LIDAR Technology

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Prepared for
Congressman Allan Mollahan's Office

Talking Points

- What is LIDAR?
- What can you do with LIDAR
- West Virginia collections
- Contracting specifications
- Deliverables and derived products
  - Example Projects
- Timelines – How long does it take?
- Accuracy
- Caveats

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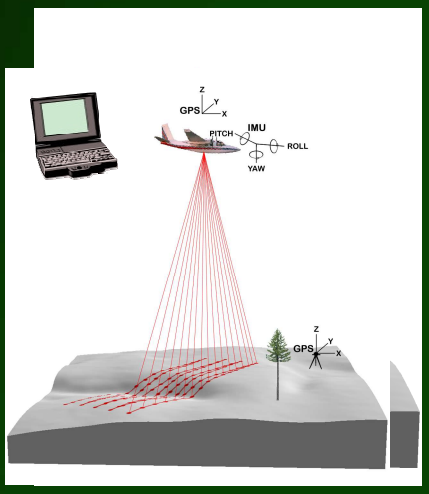
LIDAR Data Characteristics

- "Raw data" are distance measurements, aircraft position & attitude
- Vendor processes the "raw data" to produce XYZ measurements (point cloud)
- High spatial resolution
  - Typical density is 0.5-6 pulses/m^2
  - 2-3 returns/pulse in forest areas
  - Ground/canopy models typically 1 to 5m grids
- Large volume of data
  - 5,000-60,000 pulses/hectare
  - 12,500-150,000 returns/hectare
  - 0.4-5.4 megabyte/hectare

LIDAR System Components

- Scanning laser emitter-receiver unit
- Differentially-corrected GPS
- Inertial measurement unit (IMU)
- Computer to control the system and store data
- Targets of Interest



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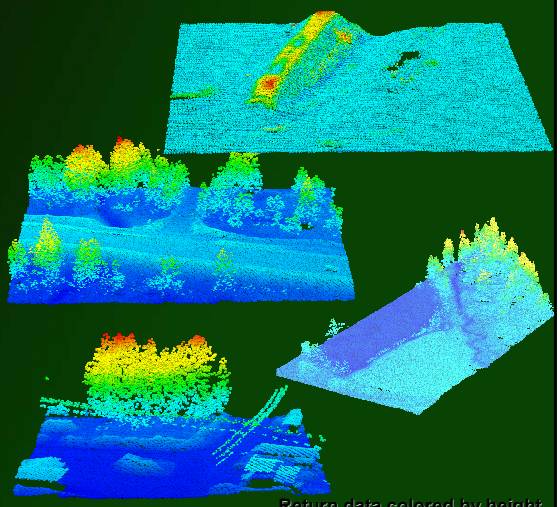
What does LIDAR measure?

- *Ground*
- *Roads and other surface features*
- *Vegetation*
- *Structures*

- *Everything visible from an aircraft that is not wet or covered by water*



Return data colored by height

Why LIDAR?

Land Managers have a need for:

- Accurate terrain for
  - Engineering
  - Hydrology models
- Down woody debris
- Detailed drainage under canopy
- Hidden structures
- Overgrown mine features

Lidar in the State of West Virginia

- In West Virginia, LIDAR has been captured for a number of counties including Jefferson, Jackson, Gilmer, and Wyoming.
- Canaan Valley National Wildlife Refuge also has limited LIDAR coverage.
- These LIDAR datasets are intended to be used as digital elevation models (DEMs). LIDAR can be used for elevation models and 1-foot contours. These LIDAR datasets are available from the WV Tech Center at WVU...

Lidar in the State of West Virginia

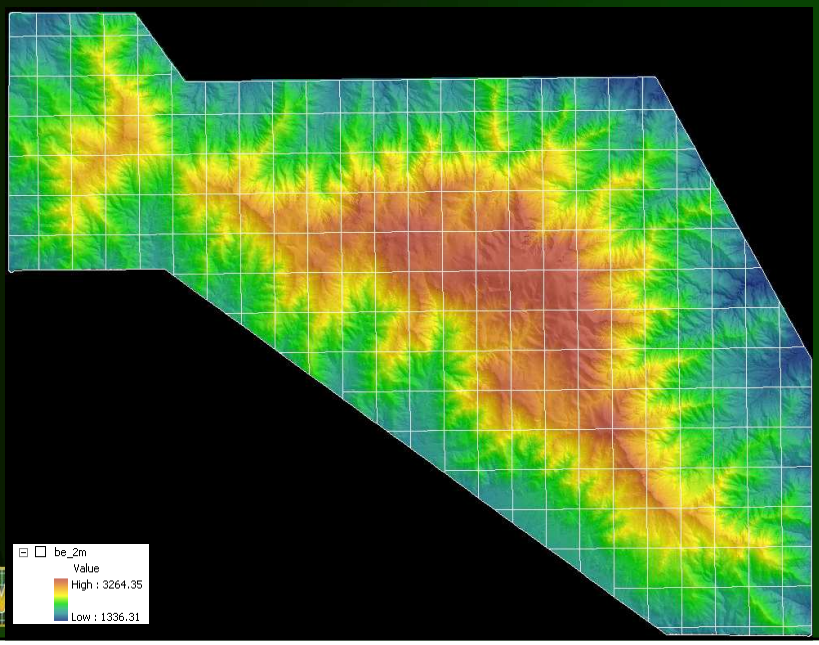
- The state has full coverage 3-meter DEMs and 10-foot contours.
- Other federal agencies have acquired LIDAR in the state including FEMA (used for flood zone mgmt, etc) and DOI.

