# LIDAR 101 & 2014 MO/AR LIDAR PARTNERS PROJECT

**NEMO GIS Workshop** 

May 22, 2014

# **PRESENTER**

### Tim Donze

- Business Development
- Surdex Corporation



# **PRESENTATION TOPICS**

What is LiDAR?

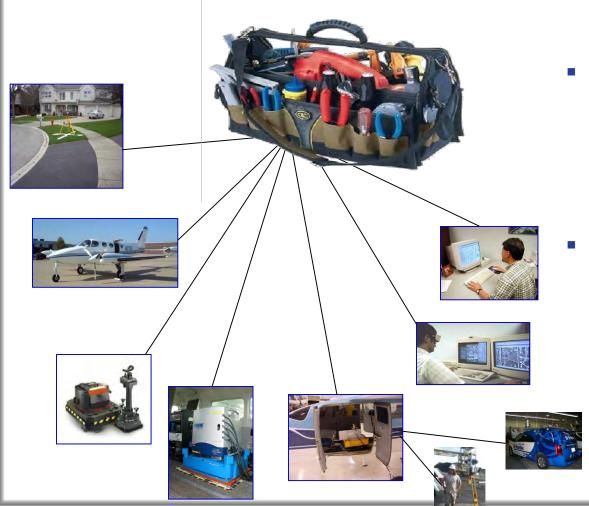
Why is LiDAR Valuable?

Missouri / Arkansas 2014 LiDAR Project

**NEMO Portion of the 2014 LiDAR Project** 

**Details and Specifications of Project** 

# Many Tools in our Tool Bag – LiDAR is just one tool



- The right tool for the task
  - Not all mapping projects created the same
  - Successful mapping projects require various tools and skills to complete
  - Project must be designed around the ability of the tool to perform the task
  - Vendor must be knowledgeable enough to make correct recommendations
- Surdex has these skills and equipment
  - Land Surveying
  - Geodetic Surveying
  - Film Cameras
  - Digital Cameras
  - LiDAR
  - Satellite Imagery
  - CAD
  - GIS
  - IT

# Sign Of The Times – Laser vs Manual

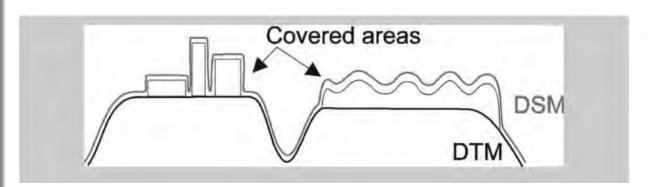


### **Digital Elevation Model (DEM)**

- The earths surface can be modeled with any number of measured elevation points
- These measurements can be combined into a Digital Elevation Model (DEM)
  - A DEM is a simple array of measured elevation points
- This DEM representation will in general model one of two surfaces.
  - A Digital Surface Model (DSM) representing the first return surface or all points measured

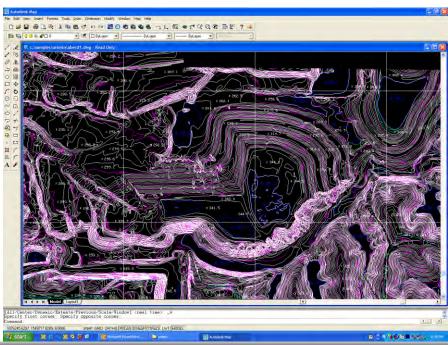
A Digital Terrain Model (DTM) representing only the points falling on the ground

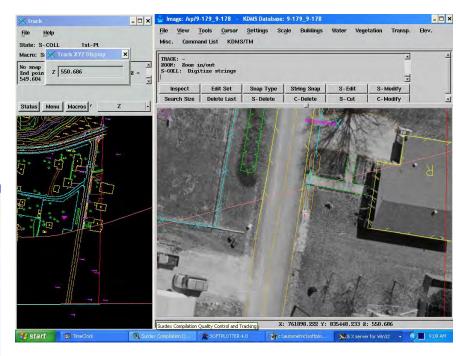
surface.



