LiDAR Workshop

Ex #1: LiDAR elevation grid creation and visualization: spatial interpolation, noise filtering, contour map, continuous or classified choropleth maps, hill-shading relief map, draping image on LiDAR.

Introduction: This exercise will guide you through a series of LiDAR data processing steps: convert LiDAR data into an ArcGIS compatible format, interpolate LiDAR point clouds into DSM grid, display and visualize LiDAR grid in a variety of ways, and disseminate the LiDAR data to the Google Earth.

Exercise Instructions:

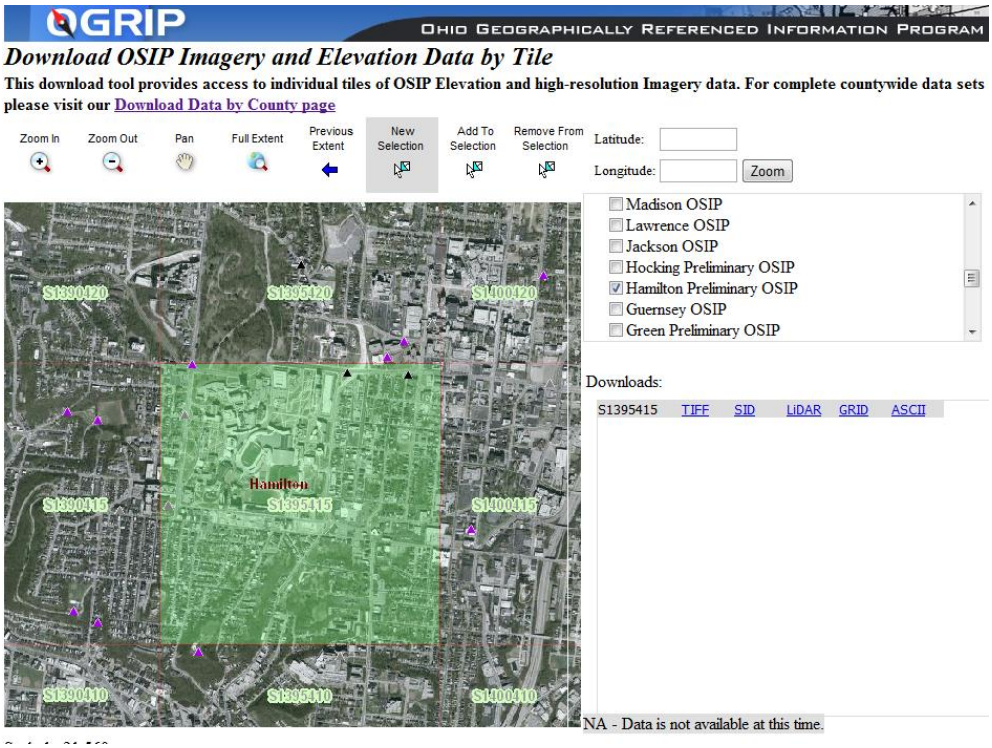
1. Downloading LiDAR Data

Ohio Statewide Imagery Program (http://ogrip.oit.ohio.gov/ProjectsInitiatives/OSIPDataDownloads.aspx)

Download OSIP Products by County (http://gistest1.oit.ohio.gov/geodatadownload/osip.aspx)

Download OSIP Products by Tile (http://gis5.oit.ohio.gov/geodatadownload/)

Standard OSIP I products included 1FT Color Orthophotography in GeoTIFF and MrSID format, 2.5FT DEM in ArcInfo GRID and ASCII grid format, and 2M LiDAR point clouds in LAS format.



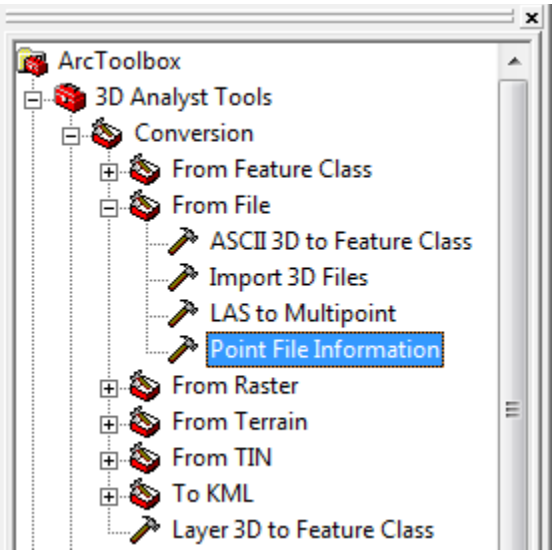
1. Understanding Raw LiDAR Data

Prior to the data analysis, LiDAR data should be checked for any inconsistencies. LiDAR data can be delivered in either binary **.las** format or ASCII **.xyz** files. The LAS file format is a public binary file format, which is an alternative to proprietary systems or a generic ASCII file interchange system used by many data providers. Details on the format can be found at http://www.asprs.org/a/society/committees/standards/asprs_las_spec_v13.pdf

The Point File Information tool in ESRI's ArcGIS Desktop 3D Analyst™ can be used to perform data quality assurance checking.

Point File Information Tool

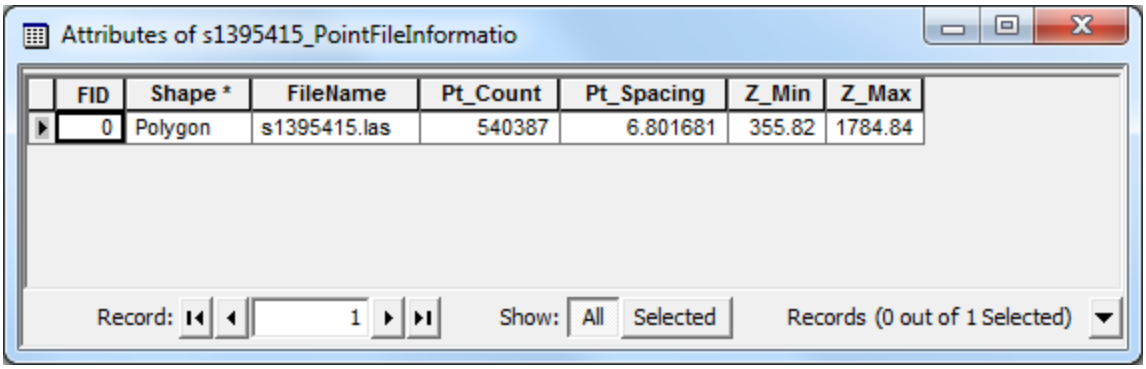
The Point File Information tool in the 3D Analyst toolbox in ArcGIS (*ArcToolbox\3D Analyst Tools\Conversion\From File\Point File Information*) reports important statistical info about the raw LiDAR files.



The tool is designed to read the headers of LAS or scan ASCII files and summarize the file contents. Because a single LiDAR file often contains millions of points and many LiDAR datasets contain more than one file, the Point File Information tool can accommodate reading one or more files by specifying either individual LiDAR files or folders.

The result from this tool is a feature class that shows the following statistics:

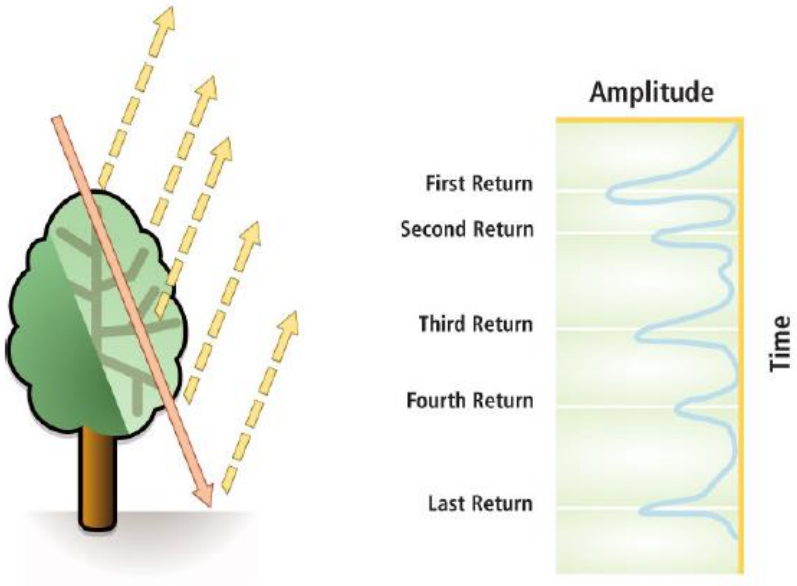
- Minimum bounding rectangle for each file
- Number of points recorded
- Average point spacing
- Minimum/Maximum z-values



You can also open the LAS.XML file to see the detailed metadata of the LiDAR file.

2. Loading the LiDAR Files to ArcGIS

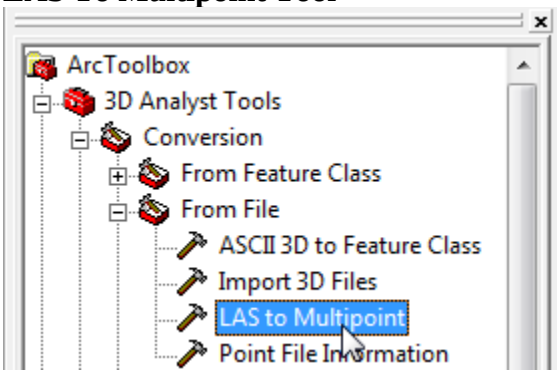
LiDAR data consist of very dense collections of points over an area, known as point clouds. One laser pulse can be returned many times to the airborne sensor. A pulse can be reflected off a tree's trunk, branches, and foliage as well as reflected off the ground. The diagram below provides a visual example of this process.