Lidar in the State of West Virginia

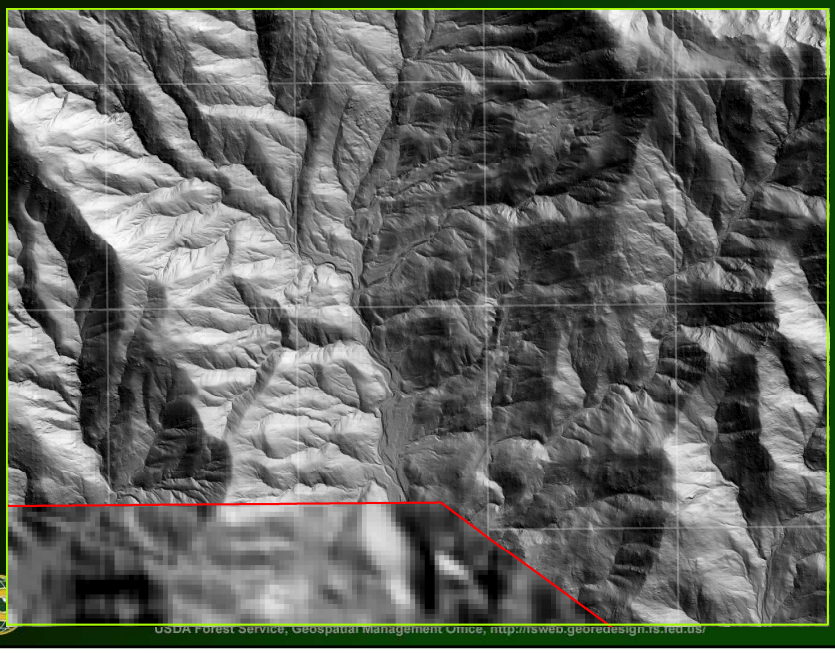
Forest Service

- We have attempted to acquire LIDAR for the Forest, but the cost is too high and the products are not cost-effective at the current time. In terms of using LIDAR for other resources we barely have the staff to handle our current work load.
- The Forest is very interested in the use of LIDAR for mapping vegetation and archaeological sites.

Data Deliverables - Bare Earth model



Comparison: 2m Lidar vs 30m USGS DEM



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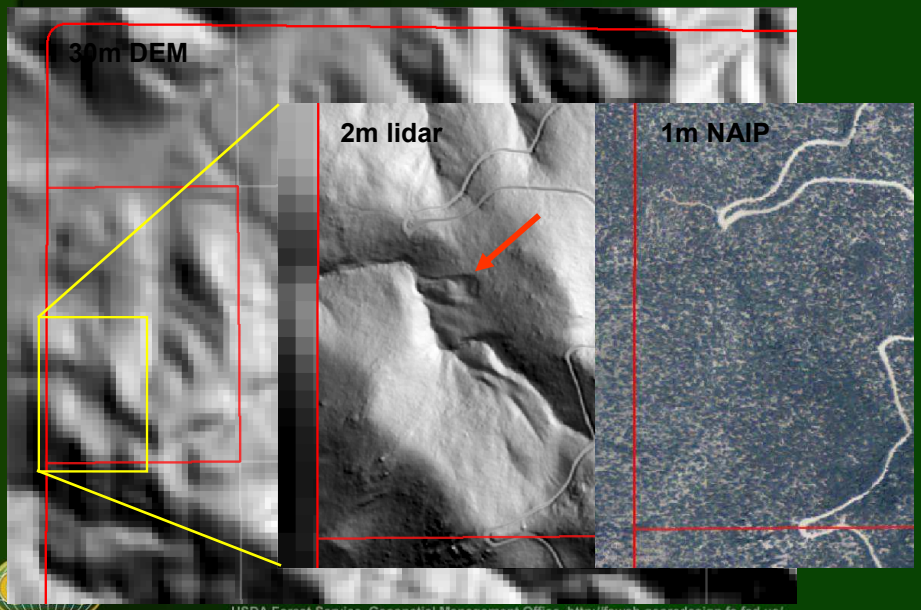
Slump Detection