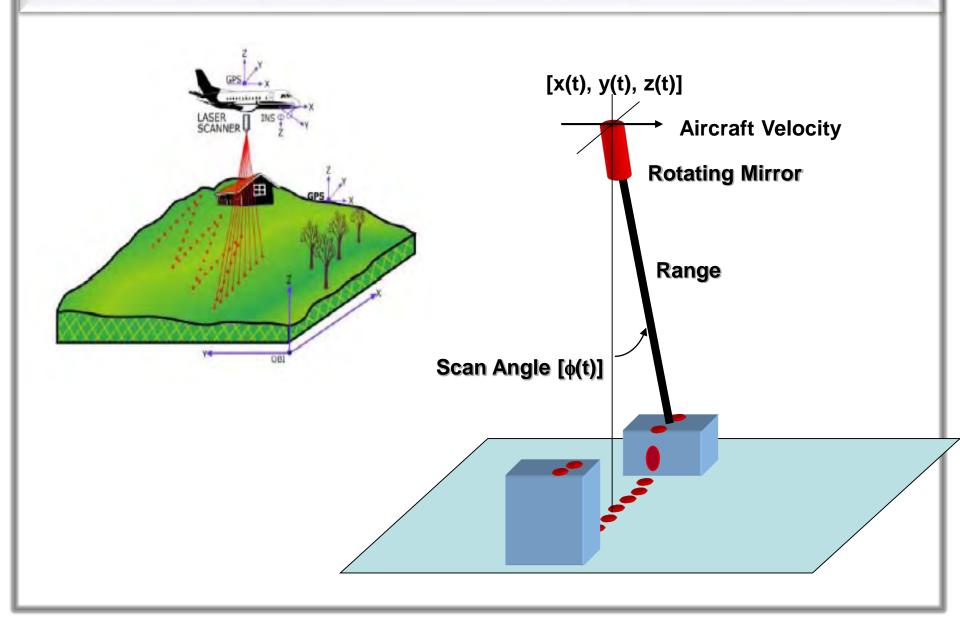
C:\samples\msd lidar\ArgonneCorridor lr.xyzi 848976.570,996762.510,606.380,0.8 848981.190,996759.010,600.120,2.8 848985.730,996755.600,599.760,3.1 848988.820,996753.290,600.120,2.4 849000.800,996745.220,602.180,1.5 848997.680,996747.600,602.050,1.6 848994.050,996750.360,601.300,2.0 848991.060,996752.610,600.480,1.9 848987.460,996755.360,599.720,2.9 848984.310,996757.740,599.560,3.5 848976.790,996763.490,618.520,0.4 848976.340,996763.800,603.960,0.4 848965.910,996785.840,616.790,2.2 848971.540,996781.580,611.370,5.2 848974.300,996779.510,615.870,1.8 848977.710,996776.950,617.510,2.1 848981.570,996774.030,617.210,2.1 848984.880,996771.540,619.310,0.3 848988.520,996768.820,620.000,1.5



