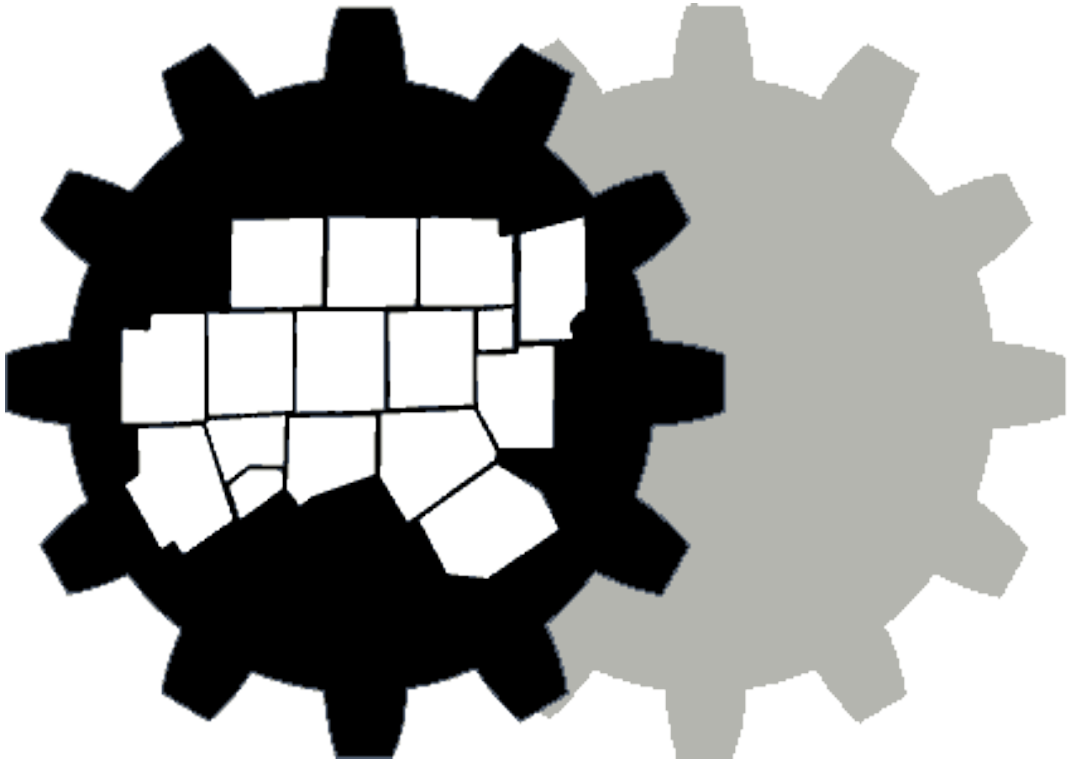
NCTCOG Regional GIS Meeting

December 1, 2015

WOOLPERT

Thanks to….



MESQUITE
T·E·X·A·S

And special thanks to….


25
12

Woolpert.

1911

Opened our first office in Dayton, Ohio

23

Offices throughout the U.S.

600

More than 600 employees

$109

More than $109 million in revenue in 2013

Woolpert Office Locations

Woolpert Markets

- Aviation
- Energy
- Facility Management
- Federal government
- K-12/higher education
- Military
- Oil and gas
- Security, defense and intelligence
- State/local government
- Transportation
- Water/utilities

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Firmwide Disciplines

- Architecture
- Asset management
- Design
- Engineering
- Geospatial
- Planning
- Project delivery/management
- Surveying
- Sustainability/LEED

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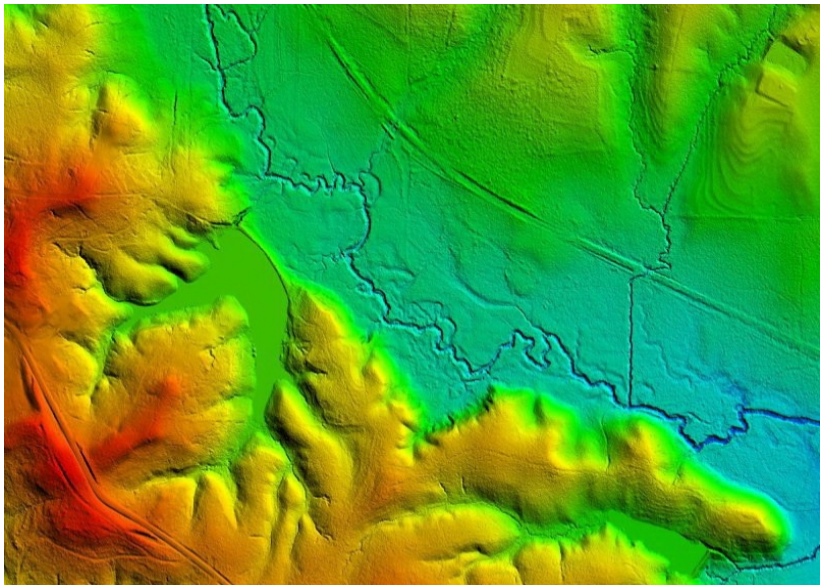
Geospatial Solutions

- Aerial mapping/orthoimagery
- Geospatial Information Systems (GIS)
- Mobile mapping
- Remote sensing/LiDAR
- Sensor integration and testing
- Terrestrial scanning/close range photogrammetry
- Surveying
- Unmanned aerial systems (UAS)



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Take away?

- General understanding and applications of CIR imagery
- A non-comprehensive listing of data features that can be extracted using 4-band imagery and Lidar
- A showcase for remote sensing technologies

NCTCOG GIS Data Products

Imagery
3-inch orthoimagery
6-inch orthoimagery
True Orthos*

Airborne LiDAR
1.2M LiDAR (8000' AGL) - 0.8 PPSM (Classified)
1.0M LiDAR (7100' AGL) - 1 PPSM (Classified)
0.7M LiDAR (6500 AGL) - 2 PPSM (Classified)
0.5M LiDAR (6000' AGL - 4 PPSM (Classified)
0.42M LiDAR (6000' AGL - 6PPSM (Classified)

Derivative Products - In Addition to LiDAR and Imagery Pricing
3D Automated Planimetrics* (New)
Impervious Surface Mapping
Solar Mapping Potrential
Change Detection
Land Cover

Contours
1' contours - 0.7 M Lidar/6" Orthoimagery
2' Contours 1.0M LiDAR/6" Orthoimagery

***3D Planimetrics/Classifications**

Buildings	Paved Roads
Sidewalks	Parking lots
Hydrolgy	Pavement pads
Groups of vegetation	Driveways
Unpaved Roads	

Paved surfac es will be in single classification.

Mobile LiDAR

NCTCOG GIS Data Products

GIS Grade Accuracy

Positional Accuracy +/-
1.0-foot - Urban +/-
2.0-foot - Rural

Acquisition

MUTCD Sign Inventory (5 attributes)

Pavement Assessment (X,Y Location)

Curb and Sidewalk Assessment (X,Y Location)

Pavement Markings

Manholes

Light Poles (X,Y Location)

Power poles (X,Y Location)

Fire Hydrants (X,Y Location)

Traffic Signals (X,Y Location)

Survey Grade Accuracy

Undivided Road Acquisition/Process to Ground

Divided Road Acquisition/Process to Ground

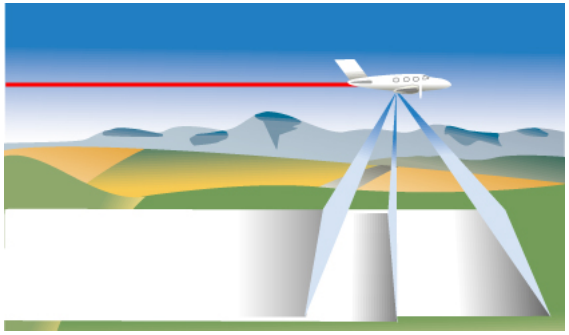
Bridge Clearances (cost per bridge)

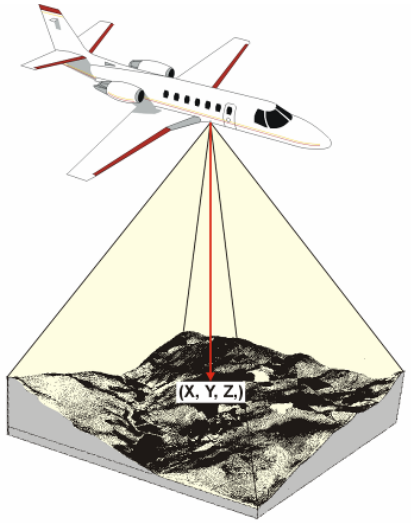
MMS Feature Extraction (plan/DTM)

All prices are for design grade mapping : +/- 0.1' at 1σ on paved surfaces 60' left and right of drive path. Control points are included in pricing structure.

