Amherst's Mapping Initiative

21st Century Basemapping…it's a whole new ballgame!

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Agenda

- Amherst's Prior Basemap Projects
- Amherst's Current Needs
- The 2009 Amherst Basemap Project
- What we are learning this time around
- Demonstration:
  - LiDAR Technology

Before We Begin...

- Our project has barely started & we've already learned that basemapping has completely changed in the past 10 years
- How often do most GIS Adminstrators end up managing a basemapping project?
- With a lot of luck, every 10 years?
- Hopefully, this presentation will help you before basemapping changes dramatically again!

Amherst's Prior Basemap Projects

- 1999 1"=40' basemap:
  - Full Planimetrics
  - DTM & 2' Elevation Contours
  - Color Orthophotography with 6" pixels
    (3" pixels in town center & UMass)
  - Surveyed Utility Structures
    (manholes, catch basins, gates, hydrants, etc)
  - 1"=100' basemap & 5' Elevation Contours in surrounding watershed
  - Cadastral maps automated to this base
- 2004 Update Project:
  - Color Orthophotography with 3" pixels townwide
  - 1' Elevation Contours along selected roadway corridors

•1999 Basemap Project

- Built upon partnerships between the Town of Amherst, UMass, Amherst College, Hampshire College & the Town of Pelham
- Specifications developed & QA/QC managed by David Weaver of Applied Geographics, Inc.
- Merrick & Co. hired as the prime vendor
- Team effort led to finding a 1" error in the elevation model before the project got beyond the pilot stage
- Greatly Successful End Product!

1999 Basemap Project Approach

- Pre-flight survey & targeting to establish ground control
- Aerial photography captured on film (at the time, the resolution & scale were too large for digital sensors)
- Innovative approaches (at the time):
  - Workstation ArcInfo used early in the production process to ensure proper topology
  - Shadow obstructions captured as a layer in order to aid in QA/QC
  - Some GIS-centric analysis to catch & correct errors

2004 Orthophoto Update Project

- Merrick was once again selected as the prime & the results were once again excellent
- Pre-flight targeting
- Imagery still captured on film
  - Digital photography was an option by then
  - Different brand of photo paper gave the imagery a decidedly "greener" look

Our Needs in 2009

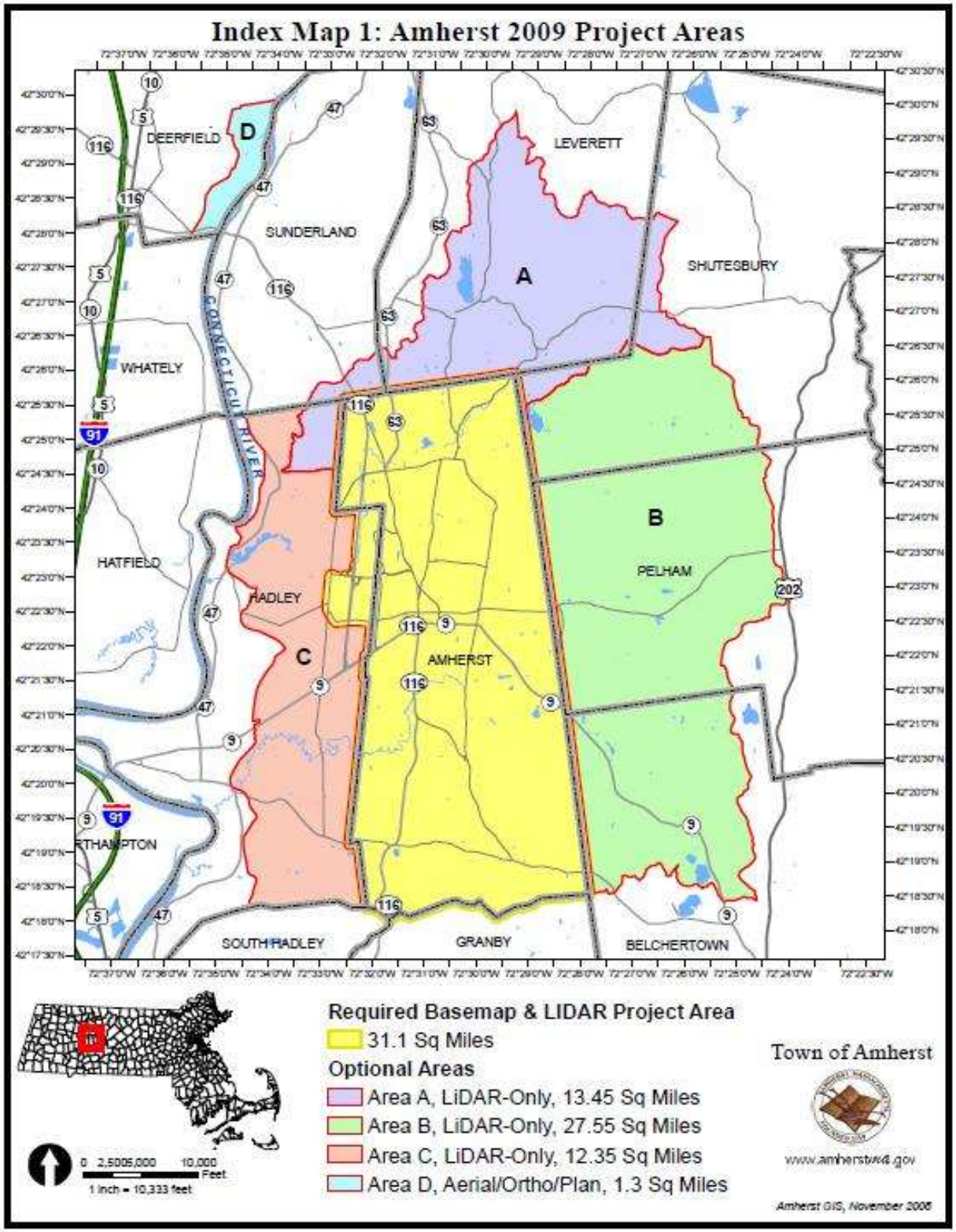
- 40' Scale Plan & Topo layers need a major update
  - Used for design plans, saving Amherst big $$ over time
- Long-Term need for better flood zone mapping
  - Flood Prone Conservancy (FPC) Zoning District is elevation-based in some areas & has proven to be impossible to accurately depict with the existing topo
    - This is a liability that has already cost Amherst hundreds of thousands in legal fees
    - Amherst is considering replacing the FPC with the FIRM 100 flood zones if those can be accurately revised