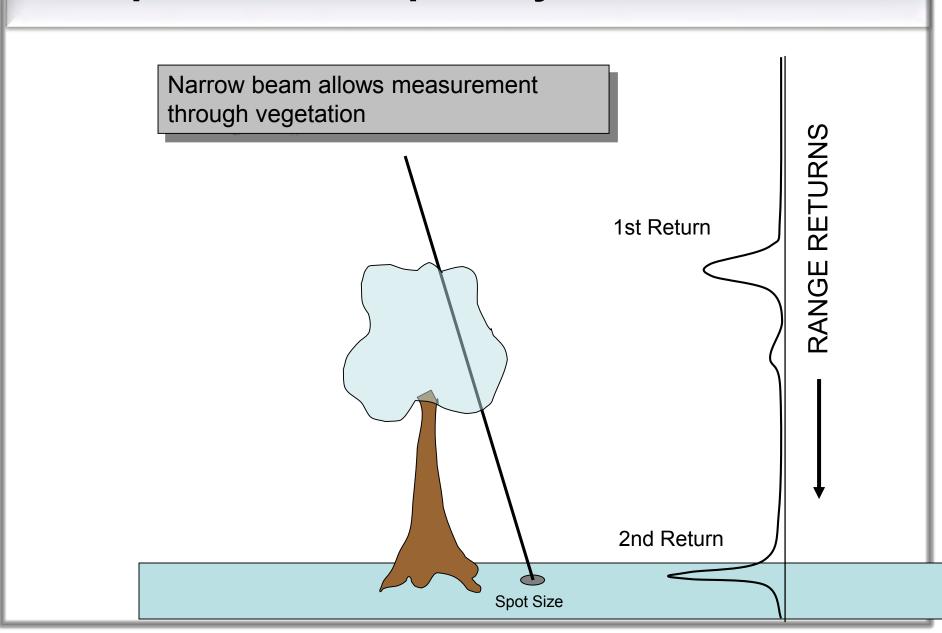




### **2012 MISSOURI LIDAR PROJECT**



# **Multiple Return Capability**



# Why LIDAR?

- Quick collection of large areas at high density
- "Day / night and all-weather operation"
- Very effective in forested areas "see through the trees"
- Can be flown all times of year
- Generally flown with low operating cost aircraft (fixed-wing and/or helicopter)
- Easier to plan missions and mobilize

# Why LIDAR?

### **Time to Collect 1 Million Points**

- Conventional Surveying: 15.5 years
- Photogrammetry: 1.5 years
- Aerial LiDAR: 6.7 seconds @ 150 kHz

### What is LIDAR use for?

- A highly accurate DEM from LiDAR will improve the quality of:
  - Ortho Imagery
  - Floodplain Maps
  - Natural Resource Management
  - Contour Mapping
  - Erosion Analysis
  - Line of Site Studies
  - Archeological Research
  - Much More...

### Post spacing over high resolution ortho





# **SURVEY GROUND CONTROL**

- Survey control points used for LiDAR calibration
- Independent survey check points collected for each delivery area (hard surface, grass, trees)
- Used the MODOT GNSS Network (CORS)





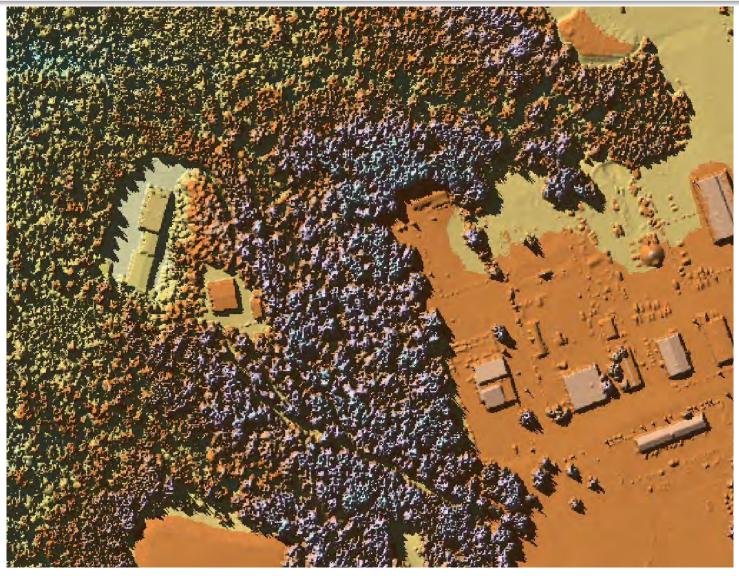




# **Point Cloud From LiDAR**

### Bare Earth DEM Calculations

- 1. Identify man made structures
- Determine ground elevation at edges
- 2. Identify vegetated areas
- Search for ground points within area
- 3. Identify open areas
- 4. Interpolate between available points
- 5. Filtering and clean-up

