

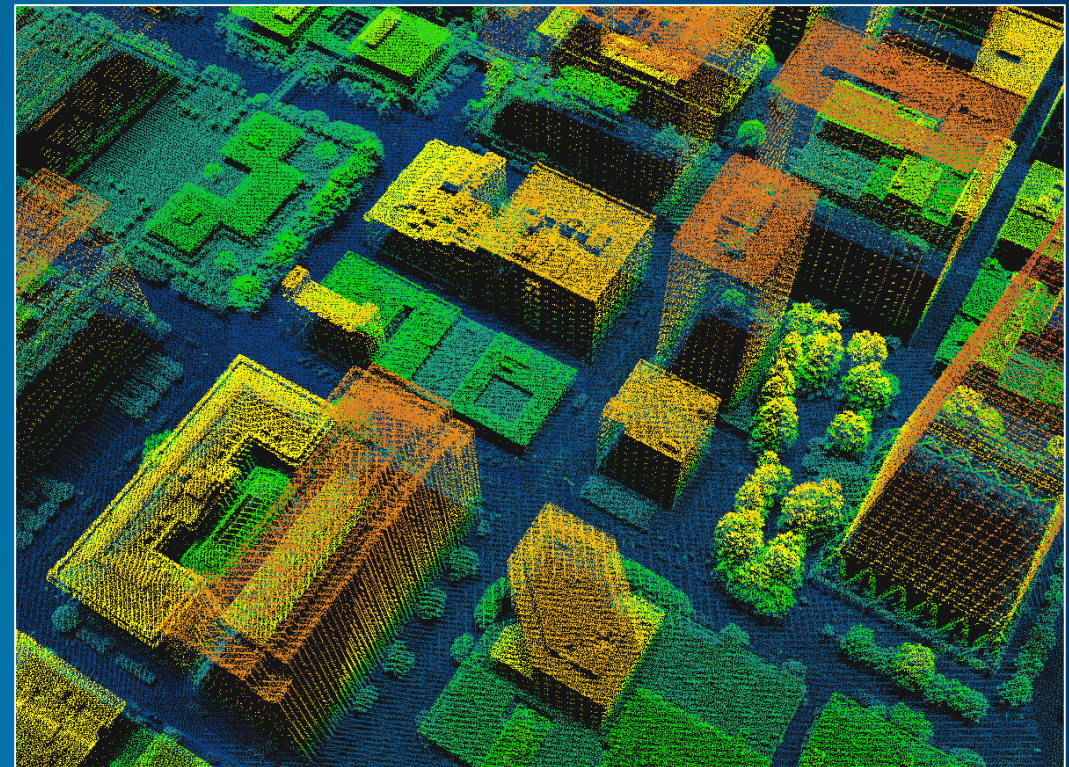


Working with Lidar and LAS Datasets

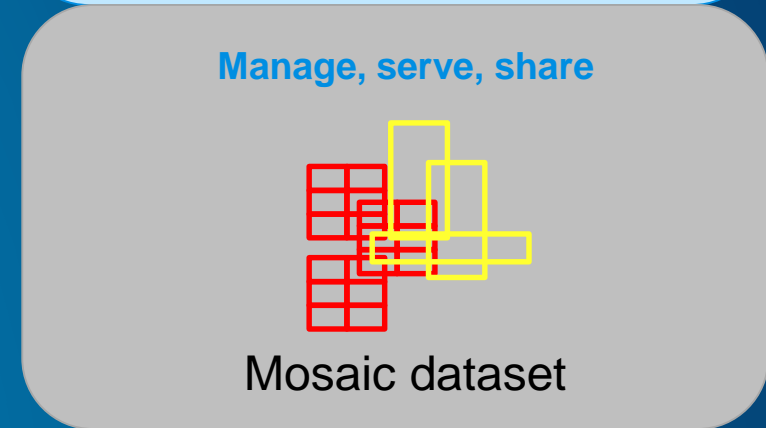
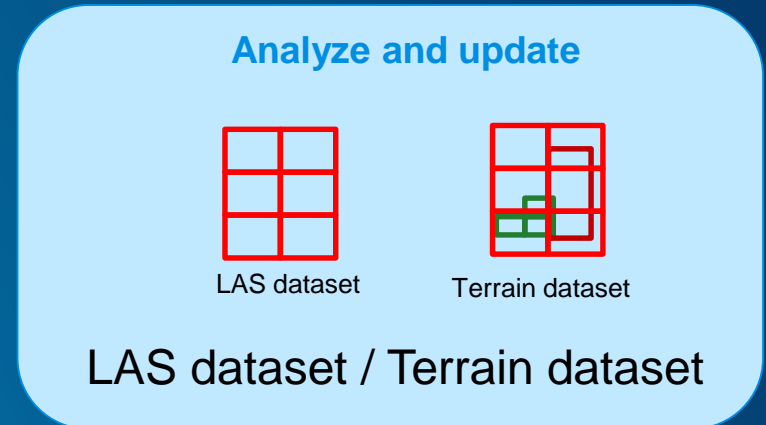
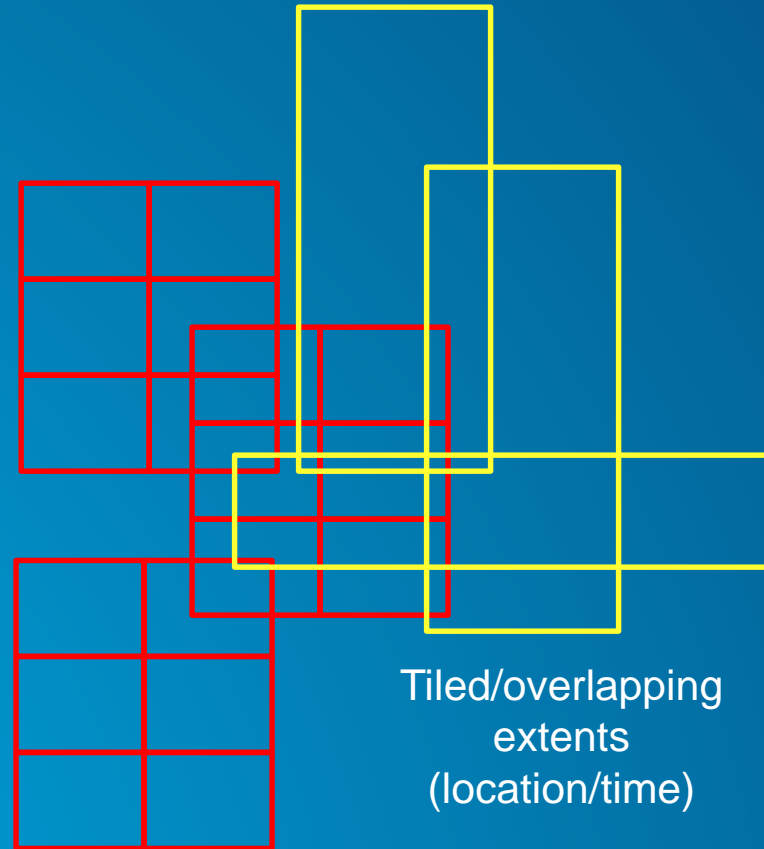
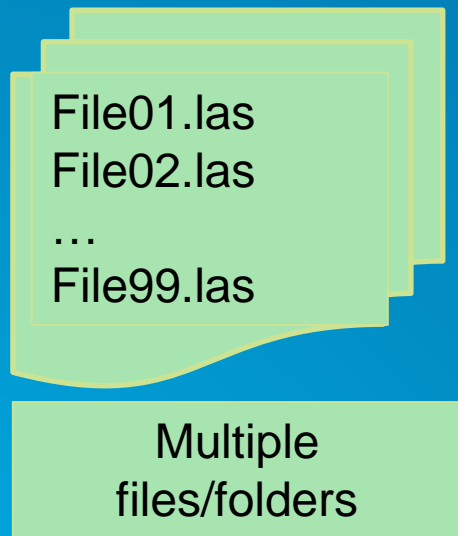
Lindsay Weitz

Agenda

- LAS and zLAS formats
- LAS Dataset – for lidar & surface constraints
- New analysis tools for lidar
- ArcGIS Pro