Geospatial Equipment

- Digital Data (Imagery)
  - Dynamic range CCD
  - 12 bit
  - Panchromatic (465-680nm)
  - Red (608-662nm)
  - Green (533-587nm)
  - Blue (428-492nm)
  - NIR (833-887nm)
- Digital Data (LiDAR)
  - X, Y and Z values
  - Intensity values
  - Patterning

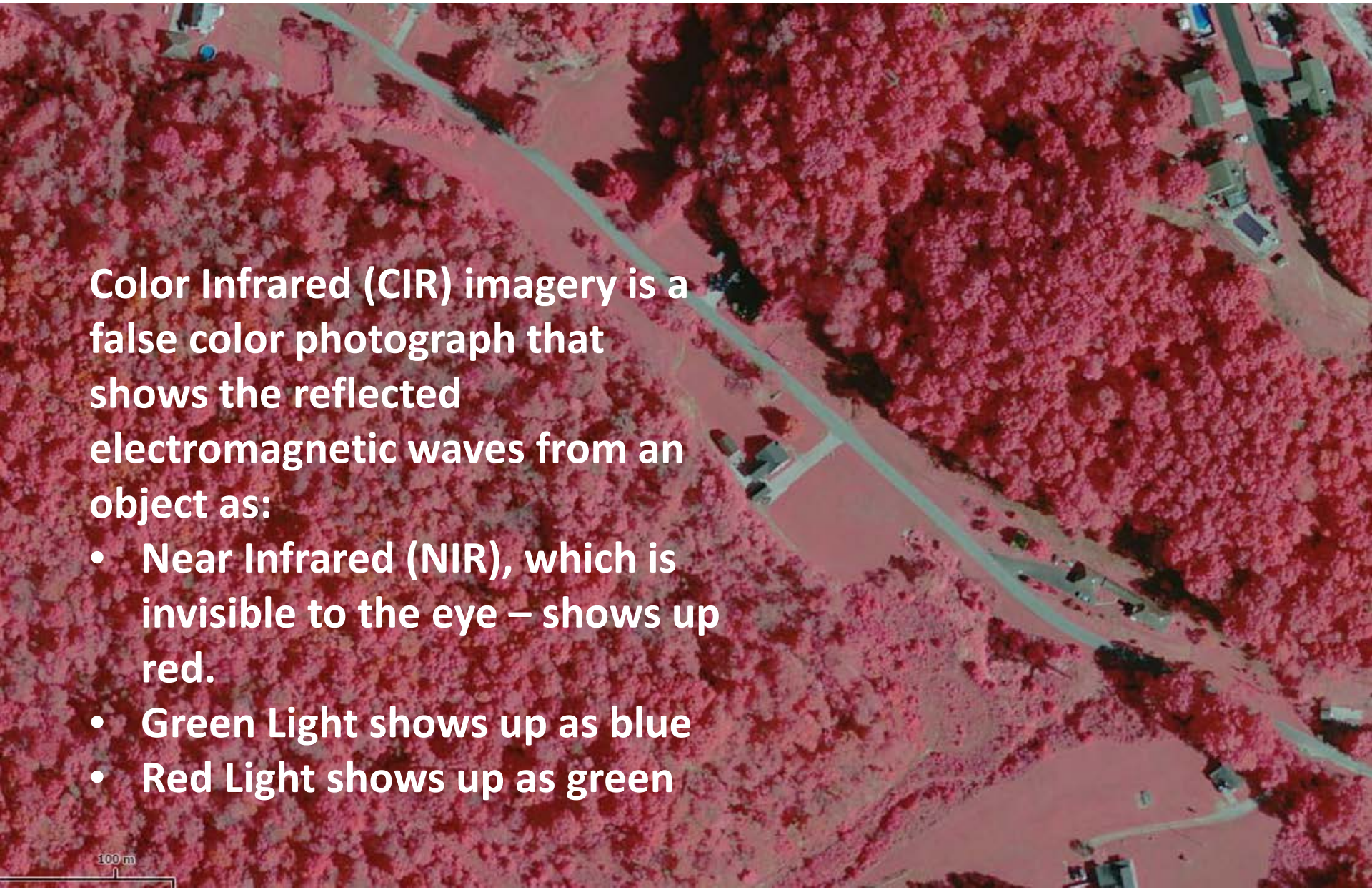




Trivia Question

- *What was CIR imagery first developed to do?*

Originally developed for the US Military in WWII to detect enemy camouflaged tanks. It is now used on all levels of government in numerous applications:



Color Infrared (CIR) imagery is a false color photograph that shows the reflected electromagnetic waves from an object as:

- Near Infrared (NIR), which is invisible to the eye – shows up red.
- Green Light shows up as blue
- Red Light shows up as green