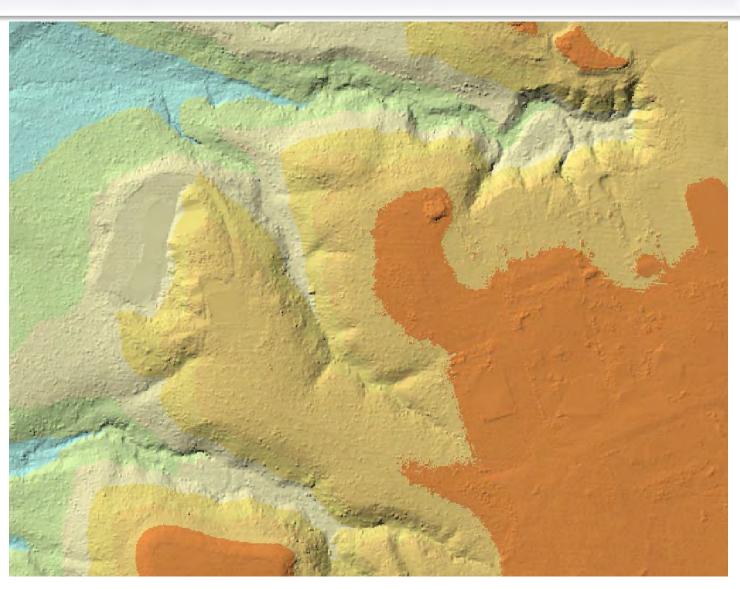


First Return DEM

# **Bare Earth Generation**

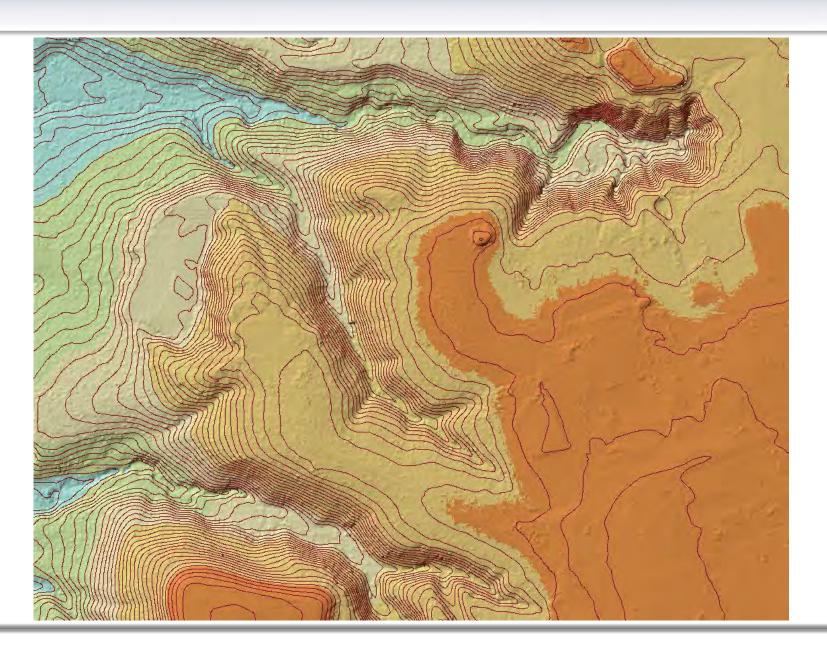
Automatically extracted Bare Earth DEM

- Ground surface with vegetation and man-made structures removed
- Critical for terrain and hydrology modeling



