

# Conservation Applications of LiDAR

## Basics of Using LiDAR Data

### Exercise #3: Visualization and Management

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# Basics of Using LiDAR Data

## Exercise #3: Visualization and Management

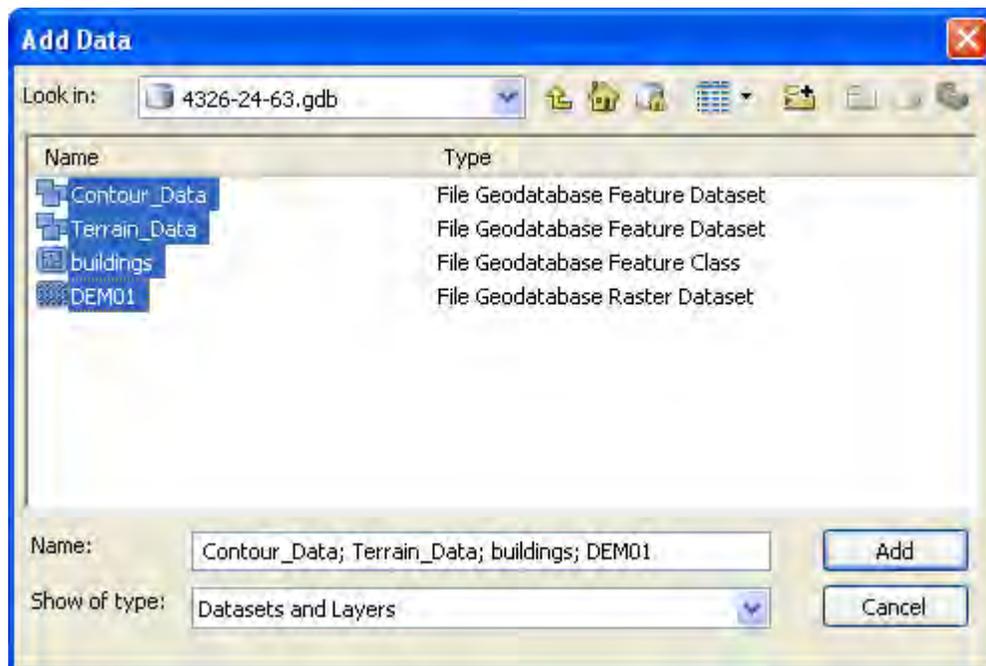
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## Exercise 3: Visualization and Management

### A. Using LiDAR Data

#### Load Data

1. Follow the instructions in “Minnesota LiDAR Data” to download the geodatabase for a single tile. The file name will be numeric and look something like this: 4326-24-63.gdb
2. Click “Add Data” , navigate to where you stored the downloaded file, and double click on the \*.gdb file name.
3. Select the top feature with a single left click, then while holding down the SHIFT key, select the last feature in the list. This will highlight all features.
4. Left click “Add”.