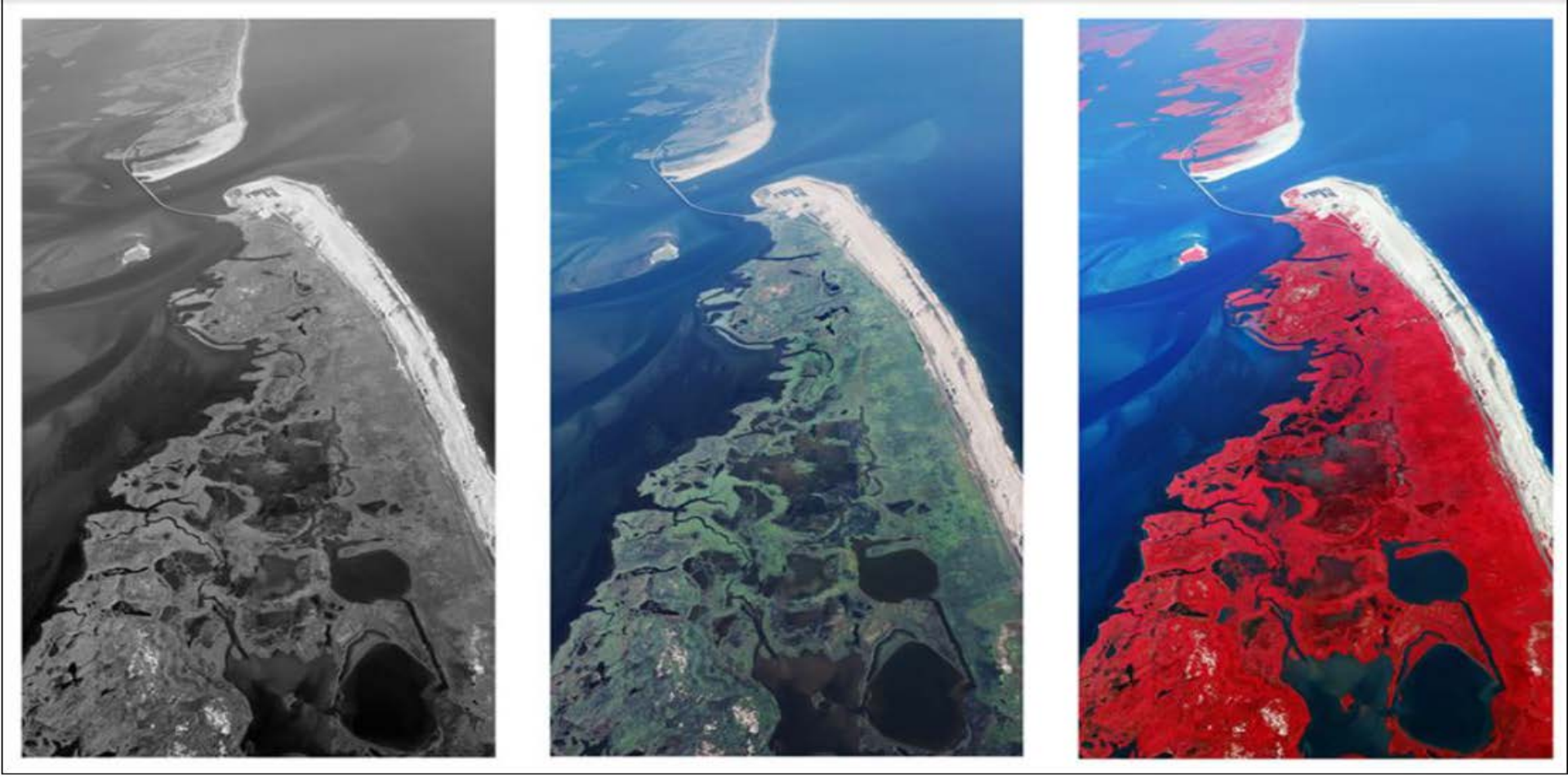
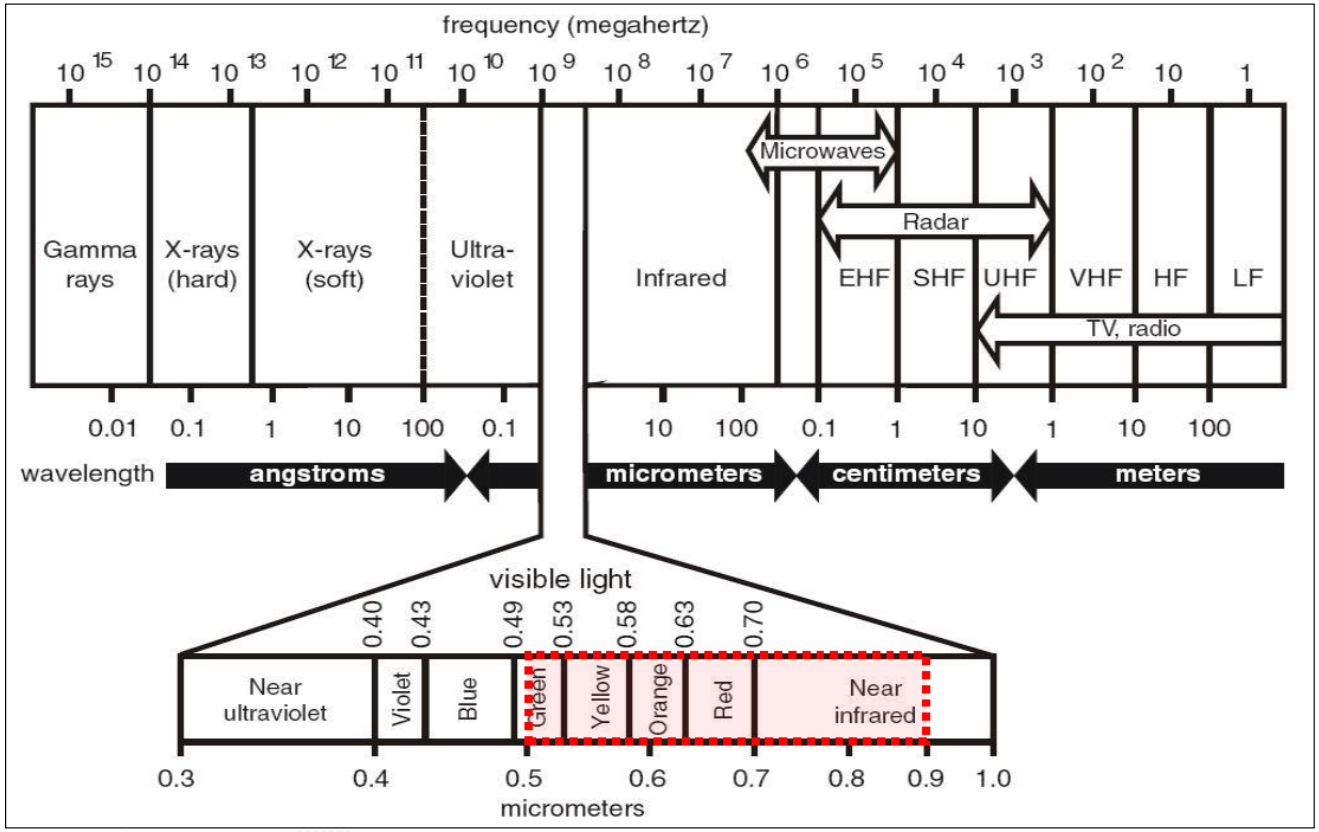
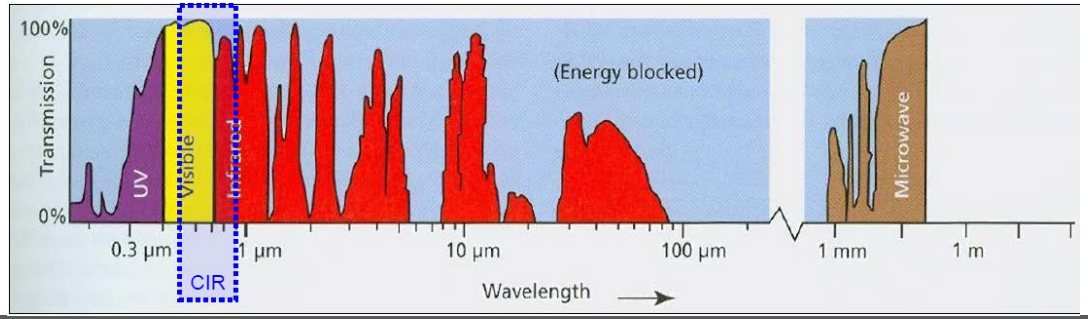


Figure 7. A comparison of panchromatic (left image), color (middle image), and CIR (right image) of North Carolina's Oregon Inlet from the north end of Pea Island looking north. CIR imagery depicts clear, blue water as black, since water absorbs NIR wavelength energy. Water with varying amounts of suspended particles appears in CIR imagery as shades of blue, because suspended particles reflect a very small amount more of green light than clear water does. Photo source: NCDOT Photogrammetry Unit. The three images were acquired in one pass on 10 August 2010 with an Intergraph Digital Mapping Camera.

The electromagnetic spectrum – divided into types of radiation by wavelength and frequency. Visible light is between 0.4 and 0.7 micrometers, with CIR extending to 0.9.





Orthoimagery – CIR Band Applications

- Identification of healthy vegetation (identifies the level of chlorophyll being produced by plant vegetation (deep red versus light pink), which is an identifier of healthy plants
- Identification of water – above ground, lakes, rivers, streams, wetlands
- If flown at an appropriate time, can be used to identify septic systems - the CIR can identify if a septic system is leaching (will identify vegetation growth occurring more rapidly at the location of the leach)
- Assist in the identification of soil composition
- Assists in the identification of impervious versus pervious surfaces
- Agricultural crop identification (depends upon the timeframe when the imagery was acquired)
- Timber Analysis – estimation of yields

Benefits of CIR Imagery – Vegetation Studies:

- Identifying areas of vegetation
- Types of vegetation
- Health of vegetation
- Submerged vegetation mapping (Benthic Mapping – Seagrass)
- Damage Assessement (Forest fires, prop scares)
- Vegetated –vs- non-vegetated areas

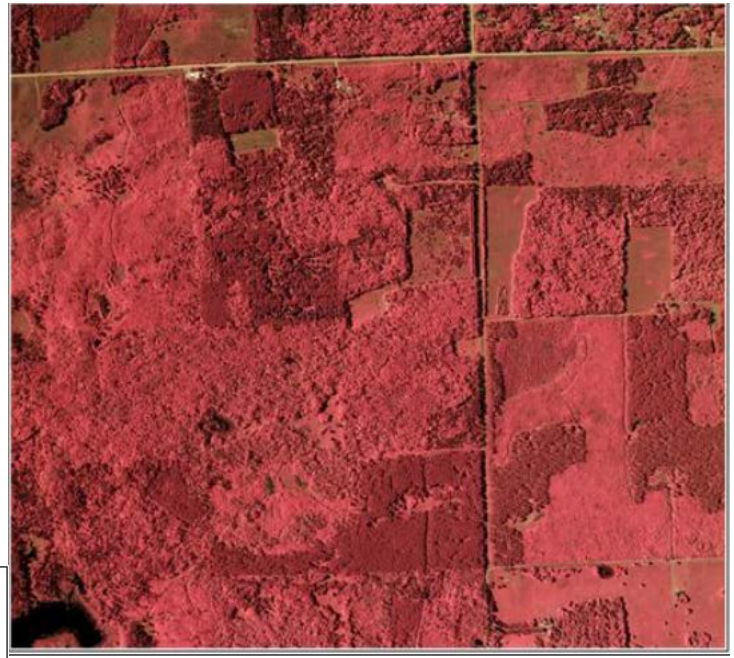
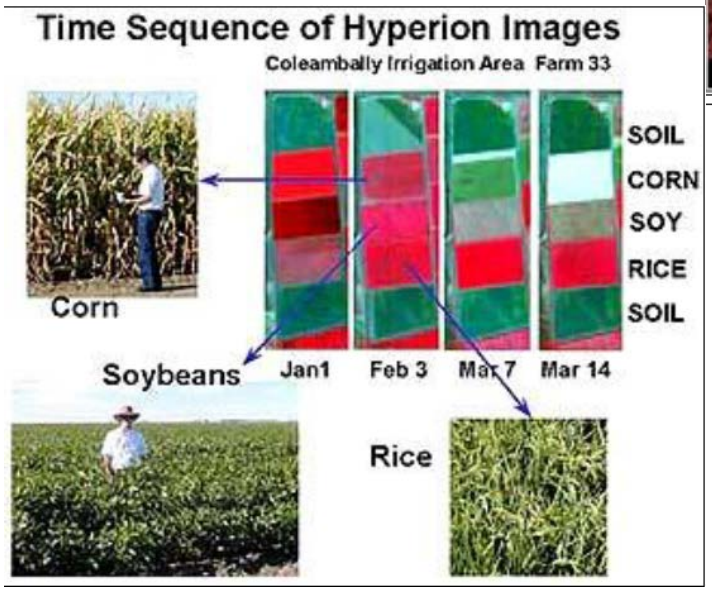


