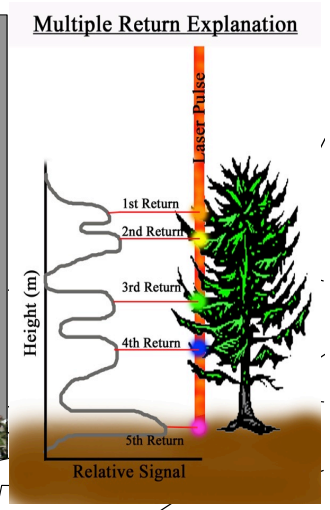
GEOL 452/552 - GIS for Geoscientists I

Lecture 23 - LiDAR

- LiDAR - some background (thanks to Chris Kahle, DNR)
- Converting Lidar point data to a raster
- Visualization/Analysis (small subset, pre-made full tiles)
- Look at online lidar data for Iowa (1m hillshaded)
- Work with Lidar elevation raster around Ames
- Data in \follow along**lidar_class_ex** (ames_lidar_data_ex.mxd)
- Customize - Extensions - Activate **Spatial Analyst** and **3D Analyst**

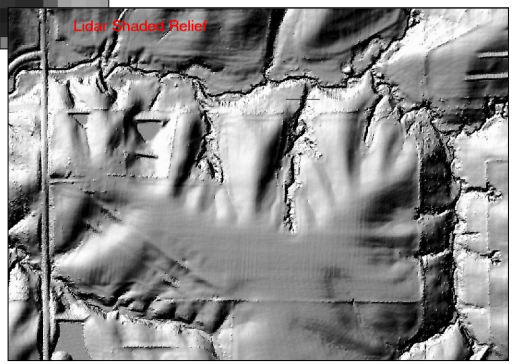
Scanning Lidar



elevation of about 5,000 feet shooting up to 150,000 pulses per second.

- **Multiple returns per pulse**
- **Waveform Returns**
- **Intensity**

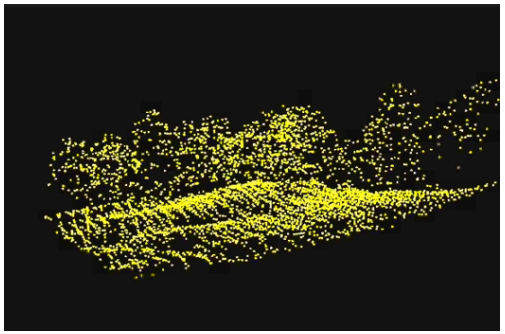
30 m DEM

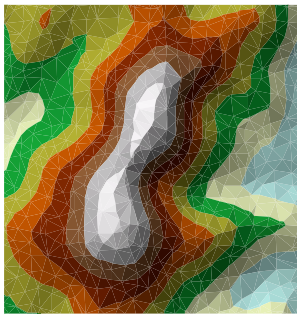


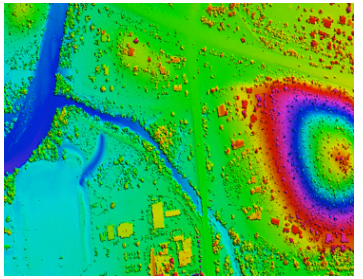
DEM from Lidar:
made from 1+ point per sample per square meter

All of Iowa now has Lidar data flown (processed?)

Lidar representations:







3D point cloud
TIN (points connected to triangles)
Raster (interpolated from 3D points)

USGS 2005 CSC-2 contract with Sanborn

- Productized LiDAR: FEMA, Standard, High-res
- FEMA and Standard Product Specs:
  - ❖1.4 m postings

Accuracies

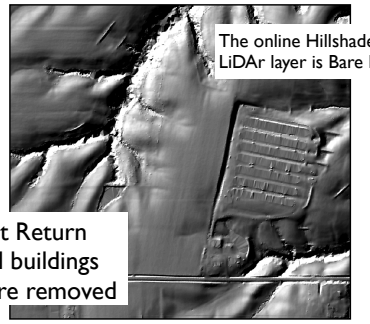
- ❖18.5 cm vertical RMS @ 95% confidence (~7.28 inches)
- ❖37 cm vertical RMS in vegetation (~14.57 inches)
- ❖1 m horizontal RMS @ 95% confidence (39.37 inches)