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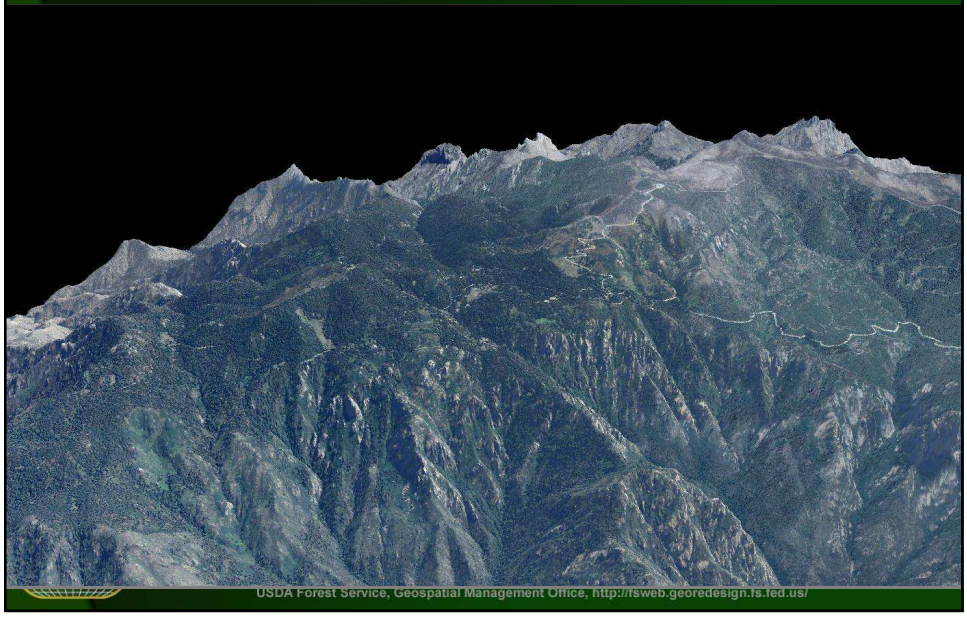
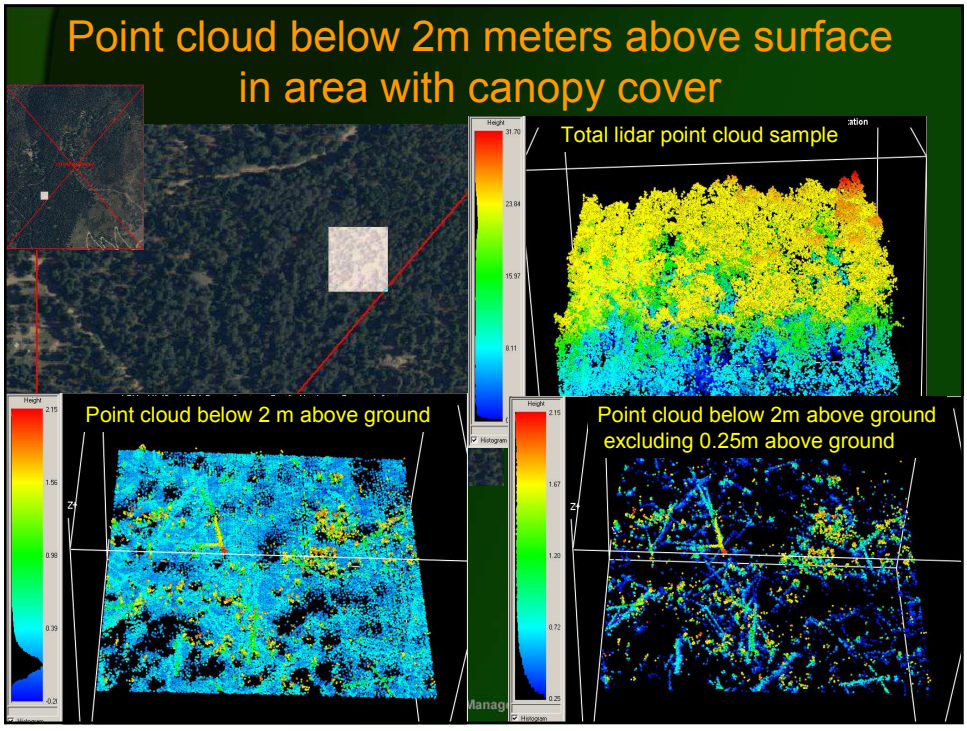
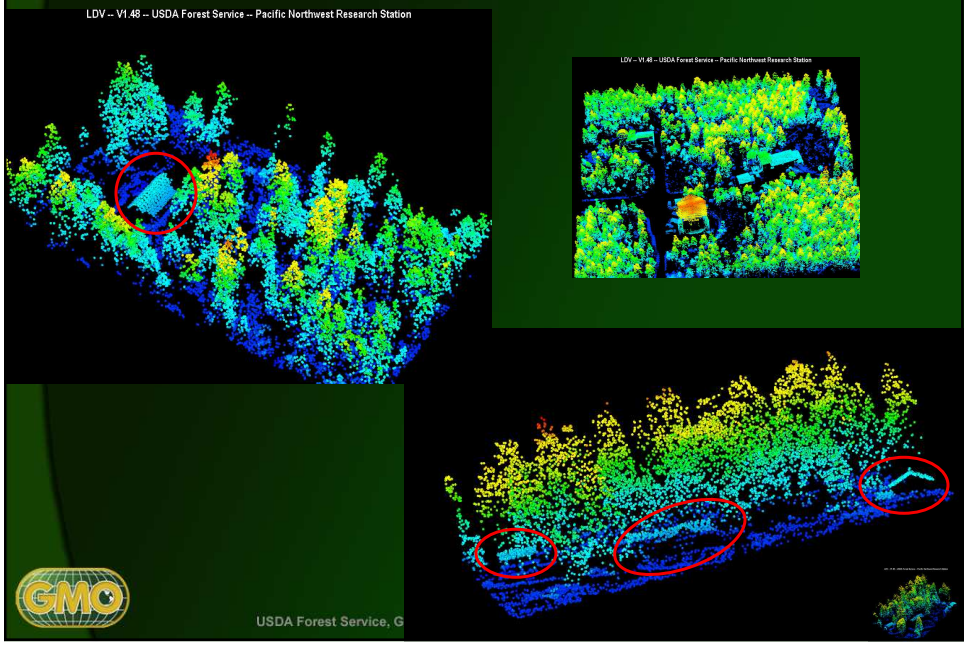
NAIP Imagery Draped on Bare Earth