Figure 11. A CIR aerial image of a forested area in Minnesota showing how CIR can be used to determine the forested acreage of various tree species:

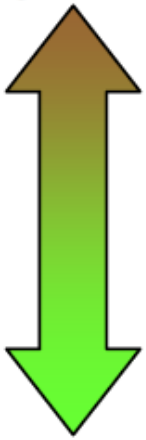
- Dark red areas: White spruce
- Medium red areas: Red Pine
- Lighter pink areas: Aspen, Maple and Oak

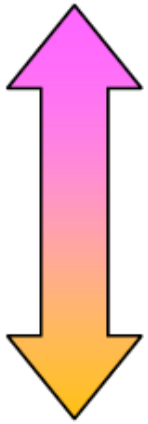


Benefits of CIR Imagery – Vegetation Types:

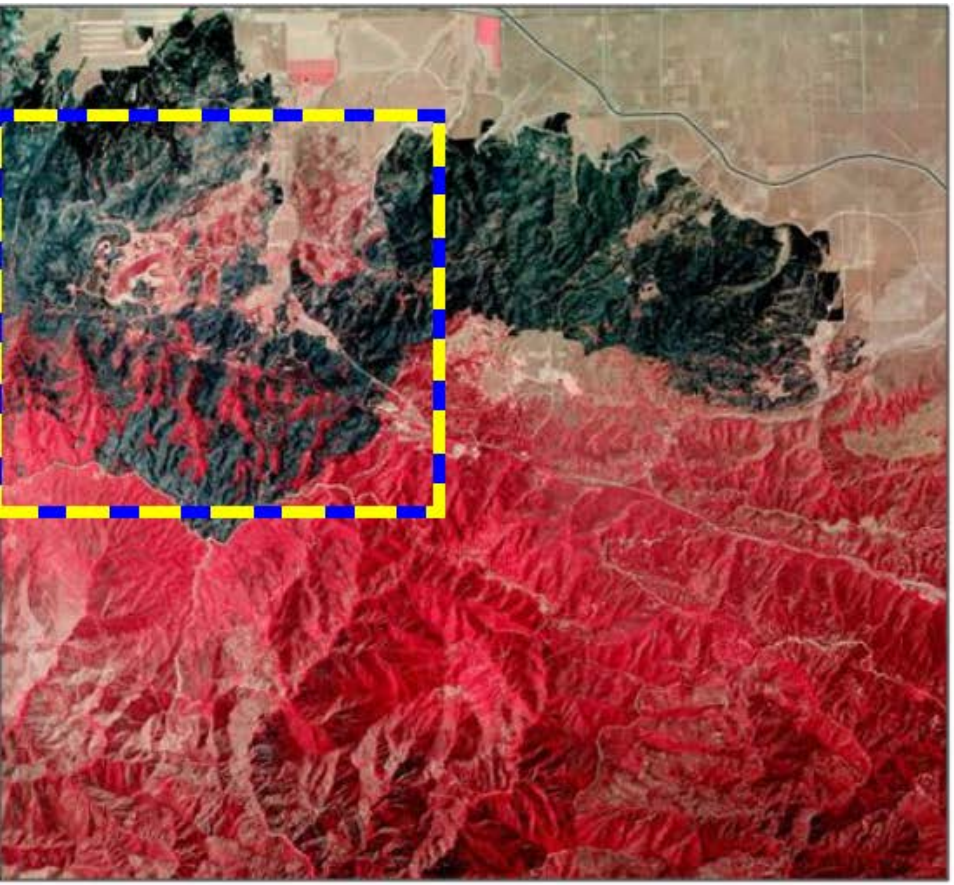
The relative color (color range) of New England tree species on CIR photography showing (USDA FS 1995):

- Softwoods (excluding hemlock) ranging from grey-brown to green
- Hardwoods (including hemlock) ranging from pink to orange

Softwood species (excluding Hemlock)	**Color range**
• White pine • Red pine • Pitch pine • Balsam fir • Red spruce • Black spruce • Tamarack • dead stem	grey-brown  green

Hardwood species (including Hemlock)	**Color range**
• Hemlock • Beech • White oak • Sugar maple • Red maple • Aspen • White birch • Red oak	pink  orange

Benefits of CIR Imagery – Damage Assessment:



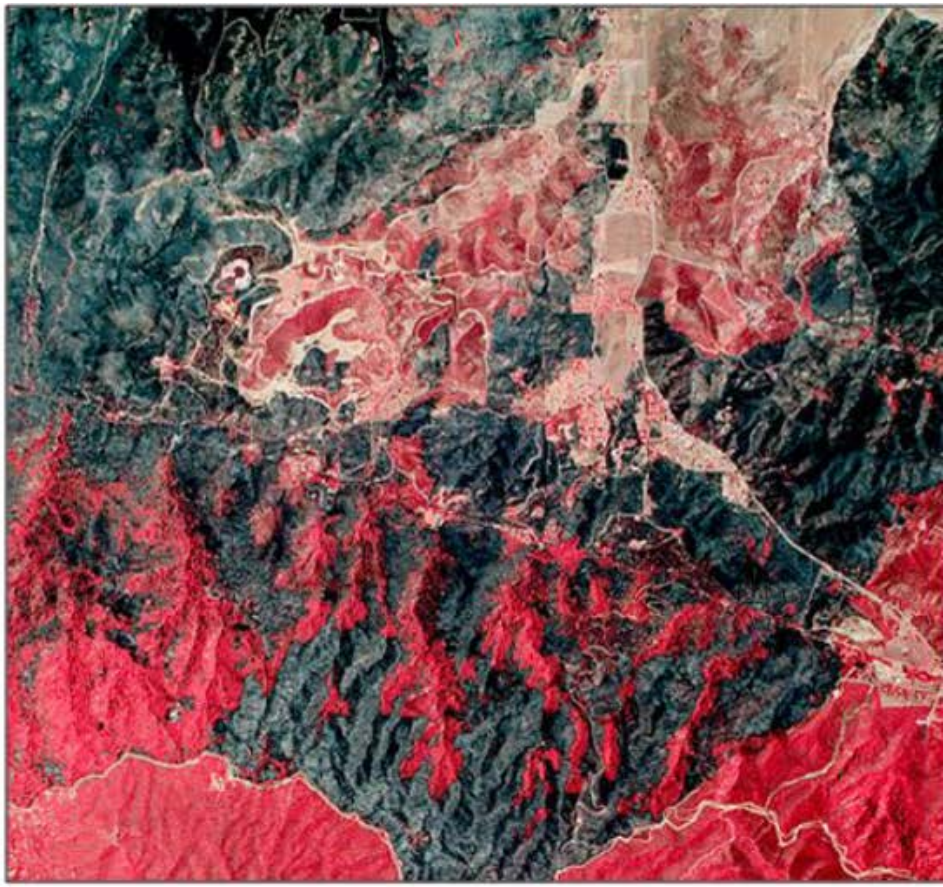
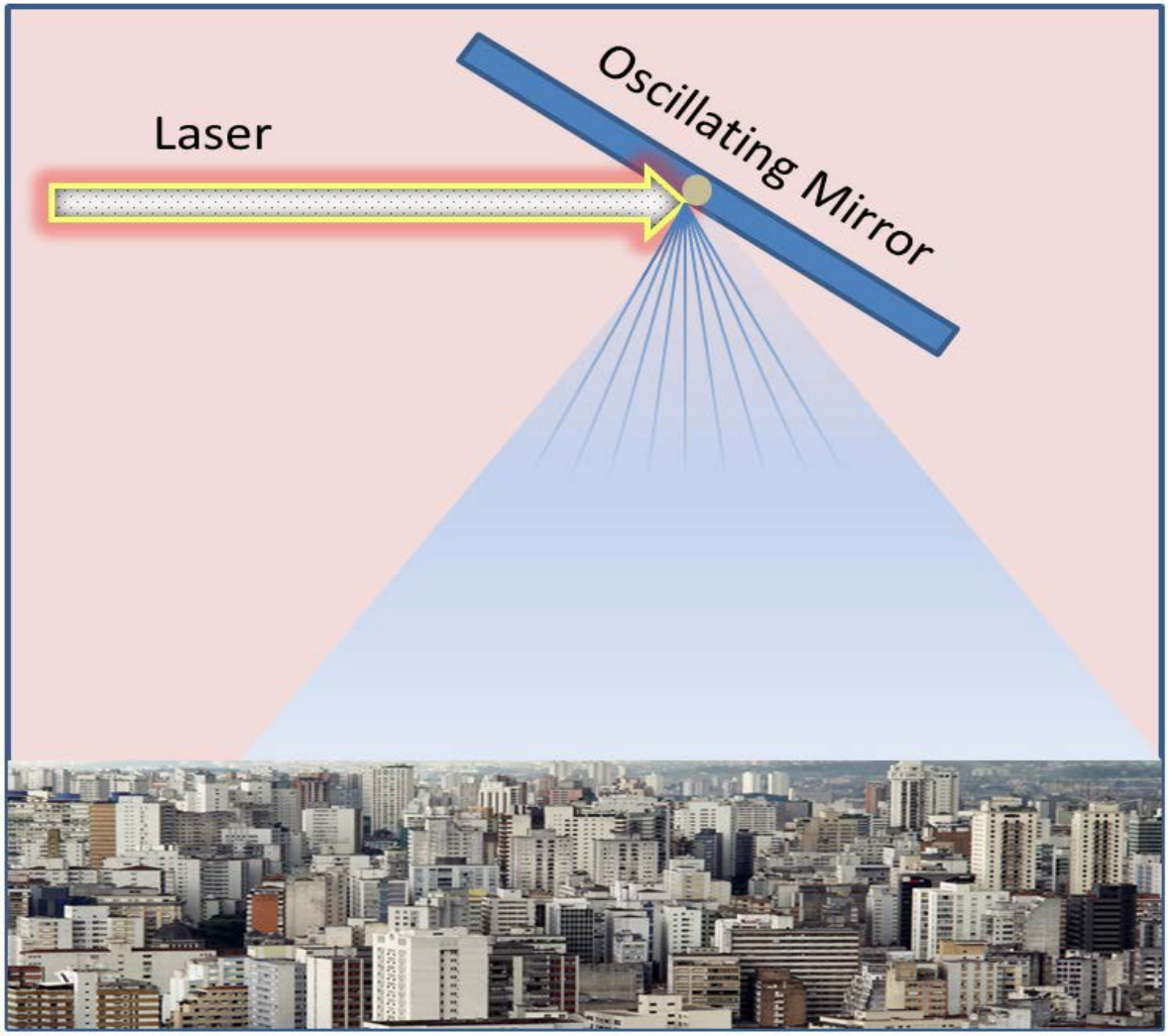