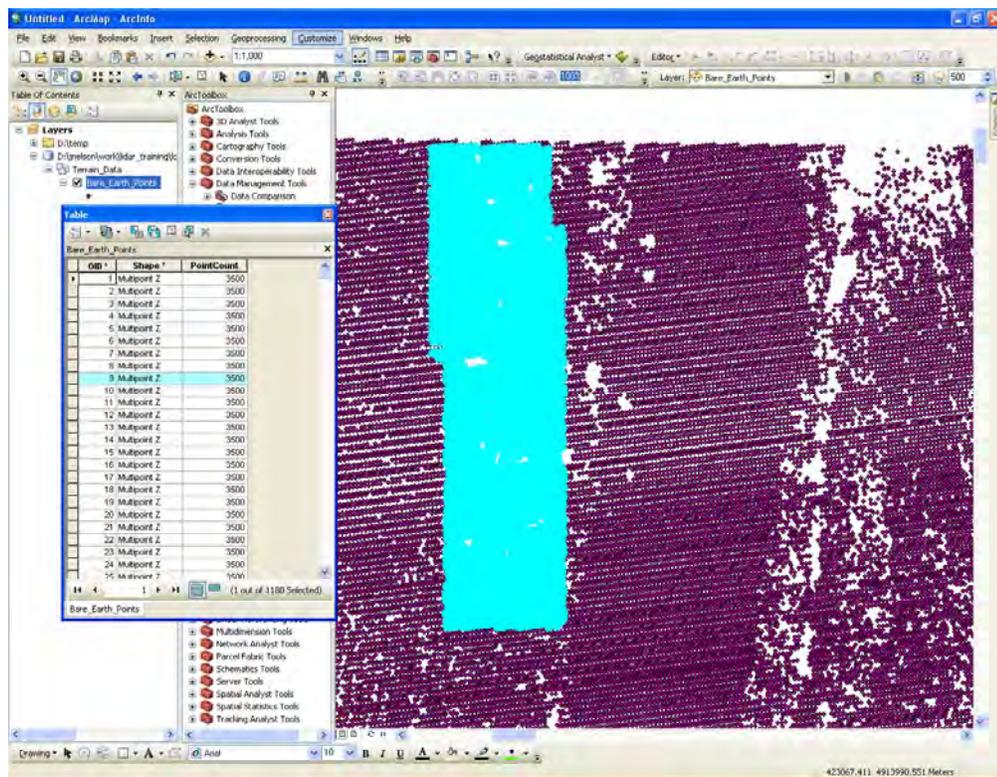


5. You'll see that many available datasets within the geodatabase are loading at once.
6. Click off the “Bare Earth Points” in the table of contents to increase draw speed.
7. View all data at various scales to better understand the data types.
  - i. Contour Data – Three contour poly-line datasets are included in the .gdb file at a 50-foot, 10-foot, and 2-foot contour interval.
  - ii. Terrain Data – Bare Earth Points are packaged as terrain data, and are individual LiDAR elevation shots after vegetation and ground cover have been removed.
  - iii. Buildings – These data are included in the .gdb file as polygons, indicating a structure as determined by the LiDAR flights.
  - iv. DEM01 – This is the bare-earth digital elevation model in 1-meter resolution.

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## Bare Earth Points

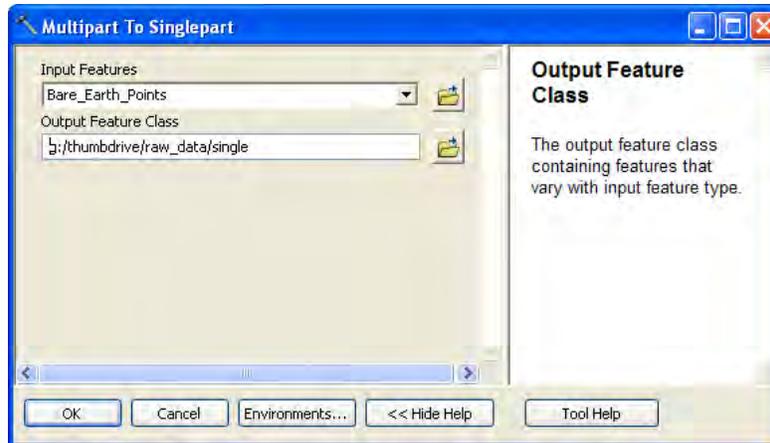
Most other available data types are in a ready-to use format, but the Bare Earth Points need a bit of work. Bare Earth points are stored as “MultiPoint” features in ArcGIS, which means that for every record in the table there is more than one point associated with it. Unfortunately, this means when downloaded and used as-is, the dataset cannot be queried for individual elevations per point. For that reason, we have to convert from multi-part to single-part features.



1. Turn off all other layers but the Bare Earth Points.
2. Right click Bare Earth Points in the table of contents, and select “Open Attribute Table”
3. Select a single record to see that there are actually 3500 points associated with this single record. Keep this record selected to convert only these points!

The following function can also be applied to larger selections or clipped areas, but keep the area small to avoid long processing times.