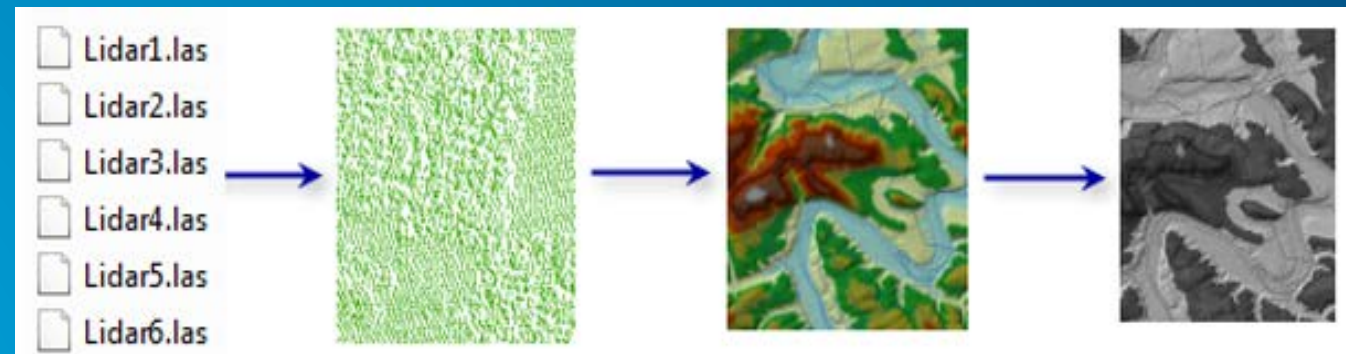


Data Structures for Lidar support in ArcGIS



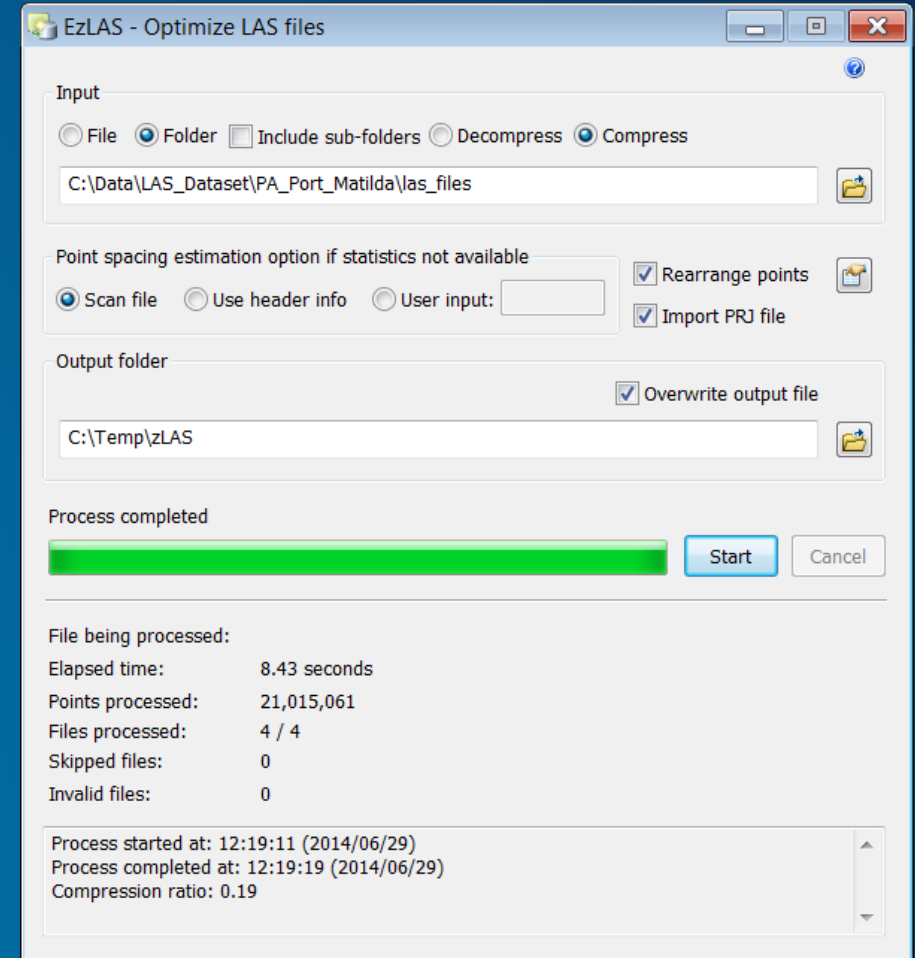
Lidar data storage – LAS files

- Binary file format developed by ASPRS
- Metadata in a header block
- Individual record for each laser pulse recorded
- Directly readable by ArcGIS
- Most common format for lidar and other point clouds (e.g. from photogrammetry), but designed as an exchange/archive format, not optimized for operational use...



Lidar data storage – zLAS

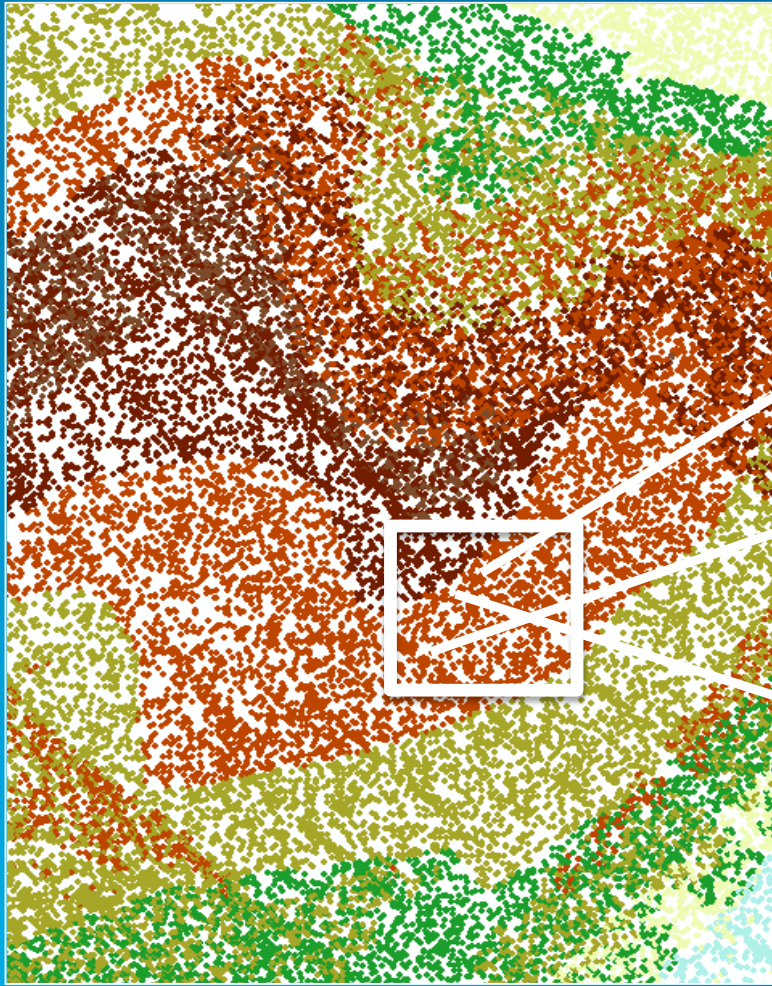
- Introduced January 2014
- Compression, sorting, and indexing
- Direct read
 - Parallel decompression added to ArcGIS apps in 10.3
- Features & Benefits
 - Re-sequence points w/ geospatial index
 - Optimized for random access
 - Lossless compression
 - Transparent integration with LAS dataset



zLAS

- **Free!! Does not require ArcGIS**
- **Support added in 10.2.1**
- **Standalone application “EzLAS” on Resource Center**
 - <http://esriurl.com/zLAS>
- **API available for developers**
 - <https://github.com/Esri/esri-zlas-io-library>
- **For more info:**
 - <http://blogs.esri.com/esri/arcgis/2014/01/10/esri-introduces-optimized-las/>
 - <http://www.lidarnews.com/content/view/10214/2/>