Figure 19. A CIR aerial image of Angeles National Forest in California showing pine fire damage in black. Zoomed-in inset shows spared ridges that would be seed sources for natural restoration. Photo source: Cirrus Digital Systems.

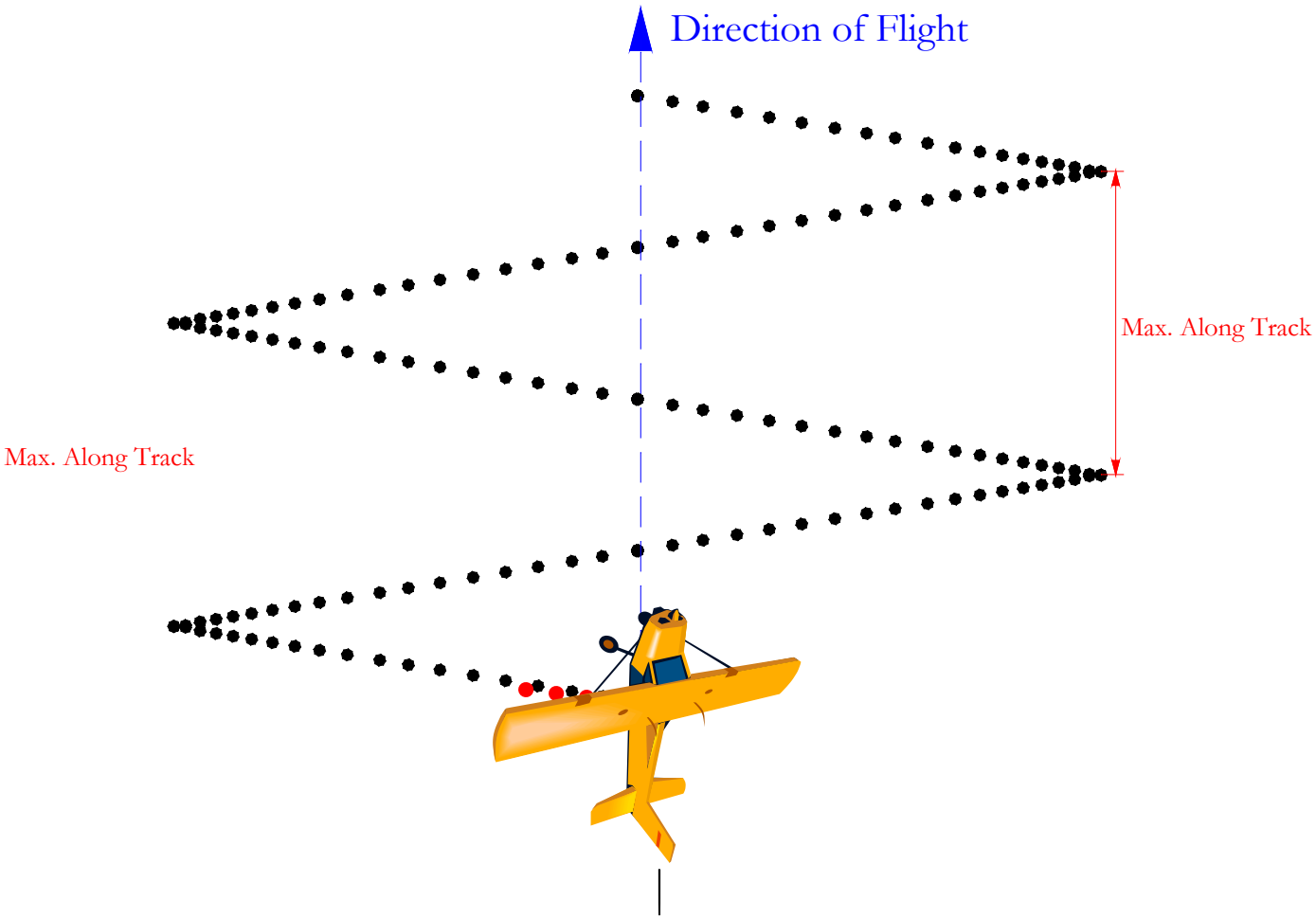
Benefits of CIR Imagery – Submerged Vegetation