Bare Earth DEM

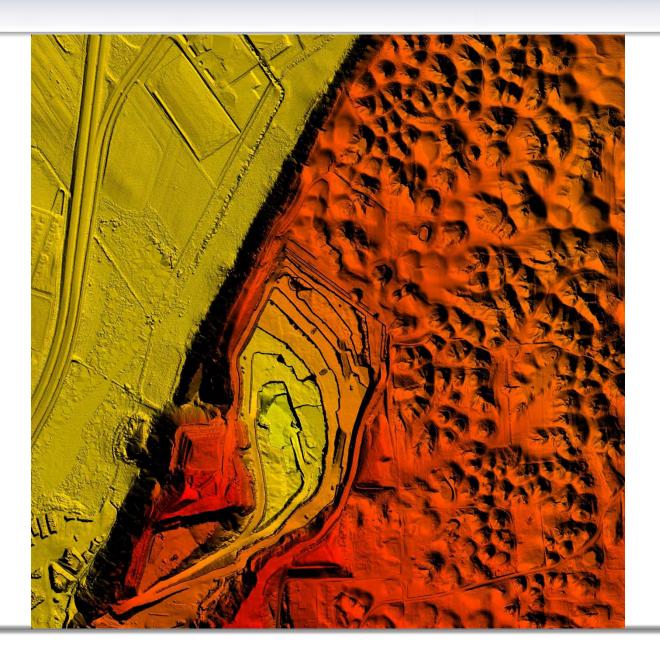
# **Contour Generation**



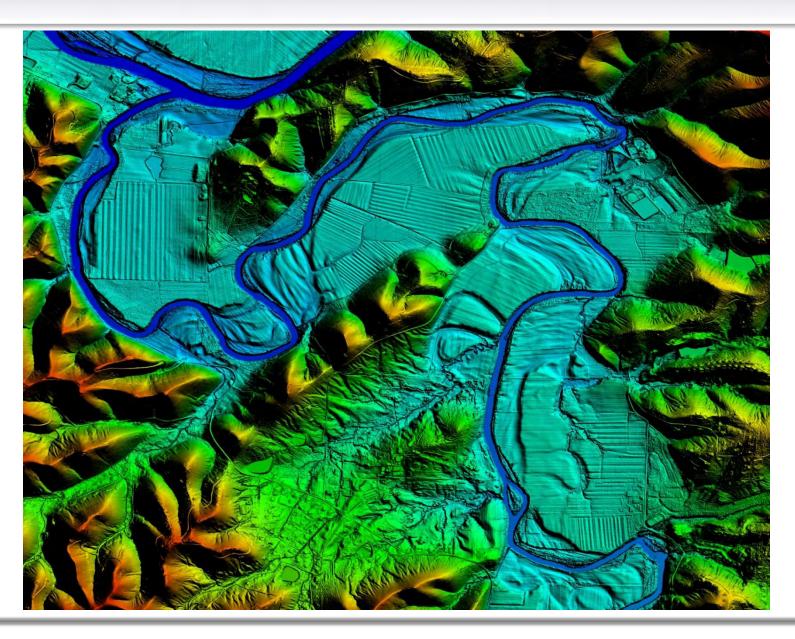
# **Point Cloud From LiDAR**

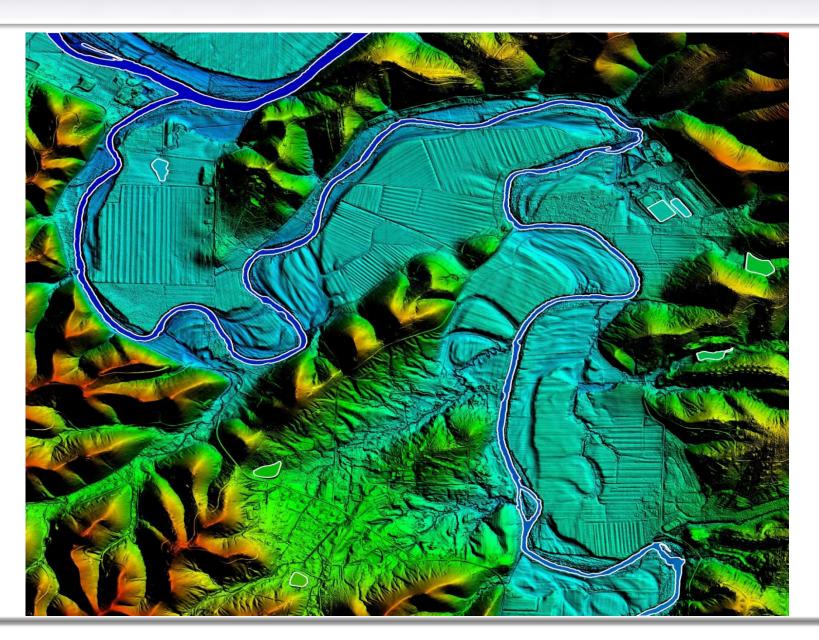


# **Bare Earth Generation**









# 1-METER PROJECT COUNTIES

- Atchison
- Holt
- Andrew
- Buchanan
- Dekalb
- Clinton
- Ray
- Grundy
- Pike
- Vernon
- Barton
- Shannon
- Knox

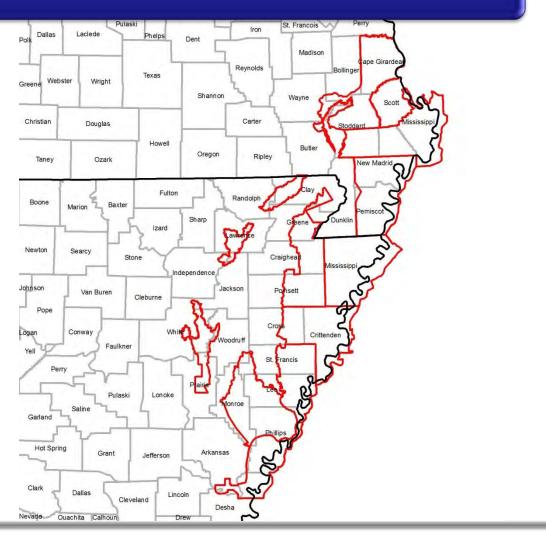




# **0.7-METER PROJECT COUNTIES**

- Clay
- Greene
- Craighead
- Mississippi
- Poinsett
- Lawrence
- Crittenden
- Cross
- St. Francis
- Lee
- Monroe
- Phillips
- Desha
- White
- Prairie