•2009 Basemap Project Design Considerations

- Planimetrics: Change Detection vs. New Map
  - Change detection can be less expensive if the areas are well-defined…but you can't always be sure of what has changed until it has been mapped
  - Decision: a new map will provide more bang for the buck
- Topo: Would LiDAR be of any benefit?
  - Accepted part of the FEMA standards for flood zone delineation
  - Potential for much more detailed topo & greatly enhanced capabilities
  - …but can we afford it?

2009 Basemap Project Design

- Partnership between Amherst, Umass & Amherst College
- Hired David Weaver at Applied Geographics to develop an RFP & assist with vendor selection
- RFP put out in December, 2008
- Core project:
  - 40' Scale Planimetrics, 2' Topo, ¼' Orthos (color & CIR), LiDAR (separate flight)
- Optional Items:
  - 3 Watershed-based optional LiDAR areas
  - 1 Plan/Topo/Ortho optional project area (Umass-owned land in Deerfield)


Index Map 1: Amherst 2009 Project Areas
DEERFIELD
D
LEVERETT
SUNDERLAND
A
SHUTESBURY
CONNECTICUT RIVER
WHATELY
HATFIELD
HADLEY
C
B
PELHAM
AMHERST
SOUTH HADLEY
GRANBY
BELCHERTOWN
Required Basemap & LIDAR Project Area
31.1 Sq Miles
Optional Areas
Area A, LiDAR-Only, 13.45 Sq Miles
Area B, LiDAR-Only, 27.55 Sq Miles
Area C, LiDAR-Only, 12.35 Sq Miles
Area D, Aerial/Ortho/Plan, 1.3 Sq Miles
Town of Amherst
www.amherstma.gov
Amherst GIS, November 2008
0 2,5005,000 10,000 Feet
1 inch = 10,333 feet

2009 Basemap Project Vendor

- 20+ copies of the RFP requested
- 5 qualified responses submitted for the RFP
- 3 clear leaders, based upon technical proposals, qualifications and references
- 1 clear winner: Infotech Enterprises America, Inc.
  - Tied for best in qualifications
  - Most aggressive schedule
    (backed by references)
  - Low Bidder
    (only price low enough to allow for all options to be funded)

2009 Basemap Project

- 2 Flights:
  - Flight with ABGPS collected Color & CIR Imagery with a digital sensor
  - LiDAR captured separately during the same week
- 25 ground control points surveyed after the imagery was in hand (known as the "photoID" method)
- Planimetrics to be compiled to match the Town's existing data model, with some new layers added
- 1' Topo option offered & accepted into the project
- LiDAR-derived DTM & raw data (.las format files)
- All layers encoded with elevations & provided in 3D format

What we are learning

Our flights were just last month, but this is what we know so far...