Benefits of CIR Imagery – Water / Wetlands - Identification

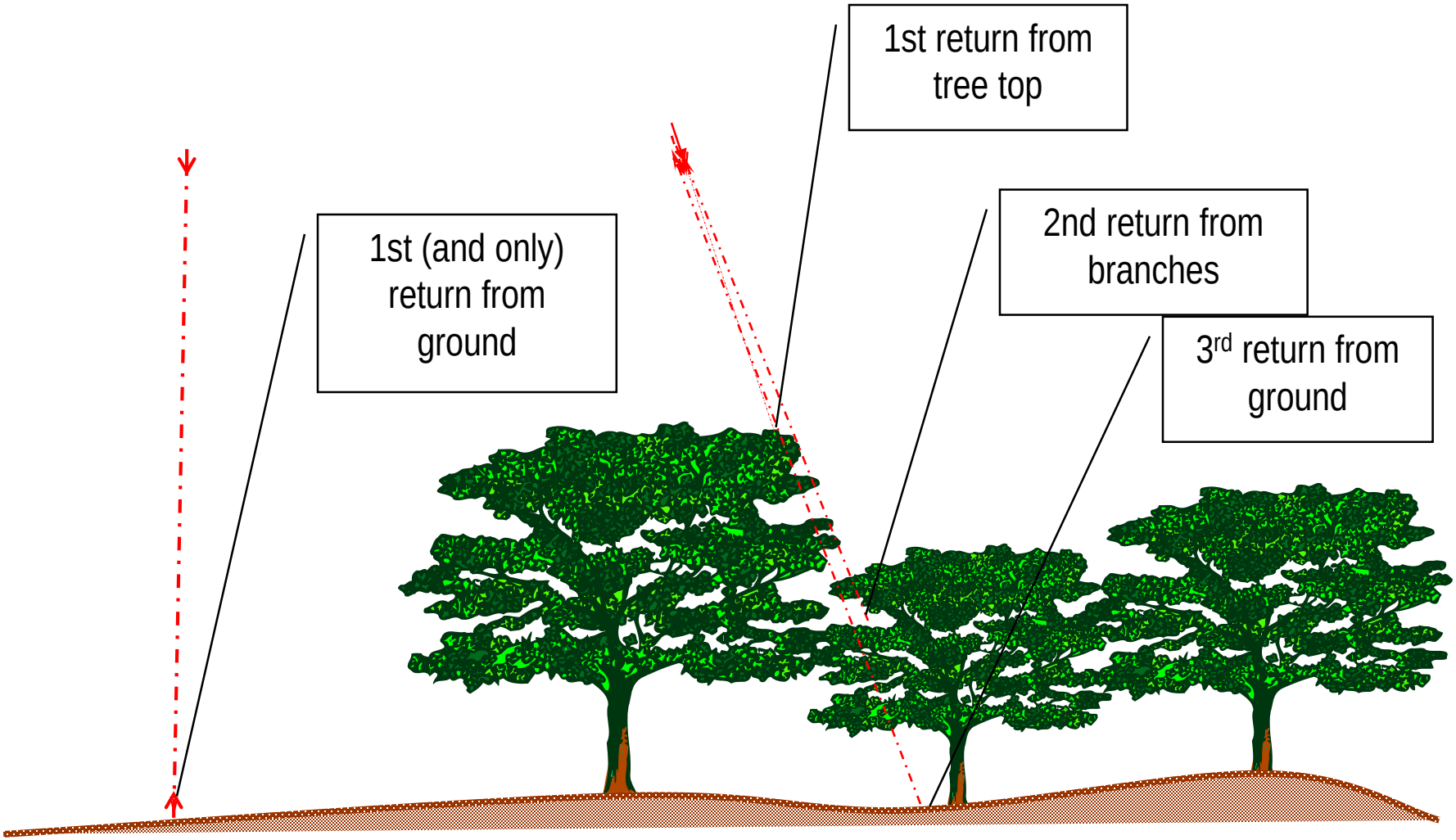
Airborne Linear Scanning Lidar



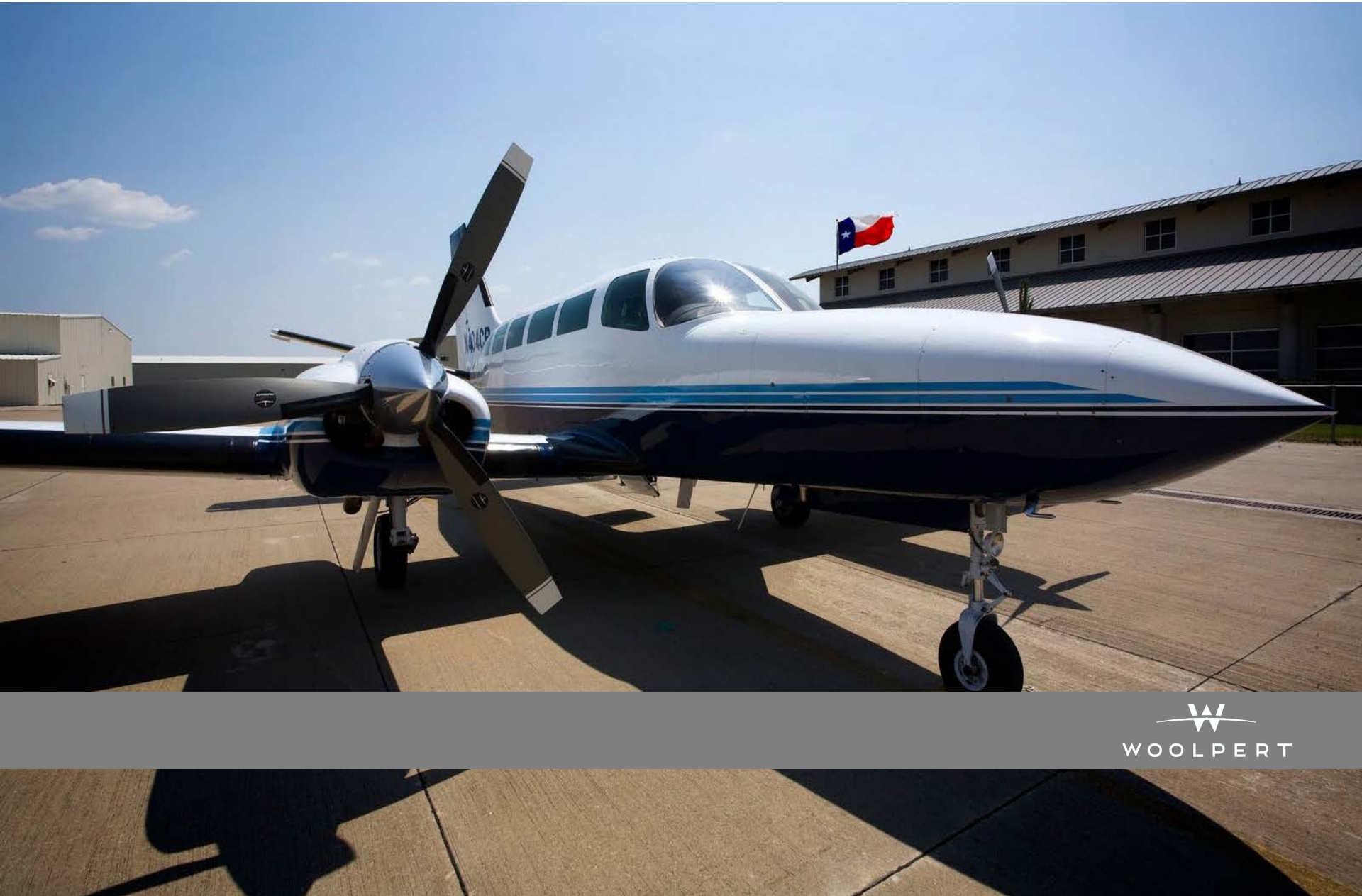
Linear Scanning Pattern



Multiple Returns Capability