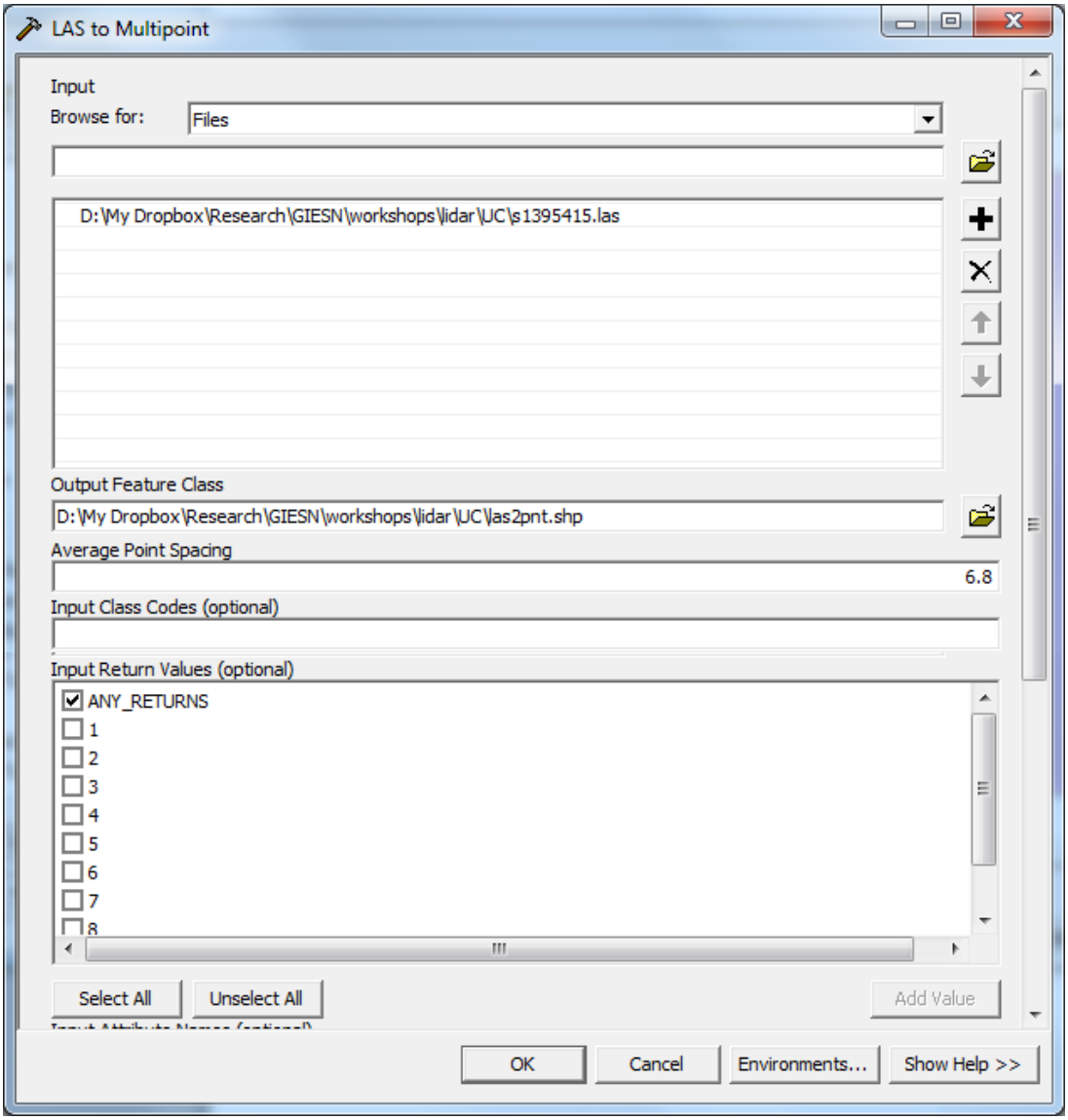
These multiple returns create a data management challenge. A single LiDAR file can typically be 60 MB to 100 MB in size and can contain several million points. If this data is loaded directly into a table, it creates many millions of records, which become difficult to be managed. This challenge is overcome by loading the points into the geodatabase feature type known as multipoint.

The tool to load LiDAR files into the geodatabase is called LAS To Multipoint. It is part of the 3D Analyst toolset in ArcGIS (*ArcToolbox\3D Analyst Tools\Conversion\From File\LAS to Multipoint*).

LAS To Multipoint Tool

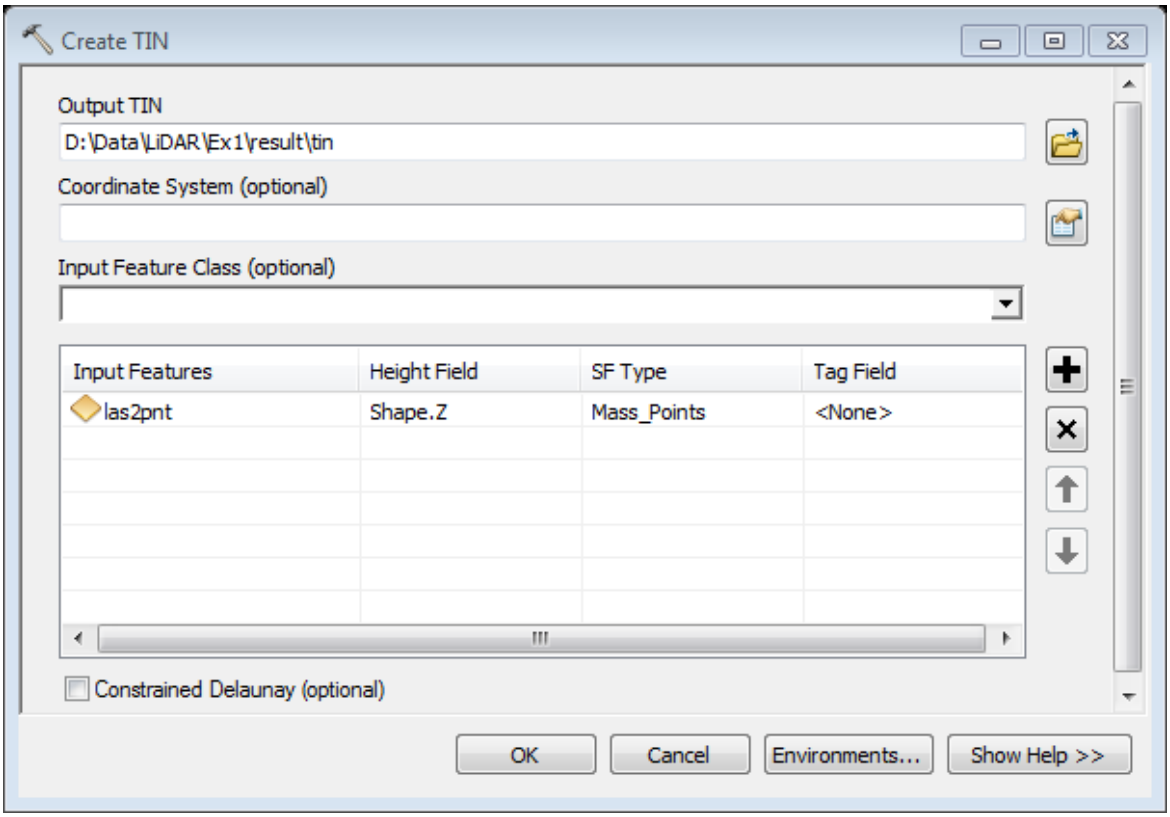


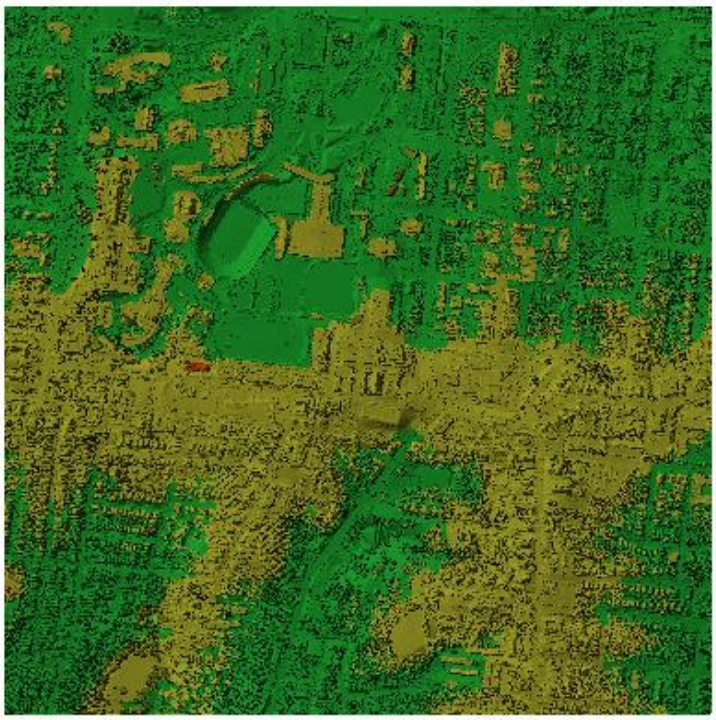
The LAS To Multipoint tool enables the user to read the LiDAR data files and load them into the geodatabase. Loading the LiDAR files in a geodatabase allows a seamless mosaic of the entire LiDAR dataset, which then can be analyzed by ArcGIS tools.



