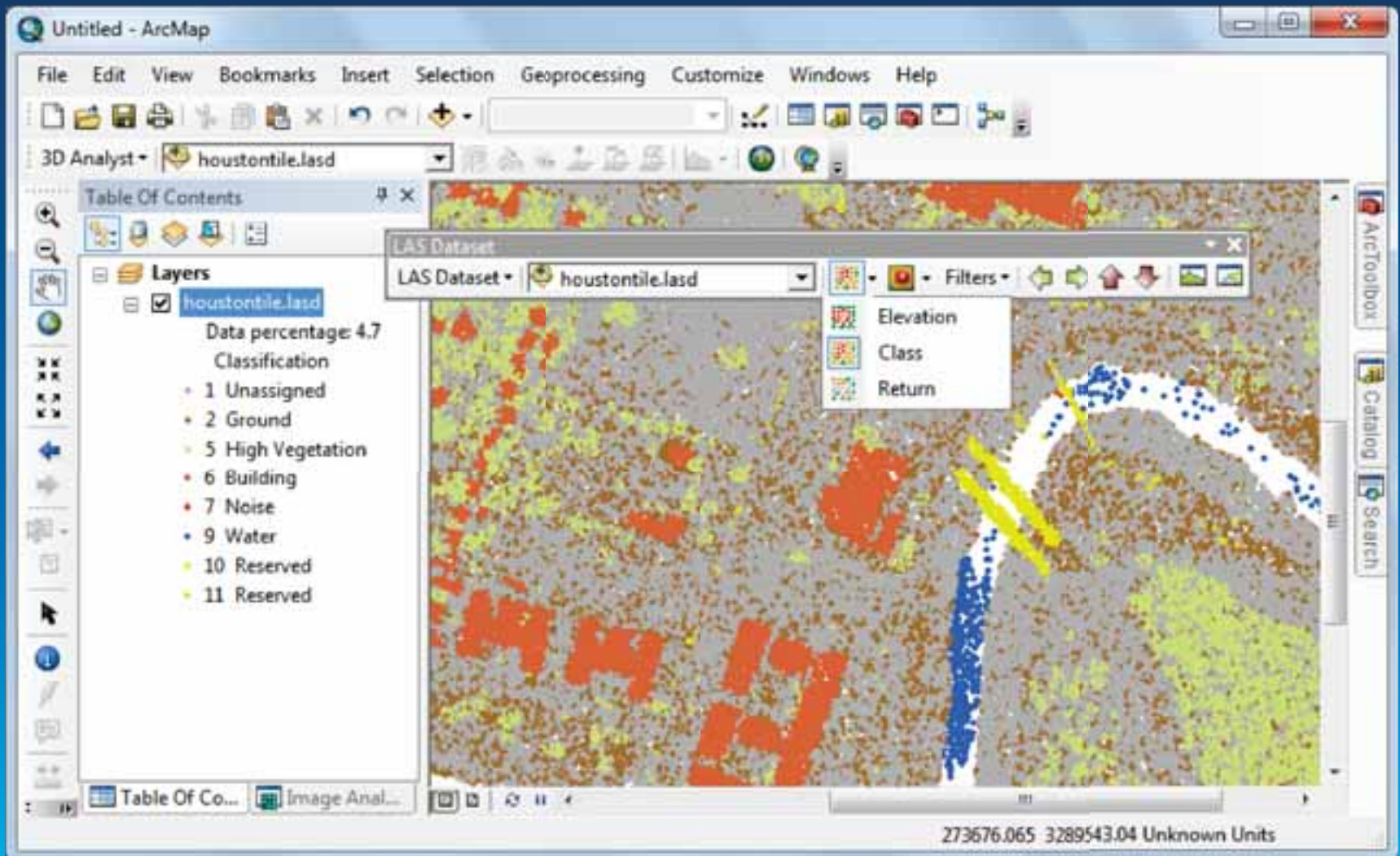
OK Cancel Apply

LAS Dataset – Analysis

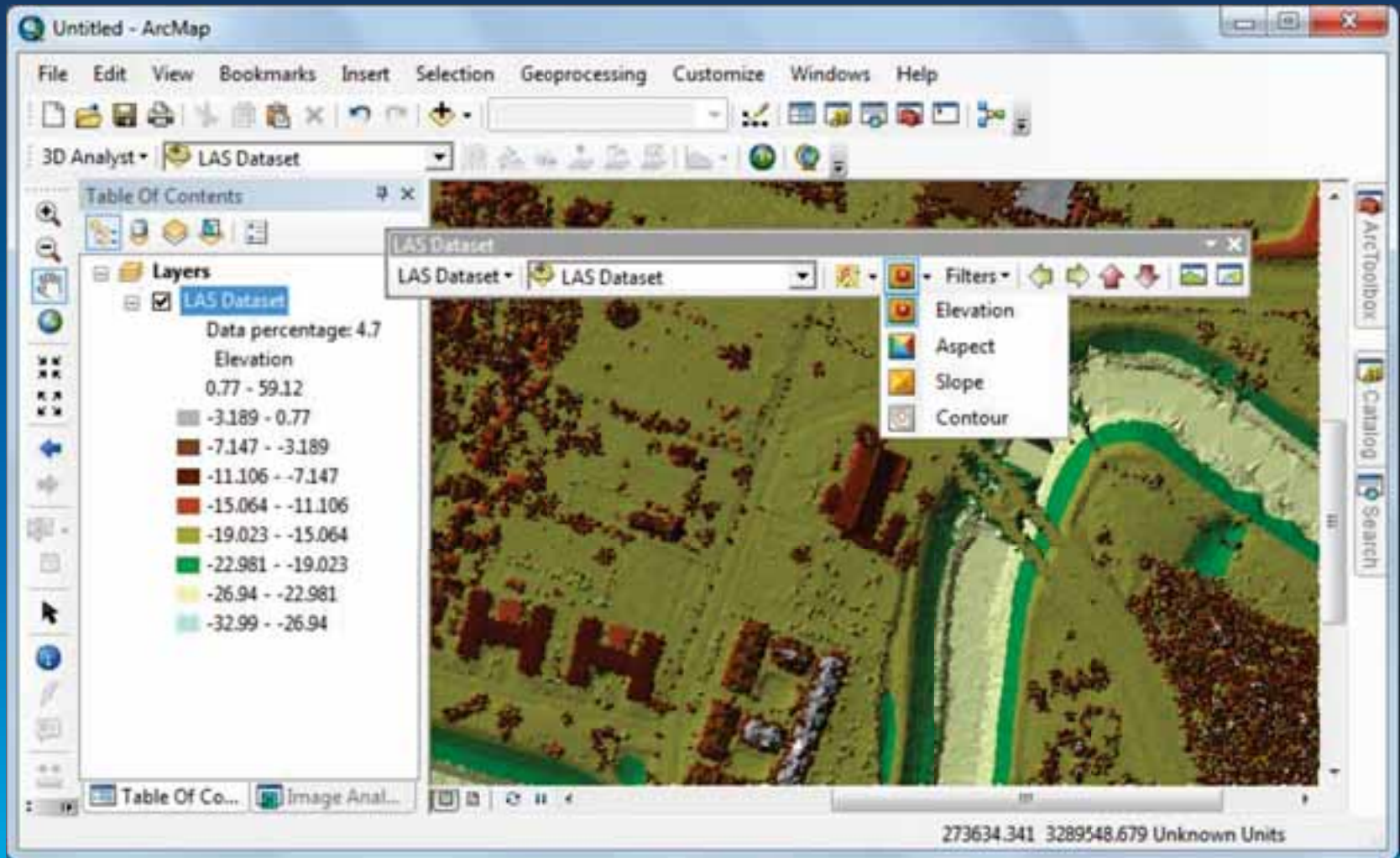
- **Derive surfaces**
 - As raster
 - As TIN
- **Direct surface analysis**
 - Interpolate shape
 - Add surface information
 - Line of sight
 - Skyline
 - Locate outliers
- **Rasterize on point metrics**
 - LAS point statistics as a surface