Provided by Leica Geosystems GIS and Mapping, LLC



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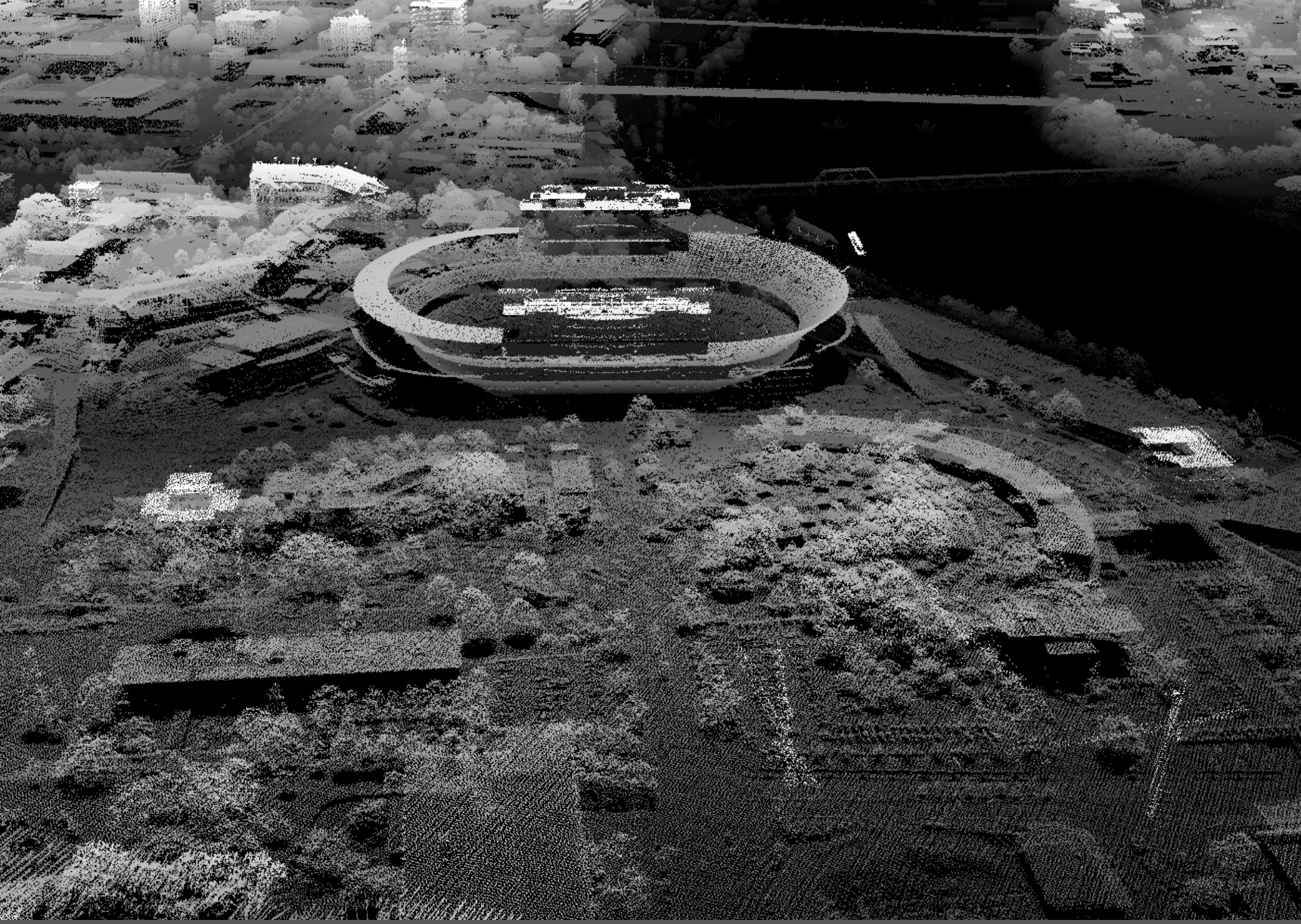
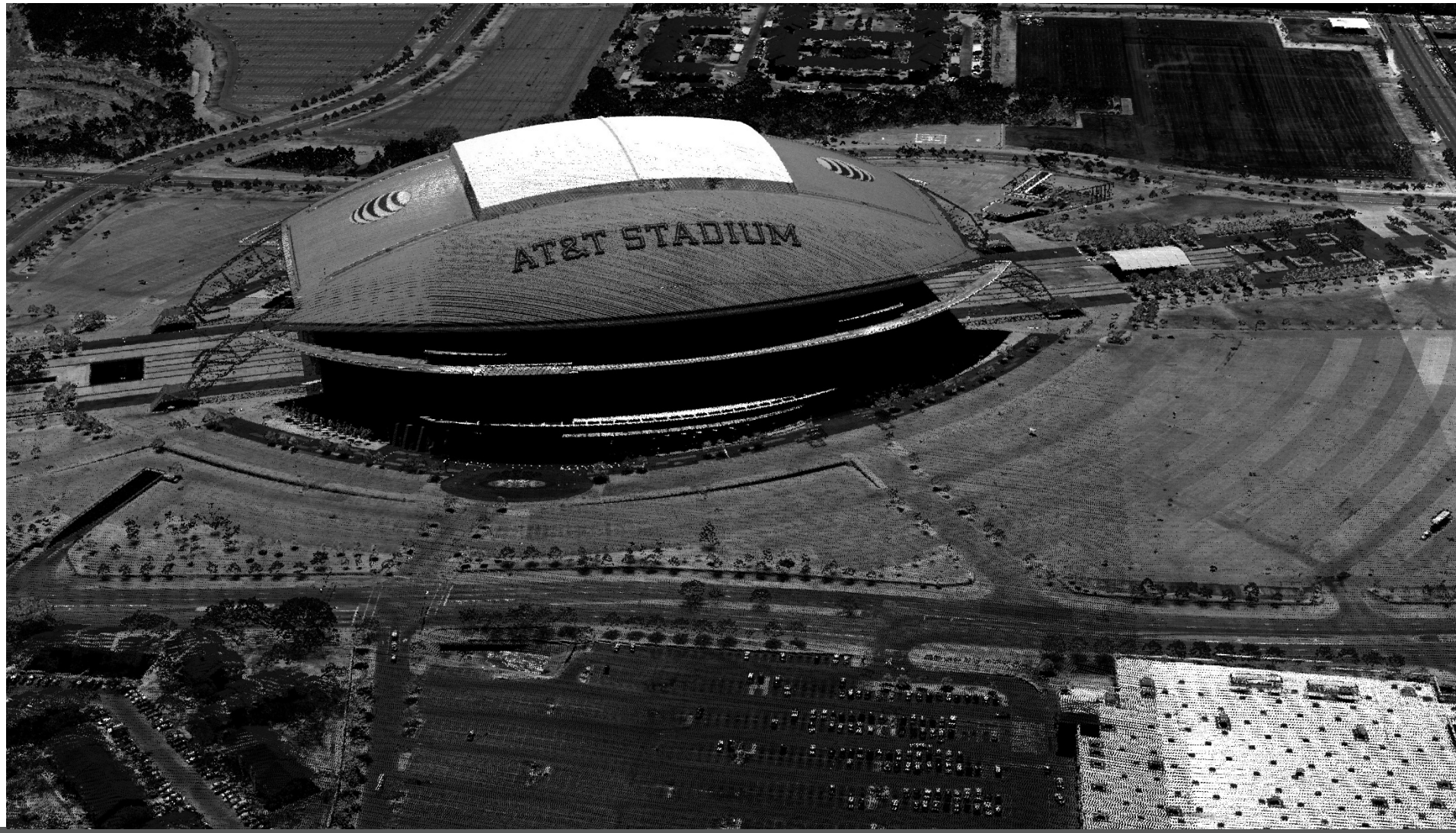
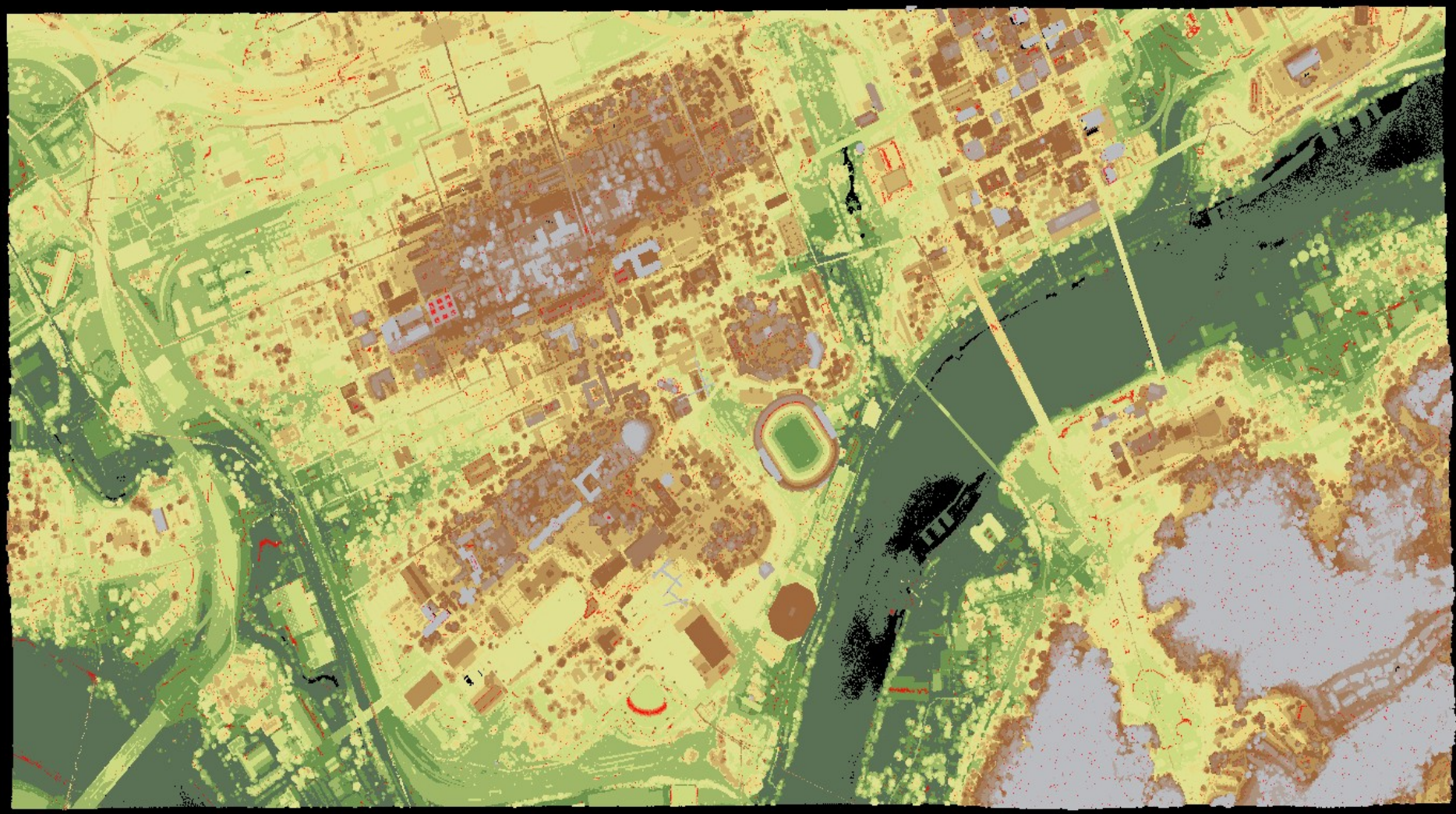
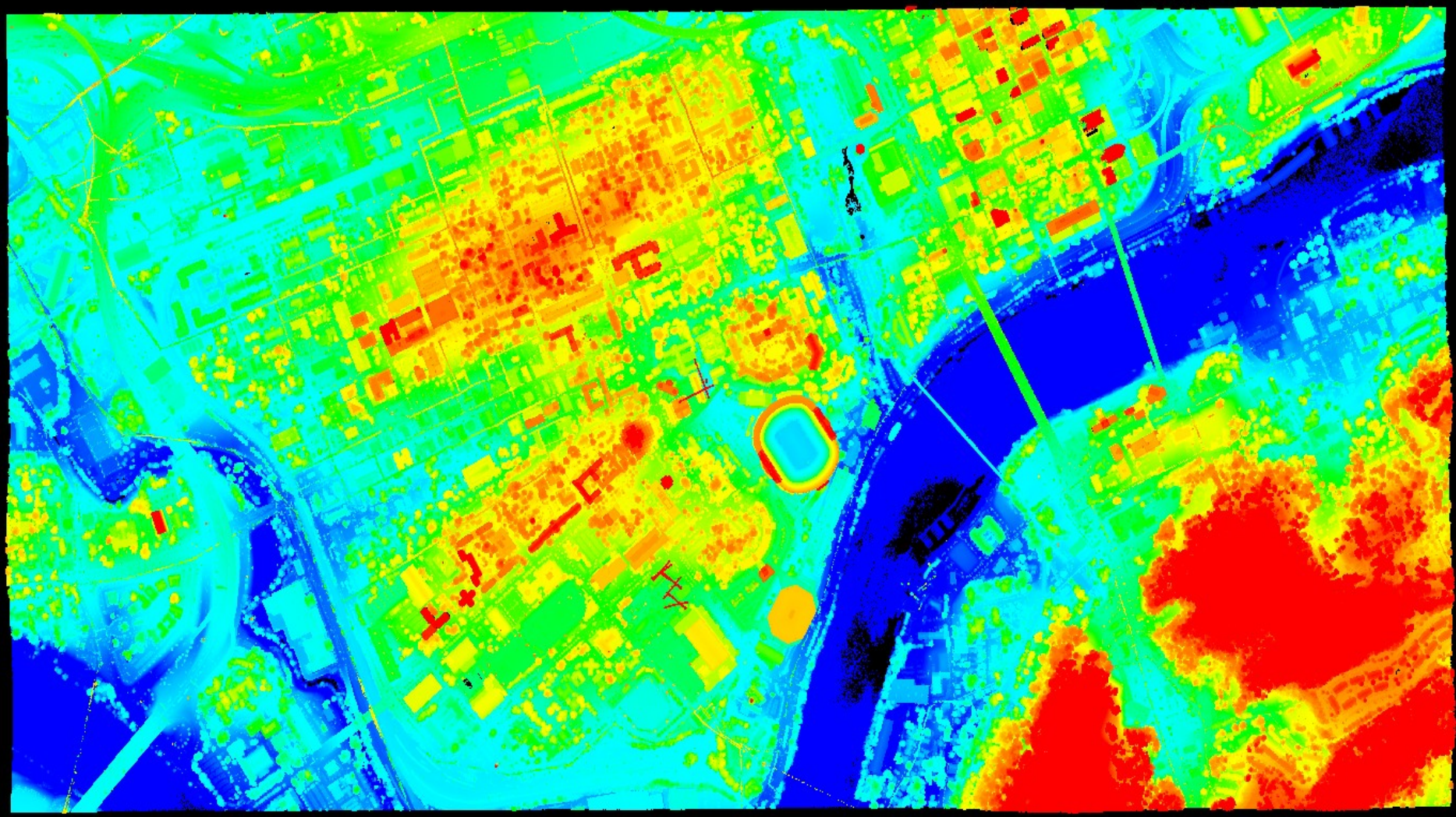