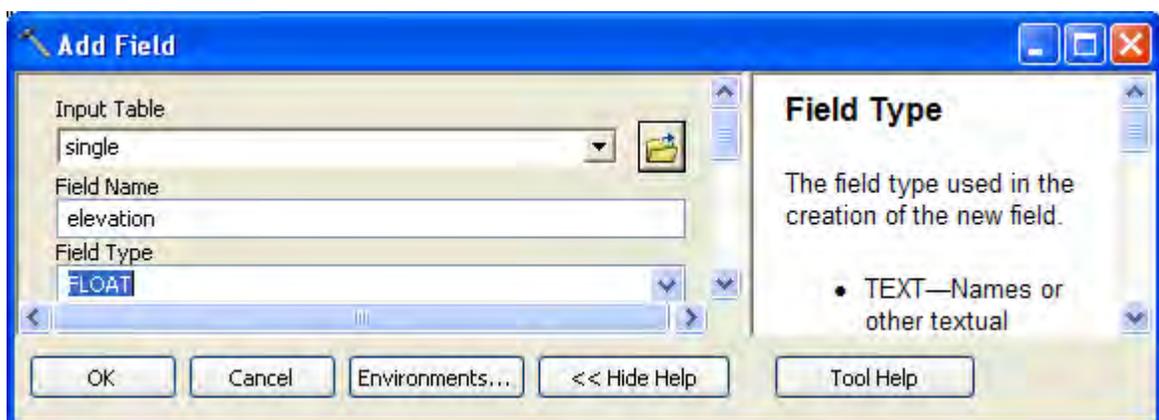
4. Go into ArcToolbox , double-click **Data Management Tools** → **Features** → **Multipart to Singlepart**.
5. **Input features** should be Bare\_Earth\_Points.
6. **Output feature class** should be (your folder)\raw\_data\single.
7. Click o.k.



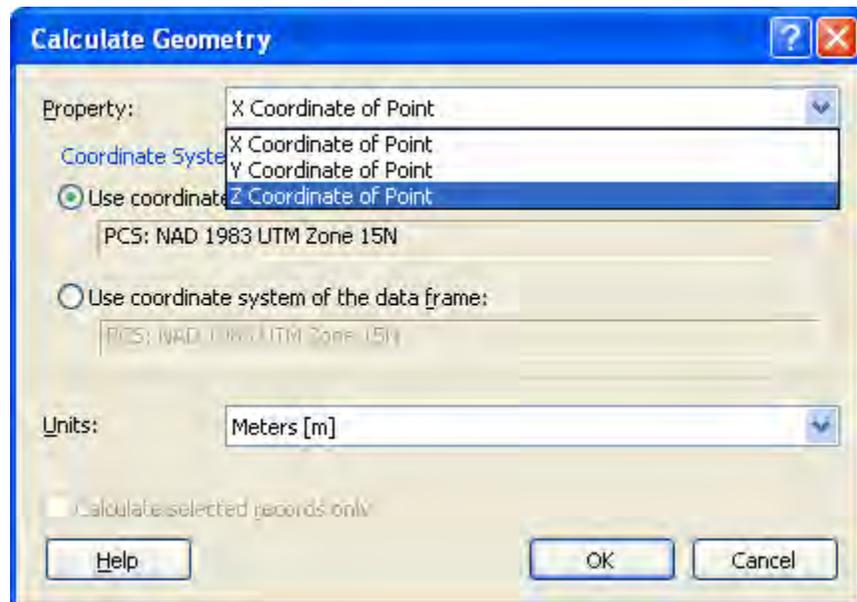
After processing, you will have a new layer named “single” with 3500 records – all the points associated with the original record selected from the Bare\_Earth\_Points layer.

Next, we’ll get the elevation data for the single points.

8. Go into ArcToolbox , double-click **Data Management** → **Fields** → **Add Field** tool add a field called “Elevation”. Set the field type to “FLOAT” as shown below. Leave all other fields to default settings. Click OK.



9. Now, right click the field you just created in the table, and select **Calculate Geometry**.
10. You will be warned that all changes will be made permanent, select “yes”.
11. Now, select the geometry that you’d like to calculate for “elevation” by selecting “Z coordinate of point” under Property. Click OK.