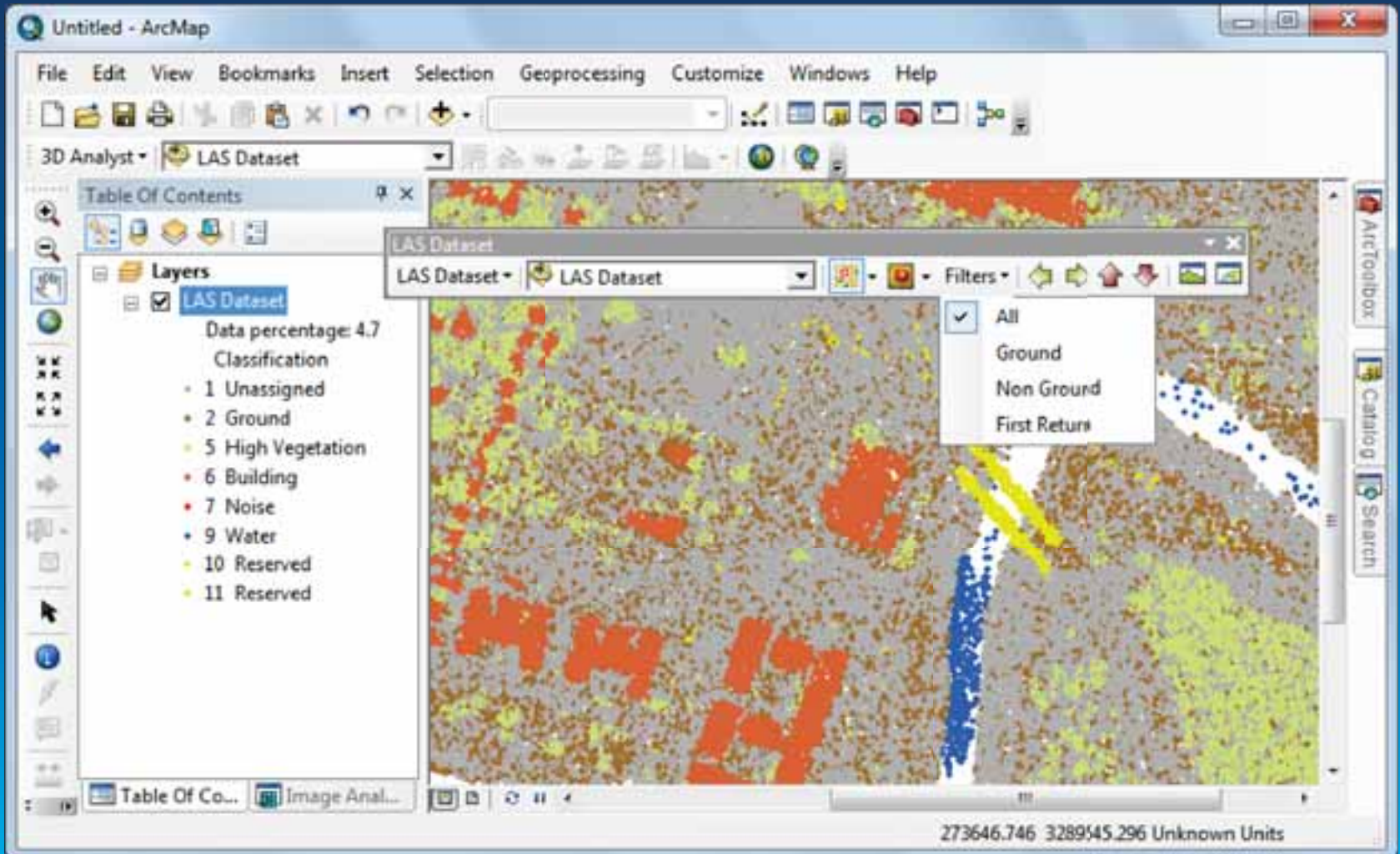
LAS Dataset – Point display



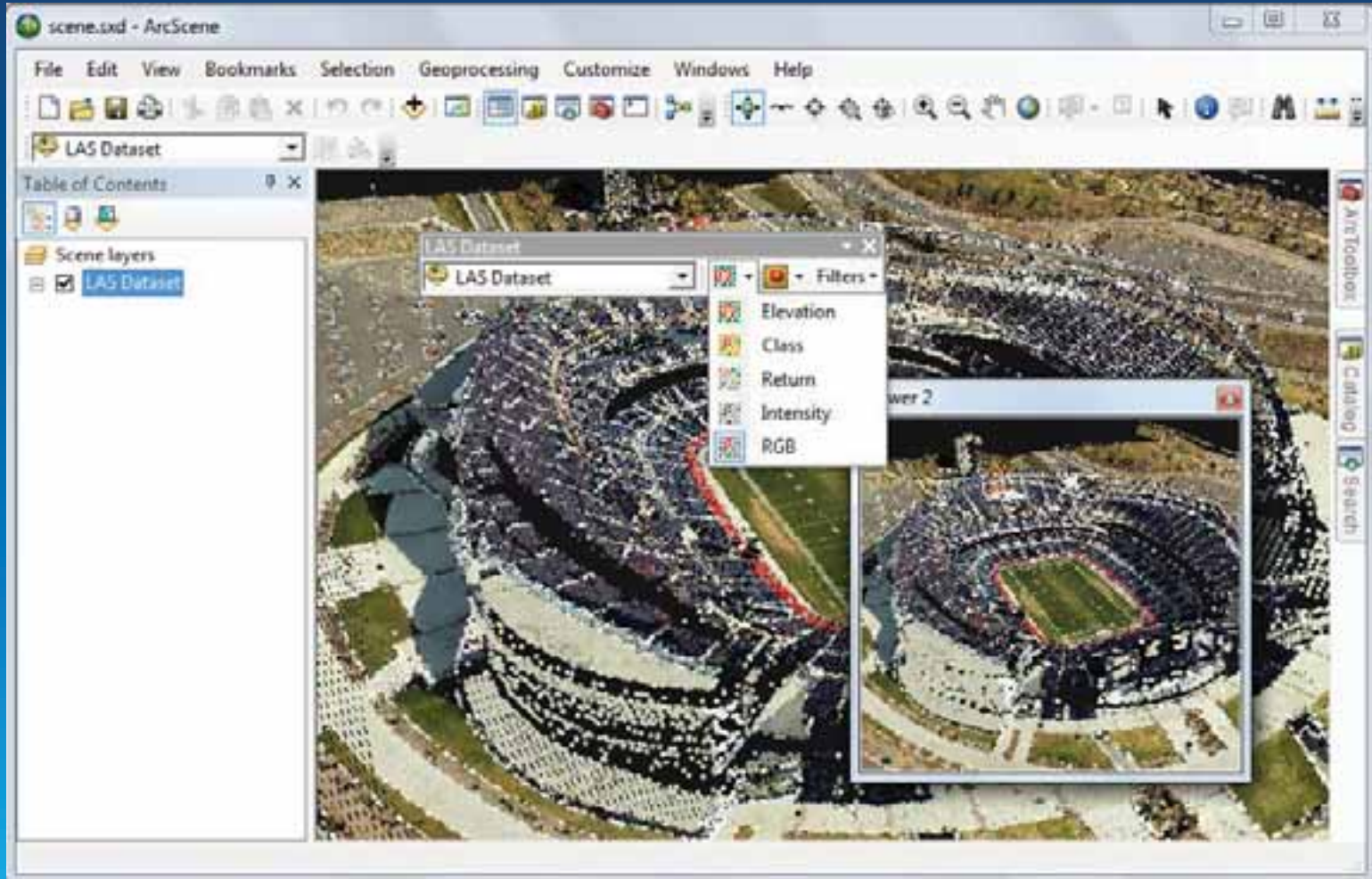
LAS Dataset – Surface Display



LAS Dataset – Point Filters



LAS Dataset – 3D Display in ArcScene



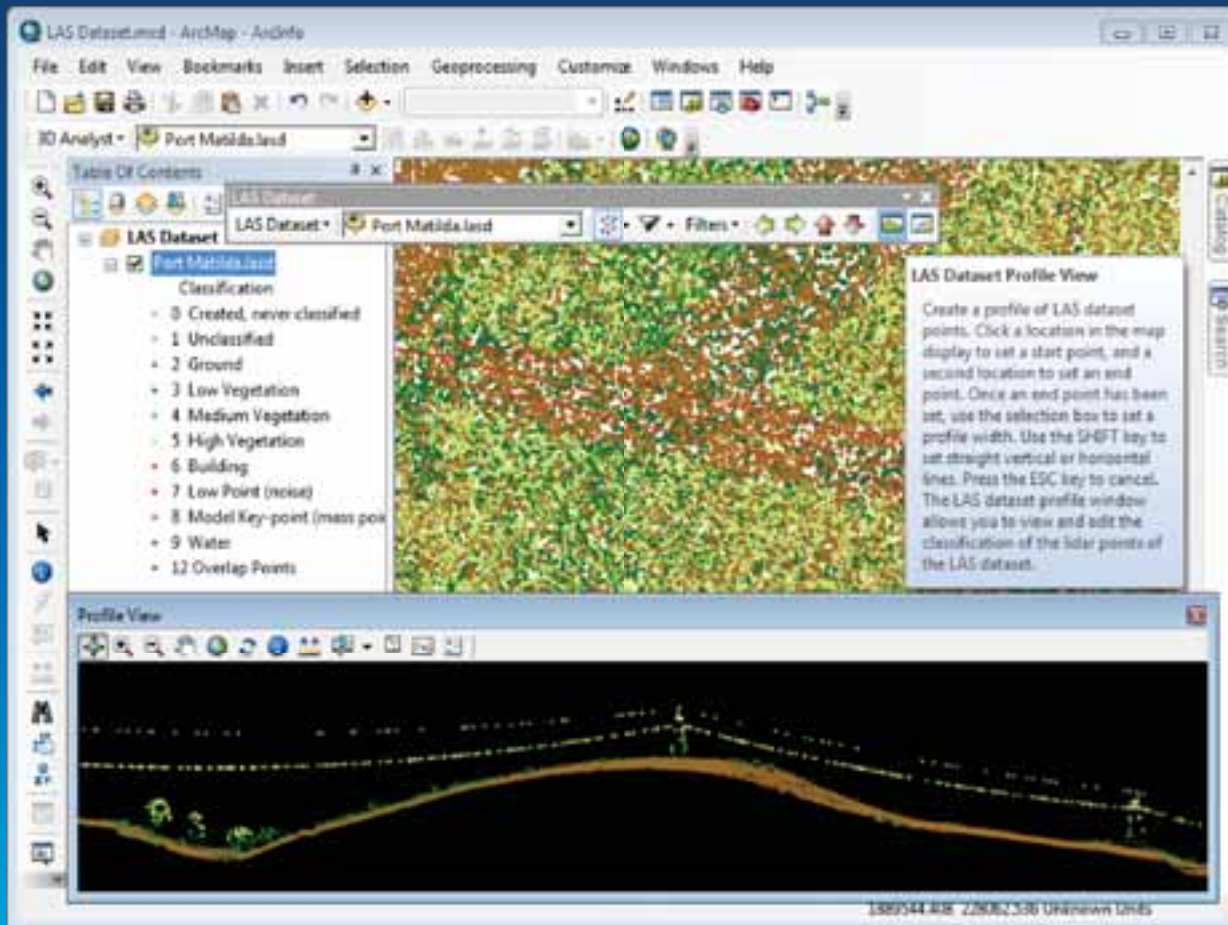
LAS Dataset

Editing Class Codes

- **Manual**
 - **Fixing data anomalies and misclassifications via point profile window**
- **Automated (GP tools)**
 - **Classify relative to feature data**
 - **Reclassify to standard LAS specification**