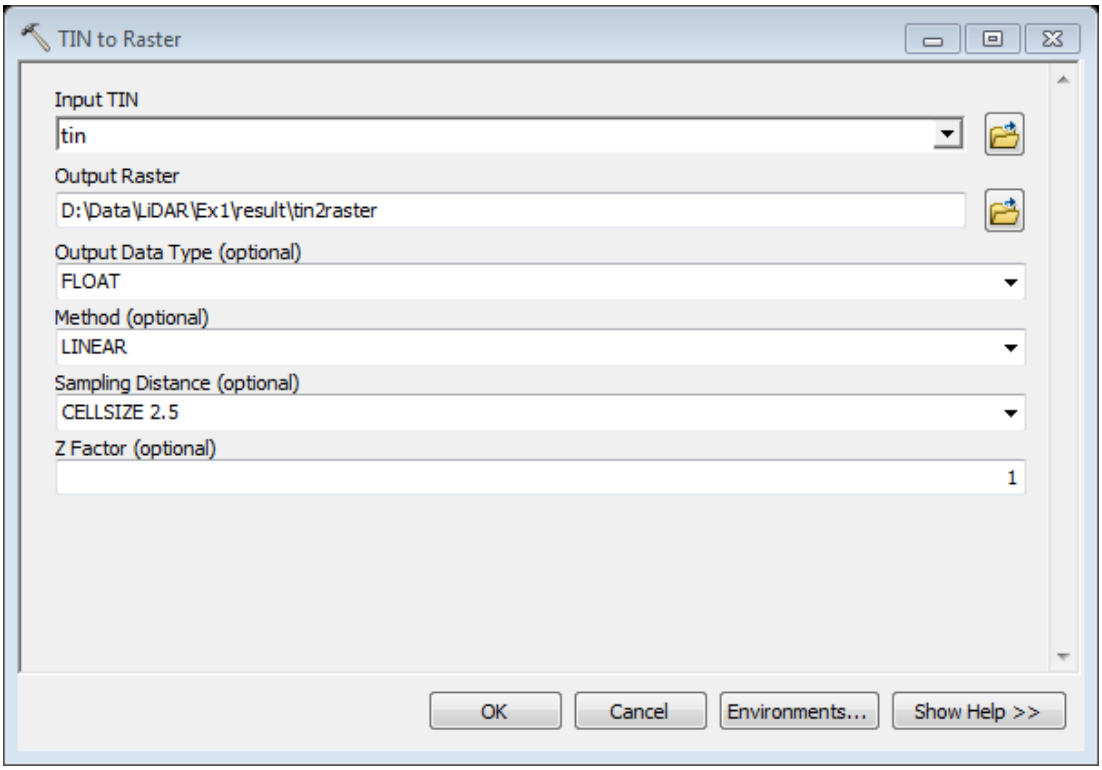
3. Building DEMs from LiDAR Data

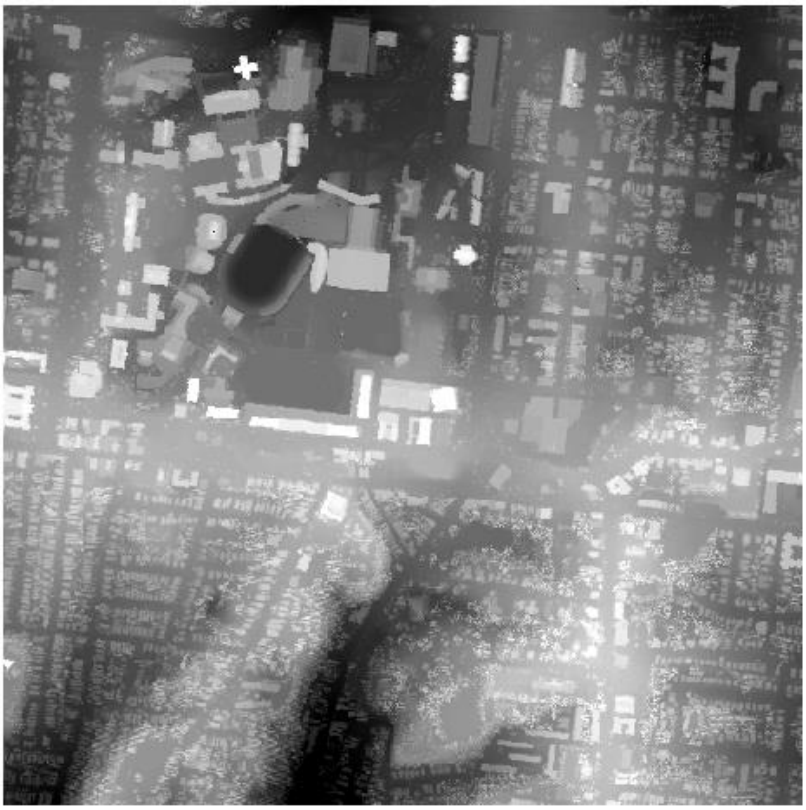
Create TIN from Multipoint (*ArcToolbox\3D Analyst Tools\Data Management \TIN\Create TIN*):



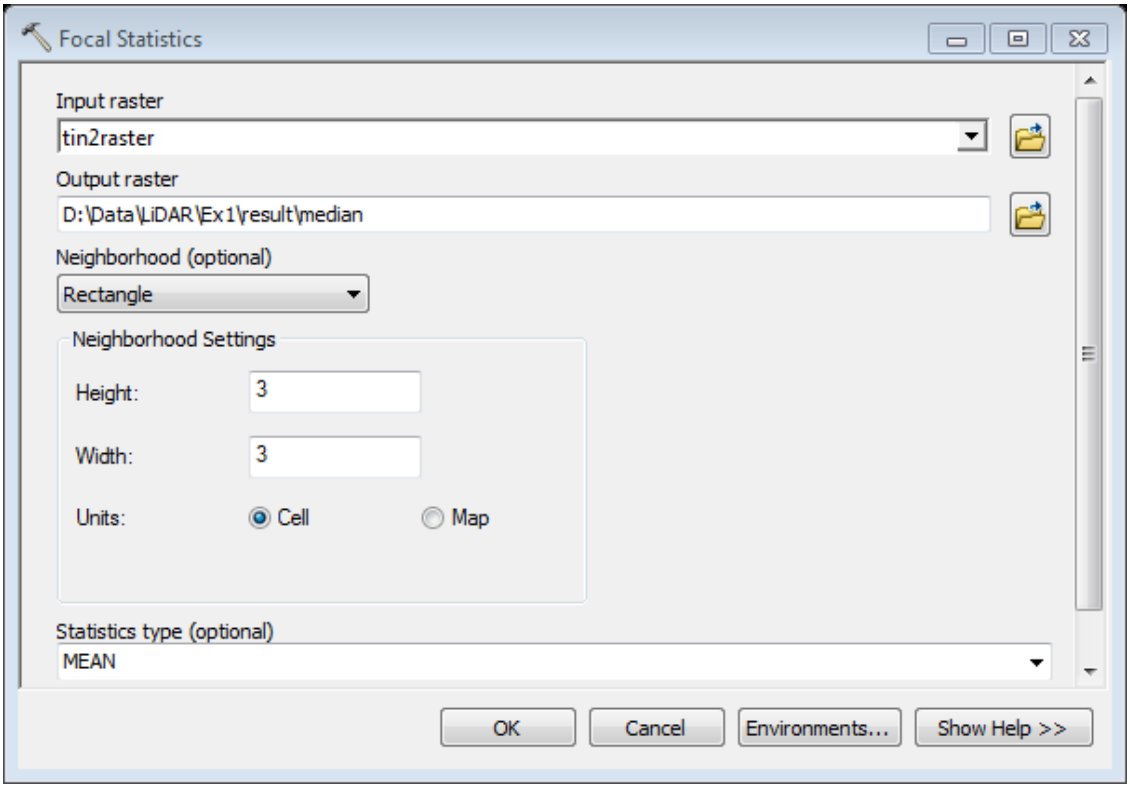


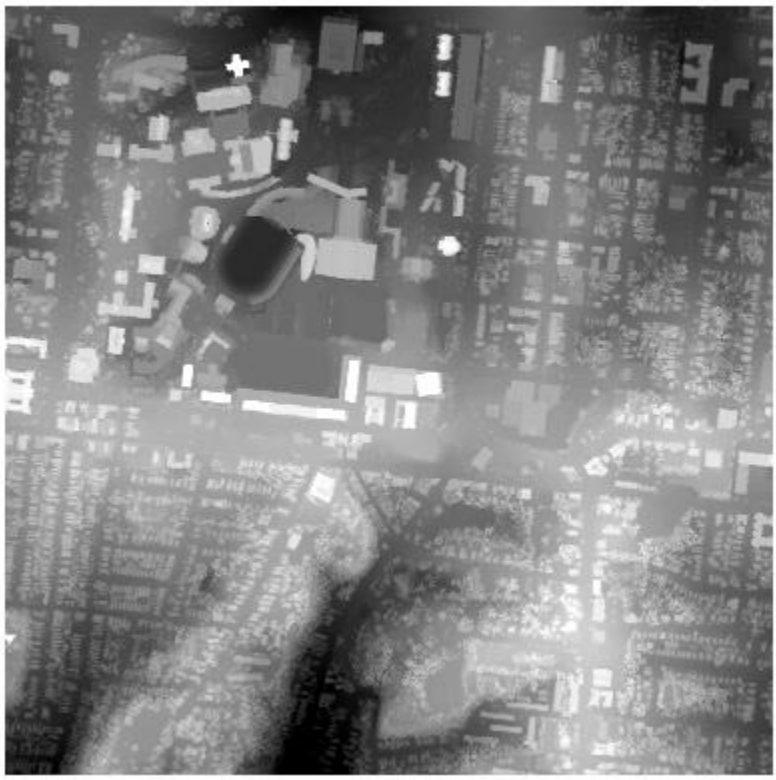
Convert TIN to Raster (*ArcToolbox\3D Analyst Tools\Conversion\From TIN\TIN to Raster)***:**