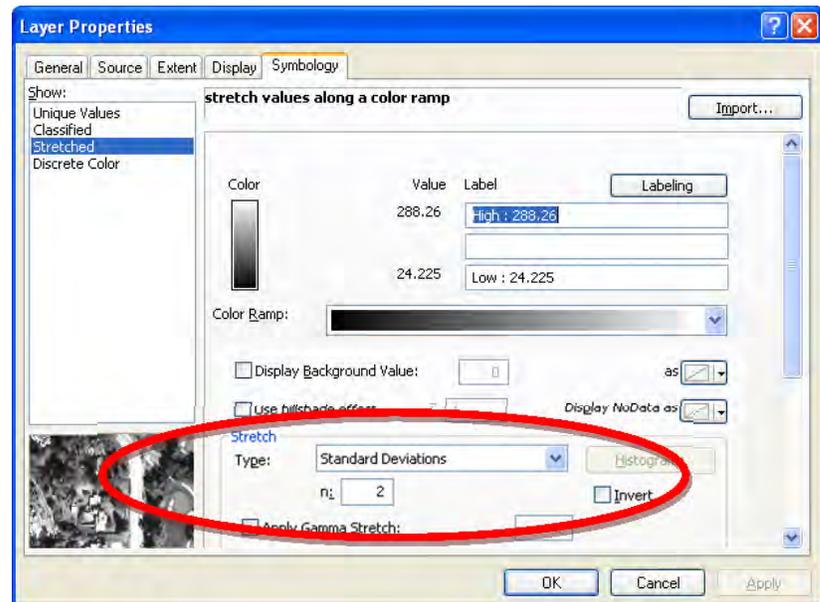


## B. Display Techniques

### Default Layer Properties

- Default or Standard Display
  - Limits “stretch” display to 2 Standard Deviations
- Statistics Drive Display – based on histogram from entire DEM
- Predefined color ramps – grayscale standard
- Nearest Neighbor Resampling performed in the background when manipulating layer properties
- Most display variables changed in Layer Properties → Symbology Tab

The standard display of any LiDAR dataset or derived product can typically be improved by using a few tools in ArcGIS. For all continuous datasets, contrast stretches can be applied by changing “stretch-type” to increase visual contrast of a portion of the landscape. The various stretch-types as listed below utilize the values histogram of the dataset to manipulate display by highlighting or subduing certain portions of the color-ramp. The result, depending on your selection, is a customized display that amplifies the contrast based on the features you’d like to study more closely.