Bare Earth Product

- ❖Vegetation removed: FEMA product 95%; (90% - Standard product)
- ❖Artifacts removed: FEMA 90%; (89% - Standard)
- ❖Outliers removed: FEMA 95%; (90% - Standard)
- ❖Buildings removed: FEMA Product 98%; (95% - Standard)

- Deliverables: ASCII x,y,z,i text files; LAS all return binary files

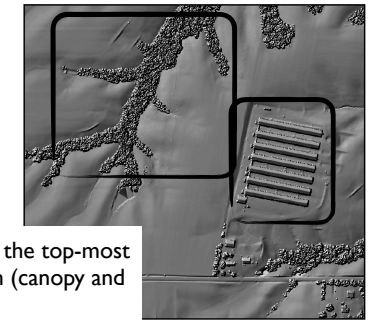
Bare Earth



The online Hillshade 10m LiDAr layer is Bare Earth

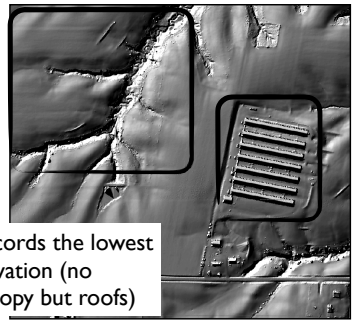
Last Return and buildings were removed

First Return



Records the top-most elevation (canopy and roofs)

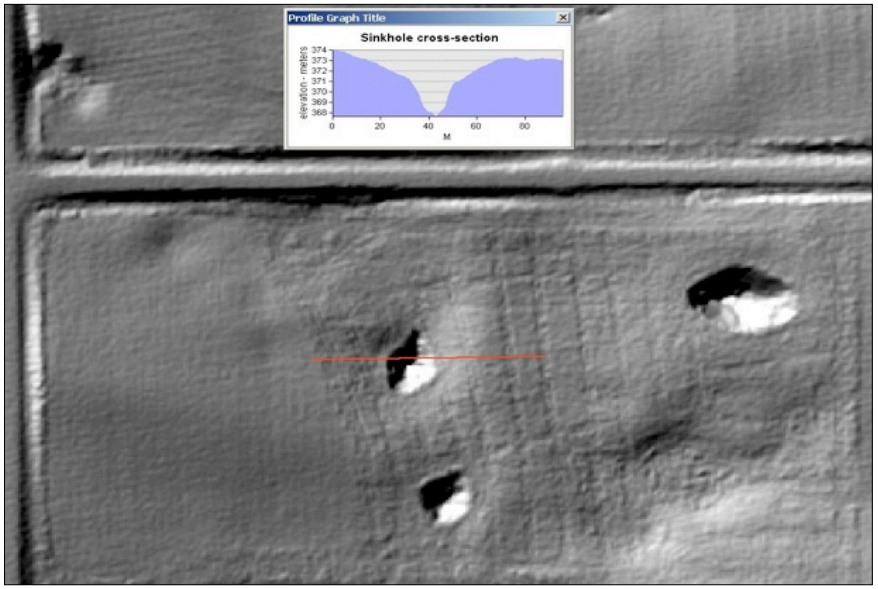
Last Return



Records the lowest elevation (no canopy but roofs)