- Basemapping has changed incredibly in a decade
  - New technologies (digital sensors, LiDAR, etc)
  - More GIS-centric approaches (finally!)
  - Data size is no longer the limitation that it was
  - Expanding industry and more competition
  - Project schedules are about ½ what they were
  - No more paper check-plots; we can indeed be paperless*
- LiDAR has an important place in basemapping
  - Can be used for producing a detailed terrain model
  - Can lower costs for DTM production
  - Provides extremely useful data for variety of purposes

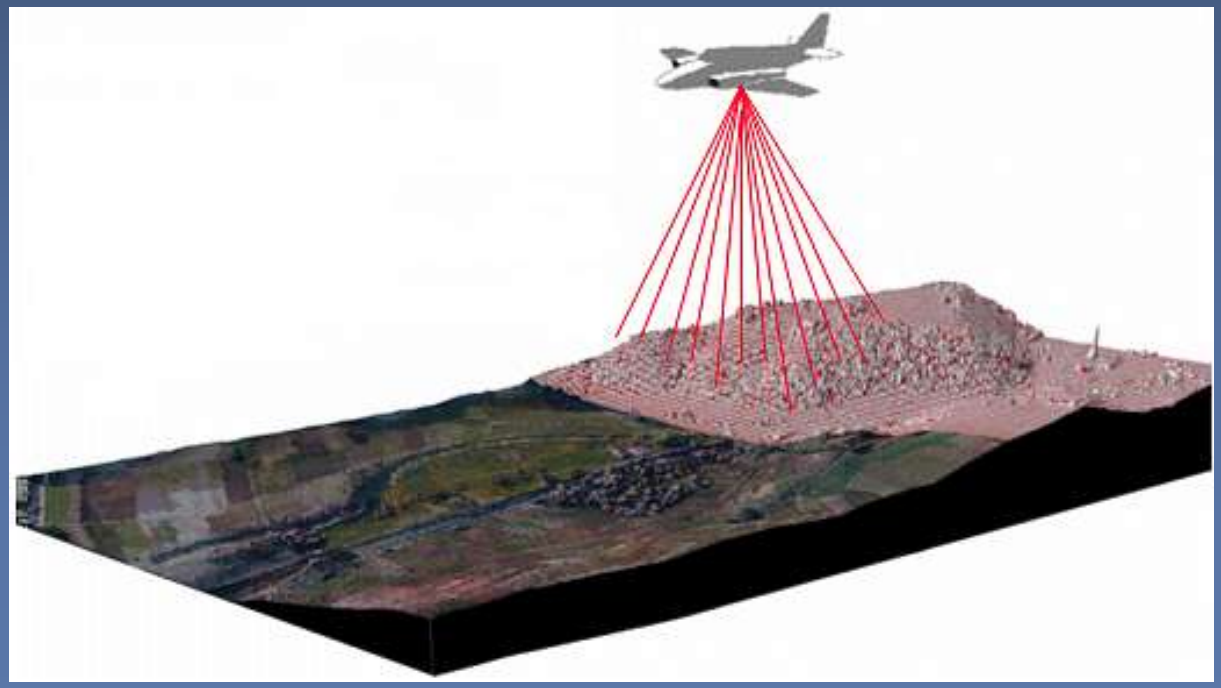
*Alright, stop laughing...I'm not counting the RFP, contract & accounting...

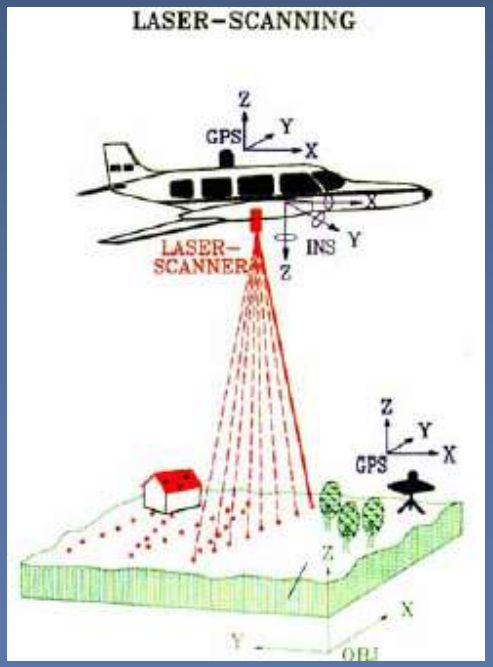
- LiDAR Demo

•LiDAR Basics

What is LiDAR? - Light Detection And Ranging

- Active airborne sensor emits several ten-thousand laser (light) pulses per second
- if *location* and *orientation* of laser scanner is known, can calculate a range measurement for each recorded echo from a laser pulse
- Laser pulses can penetrate forest canopy through gaps
- Some laser pulses reach forest floor, other returns reflect from canopy, buildings and other surfaces
- Allows for detailed modeling of terrain surface with or without vegetation.