Rearranging Point Records

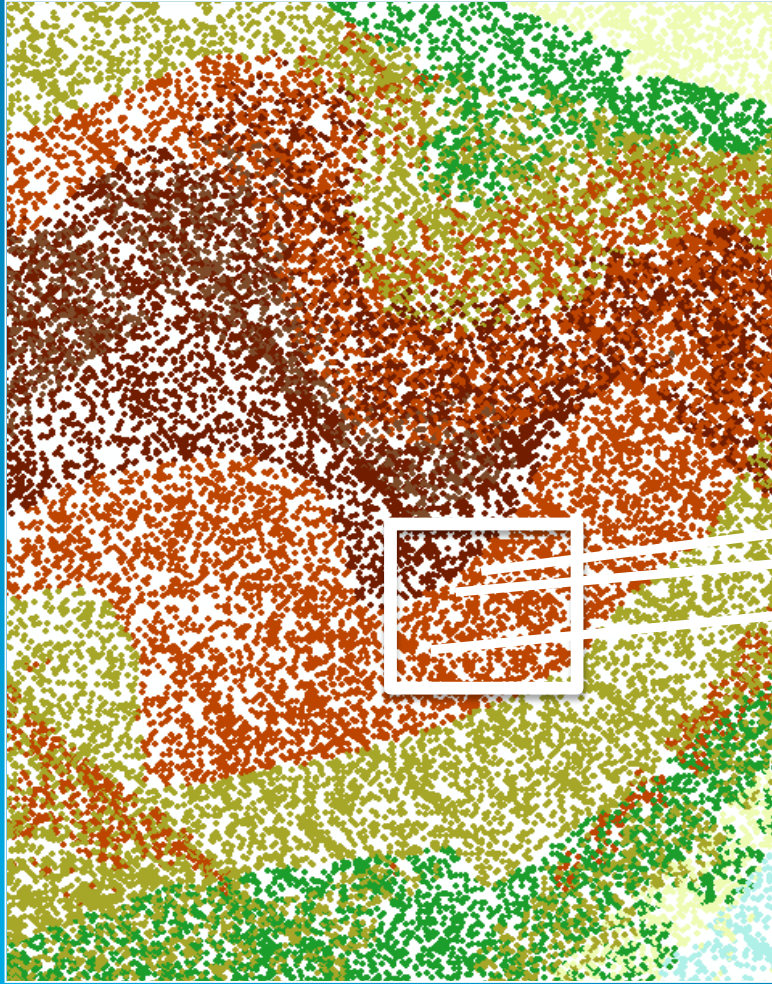


Spatial distribution of points



Physical location in file

Rearranging Point Records



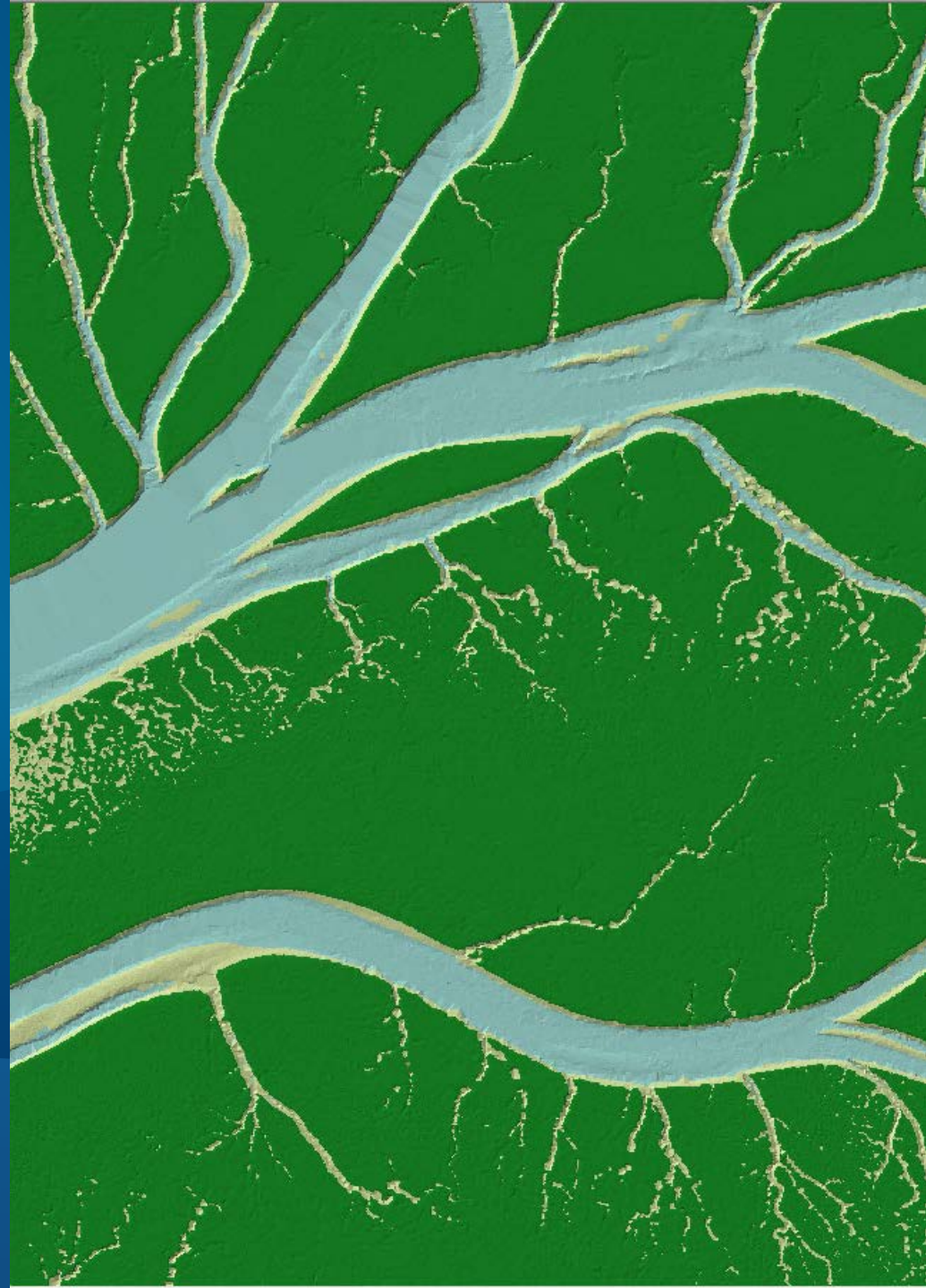
Spatial distribution of points



Physical location in file

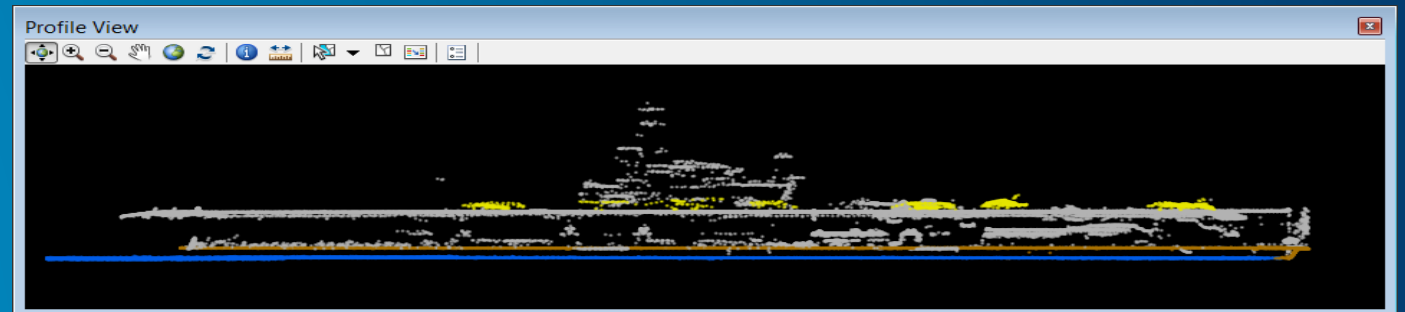
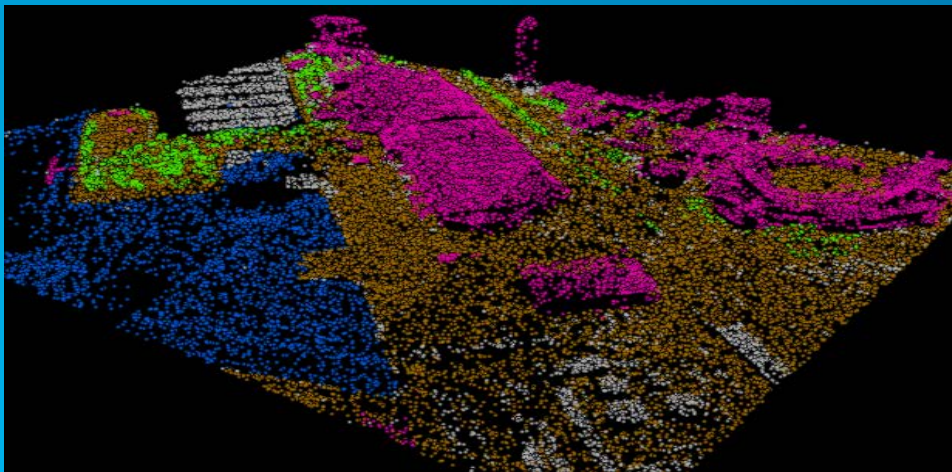
LAS dataset

Lindsay Weitz



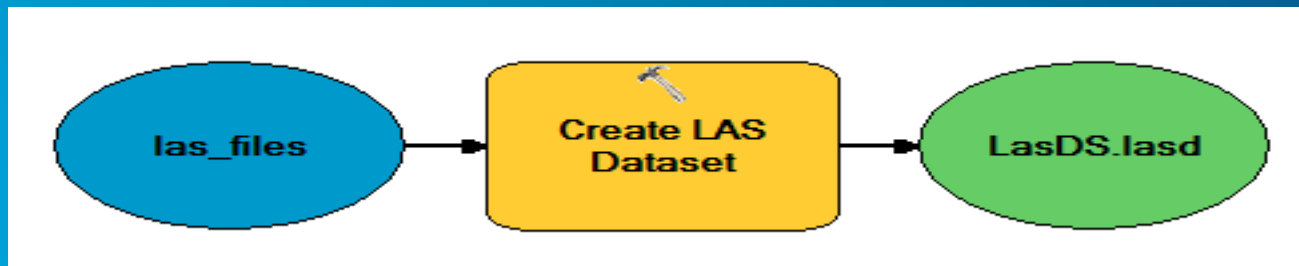
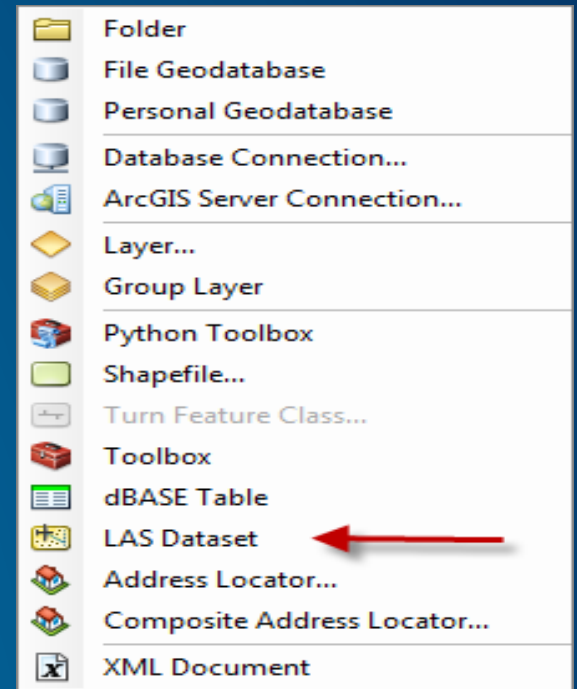
Lidar data with a LAS dataset

- Direct read of LAS or zLAS format lidar
- File based
- QA/QC tools
- Stores references to LAS/zLAS files on disk
- Optionally reference breakline and control point data
- Treats a collection of LAS/zLAS files as one logical dataset (“Project”)



Create a LAS dataset

- Interactively through ArcCatalog
 - Use the file folder context menu
- Using scripts and models with geoprocessing tools



QA/QC: LAS file based statistics

- LAS Dataset Properties: LAS File Statistics

LAS Dataset Properties

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

Show: Show full path of LAS files

LAS File	Version	Point Count	Point Spacing	Z Min	Z Max	Statistics
Tile000001.las	1.2	4,185,584	2.752	-1329.980	841.490	...
Tile000002.las	1.2	4,385,886	2.790	163.250	913.630	...
Tile000003.las	1.2	4,443,149	2.754	208.390	1570.620	...
Tile000004.las	1.2	4,516,182	2.672	306.460	3985.370	...
Tile000005.las	1.2	4,594,846	2.712	-1465.180	2222.280	...
Tile000006.las	1.2	3,932,164	2.841	270.430	4117.540	...
Tile000007.las	1.2	4,055,510	2.852	-1293.050	4443.310	...
Tile000008.las	1.2	3,753,963	2.924	-888.170	4304.190	...
Tile000009.las	1.2	4,137,014	2.730	269.300	2713.120	...
Tile000010.las	1.2	3,991,642	2.809	253.860	4781.180	...
Tile000011.las	1.2	4,191,951	2.745	304.500	1170.370	...
Tile000012.las	1.2	4,002,169	2.776	172.900	1126.230	...
Tile000013.las	1.2	4,096,047	2.839	131.850	1229.190	...
Tile000014.las	1.2	4,243,287	2.854	-1278.000	2263.900	...
Tile000015.las	1.2	4,376,649	2.791	141.000	876.760	...
Tile000016.las	1.2	4,515,783	2.758	251.510	954.270	...
Tile000017.las	1.2	4,375,951	2.804	153.780	804.680	...
Tile000018.las	1.2	4,819,498	2.668	-1276.780	1308.510	...
Tile000019.las	1.2	3,633,209	2.894	56.650	4792.580	...