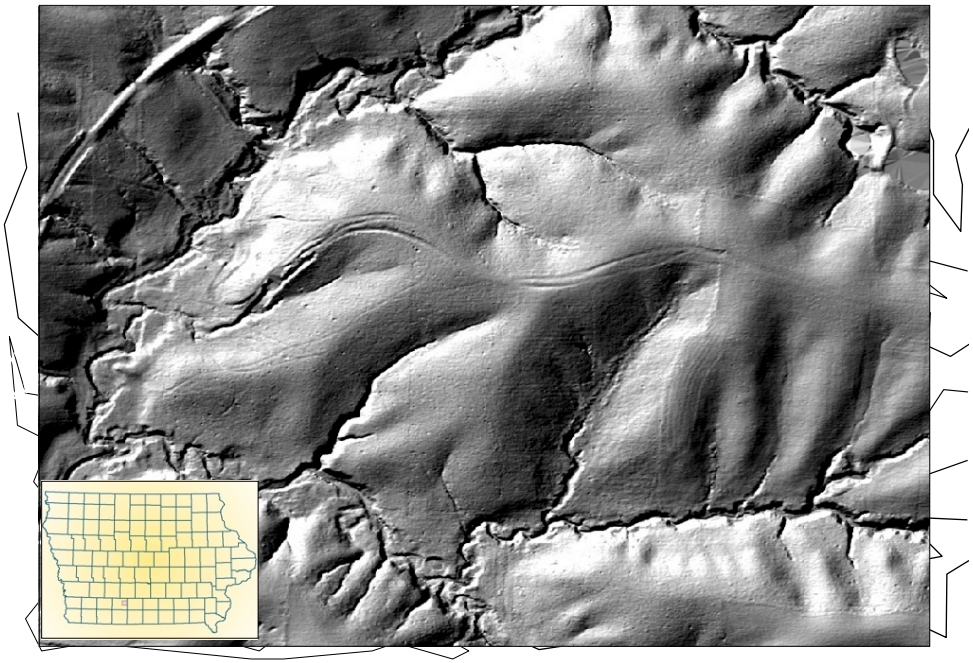
Intensity

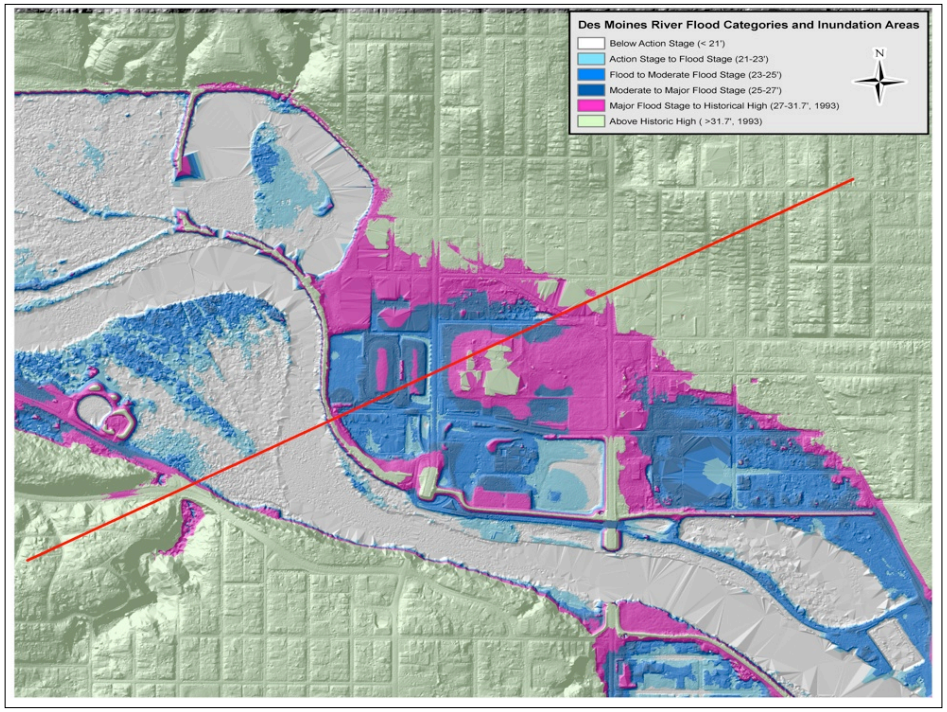
Special! Records the intensity (or loss) of the reflected laser energy:
forrest = low returns (high loss) => black
cement = lots of energy returned => white



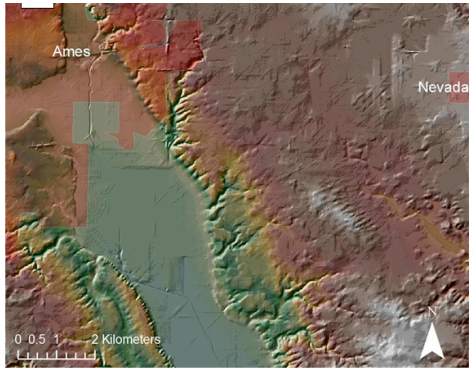
Find and measure sinkholes under vegetation cover