•LiDAR Basics

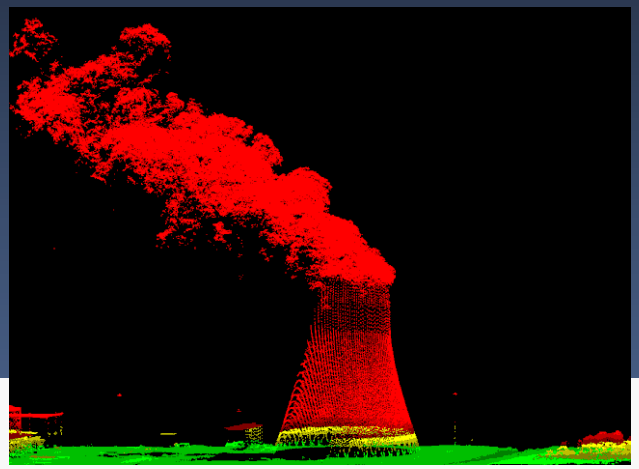
What LiDAR is NOT

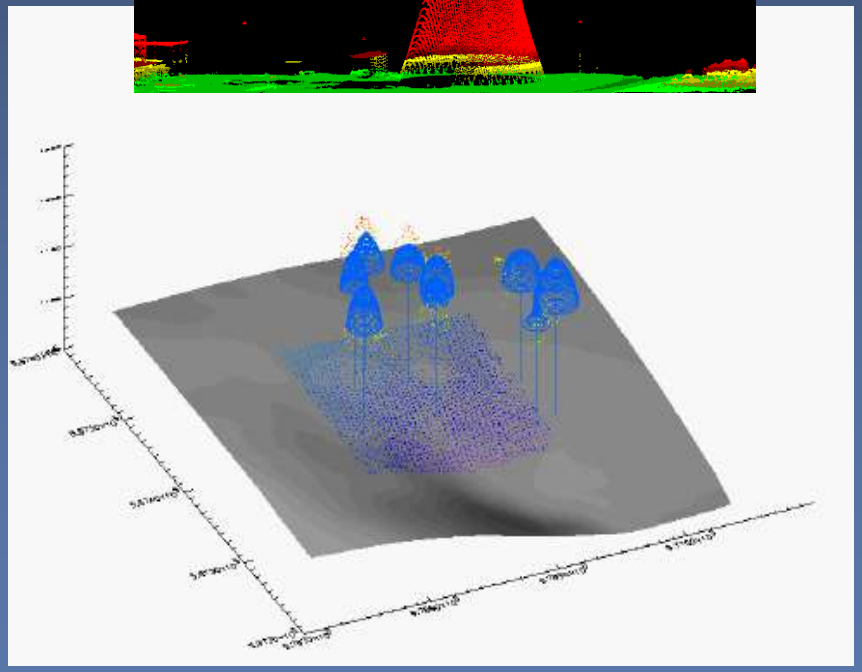
- The answer to all your elevation requirements
- All weather
  - Target must be visible within the selected EM spectrum
  - No rain or fog
  - Must be below clouds
- able to "penetrate vegetation"
  - LiDAR can penetrate openings in the vegetation cover but cannot see through closed canopies