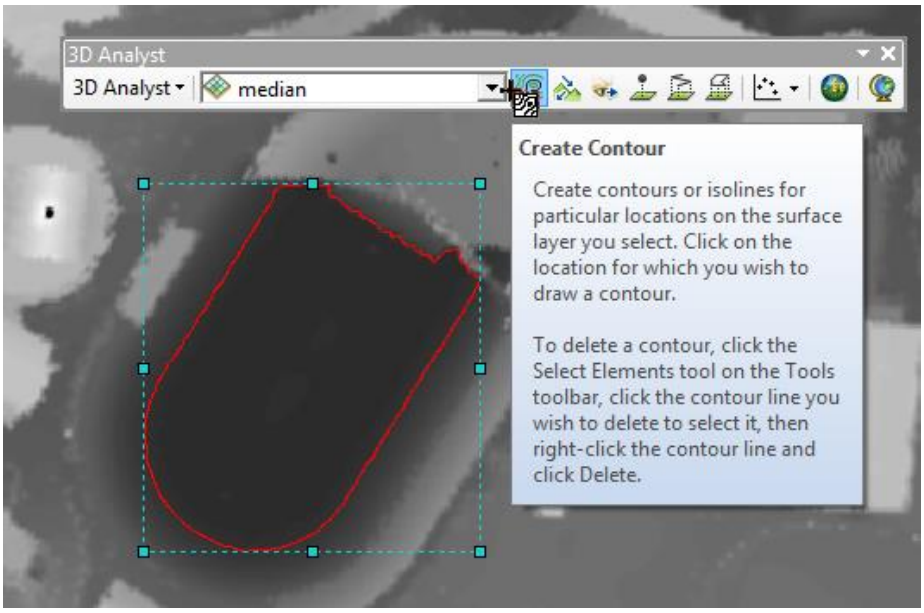
Raster DEM Noise Filtering (*ArcToolbox\Spatial Analyst Tools\Neighborhood\Focal Statistics*)**:**