Add Files... Add Folders... Remove

OK Cancel Apply

LAS File Properties and Statistics

General

Has RGB: No
Has GPS Time: Yes (Week Time)
System ID:
Generating Software: TerraScan
Project ID: {00000000-0000-0000-0000-000000000000}
File Source ID: 0
Variable Length Reco... 0

Extent

Min X: 6107000.010000 Max X: 6112000.000000
Min Y: 2156000.000000 Max Y: 2160999.990000
Min Z: -1329.980000 Max Z: 841.490000

X Range: 4999.990000
Y Range: 4999.990000
Z Range: 2171.470000

XY Linear Unit: <Not Available>
Z Unit: <Not Available>

Returns

Return	Point Count	%	Z Min	Z Max
First	2,703,864	64.60	354.09	841.49
Second	309,756	7.40	-1329.98	823.06
Third	39,249	0.94	354.32	804.13
Fourth	3,106	0.07	354.25	737.85
Last	2,702,854	64.58	-1329.98	835.17
Single	2,393,172	57.18	354.09	835.17

Classification Codes

Classification	Point Count	%	Z Min	Z Max	Min Inte...	Max Inte...	Syntheti...
1 Unassigned	324,038	7.74	354.52	831.89	1	5100	0
2 Ground	1,510,439	36.09	354.06	831.92	1	5100	0
4 Medium Vegetation	434,338	10.38	355.60	841.49	1	5100	0
5 High Vegetation	773,612	18.48	355.89	835.17	1	5100	0
7 Noise	5,890	0.14	-1329.98	828.10	1	116	0
10 Reserved	7,658	0.18	473.54	611.93	3	240	0

Previous File Next File Update Force recalculate OK

QA/QC: LAS dataset based statistics

- LAS Dataset Properties: LAS Dataset 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 five return types. The 'Attributes' table shows statistics for seven attributes. The 'Classification Codes' table shows data for ten classification codes. The 'Classification Flags' table shows data for three flags. There are also 'Update' and 'Force recalculate' buttons, and a status message 'Statistics up to date.' at the bottom.

Returns

Return	Point Count	%	Z Min	Z Max
First	127,142,853	64.47	-2.87	4904.20
Second	14,114,138	7.16	-1465.18	3865.93
Third	2,311,095	1.17	-24.17	3856.25
Fourth	288,130	0.15	3.48	1042.10
Last	127,075,116	64.43	-1465.18	3110.63
Single	112,971,756	57.28	-2.87	3110.63

Attributes

Name	Min	Max
Return No.	1	4
Intensity	1	5100
Class Code	1	13
Scan Angle	-20	21
User Data	32	32
Point Source	1	22

Classification Codes

Classification	Point Count	%	Z Min	Z Max	Min Int...	Max Int...	Synthe...
1 Unassigned	15,089,345	7.65	-2.52	1037.80	1	5100	0
2 Ground	71,967,419	36.49	-2.68	1027.81	1	5100	0
4 Medium Vegetation	20,540,689	10.41	0.95	1091.61	1	5100	0
5 High Vegetation	35,520,764	18.01	-1.11	1092.23	1	5100	0
6 Building	2,205	0.00	240.90	255.09	7	159	0
7 Noise	600,129	0.30	-1465.18	1020.76	1	5100	0
10 Reserved	135,090	0.07	21.83	611.93	1	1160	0

Classification Flags

Name	Point Count	%
Model Key	0	0.00
Synthetic	0	0.00
Withheld	53,368,166	27.06

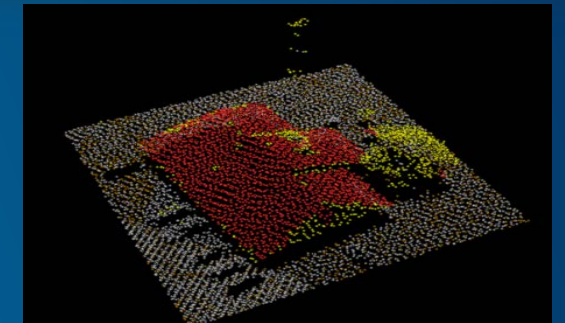
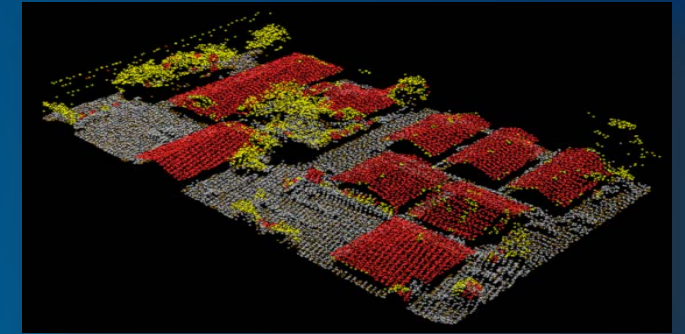
Update Force recalculate

Statistics up to date.

OK Cancel Apply

Edit classification codes

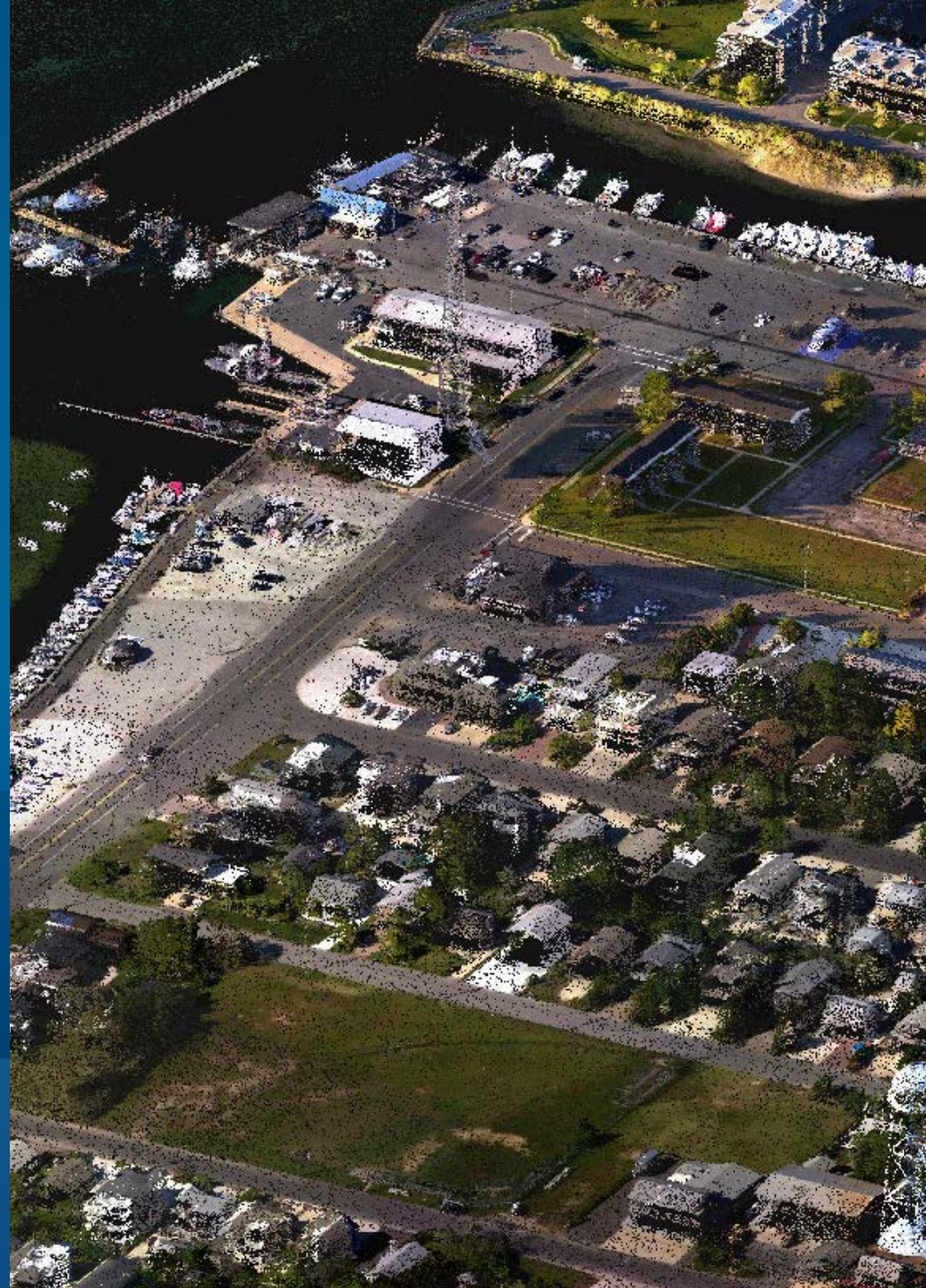
- Interactive
 - Fixing data anomalies and misclassifications via point profile window
- Automated (GP tools)
 - Classify relative to feature data
 - Reclassify to standard LAS specification