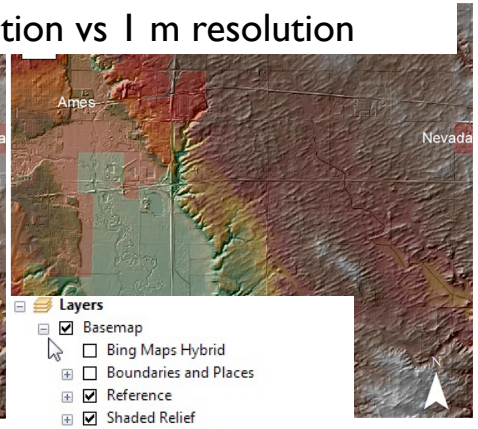
Mormon Trail remnants – Union County, Iowa



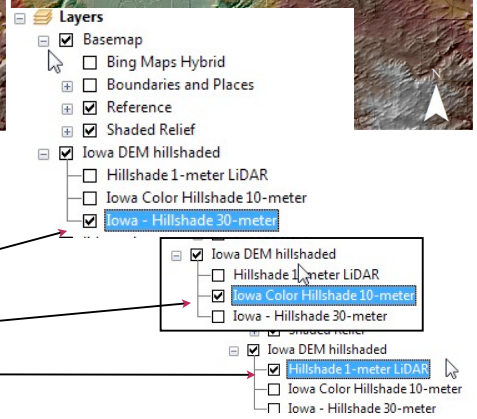


Let's look at 10m resolution vs 1 m resolution



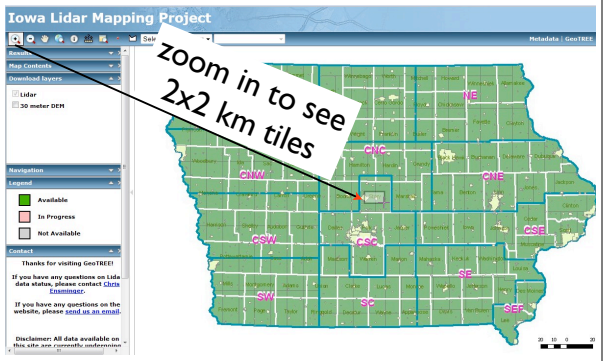


- Load ames_lidar_data_ex.mxd
- I've added Iowa DEM **hillshaded** online data
- look at 30 m (100 ft), 10 m (30 ft) then Lidar (1 m, 3 ft)



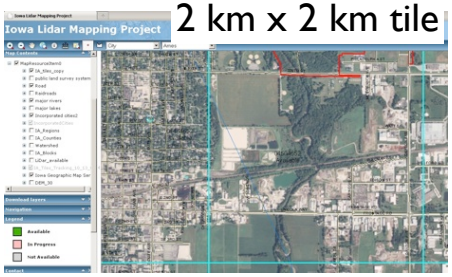
Lidar - how to get from Points to raster

- Iowa: Need to download raw data in 2 km x 2 km "tiles"
- Download tiles as .las format (binary) or .xyzi (text)
- Each tile: ~ 2 - 3 million points (!), size: 100 Mb (compressed), Shape file: 300 Mb
- Raw resolution: ~1 m (x/y) but needs processing into rasters
- www.geotree.uni.edu/lidar/ (google geotree lidar)
- need to install 7zip (freeware zip) to uncompress .7z files
- Processed (IGS?):
  - 3m resolution DEM (cm Z resolution in integers) and 1 m resolution hillshade from Iowa Geological Survey

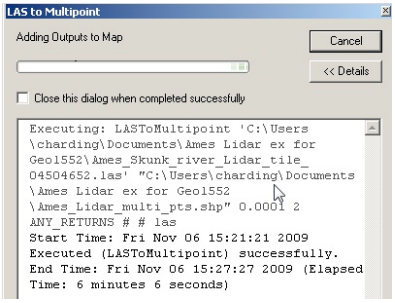


Convert a 2x2 km tile of raw Lidar Data points (.las file) into a DEM (raster)