- CapeGirardeau
- Stoddard
- Mississippi
- New Madrid
- Pemiscot
- Wayne
- Butler



# **2014 PROJECT PARTNERS**

- U.S. Army Corps of Engineers (USACE, Contract Manager)
- Natural Resources Conservation Service (NRCS)
- United States Geological Survey (USGS)
- MO Department of Natural Resources (DNR)
- Arkansas Game & Fish Commission (ARGF)





**US Army Corps of Engineers** 







# **PROJECT COORDINATION**

Coordinated through the **Data Development Committee** of the **Missouri GIS Advisory Council**.

Follow-up to a prior multi-agency LiDAR acquisition in previous years.

Project areas were driven by agricultural, water sheds & wildlife management needs

Collaboration allowed multiple agencies to join the project and gained the benefits of economy of scale.

### PROJECT CONTRACTING

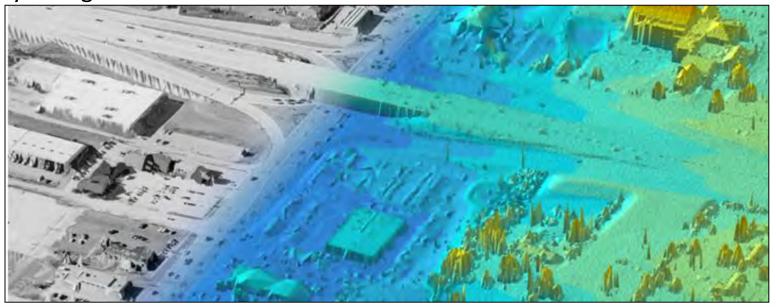
Partners agreed to use previously negotiated IDIQ A-E contracts through the USACE St. Louis District's Center of Expertise for Photogrammetric Mapping

 Ted Stanton, USACE, deftly handled pooling funds from all agencies (even across fiscal years) and negotiating the task order with Surdex Corporation

# PROJECT OVERVIEW

### Referred to as the MO/AR LiDAR Project

- **Project Area:** portions of 30 MO Counties & 14 AR Counties totaling 20,295 square miles
- **Purpose:** high resolution LiDAR data to generate bare-earth models & hydrologic break lines



### **PROJECT SPECIFICATIONS**

0.7 meter & 1 meter LiDAR ground sample distance

Collected leaf-off, snow-free, water at normal or below normal levels

Data processing follows USGS LiDAR Base LiDAR specification V 1.0

Data accuracies follow NDEP guidelines, V1.0 for NSSDA of 95% confidence for 2' contours and ASPRS Class I standards

Hydro Enforced breaklines collected for ponds 2+ acres and rivers 100' or wider

# LIDAR ACQUISITION

- Cessna 335 & Leica ALS70HP (pictured)
- Cessna 402 & Orion H300 (ASI)





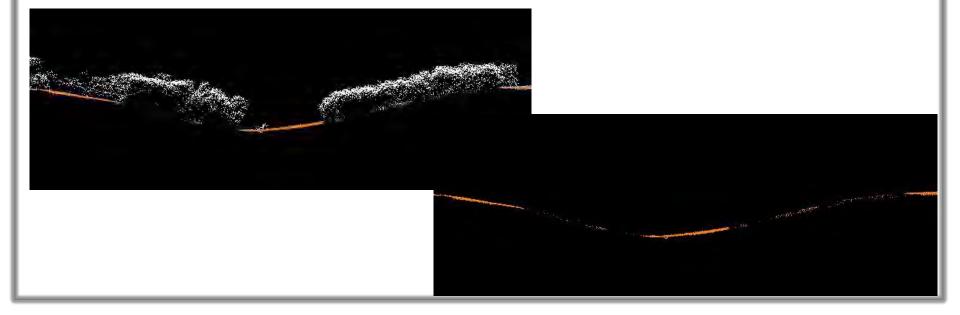
# **LIDAR ACQUISITION**

- Surdex & Aerial Surveys International
- Data Acquired from November 27, 2013 April 2014
- Flight Altitude ~7,000'- 9,000' AGL
- Airspeed: ~150 knots
- Average Point Spacing: .60m & .90m
- Returns Per Pulse: 4+ Intensity
- Field of View: 40 degrees
- Average Line Overlap: 20%
- Scan Frequency: 38.6 & 29.7 Hertz
- Airborne GPS: 25 mile max.