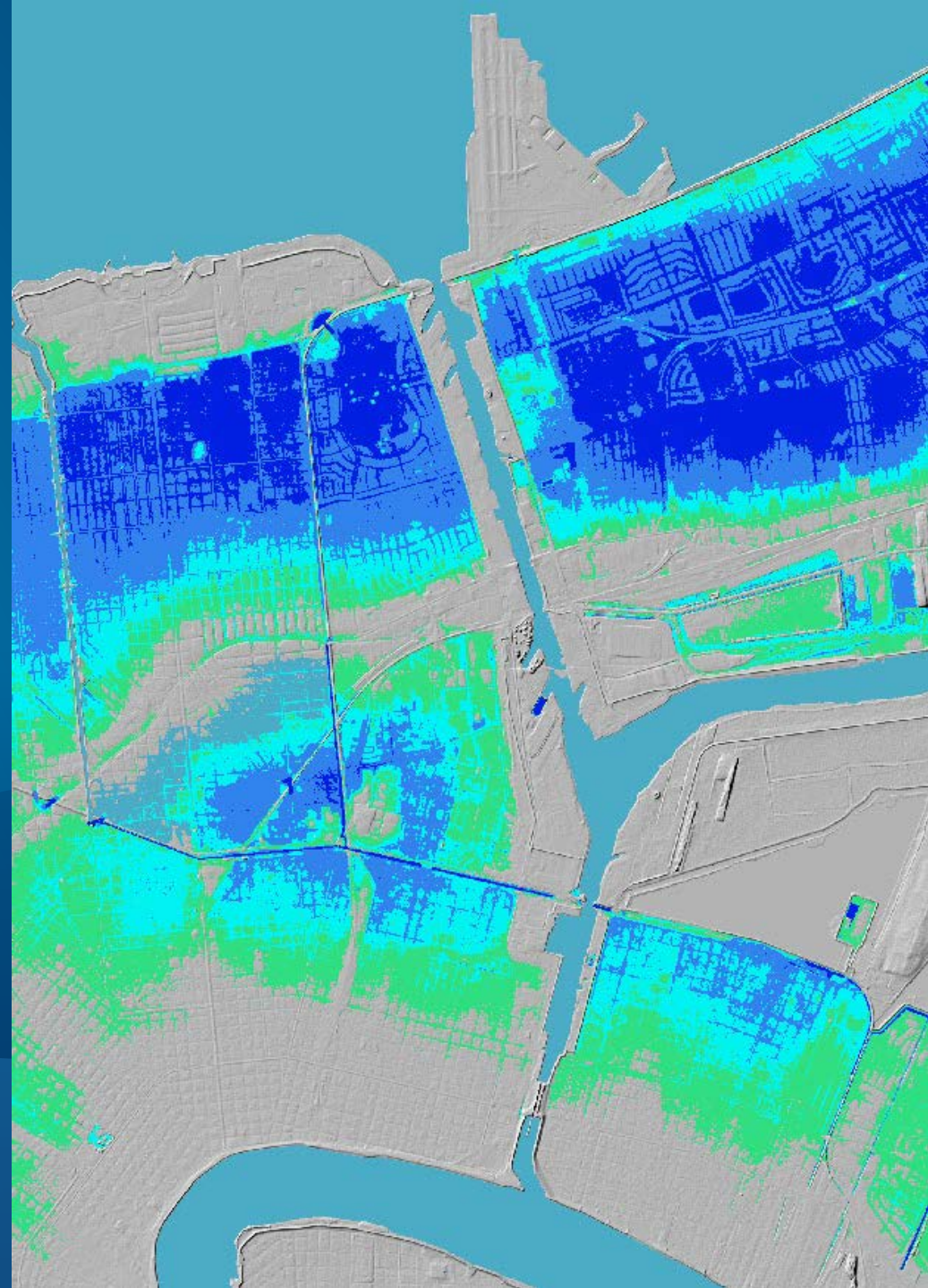
DEMO

LAS dataset demo

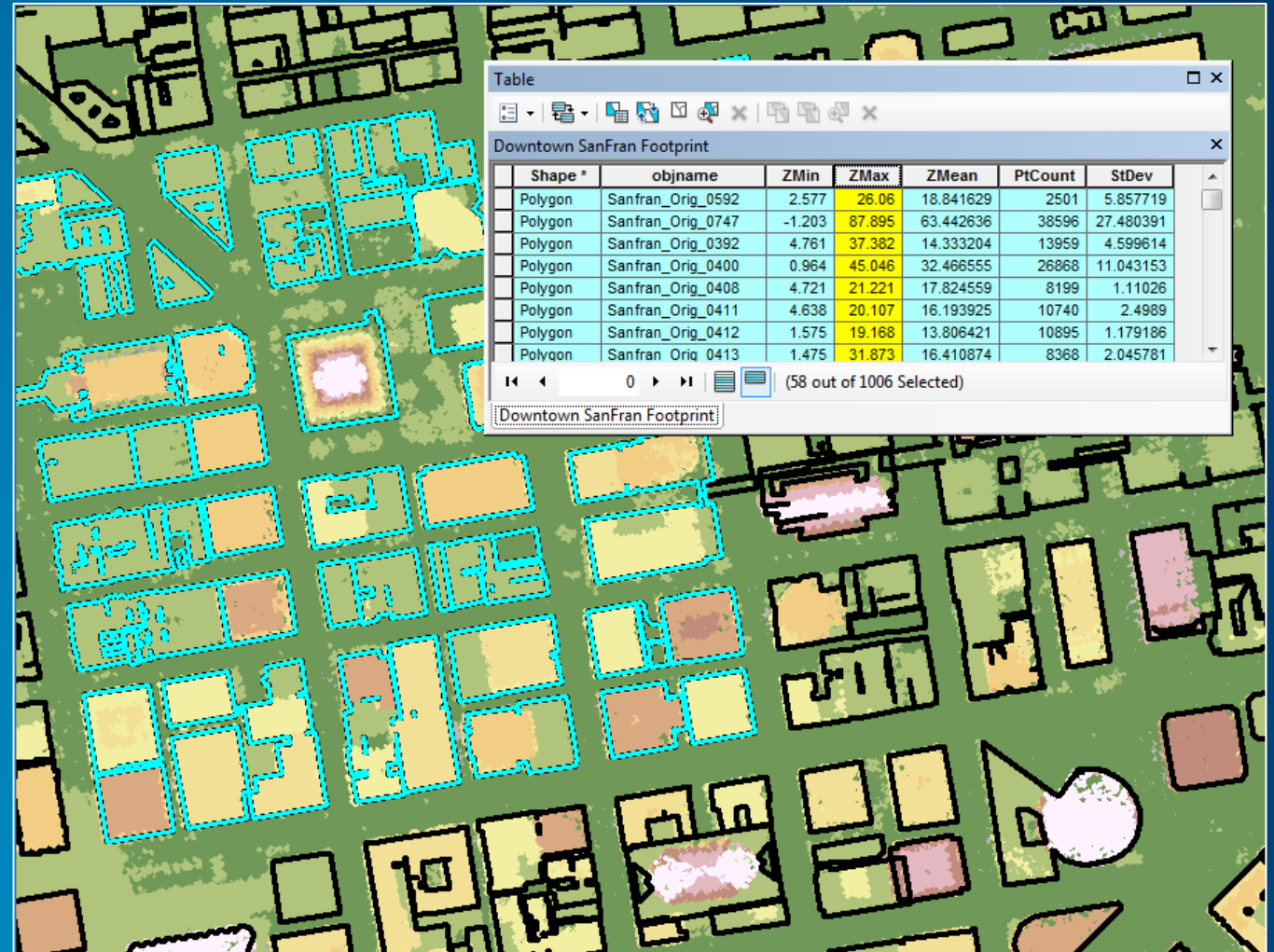
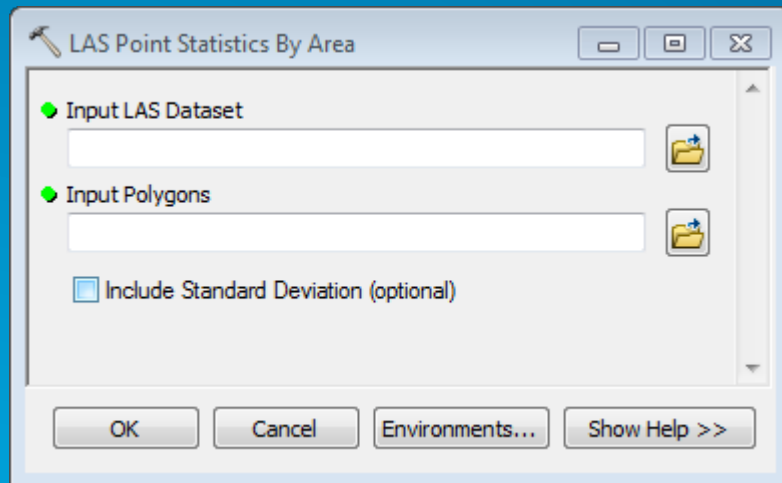
Lindsay Weitz