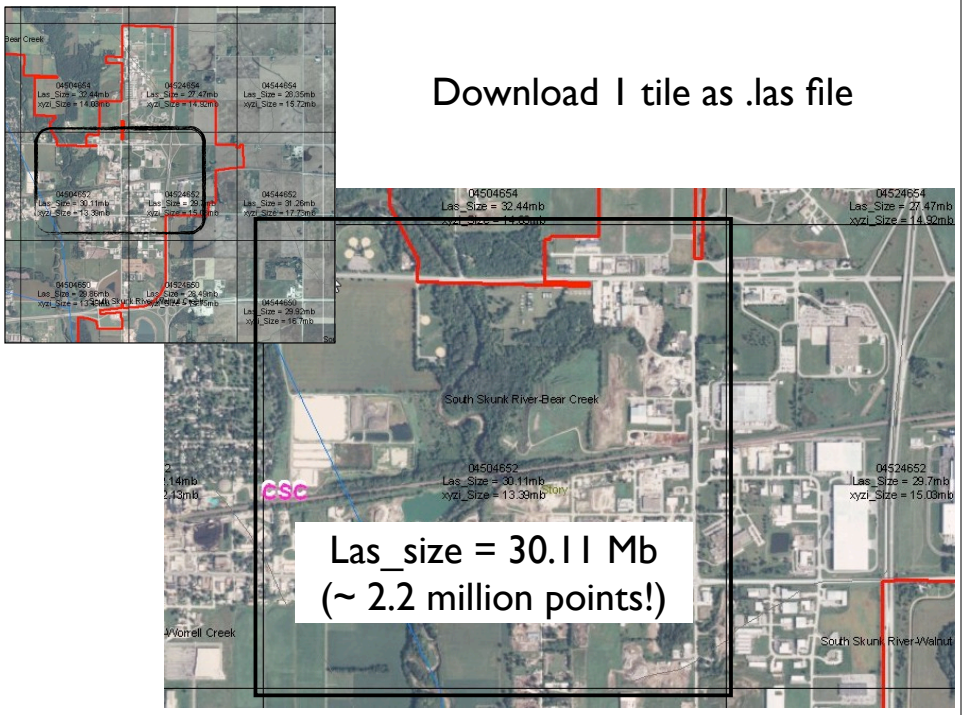
- Download .las file (1 tile)
- Convert .las file into (Multi) point shape file
- each multi-point contains ~3400 "real point"
- ArcTools: 3D Analyst - Conversion - From File - LAS to Multipoint
- (Remember to activate 3D analyst extension, even for ArcTools)