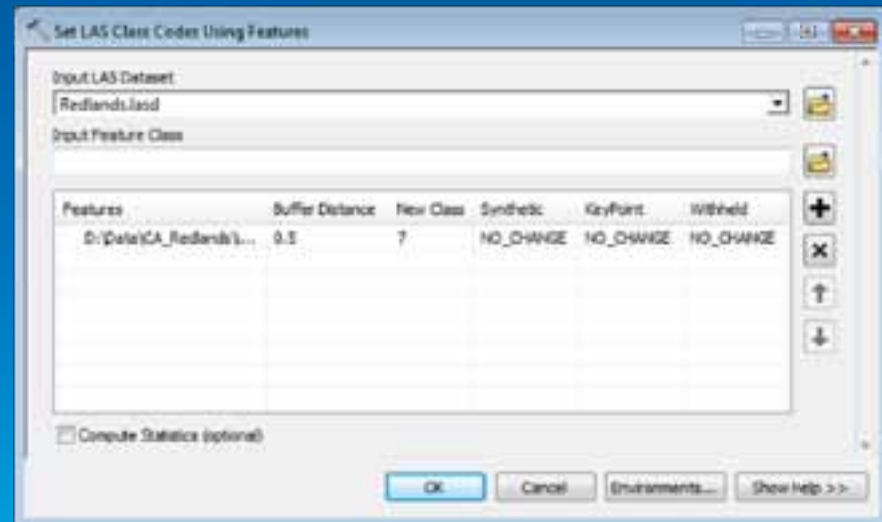
LAS Dataset

- Interactive Editing



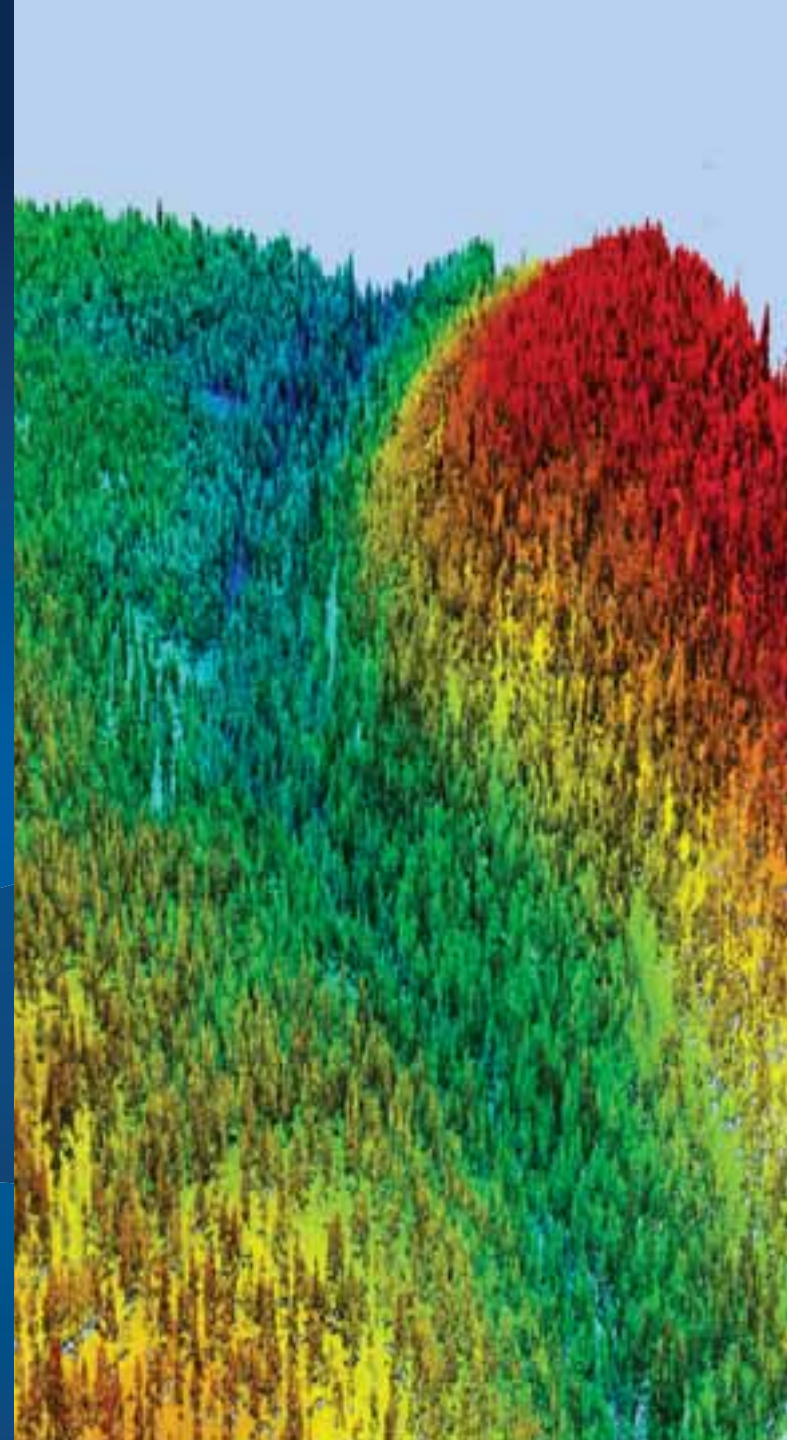
LAS Dataset – Manage

- **Batch Oriented Editing**
 - Change LAS Class Codes tool
 - Set class by proximity to feature data
 - Set LAS Class Codes Using Features
 - Reclassify old class to new class