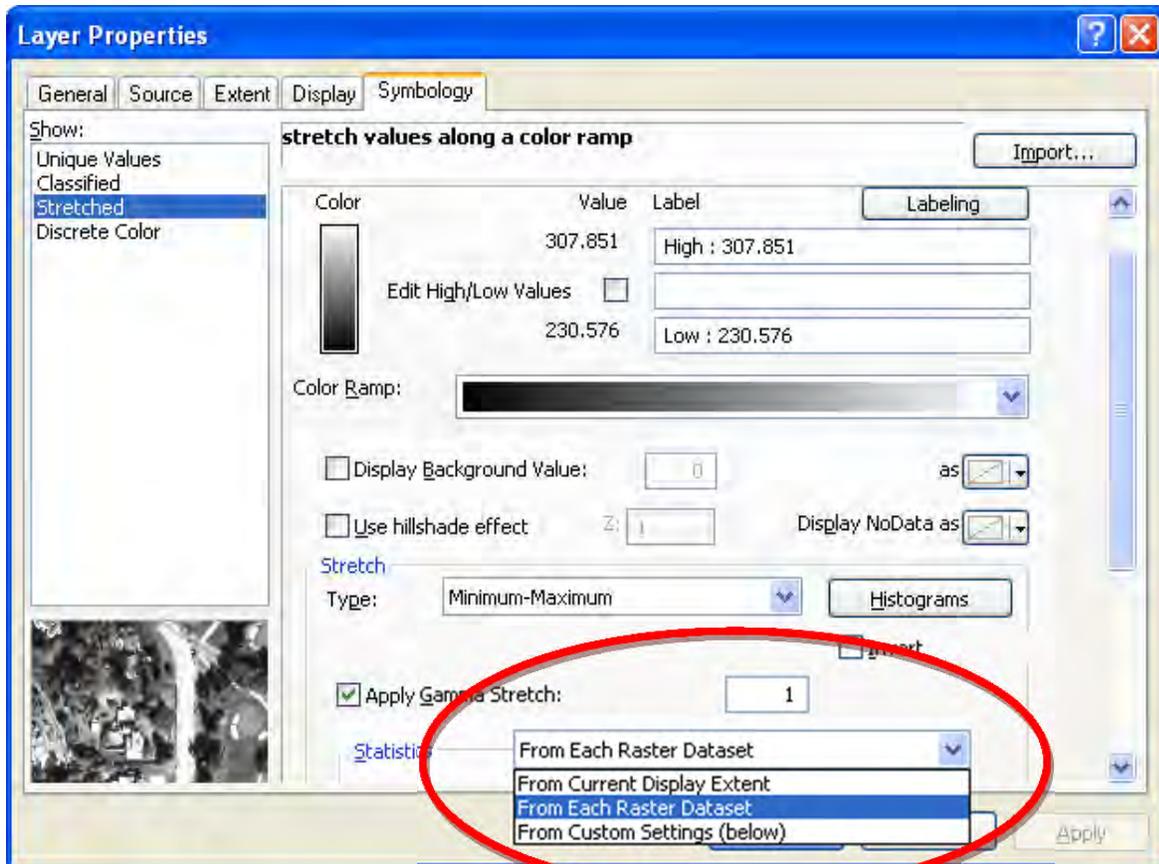
### Stretch Types

1. Select the DEM Layer, right-click → **Properties**→**Symbology** tab.
2. Under “stretched” view the “Histograms” button. When you adjust the histogram, you see multiple sets of vertical bars: the purple bars represent the current display values, and the gray bars represent your original values.
3. Examine how “stretch” type affects display by selecting each of the following and zooming in, paying careful attention to the notes for each one:
  - Custom or Histogram Specification – Manually defined – not recommended
  - Standard Deviations – Standard display
  - Histogram Equalize – This setting accentuates minor variations – uplands in this case – by applying the value display equally across the entire histogram
  - Minimum/Maximum – This setting accentuates larger variations in relief - dendritic drainage in this case – by visually ignoring the tails of the histogram
4. Gamma – This can be used with Standard Deviation or Min/Max stretch types. By applying a gamma correction, you can control the overall brightness of a raster dataset, to enhance the overall contrast and interpretation of the image.

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## Statistics Calculations

1. Select DEM Layer, right-click → **Properties**→**Symbology** tab→”stretched” sub-menu
2. From Statistics select “From Each Raster Dataset”– then zoom to different extents

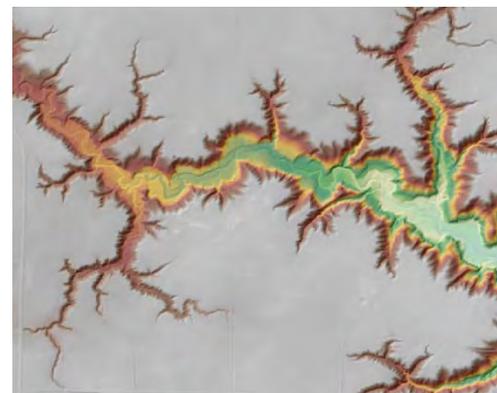


3. If using “From Current Display Extent” for printing, you need to save as XML.
4. Select DEM Layer, right-click → **Properties**→**Symbology** tab→”stretched”→”Statistics” submenus to select “Import” for your previously saved XML file.

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## Adding Color

1. Select DEM Layer, right-click → **Properties**→**Symbology** tab→”stretched” sub-menu
2. Select various displays from “color ramp” to bring out different effects. Many elevation ramps are multi-chromatic, a few will be demonstrated in this exercise.