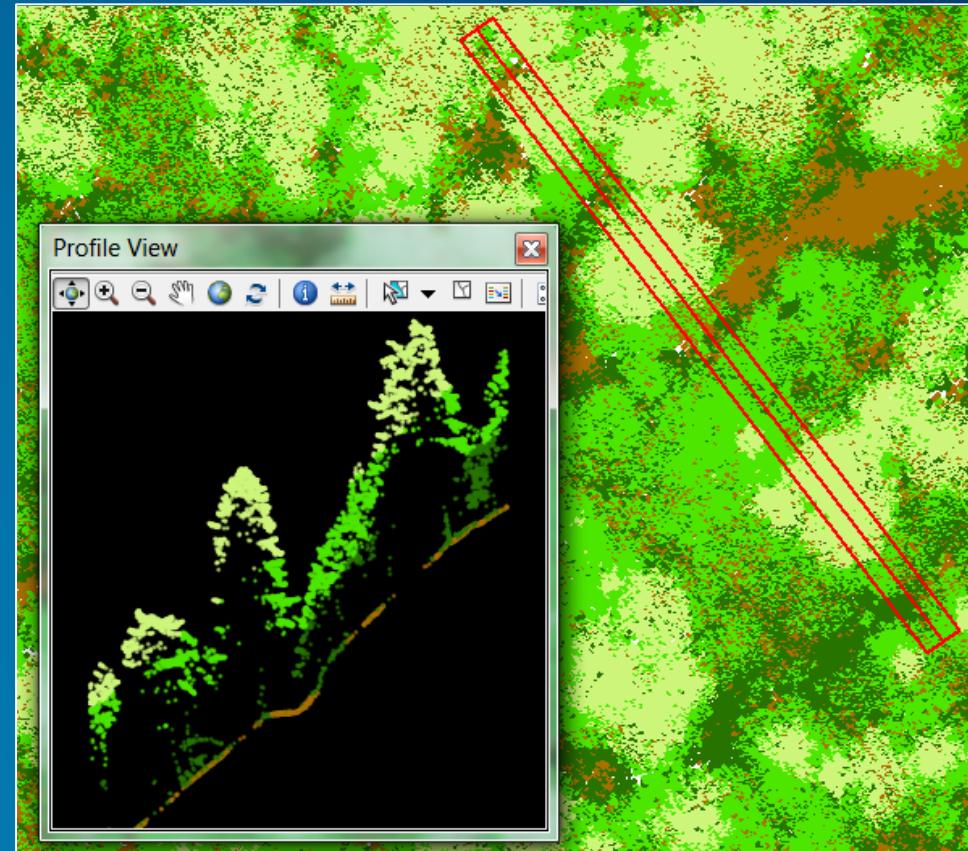
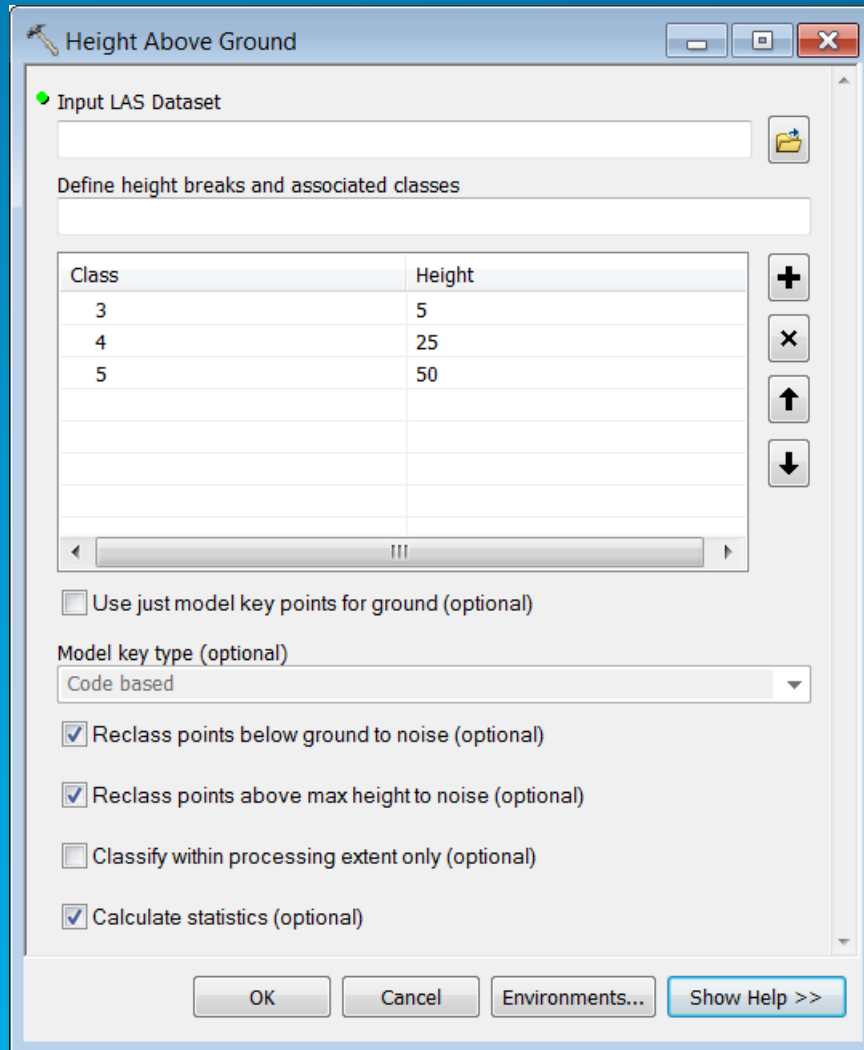
Lidar Related Analysis Tools



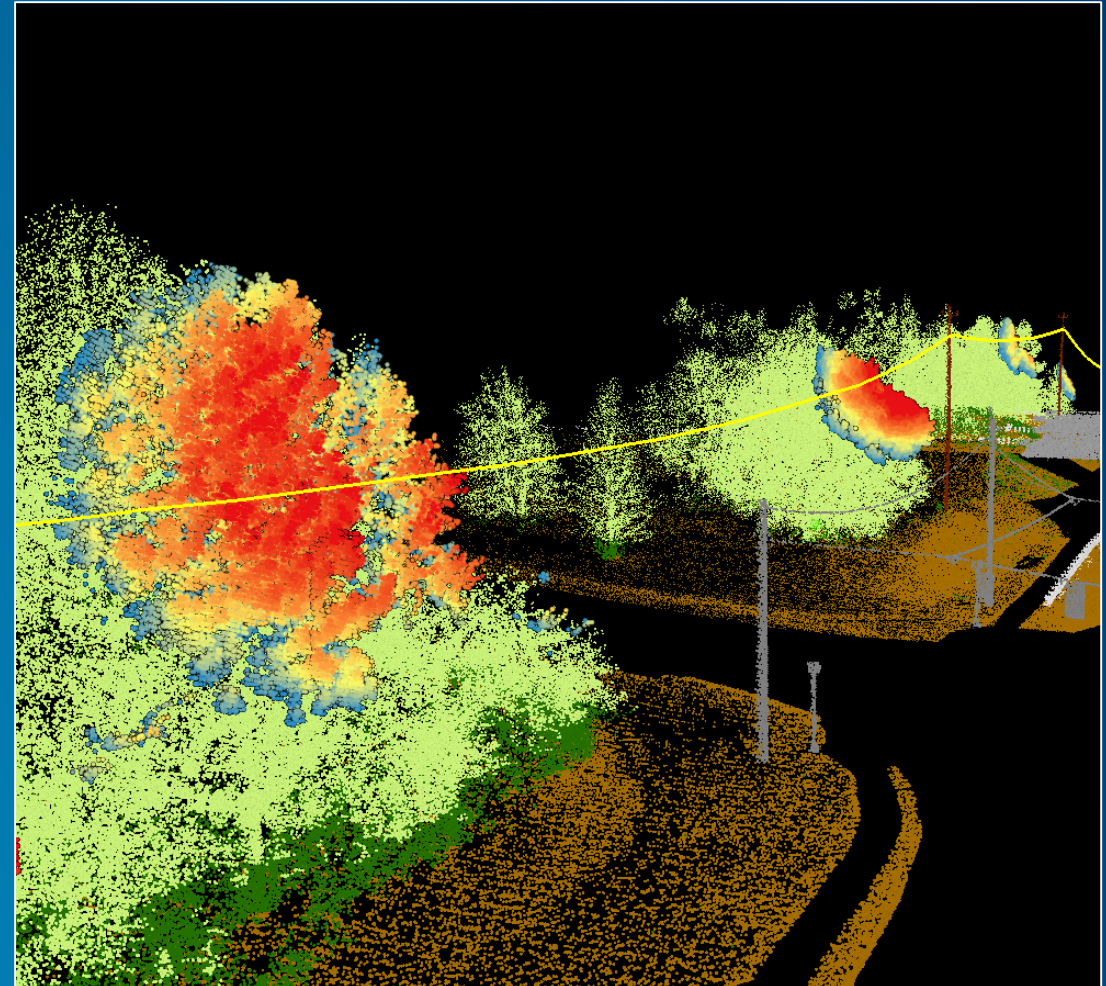
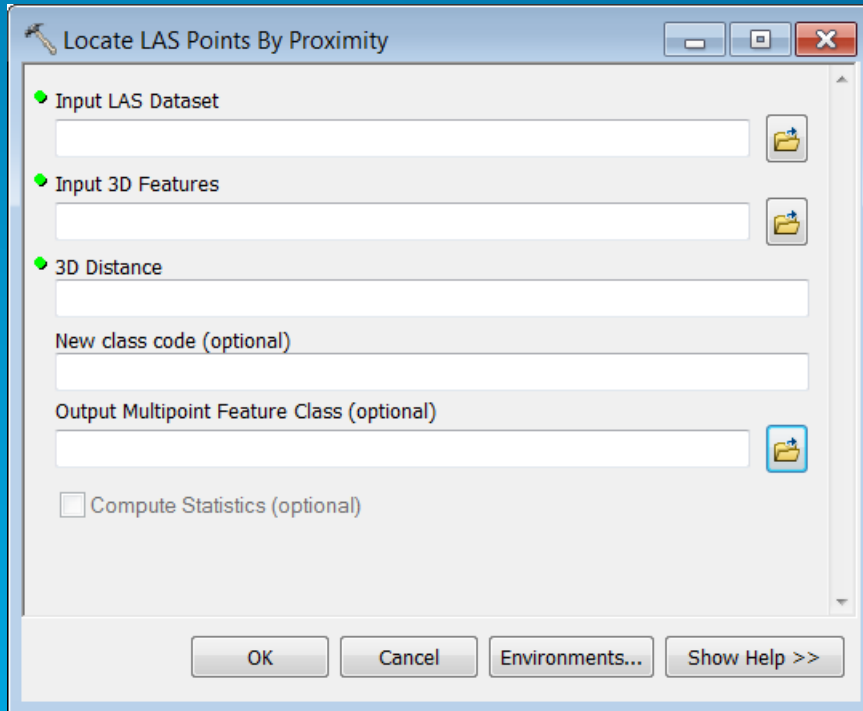
LAS Point Statistics By Area