LiDAR Basics

Point Cloud

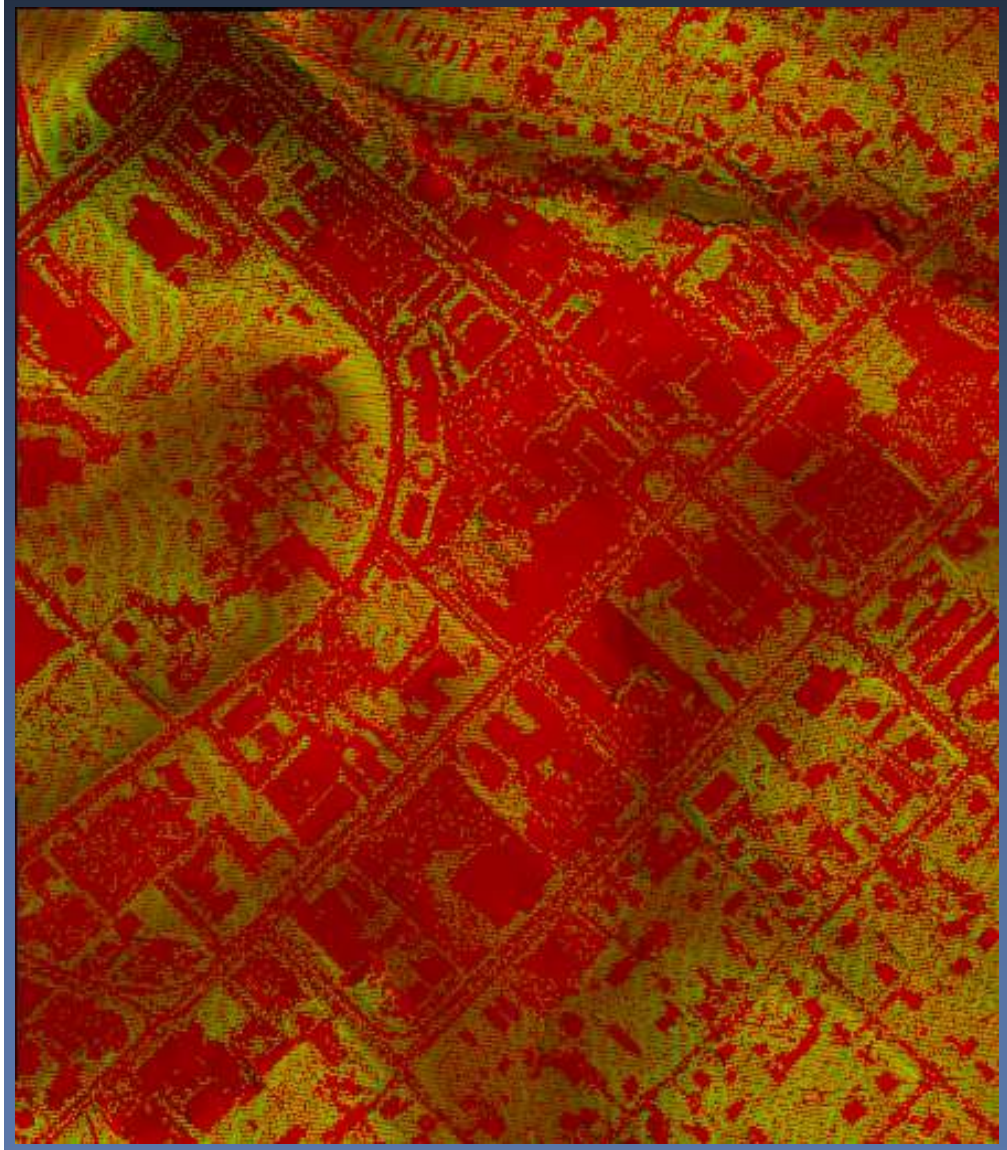
- **"First returns"** provide Digital Surface Models (DSMs)
  - Roof tops
  - Tree tops
  - Open Earth