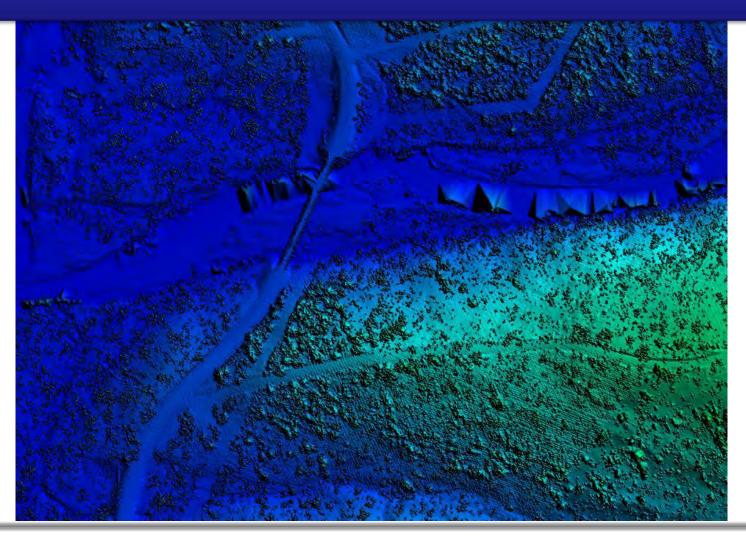


# LIDAR DATA POST PROCESSING

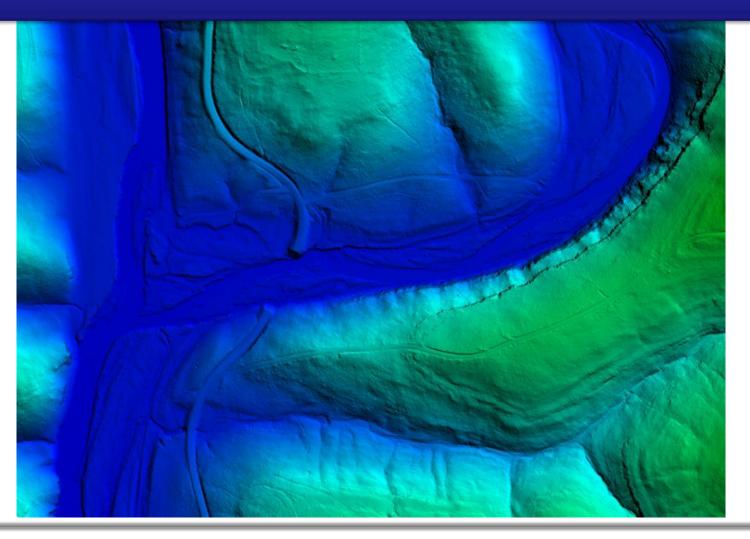
- All 20,295 square miles post processed at Surdex
- Automated and manual filtering techniques were used for creation of the bare-earth surface
- 95%+ removal of artifacts, outliers, voids, errors, noise, anomalies, manmade features & vegetation