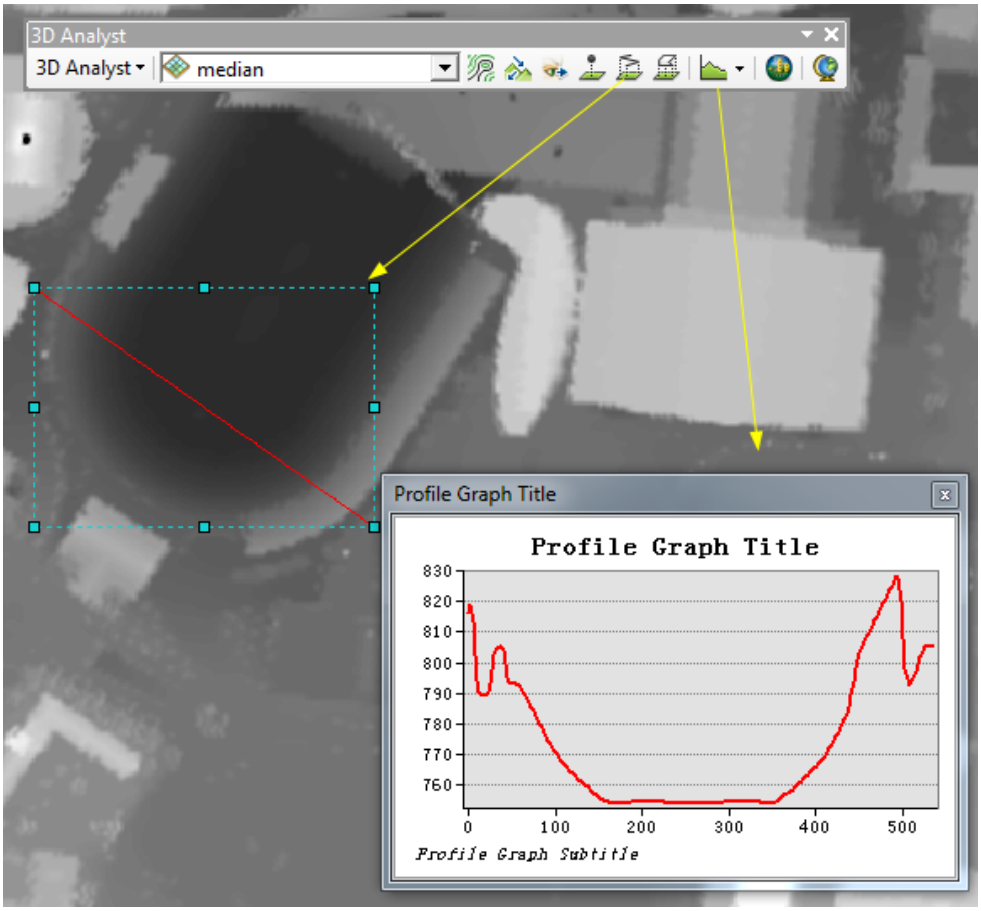


4. Creating Contours and Profiles

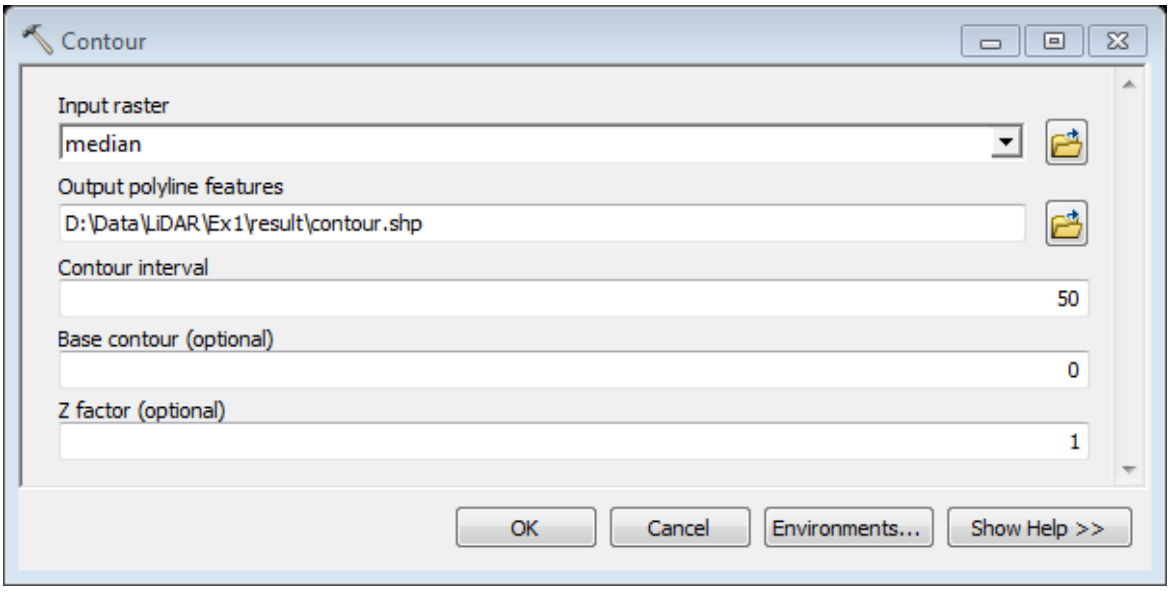
Create Iso-contour Line

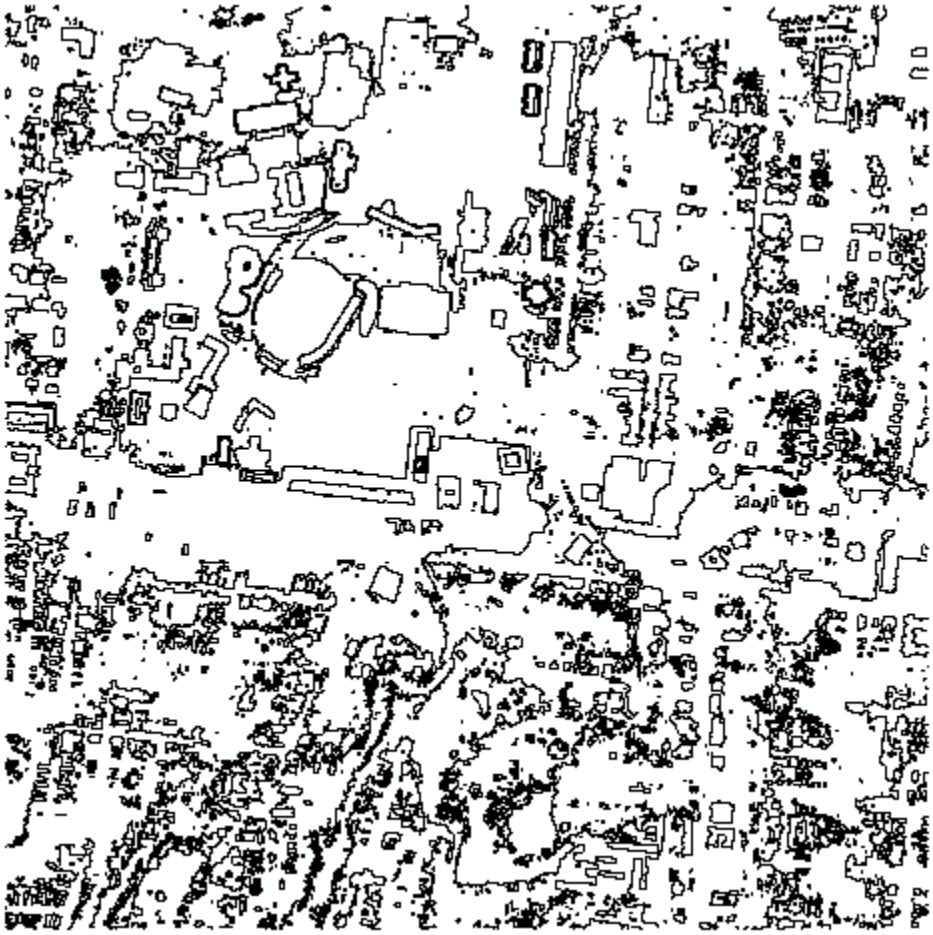


Create Profile Graph



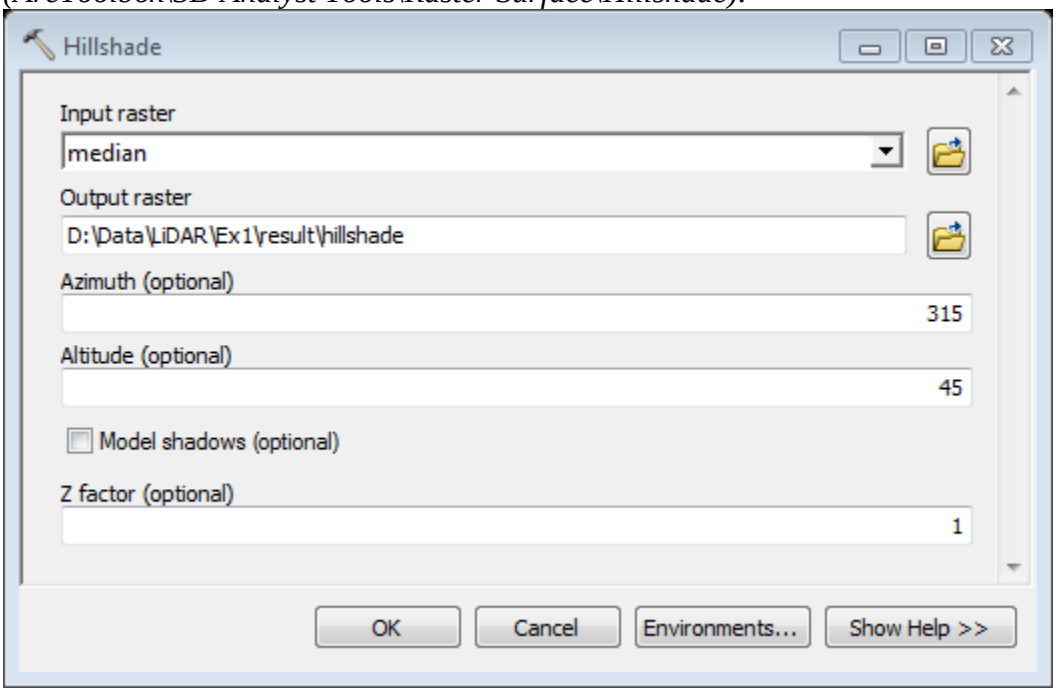
Create Contour Map (*ArcToolbox\3D Analyst Tools\Raster Surface\Coutour):*

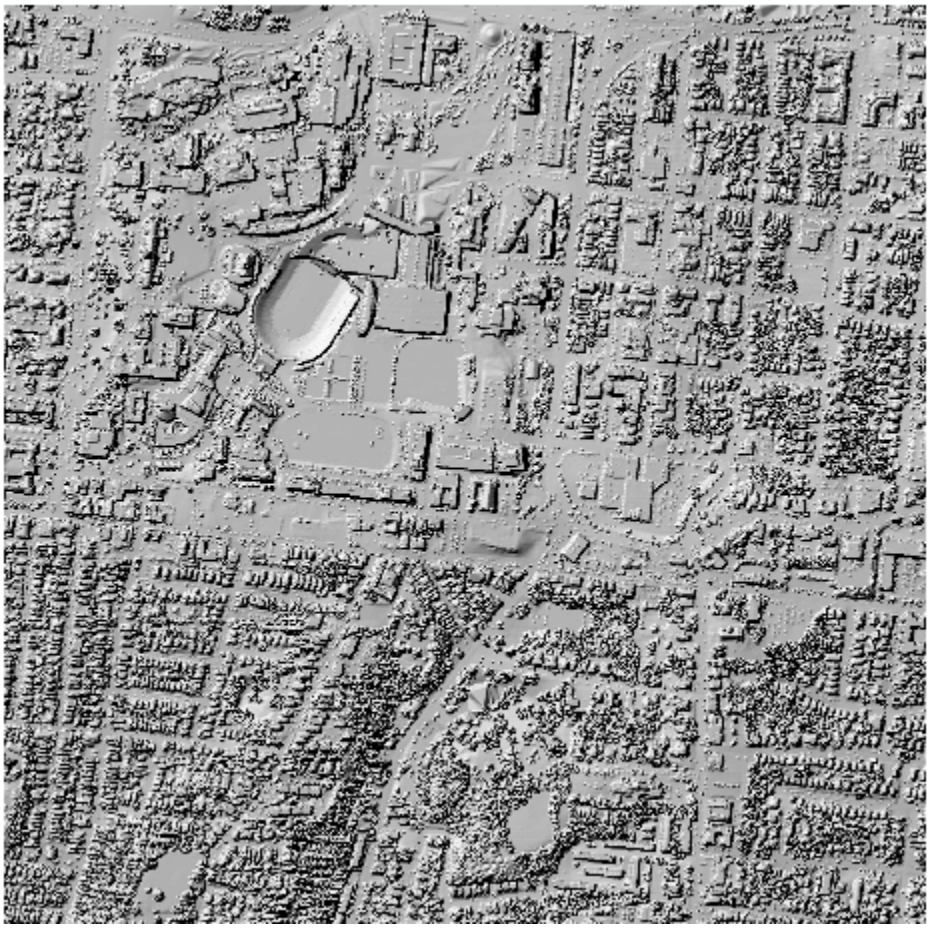




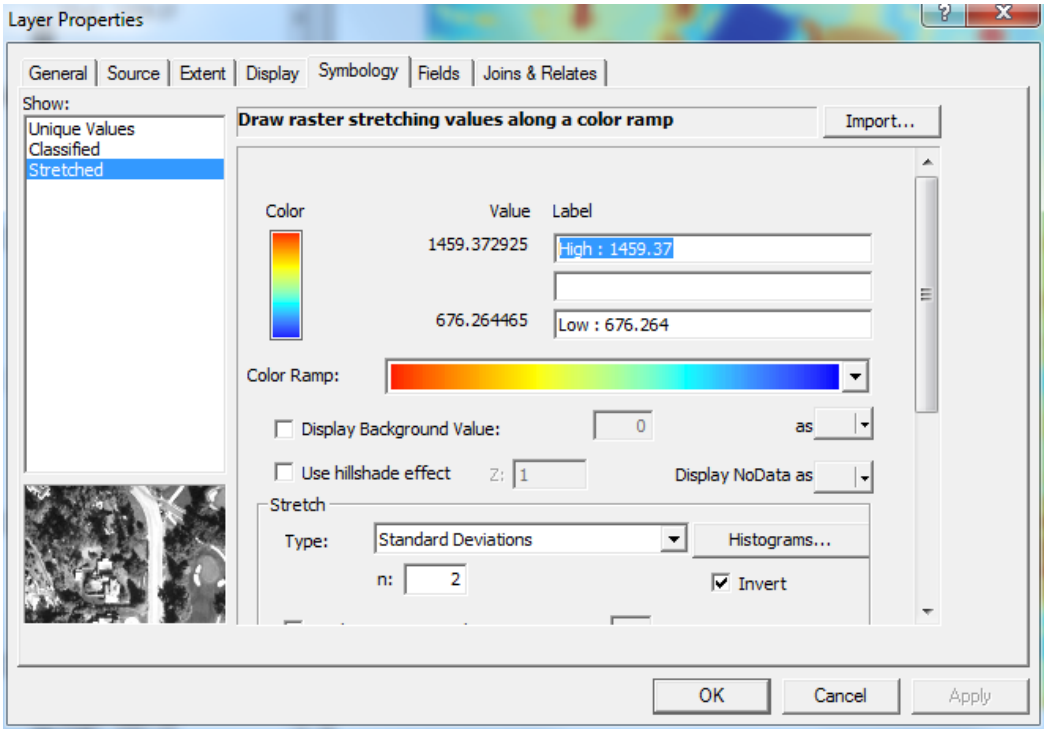
5. ***Generating Hill-shading Relief Map***

(ArcToolbox\3D Analyst Tools\Raster Surface\Hillshade):