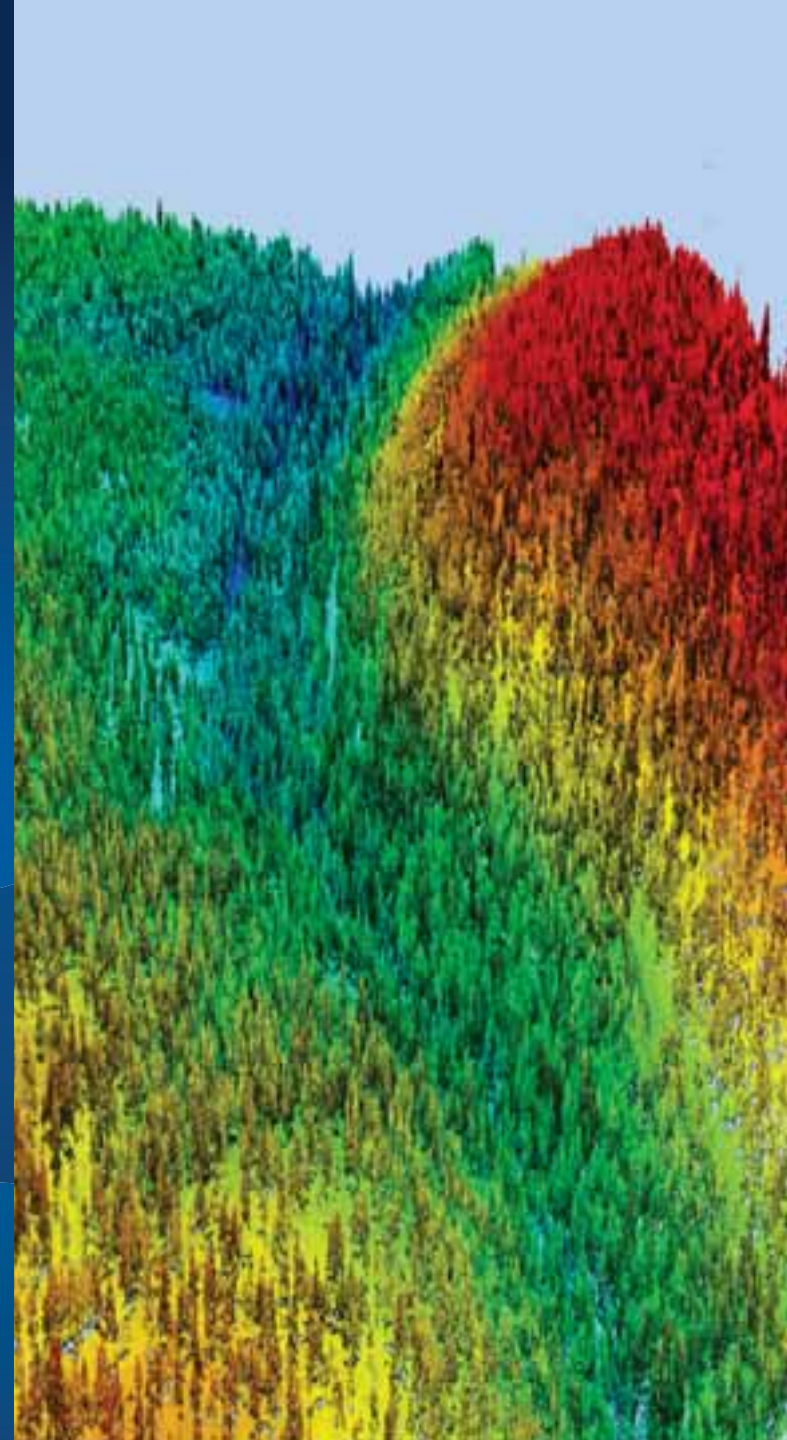
Demo

Create and use LAS Datasets



Topic

Sharing: Mosaic Datasets and Image Services



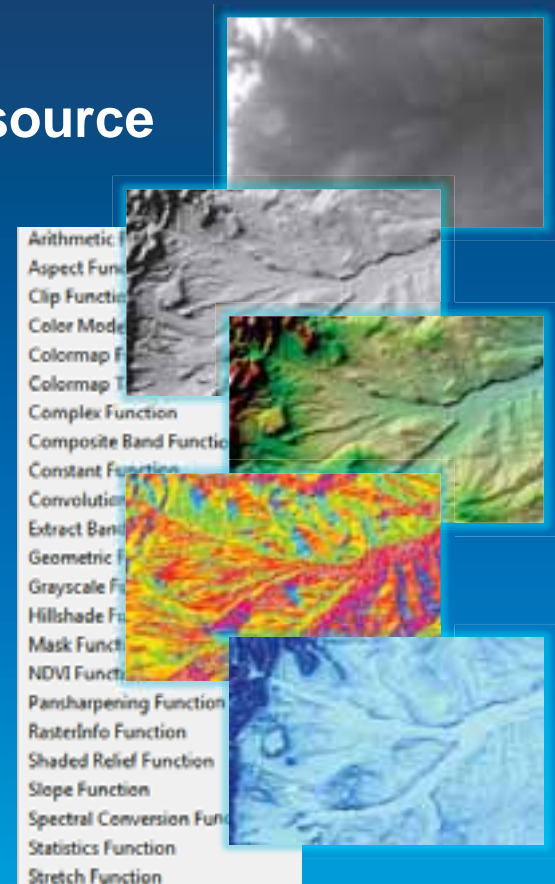
What is the Mosaic Dataset?

- A geodatabase data model used to catalog, process, visualize and share your collections of imagery and lidar data
- Support for
 - LAS files
 - LAS datasets
 - Terrain datasets
- Indirect data management
- Unlimited size
- Provides dynamic rasterization, mosaicking, and on-the-fly processing



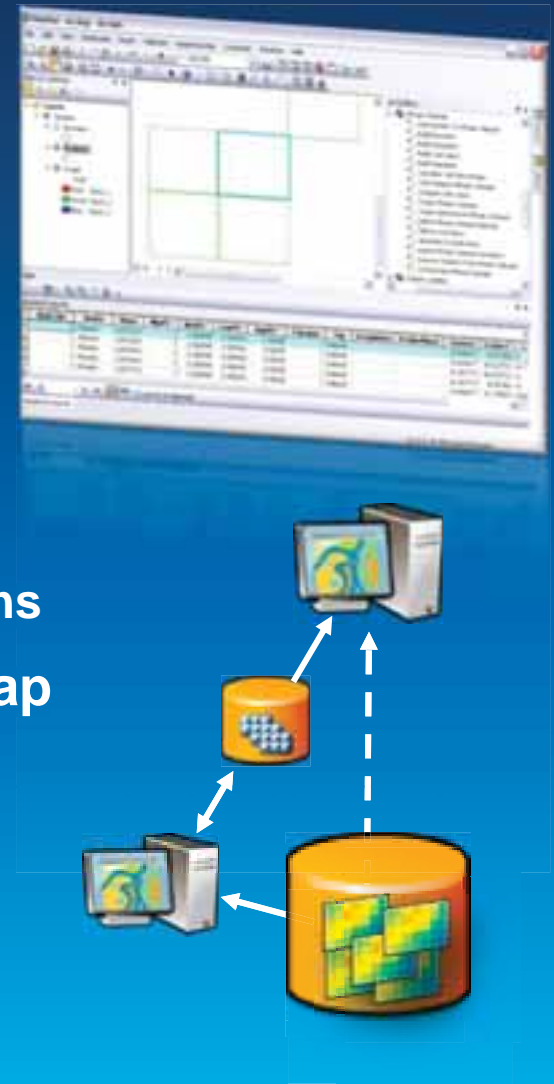
On-The-Fly Processing

- Data is processed as it is accessed
- Create multiple products from one source
- Processing for elevation
 - Hillshade
 - Shaded Relief
 - Aspect
 - Slope
 - Convolution Filters
- Define processing functions
 - On each item
 - On entire collection