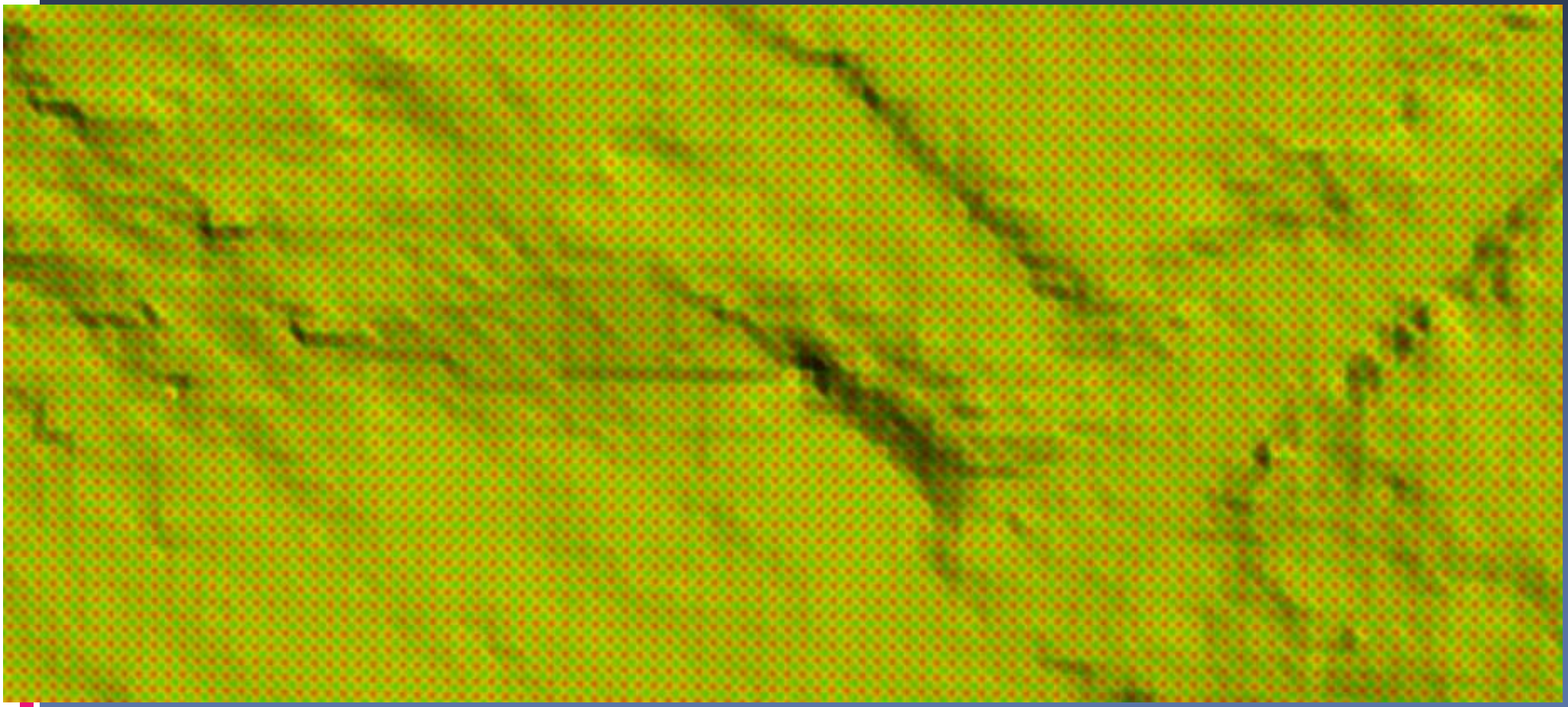


- **"Last returns"** can provide Digital Elevation Models (DEMs) of the "bare earth" if fully processed to remove buildings and vegetation that were not penetrated by the LIDAR pulses