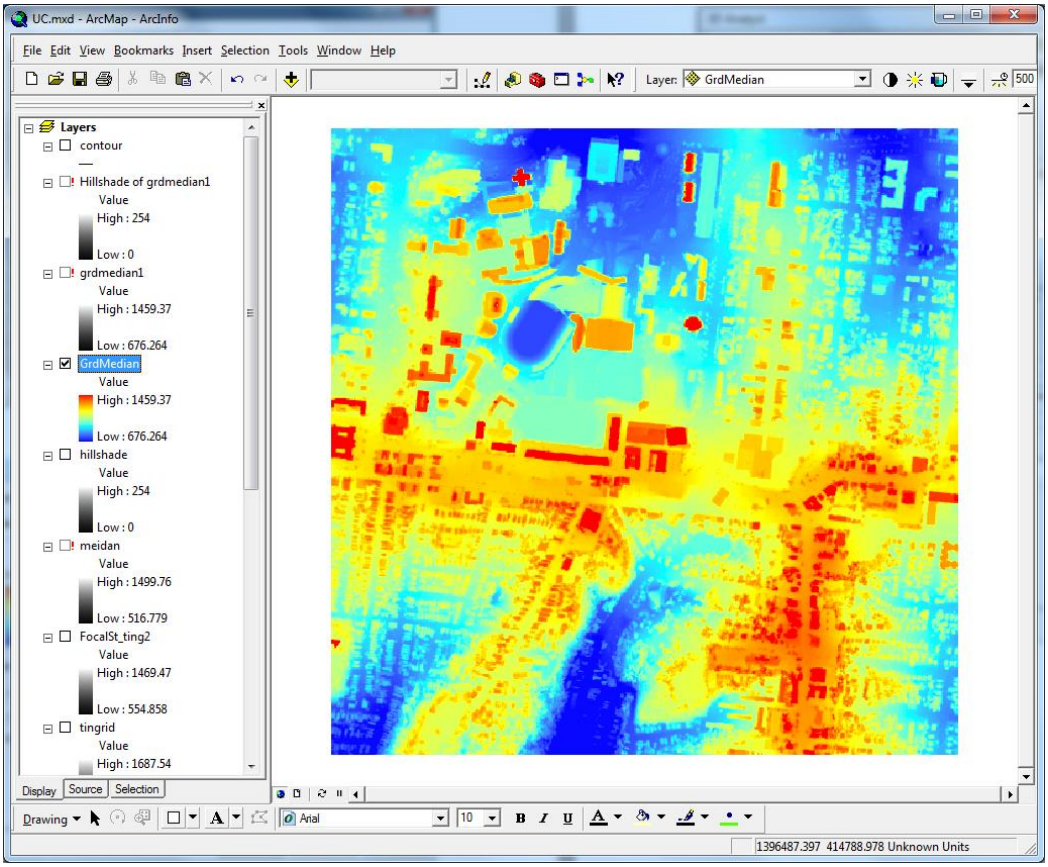




6. Visualizing LiDAR DEM using ArcScene

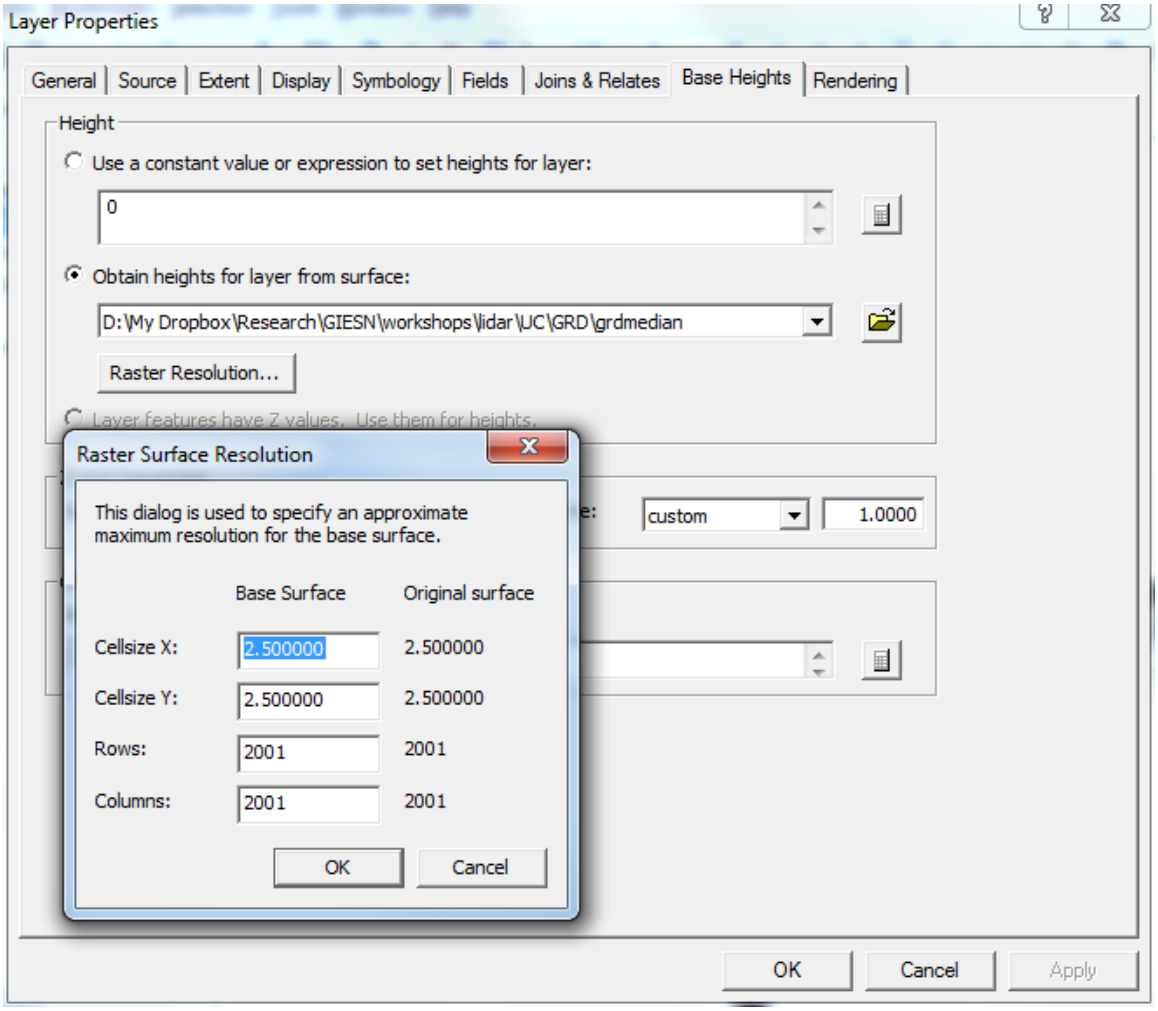


Continuous Choropleth Map of LiDAR DEM

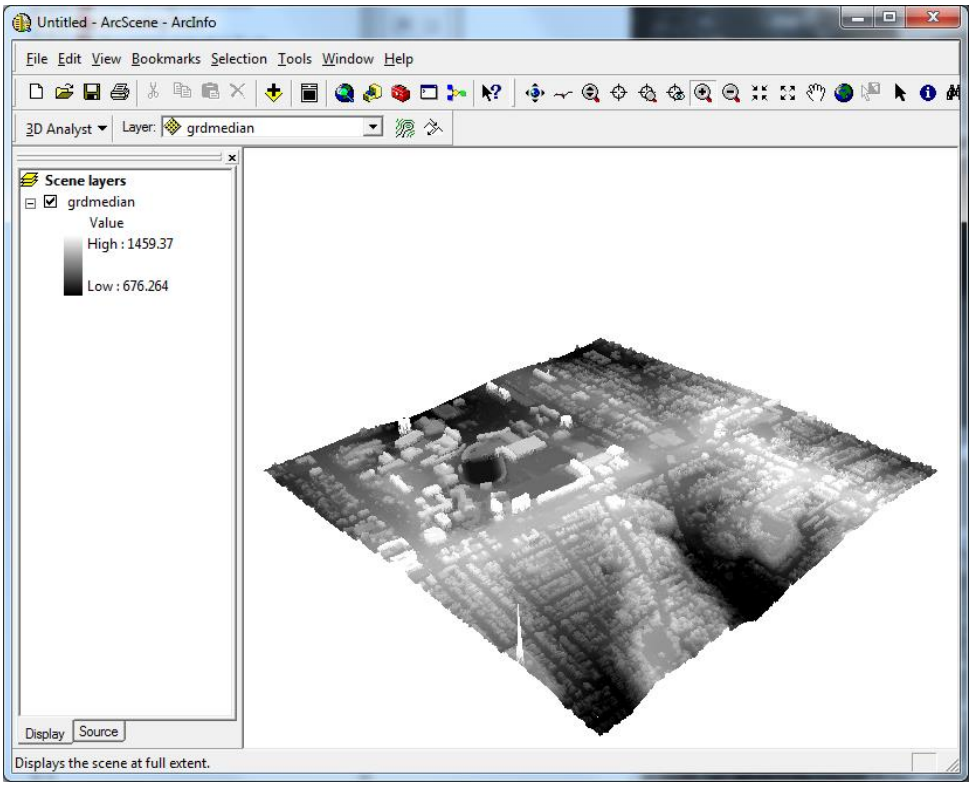


Invoke ArcScene