Classify LAS by Height

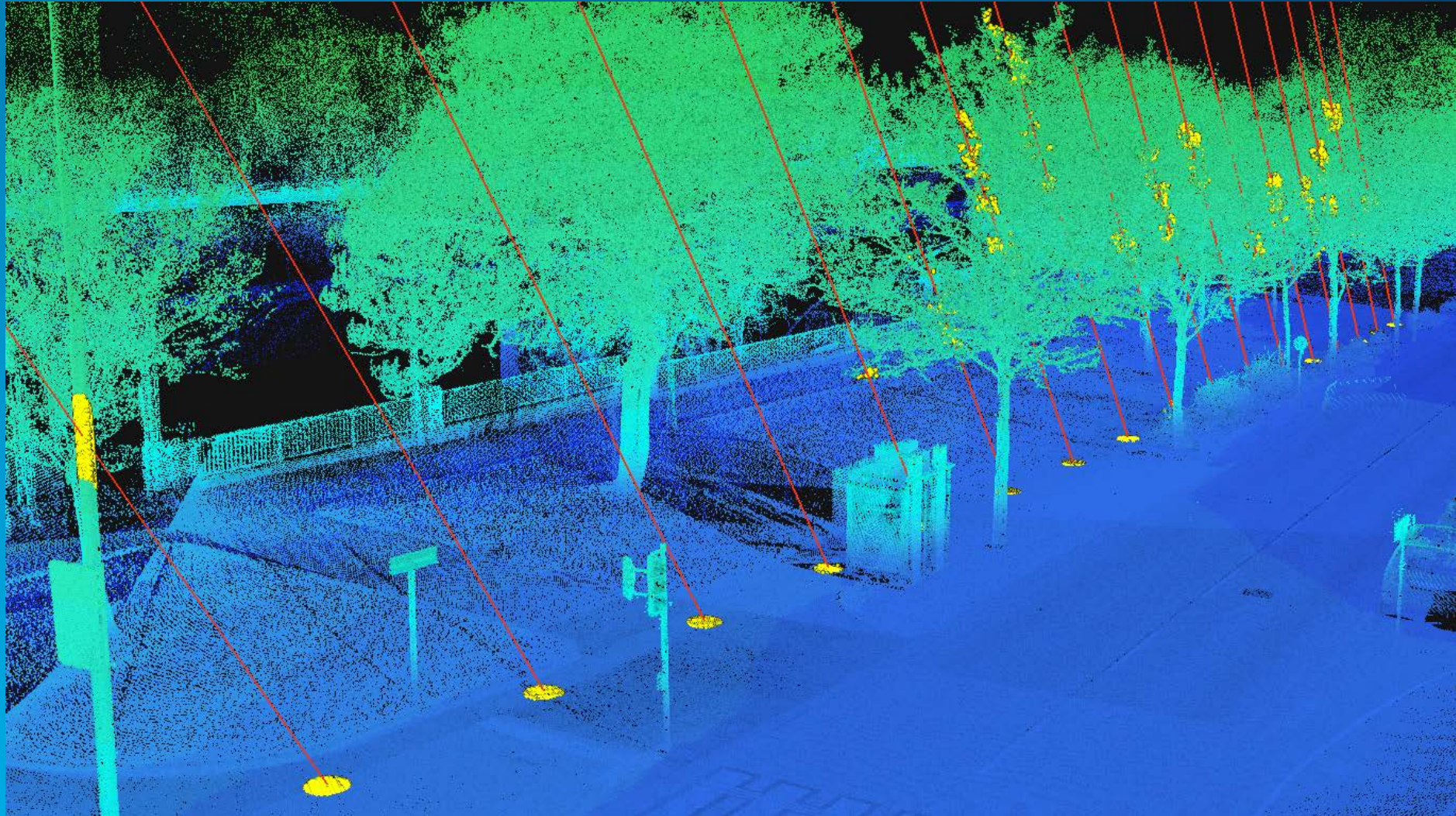


Locate LAS Points By Proximity

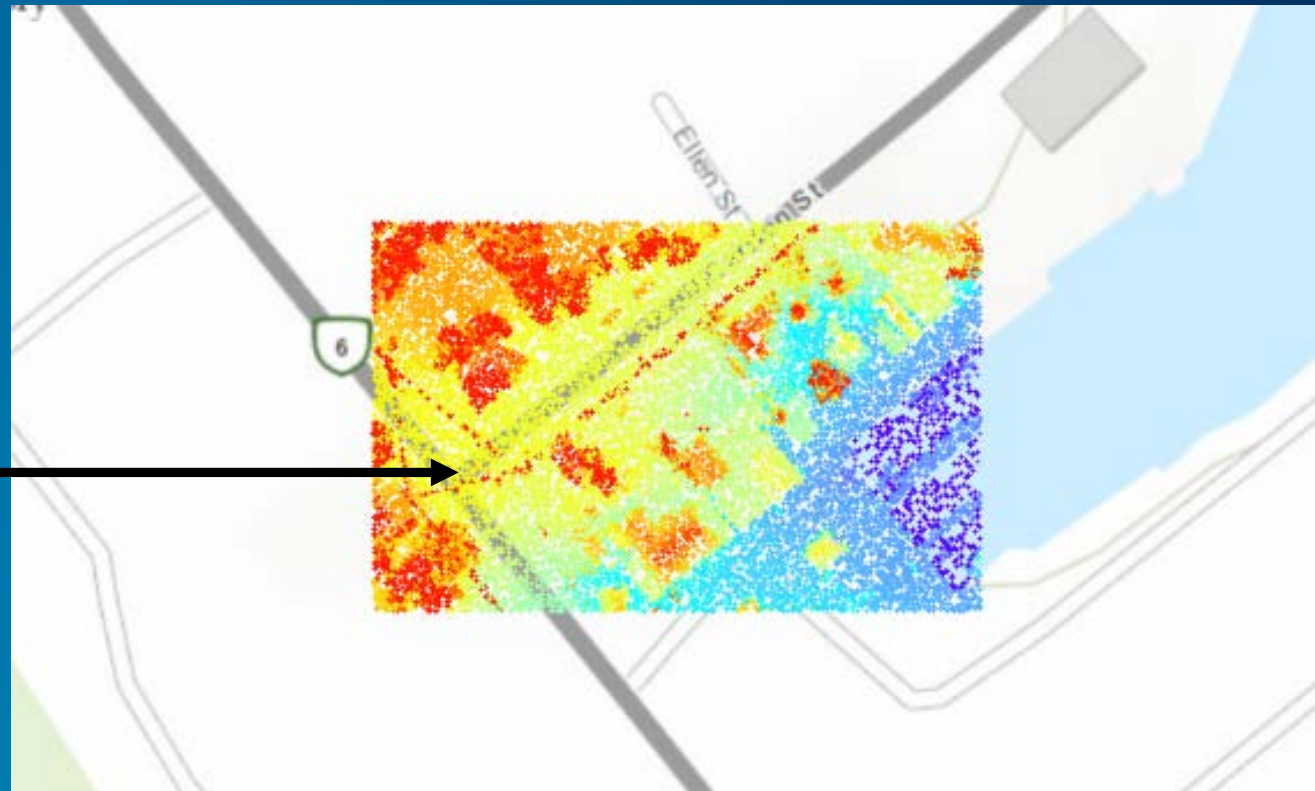
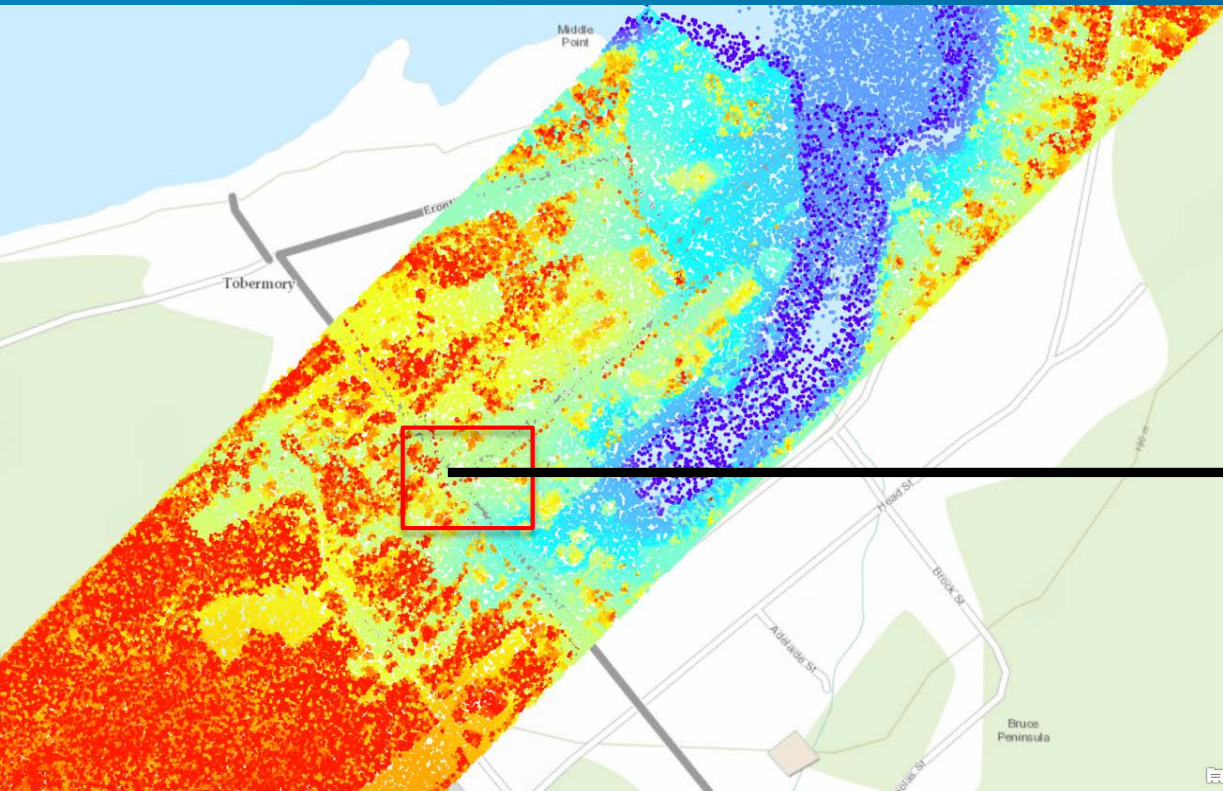