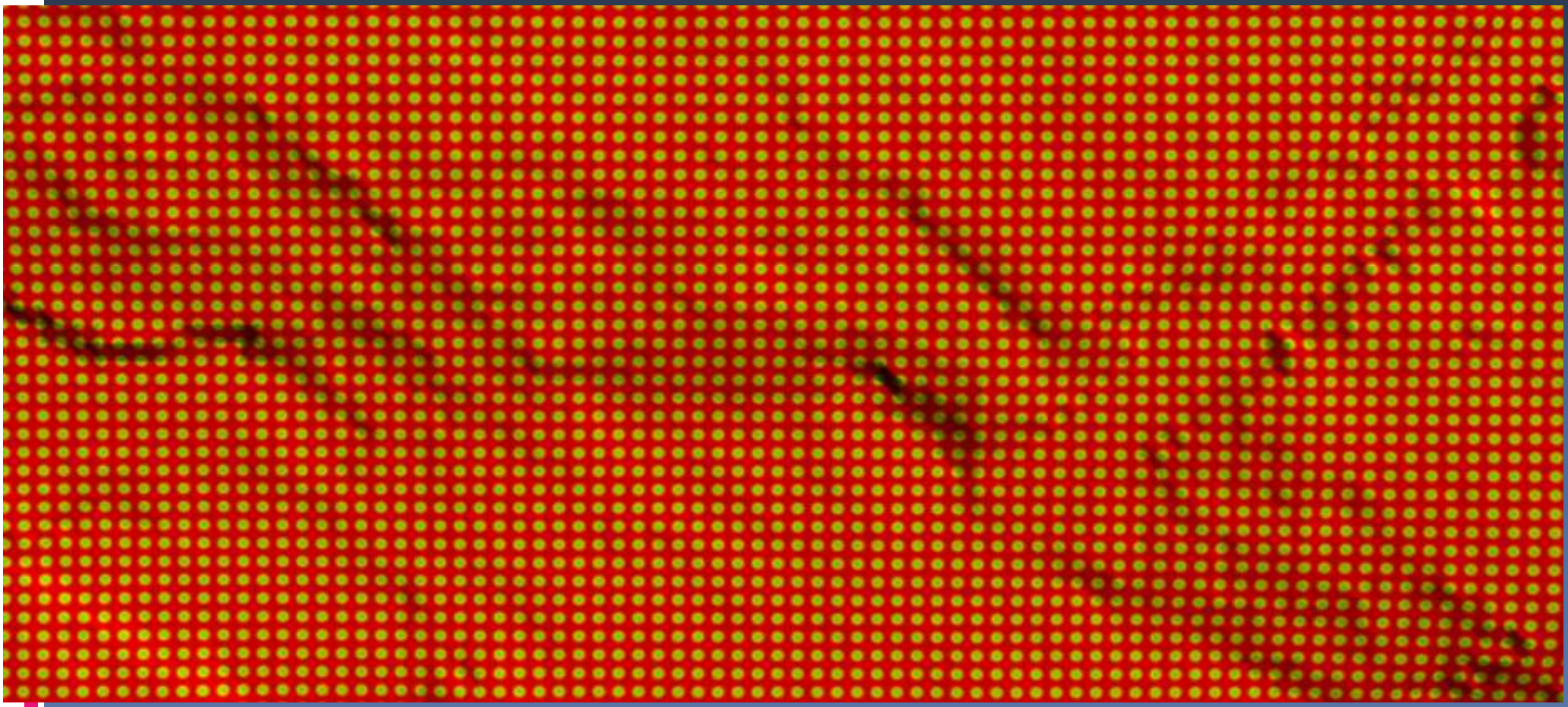
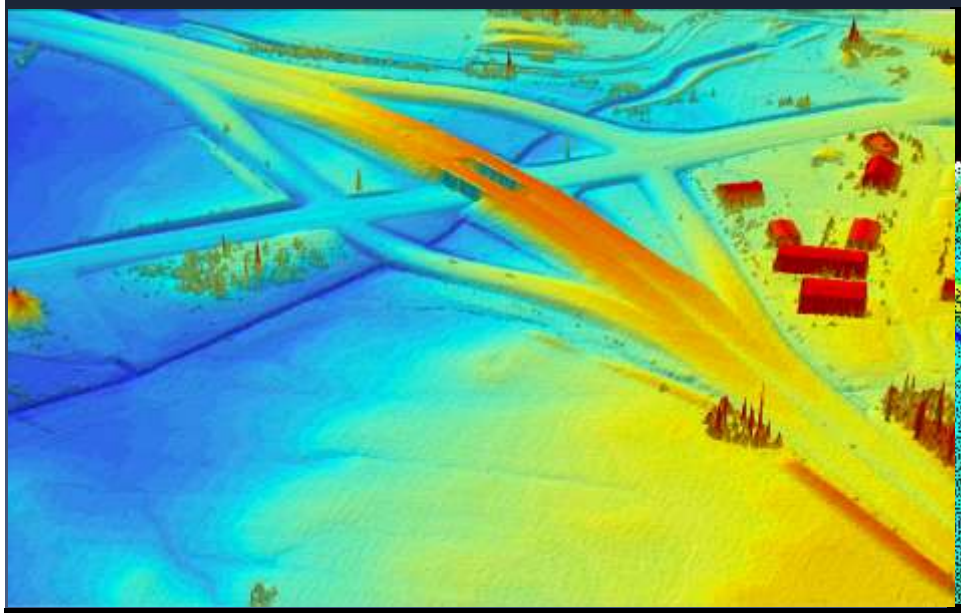
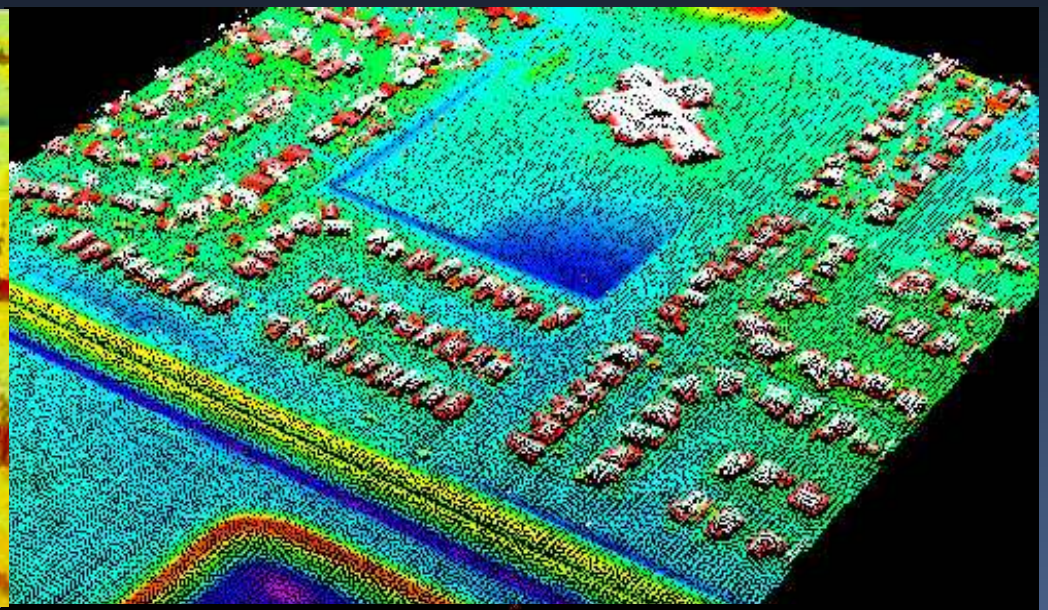
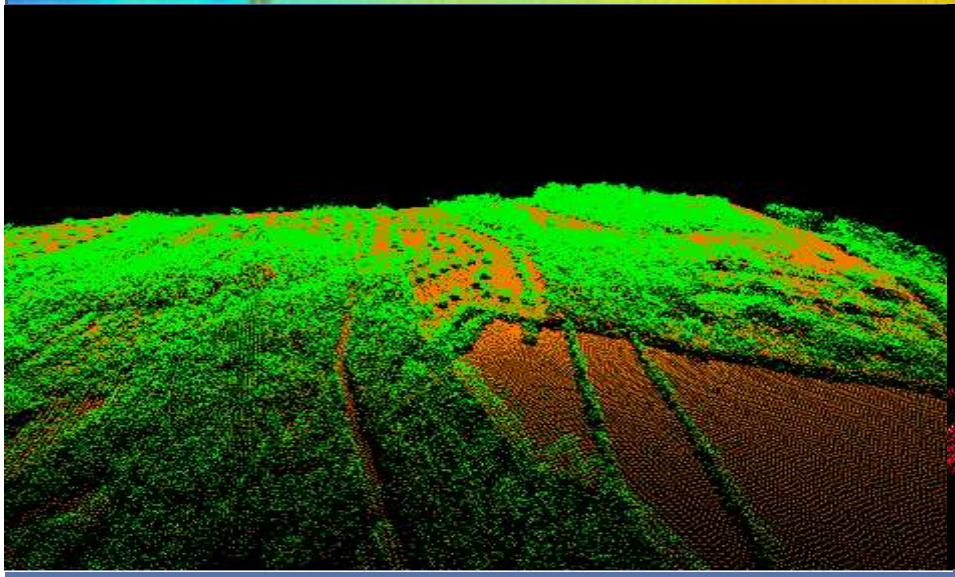