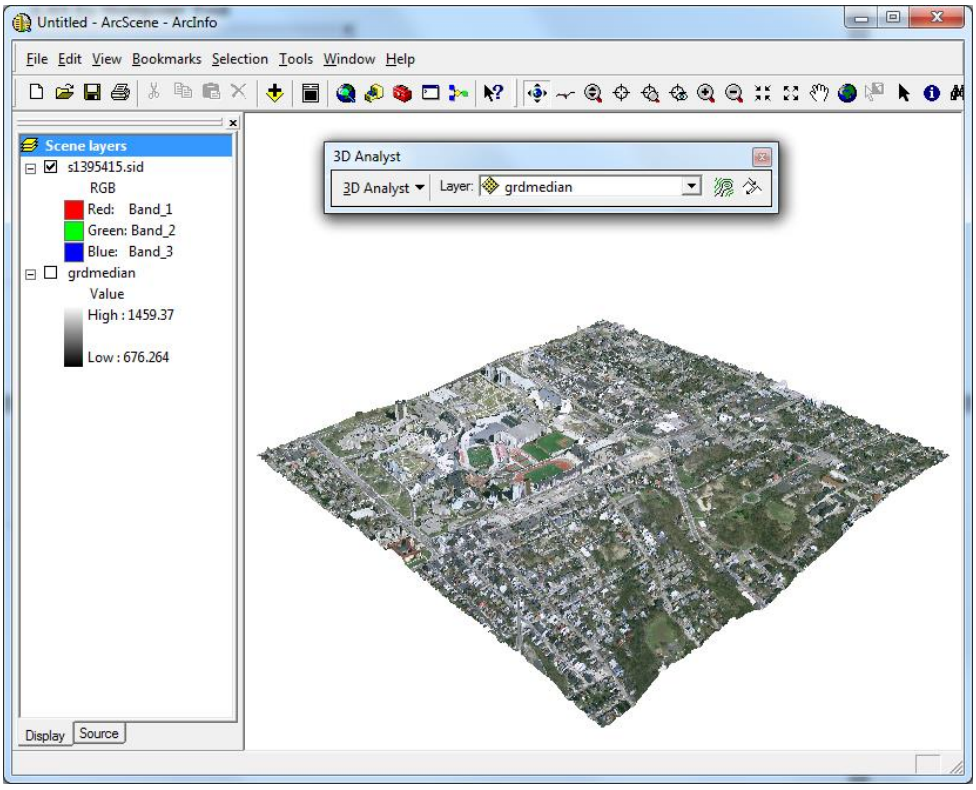
Change Layer Properties



3D Visualization of LiDAR DEM

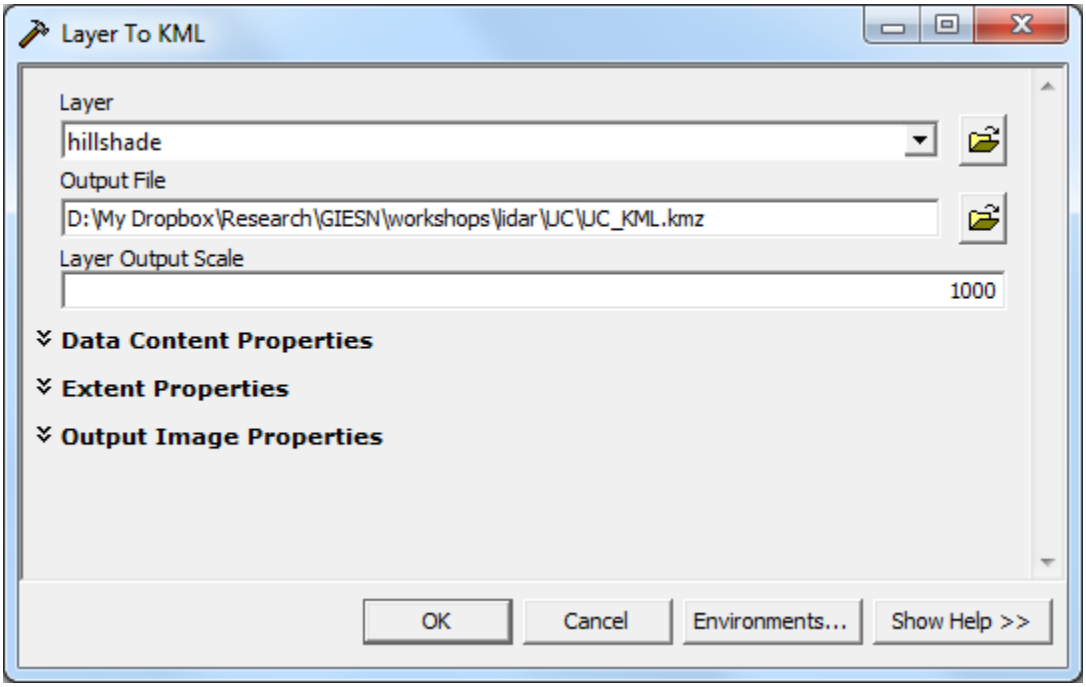


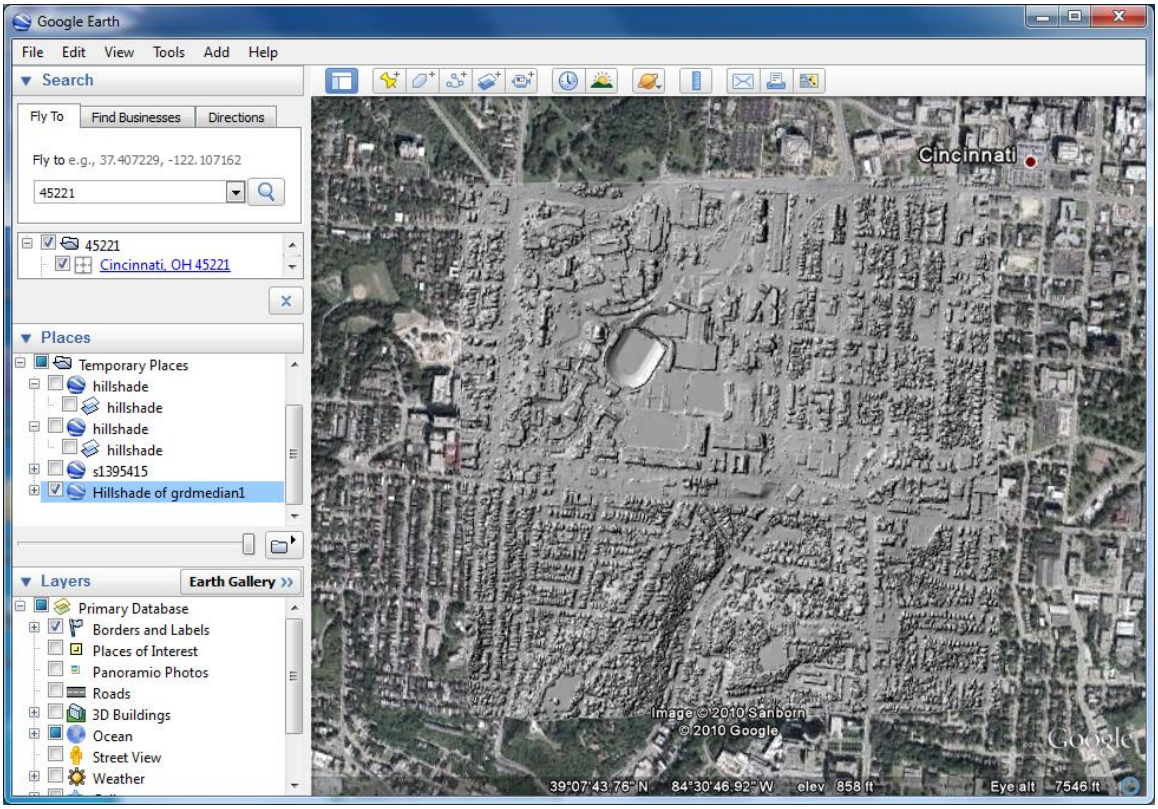
3D Visualization of Airphoto Draped on LiDAR DEM