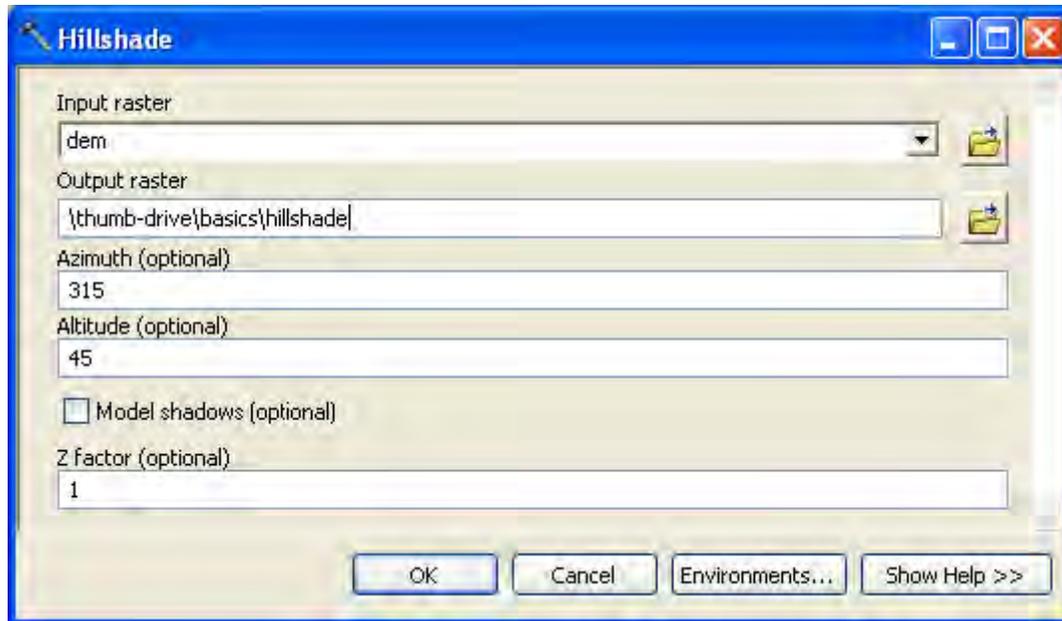


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## Adding Depth and 3D Effect

Shaded relief adds depth and perspective while simulating a lighted surface (DEM). Temporary hillshade effects can be created within Layer Properties, but are “quick and dirty,” not yielding consistent results compared to the below method.

1. **ArcToolbox** → **Spatial Analyst Tools** → **Surface** → **Hillshade** 
2. **Input Raster:** DEM
3. **Output Raster:** (your folder)\hillshade



4. Arrange elevation on top of hillshade in table of contents
5. Make elevation display 35 – 50% transparent. **Layer Properties** → **Display Tab** → **Transparency**

## C. Visualization / Comparative Techniques

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### Orthophoto/DEM Comparison

Often, the best way to understand differences in your landscape is to view each layer in conjunction with other layers. By paying careful attention to a specific portion of the landscape, one can overlay orthophotography on a DEM to gain a better understanding of the area.

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### Add MNGEO Web Map Service (WMS)

1. Open ArcMap and click on 'Add Data'
2. Look in the Catalog, and click on 'GIS Servers'
3. Highlight 'Add WMS Server' so that it appears in the Name window, and hit 'Add'. An 'Add WMS Server' window will pop up.

4. To bring up the Imagery server, type **http://geoint.lmic.state.mn.us/cgi-bin/wms?** in the URL window. You can click on the 'Layers' button to see a list of the layers available under the wms. Click 'OK'.
5. To bring up the Scanned DRG server, type **http://geoint.lmic.state.mn.us/cgi-bin/wmsz?** in the URL window. You can hit the 'Get Layers' button to see a list of the layers available under the wms. Click 'OK'.
6. Now when you look under 'GIS Servers' you have two new entries: 'LMIC WMS server (aerial photography) on geoint.lmic.state.mn.us' and 'LMIC WMS server (quad sheet drgs) on geoint.lmic.state.mn.us'
7. Still in the 'Add Data' window under 'GIS Servers', highlight one of the services listed under #6 to bring it into the 'Name' window, then click on 'Add'. The service, with all of its layers, has now been added to your ArcMap project.
8. Click on the '+' to open the map service

## Swipe

1. To display the **Effects Toolbar**, right-click anywhere in the toolbar and select **Effects**.
2. Select the **Swipe Tool** to "wipe" a layer using a horizontal or vertical line across the screen.