Data courtesy of PhotoScience

Locate LAS Points By Proximity



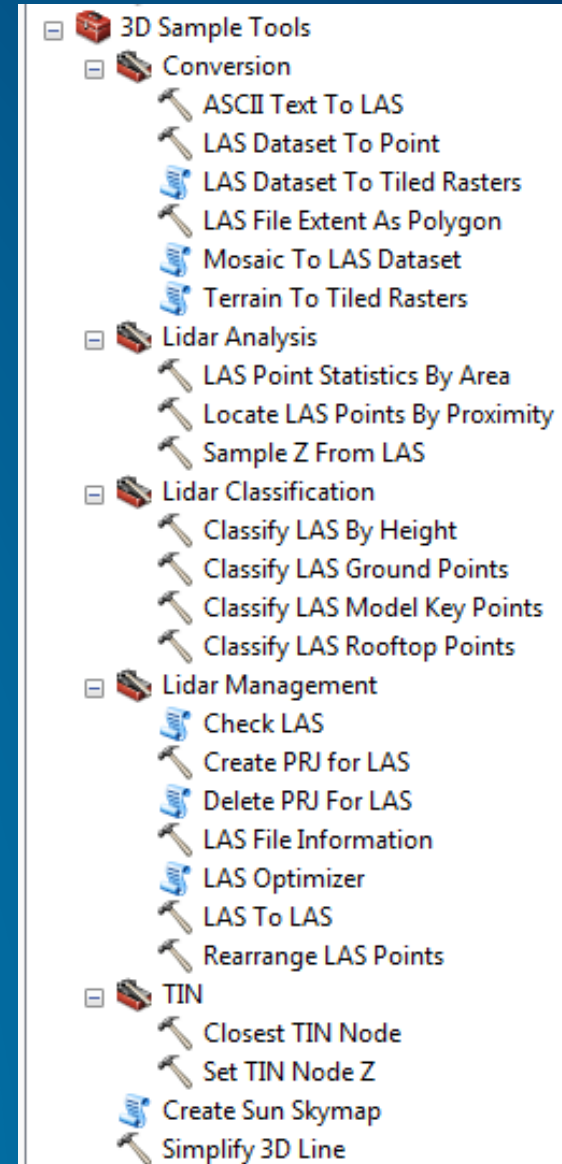
Extract LAS



Data courtesy of Optech

Lidar/3D Sample Tools

- Available in ArcGIS 10.2 and 10.3
- Sample geoprocessing tools
 - Esri 3D Resource Center
 - <http://links.esri.com/3dSamples>



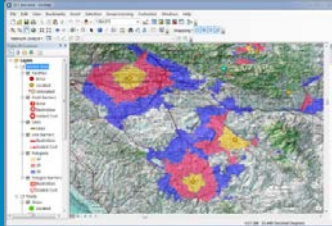
Best Practices

- Tiled LAS, v1.1 or higher
- Projected, rearranged, indexed
 - zLAS
- File size: 1 – 2 GB or less (<500 MB if not rearranged)
- Keep file I/O local, avoid network
- Study area boundary included as constraint
- Airborne lidar
 - Classified (bare earth, non-ground)
 - Breaklines for hydro enforcement
- Terrestrial lidar
 - RGB & intensity values, classified

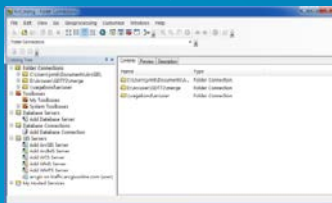
* Also applies to photogrammetric point clouds

Application Fusion: ArcGIS Pro

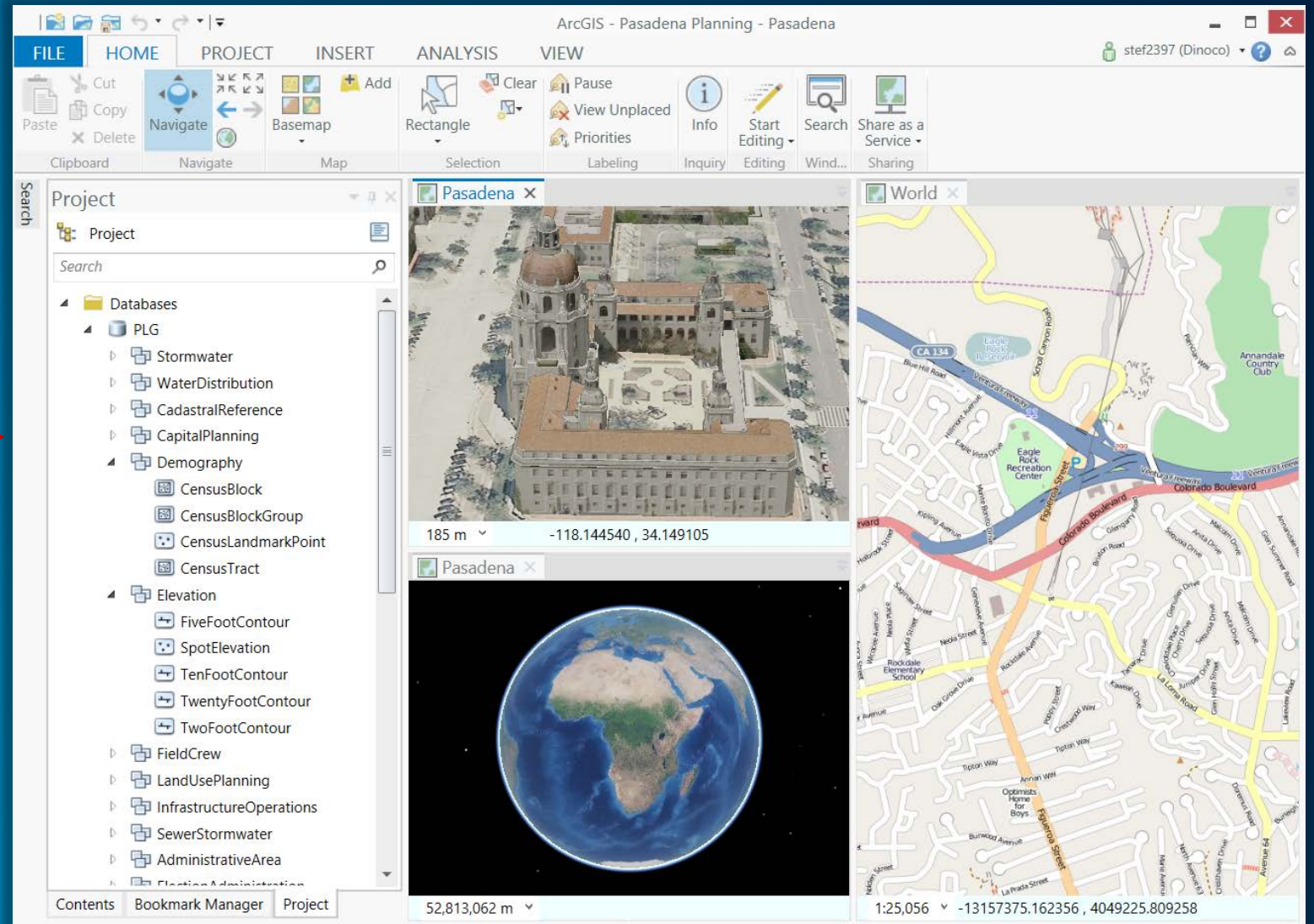
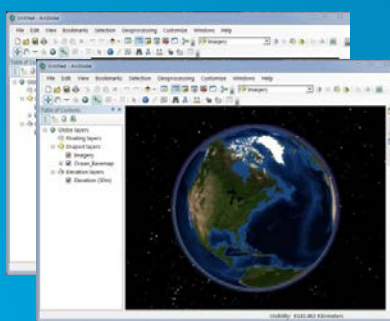
ArcMap



ArcCatalog



ArcGlobe / ArcScene



Lidar in ArcGIS Pro

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Thank you...

- Please fill out the session survey:

Offering ID: 853 / 2163

Online – www.esri.com/ucsessionsurveys

Paper – pick up and put in drop box



Understanding our world.