7. Distributing LiDAR Products using KML

ArcToolbox→3D Analyst Tools→Conversion→To KML→Layer To KML





8. Adding LiDAR data to a LAS dataset

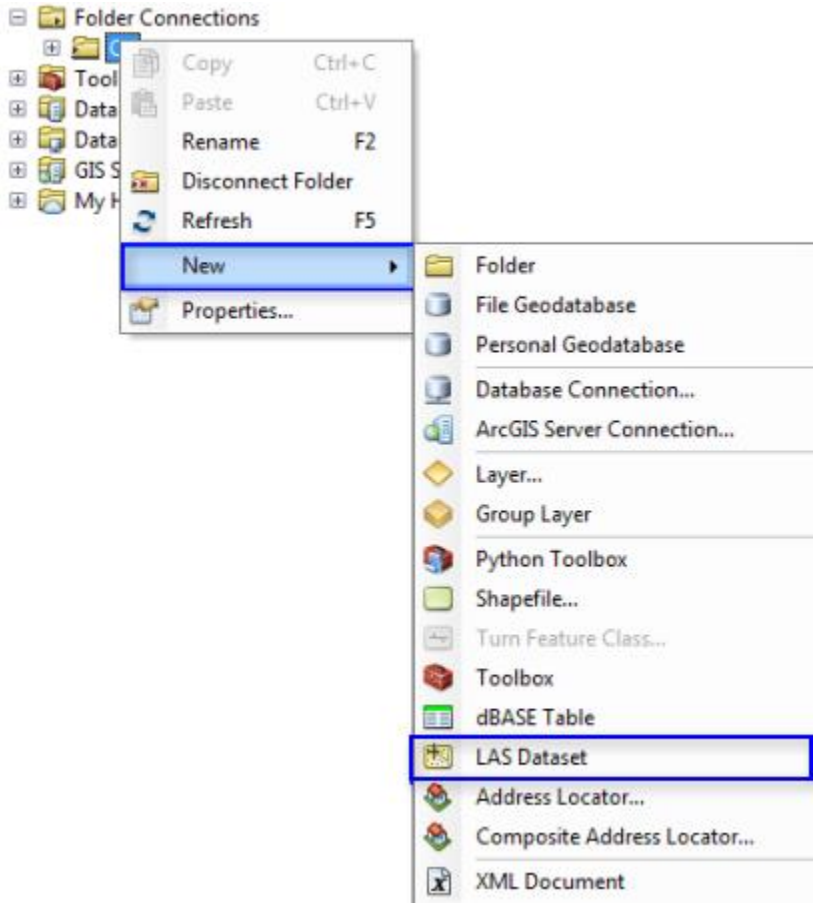
A LAS dataset stores reference to one or more LAS files on disk, as well as to additional surface features. The LAS dataset allows you to examine LAS files, in their native format, quickly and easily, providing detailed statistics and area coverage of the LiDAR data contained in the LAS files. There are two ways in which to create a LAS dataset: interactively through the context menu or through a geoprocessing tool. The two following sets of steps describe how to create a LAS dataset using either the context menu or the Create LAS Dataset geoprocessing tool.

Create a LAS Dataset using the context menu

The context menu in ArcCatalog or the ***Catalog*** window provides access to create a LAS dataset. This approach is recommended when interactively defining a LAS dataset.

Steps:

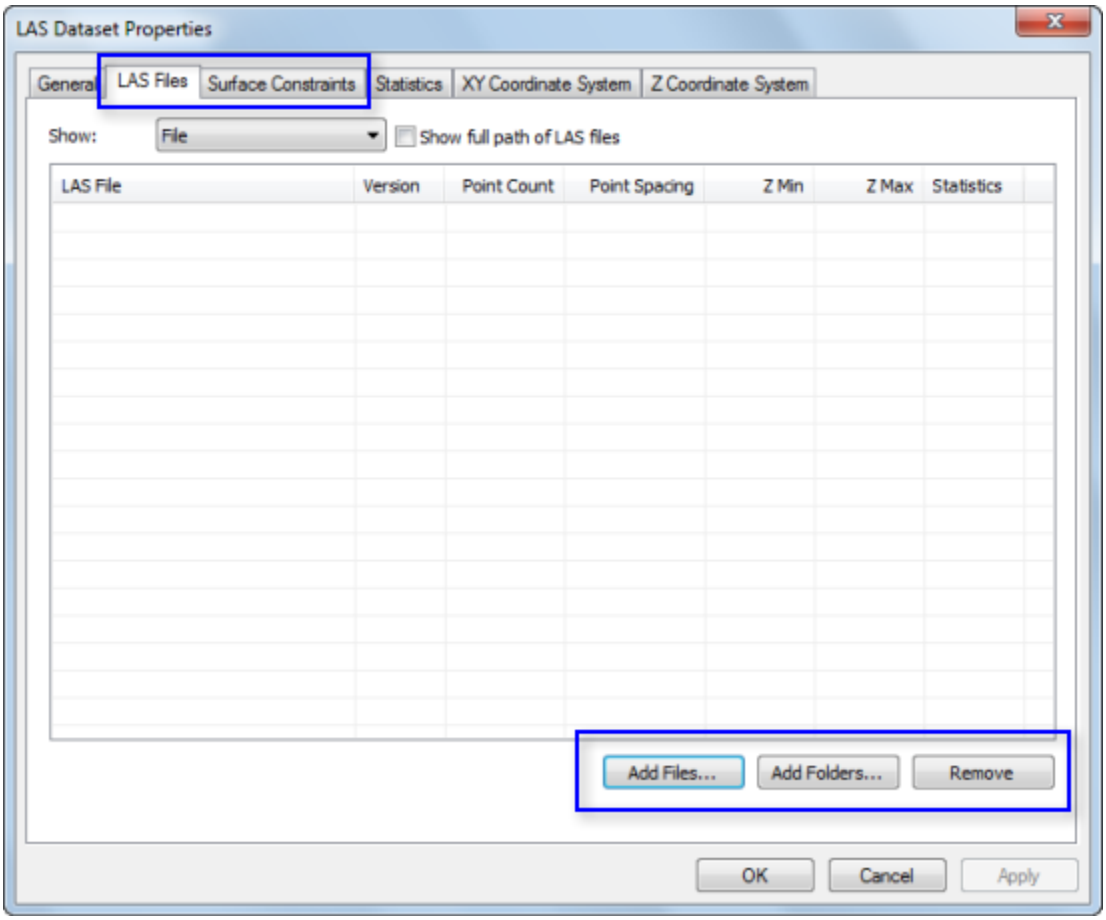
1. Right-click the folder where the LAS dataset is to be created to display the folder context menu.
2. From the context menu, click **New** > **LAS Dataset**.



3. Rename the LAS dataset from **New Las Dataset** to an appropriate name for the project.

4. Double-click the new LAS dataset to open the ***LAS Dataset Properties*** dialog box.
5. Select the **LAS Files** tab to add LAS files to the LAS dataset. You can either select the **Add Files** button or the **Add Folder** button to add LAS files to the new LAS dataset.
6. Select the **Surface Constraints** tabs to add additional surface constraint data to the LAS dataset.

You can also remove any LAS files or surface constraints from the LAS dataset using the ***LAS Dataset Properties*** window using the **Remove** button on either tab.

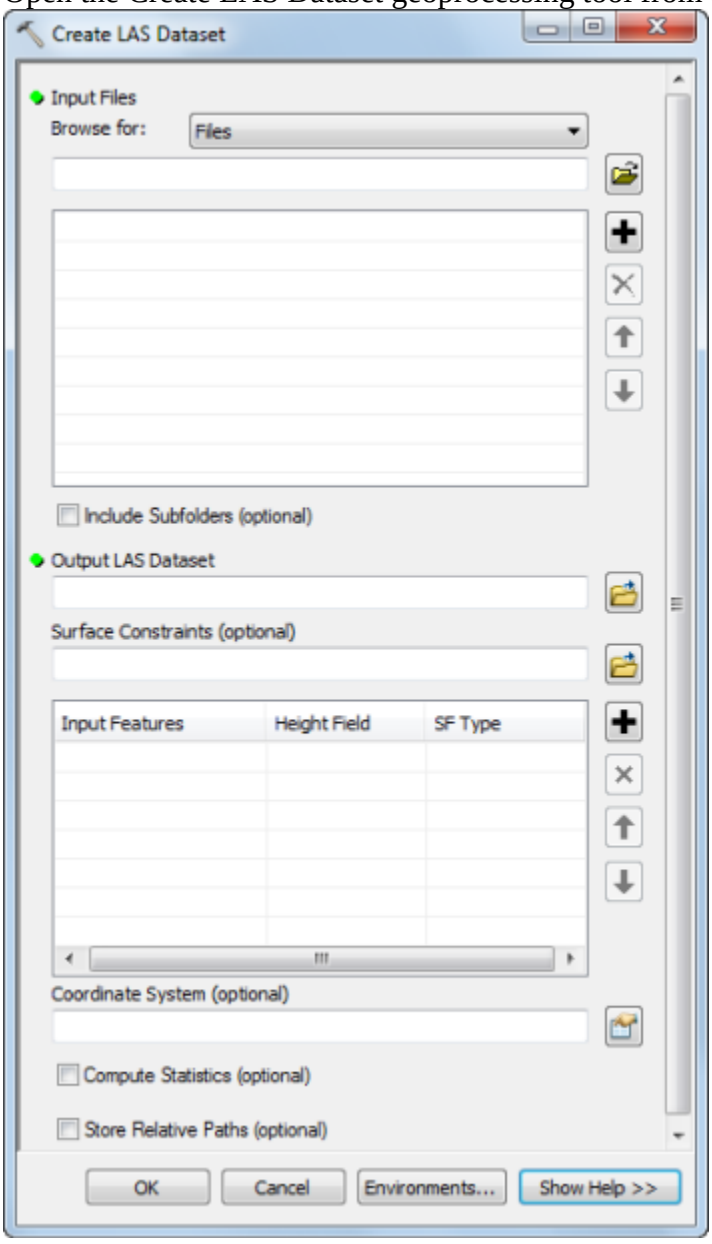


Create a LAS Dataset using the geoprocessing tool

The Create LAS Dataset geoprocessing tool's primary use is for automating the creation of LAS datasets in scripts and in models.

Steps:

1. Open the Create LAS Dataset geoprocessing tool from the Data Management toolbox.



2. To specify the **Input Files**, select either **File** or **Folder** from the drop-down menu. Based on your selection, browse to either a single LAS file or to a folder containing a series of LAS files. If the specified LAS folder contains subfolders of LAS files, select the **Include Subfolders** option.
3. Use the **Output LAS Dataset** option to set a location on disk where the LAS dataset will be created.

9. Using the interactive toolbar tools for LAS datasets

The LAS Dataset toolbar provides an efficient way in which to toggle between different displays of the LiDAR points as a TIN-based surface or as a point cloud. The toolbar allows you to utilize the LiDAR point attributes, as well as display LiDAR data quickly by predefined filter settings.