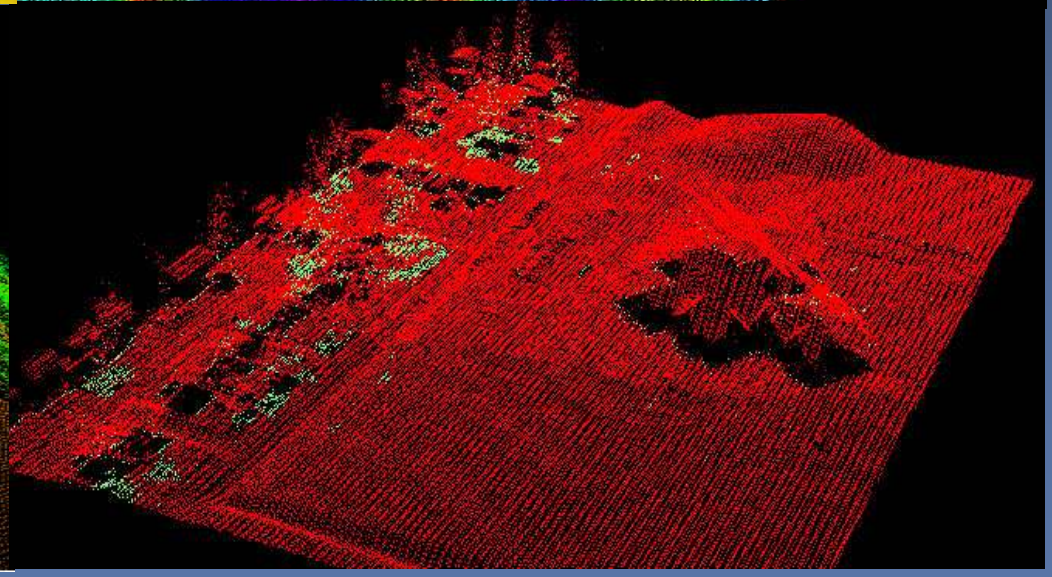
LiDAR Basics – Bare Earth



LiDAR Basics – 5 foot grid



LiDAR Basics – 10 foot grid



LiDAR Basics - Viewing