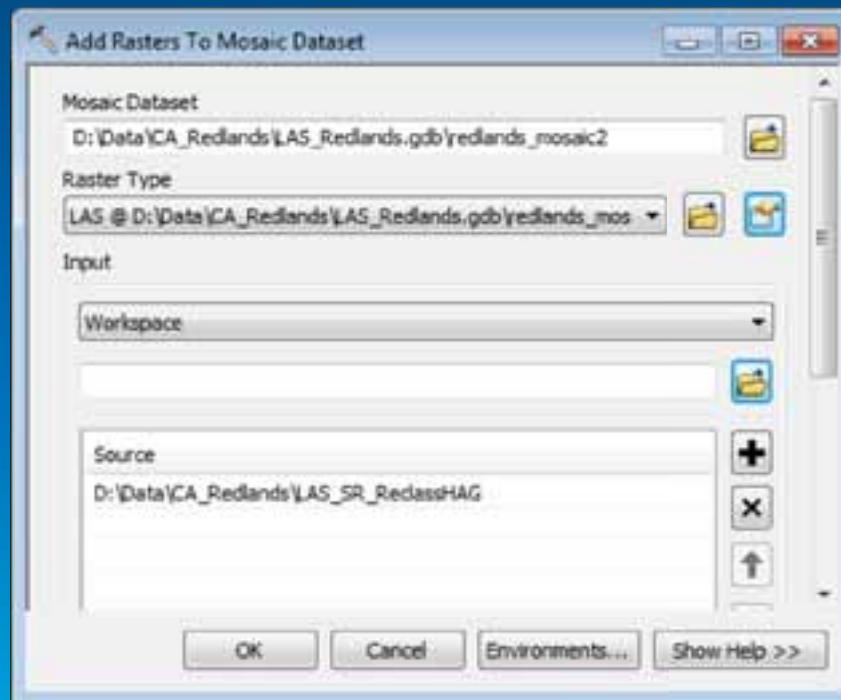
Building a Mosaic Dataset

- **Store in a geodatabase**
 - Build with geoprocessing tools
 - Automation with models or Python
- **Simple workflow**
 1. Create mosaic dataset
 2. Add imagery
 3. Optionally, edit properties and functions
- **Can interactively edit and view in ArcMap**
 - All layers are displayed
 - Edit and add fields in table window



Mosaic Dataset – Adding Lidar

- Lidar sources treated as raster type
 - LAS
 - LAS Dataset
 - Terrain Dataset



LAS Type Properties

Raster Type Properties

General Properties LAS Functions

Input Properties

Return types: Any
First
Second
Third
Fourth

Data type: Las Data 2

Class types: Any
0. Never Classified
1. Unclassified
2. Ground
3. Low Vegetation
4. Medium Vegetation
5. High Vegetation
6. Building
7. Man-Made Point

Output Properties

Pixel size (Required): 10

Binning

Cell aggregation type: Maximum

Void filling: None

Maximum width (blank or 0 = no limit)

Triangulation

Z factor: 1

Cache folder: D:\Data\CA_Redlands\LAS_Redlands.C

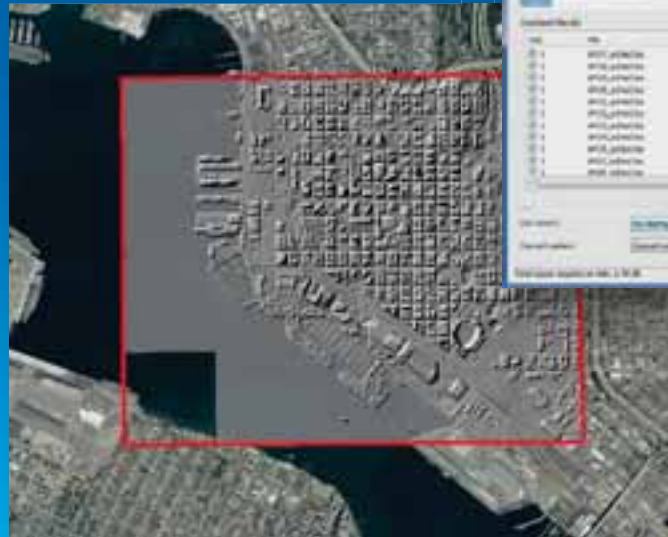
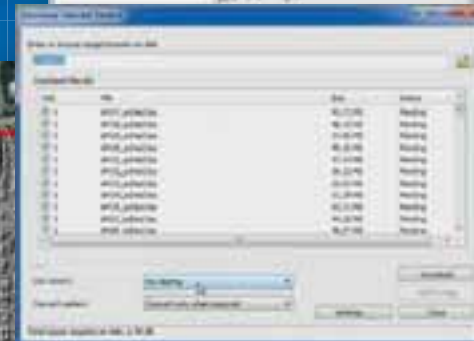
Number of cached surfaces: 10

Treat each folder as a dataset

OK Cancel Apply

Sharing Lidar Data

- Share as image services
- Easy to
 - Access
 - Discover
 - Download



Elevation Service – Download

The screenshot displays the ArcMap interface with the 'Elevation Service' layer selected in the Table of Contents. A context menu is open over the layer, and the 'Data' option is selected, which has opened a sub-menu where 'Download Selected Rasters...' is highlighted. A dialog box titled 'Download Selected Rasters' is open, showing a list of raster files with their IDs, names, sizes, and download statuses. The dialog also includes options for 'Clip rasters' and 'Convert rasters', and a 'Total space required on disk' of 58.89 MB.