Point cloud below 2m meters above surface in area with canopy cover



Structures in the Woods



LIDAR-derived information layers

- Flight information
- LIDAR system settings
- Bare-earth surface model (2 to 5m grid)
- All return data
- Bare-earth return data
- LIDAR intensity image
- Canopy surface model (2 to 5m grid)
- Canopy height model (2 to 5m grid)
- Canopy cover layer (5m grid)

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Project Time Line: Phase 1 (2007-2008)

Topic	Duration (weeks)	Time line
Lidar acquisition specification	12	February – June 2008
Project Coordination, workshop and conference calls	1	January – September 2008
Compiling the RFQ info	1	July 2008
RFQ bid posting		July 2008
RFQ evaluation	3	August 2008
Field data protocol development and testing	2	Summer 2008
Data acquisition	1	End of September 2008

Project Time Line: Phase 2 (2008-2009)

Topic	*Duration (wks)*	*Time line*
Data delivery		Early February 2009 (expected by early Dec 2008)
QA/QC	4	Early March 2009
Project Coordination and conference calls	1	Early March – August 2009
Data analysis and methods development	6	Mid April 2009
Aspen delineation (Including write up)	3	April – May 2009
Creating supporting field data sheets	1	April – May 2009
Report writing (draft + editing)	7 (5 + 2)	May 2009
Field data protocol development completion	2	Spring 2009
Field data collection (CNF)	12	Summer 2009
Workshop preparation	6	June-July-August 2009
Workshop	0.5	17- 19 August 2009

Accuracy

- (X,Y,Z) position of each return (scanners specs)
  - 10-100 cm horizontal
  - 10-25 cm vertical
- Ground surface (bare-earth surface)
  - What is the ground (grass, rocks, stumps)?
  - Compared to topo survey: elevations are ±20 cm
- Tree heights
  - Do you hit the tree?
  - Is the top of the tree large enough to result in a return?
  - Do you get data from the ground under the tree crown?
  - In general, heights from LIDAR are 1-2 m too short

LIDAR Issues

- Derived products can be large
  - Gridded bare-earth and canopy surface products using 1.0 to 2.5 m cells
  - Area-wide layers are NOT common
    - Layers produced in several sections
- Finding storage for all products can be a problem
  - 100+ Gb is common, 250+ Gb is not uncommon
  - Delivery on external hard drive
    - Not always practical for day to day use
- Limited software options for viewing and manipulating “raw” data and derived products

Conclusions

- LIDAR applications in forestry are growing
- Much potential has been realized…more to come
- LIDAR data are being collected for large land areas (county & state)
- The prospect of wall-to-wall vegetation data encourages more detailed multi-resource analyses