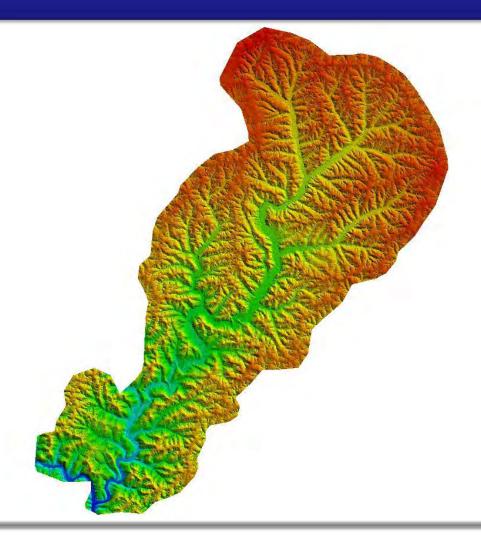
# LIDAR FIRST RETURN DATA



# SHANNON CO. BARE-EARTH DATA



# SHANNON CO. LIDAR BARE-EARTH DATA



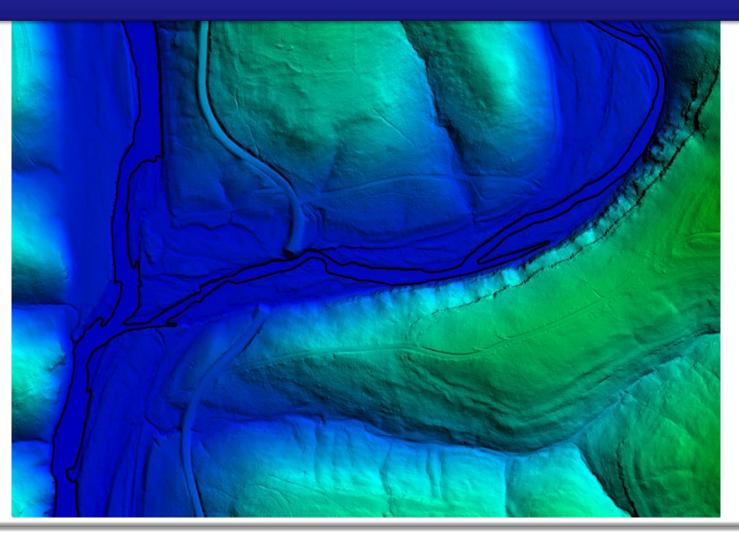
### HYDRO ENFORCED BREAKLINES

Hydro-enforcement flattens the elevations of all ponds/lakes and also keeps streams/rivers flowing downhill

2+ acre ponds & ~100'+ rivers were collected

Collection is done in ArcMap using the bare-earth shaded relief and draped to the LAS data

# SHANNON CO. BARE-EARTH DATA WITH HYDRO



# **PROJECT DELIVERABLES**

Deliverables in UTM NAD83 Zone 15 or 16, NAVD88, Meters

**Classified Bare Earth & First Return LAS Tiles** 

Imagine 32-Bit, 1-Meter Grid Bare-Earth Tiles

**Hydro-Flattened Breaklines in 3D Shapefile Format** 

**FGDC Metadata in XML format** 

# **PROJECT STATUS**

**Streaming Deliveries from April 2014 to January 2015** 

**USGS Performing QA/QC Data Review** 

**Partner Deliveries Post USGS Review** 

**Project Completion by March 2015** 

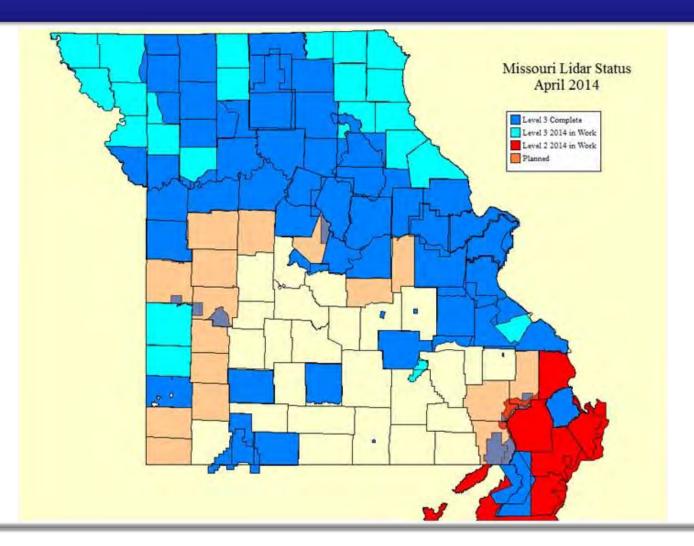
# MISSOURI DATA AVAILABILITY

Data availability through MSDIS,

http://www.msdis.missouri.edu/data/lidar/index.html

Liz Cook, Elizabeth.Cook@mo.usda.gov

# FUTURE PROJECTS & FUNDING



### **2012 MISSOURI LIDAR PROJECT**

# QUESTIONS