ID	File	Size	Status
1	227815726.tif	495.08 kB/495...	Done
2	227815730.tif	7.02 MB/7.02 MB	Done
3	22831770.tif	38.24 MB	Downloading...
4	22831772.tif	3.02 MB	Pending...
5	22831775.tif	29.44 MB	Pending...
6	22831772.tif	25.24 MB	Pending...
7	22831774.tif	56.53 kB	Pending...
8	22841777.tif	35.62 MB	Pending...
9	22841774.tif	1.72 MB	Pending...

Download Selected Rasters
Opens the Download Selected Rasters window. This dialog allows you to download the selected items of the dataset.

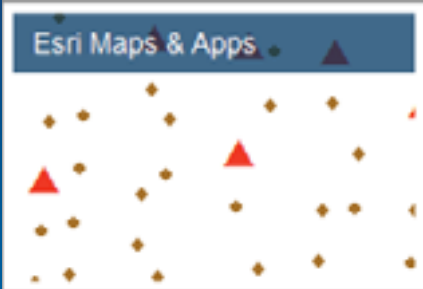
2278156.905 1770568.299 Feet

3D Resource Center - Utilities

CheckLAS



LAS Model Key



LAS To LAS



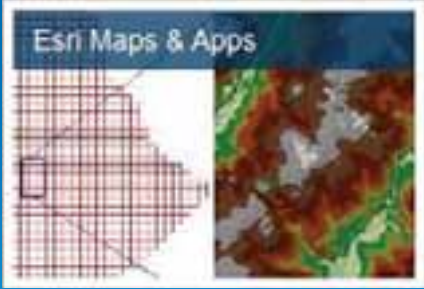
Height Above Ground



Ground Classifier

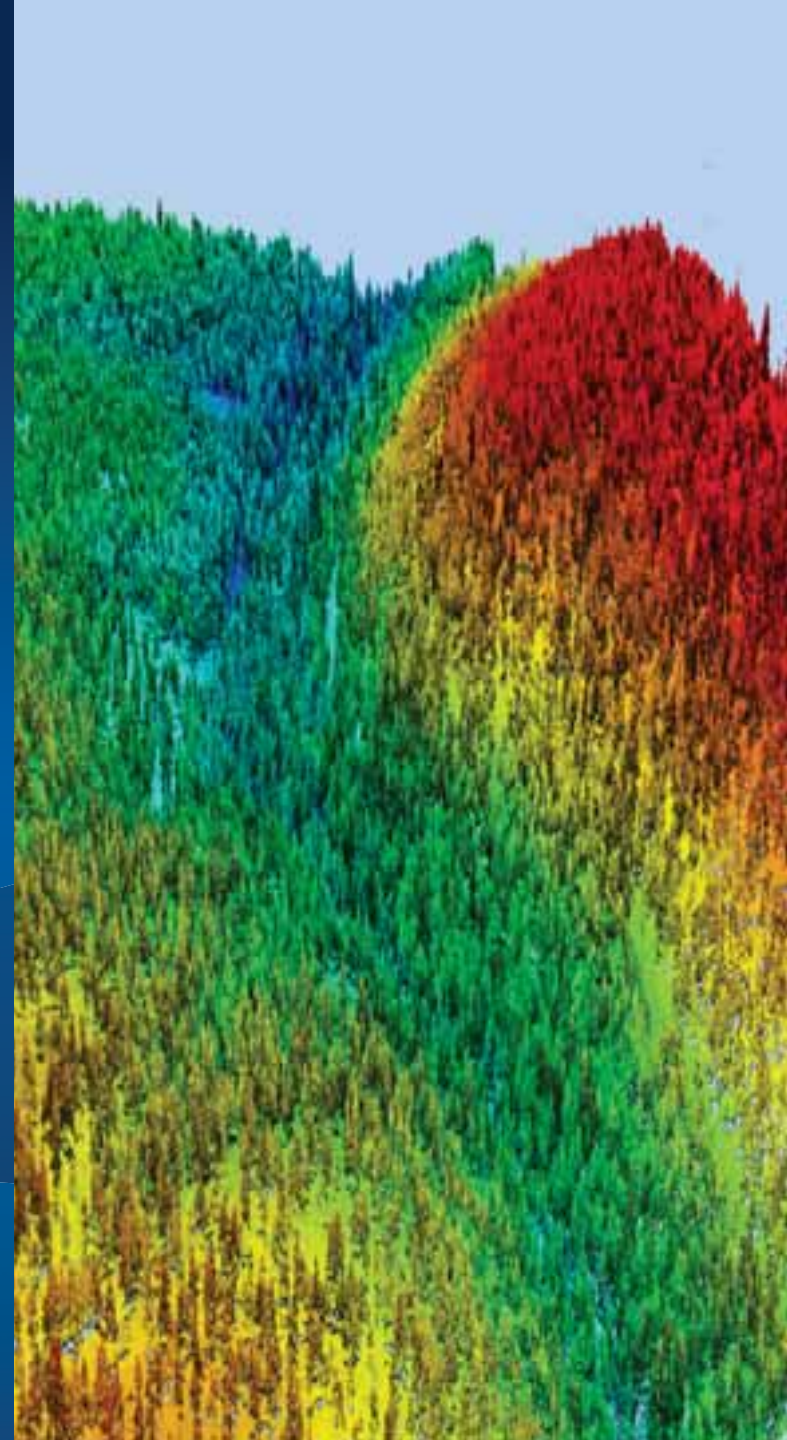


LAS Dataset Tools



Demo

Sharing: Mosaic Datasets and Image Services





Understanding our world.