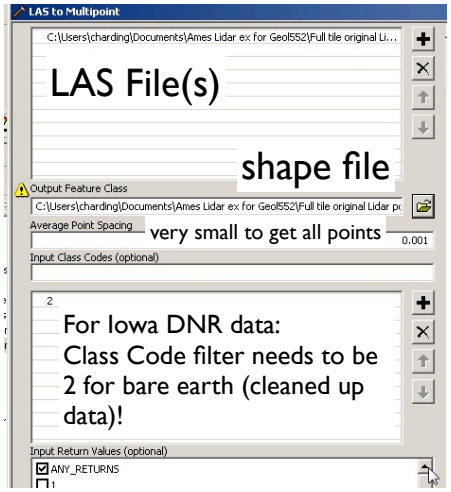


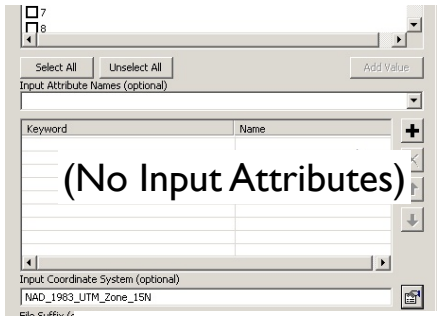
2 km x 2 km tile



Download 1 tile as .las file







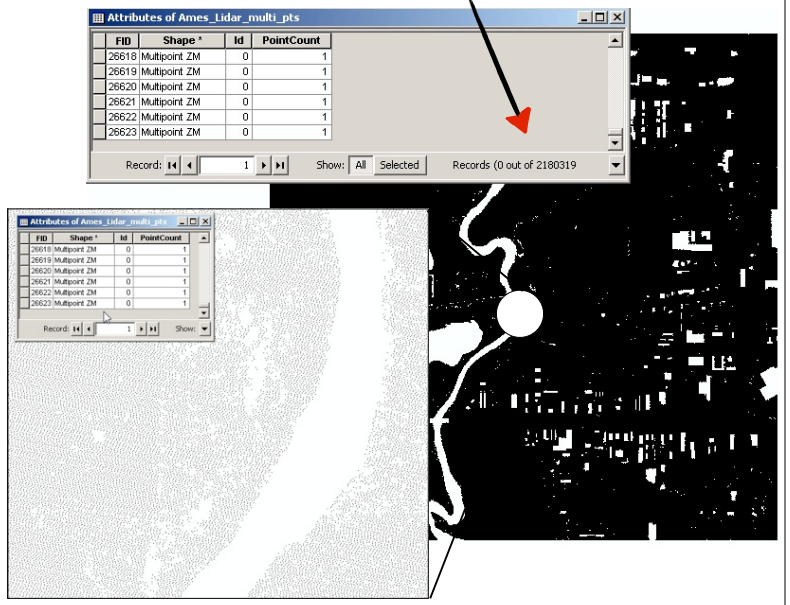
Set to UTM15 NAD 83 (in Iowa)

(tool takes 5-10 min per tile)

ANY RETURNS

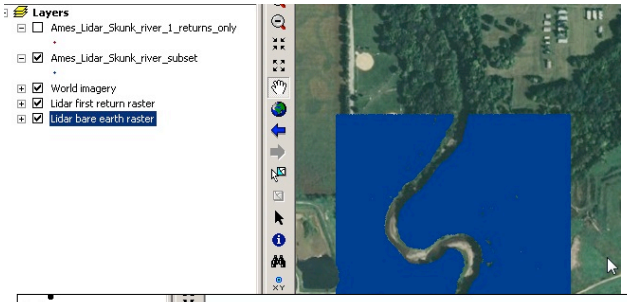
- Creates Multipoint shape file
- Means: each feature contains many points
- Here 26k multipoints, 2.2 Mio points total (full tile)
- Includes elevations (Z) but no real attributes*

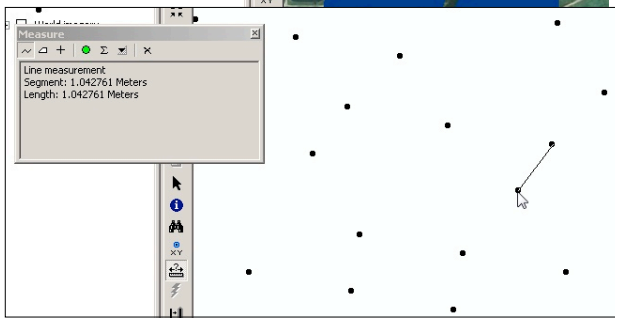
2.2 million points total



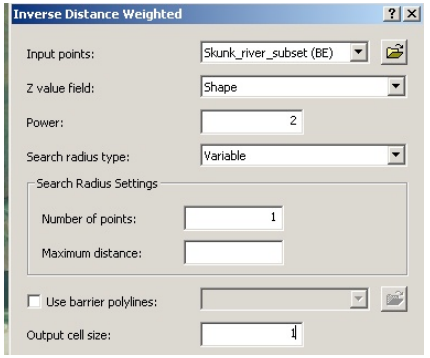
Your turn:

- load Ames_lidar_data.mxd
- let's assume you've already created a point shapefile from .las file
- Use: Skunk_river_bare_earth (blue points)
- This is Bare Earth data
- Subset of 132k points instead of full 2-3 mio.
- zoom in, measure point distance between some points
- But: what's the elevation?