3. Make sure the layer you want to "swipe" is shown in the "Layer:" box.
4. Click on the map and drag to swipe (*do not release mouse button; the mouse must be depressed to get the swipe effect.*)

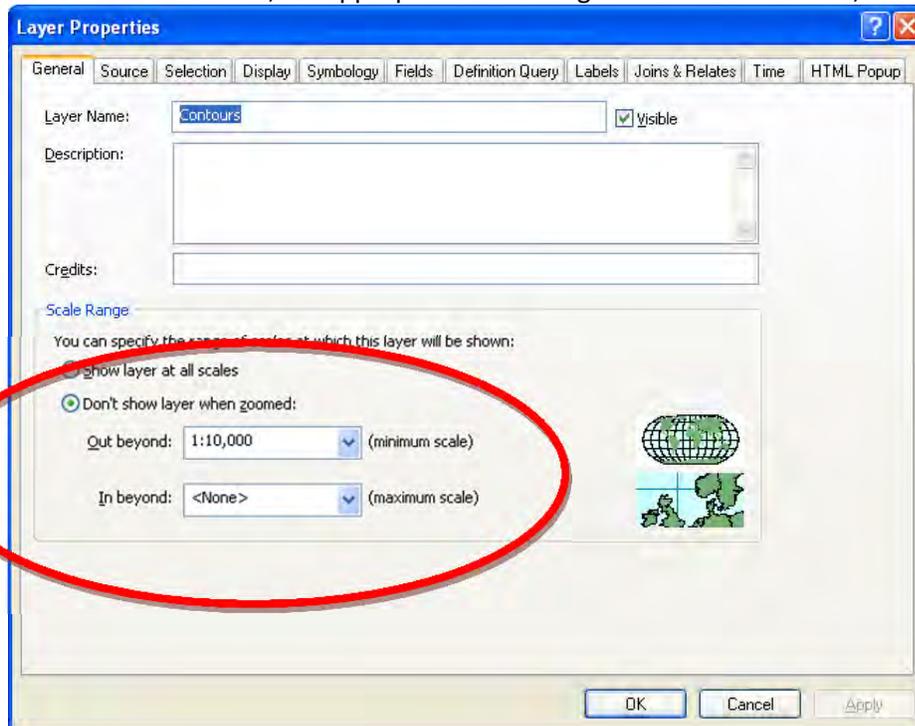
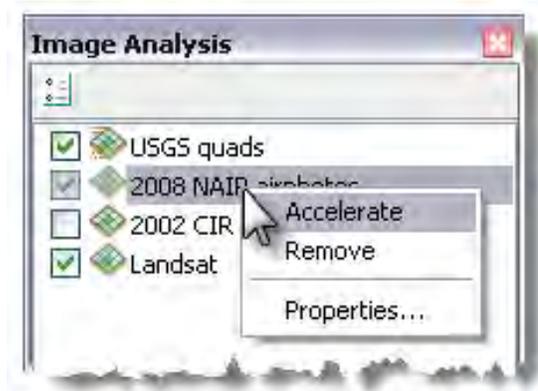
Example of swipe:



## D. Managing Large Datasets

### Basic Tips

- Gear up – Ease of use is often hardware dependent
  - CPU – multiple core, fast processors
  - RAM – 64 bit systems allow more RAM – upgrade
  - Disks – High speed, large – cheap!
- Work locally – network speed, USB cables, etc. slow down processing
- Allow 20% overage for storage space – ensures better disk functionality, along with the option to defrag or disk check for bad sectors
- Store source elevation information only if space is available – download is fast and easy
- Avoid display of multiple LiDAR scenes – hang-ups
- Image Analysis – Accelerated rendering, test this with larger display datasets
- Calculate BOTH Statistics AND Pyramids for faster drawing later
- Backup – external hard drives cheap, failing to archive data it took days to process is not
- Contour data can clutter screen, set appropriate scale range limiters such as 1:10,000