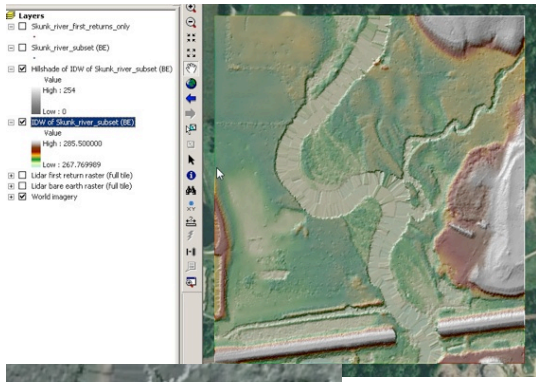


- Let's make a DEM raster from points
- (1 m bare-earth DEM)
- Use inverse-distance-weighting (IDW) interpolation
- (Spatial Analyst - Interpolate to raster)
- power = 2, Variable search radius
- BUT, number of points = 1
- elevation from closest point
- output cell size: 1 m



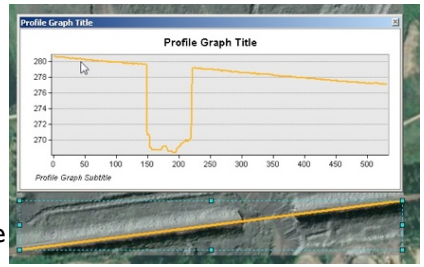
Symbolize DEM as: stretched, with elevation color, Minimum-Maximum

- Make hillshade (Spatial A. - Surface Analysis) of bare earth DEM (25 degr. Azimuth)
- Layer Properties - Display
- Switch on World Imagery layer
- make hillshade 30% transparent (contrast 20%)
- set to bilinear Interpolation (Resample)
- So ... what happened here?



more

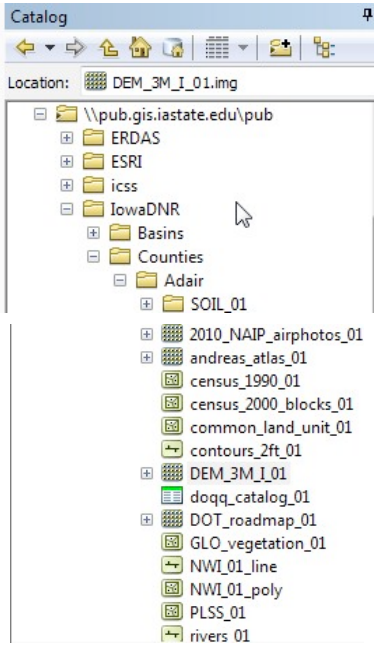
- make a profile on bare earth DEM, figure out the grade of the railroad
- make another "DEM" and hillshade but now from **first returns** (FR) point layer (Skunk_river_first_returns)
- this will show the tree canopy, top of buildings
- How would you visualize the differences in elevation from bare earth to first returns? (same colormaps, Effects toolbar)



- Backup: in "full tile" layer groups:
- pre-made bare Earth and first return rasters (1 m res.)

New: 1 m Lidar hillshade raster per county

- \\pub.gis.iastate.edu\pub
- IowaDNR - Counties
- Copy DEM_3M_I_XX
- XX <- county number
- rasters in jp2 (Jpeg2) format, per county
- Digital Elevation model made from radar:
  - at a 3 m lateral resolution (not 1m)
  - cells have elevation values in **cm not meters**



Wrap - up

17-Nov	Ch 8 - Raster Analysis	lidar ex. / suitability analy
22-Nov	Thanksgiving Break	Thanskgiving break
24-Nov		Thanskgiving break
29-Nov	Work on Class Project (Geol 552)	Work on class project
1-Dec		Work on class project
6-Dec	Review for Final	Work on class project
8-Dec	Project Presentations	
TBA	Final exam	

- No more lectures, please find and work on a class project
- Week after Thank giving break: I'll be here TT 9-11 for help with projects!
- All meet again here for Final exam Prep/Review session on Dec. 6 (Tues. Dead week)
- Material: textbook chapters 1 - 8, 11,12
- Need review questions! Use Bb - Discussions
- Dec. 98 All meet here for project presentations (10 slides, 10 min., powerpoint)
- Final: Multiple Choice test (20 min.) + practical test (60 min) (??? Tues. Dec 13, noon-3 ???)
- Poster version of class project (300 dpi, 90% (or less) jpg, should end up < 10 Mb),
  due Dec. 17