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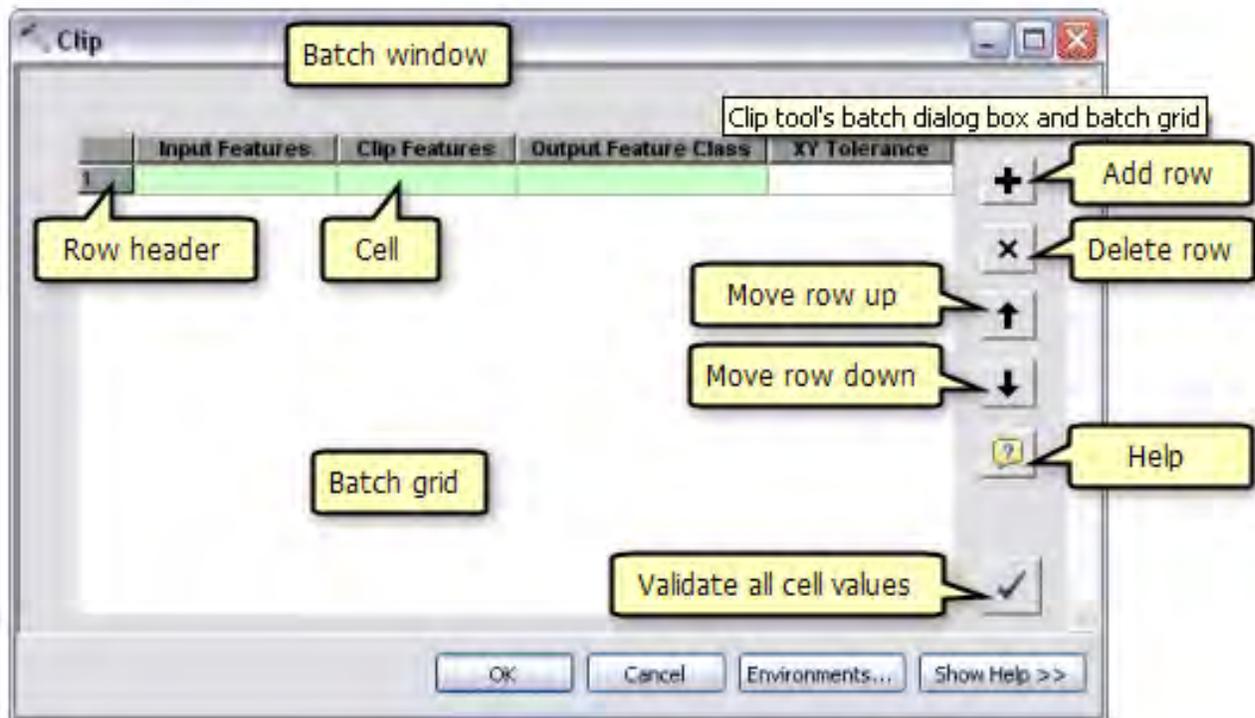
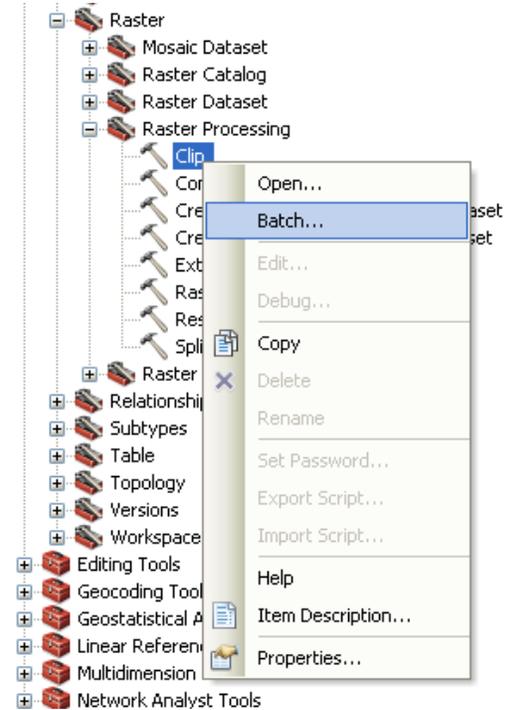
## Strategy - Divide, Then Conquer

A critical concept in working with LiDAR data involves using “pilot areas” to test processing techniques and methodology on before applying to entire dataset. The “try it and see” approach to LiDAR processing is frustrating and time consuming. Once processing steps have been tested on smaller areas, utilize batch processing or scripting to maximize “autopilot” overnight processing.

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## Batch Processing

- Great tactic for processing any dataset which requires running the same tool against a large number of areas
- With LiDAR data, the limitation is often the processing speed in which a single dataset can be run
- Processing in these smaller chunks is more efficient should files be missing, corrupt, or otherwise unstable
- Batch processing is VERY user-friendly and non-intimidating for those who don't write code



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