AT&T STADIUM





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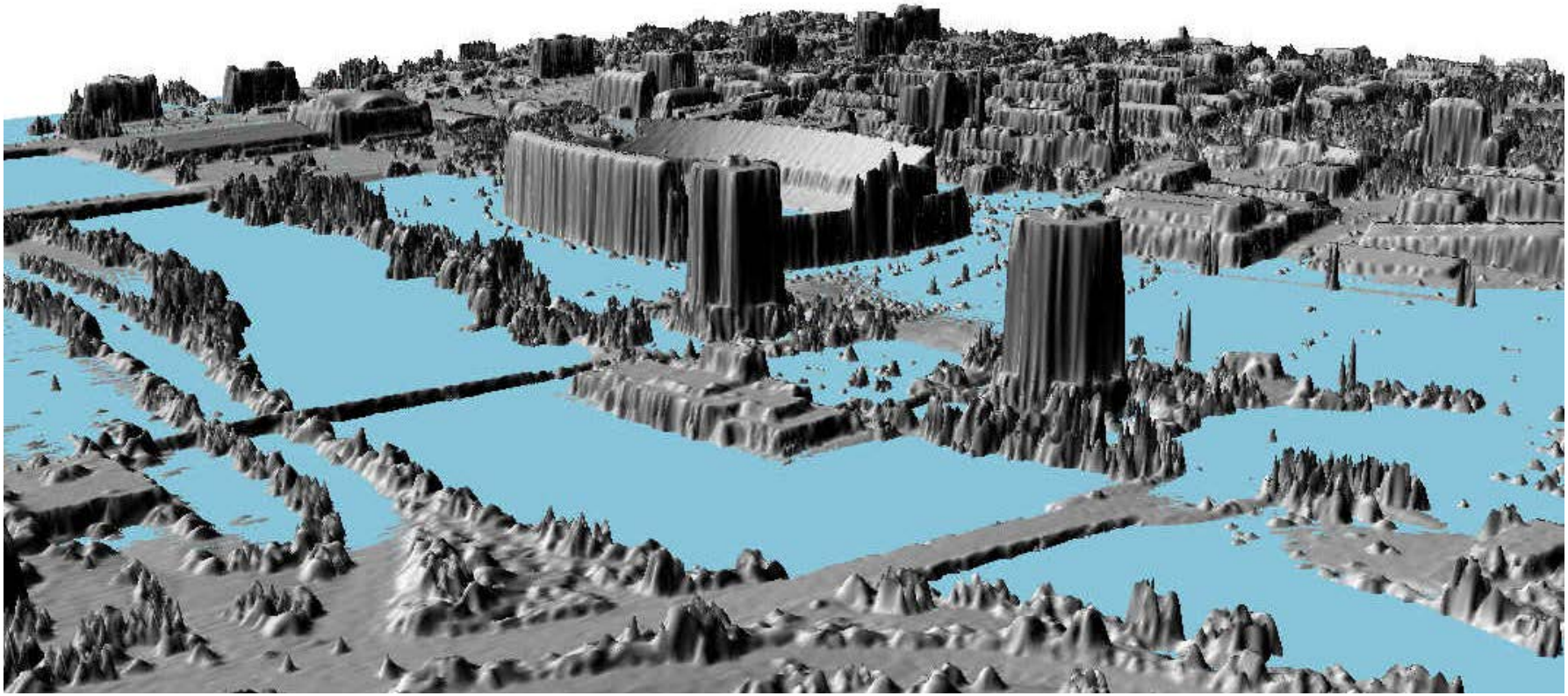
LiDAR for Predictive Flood Modeling

City of Columbus, Ohio



River Elevation – (715ft – 725ft)

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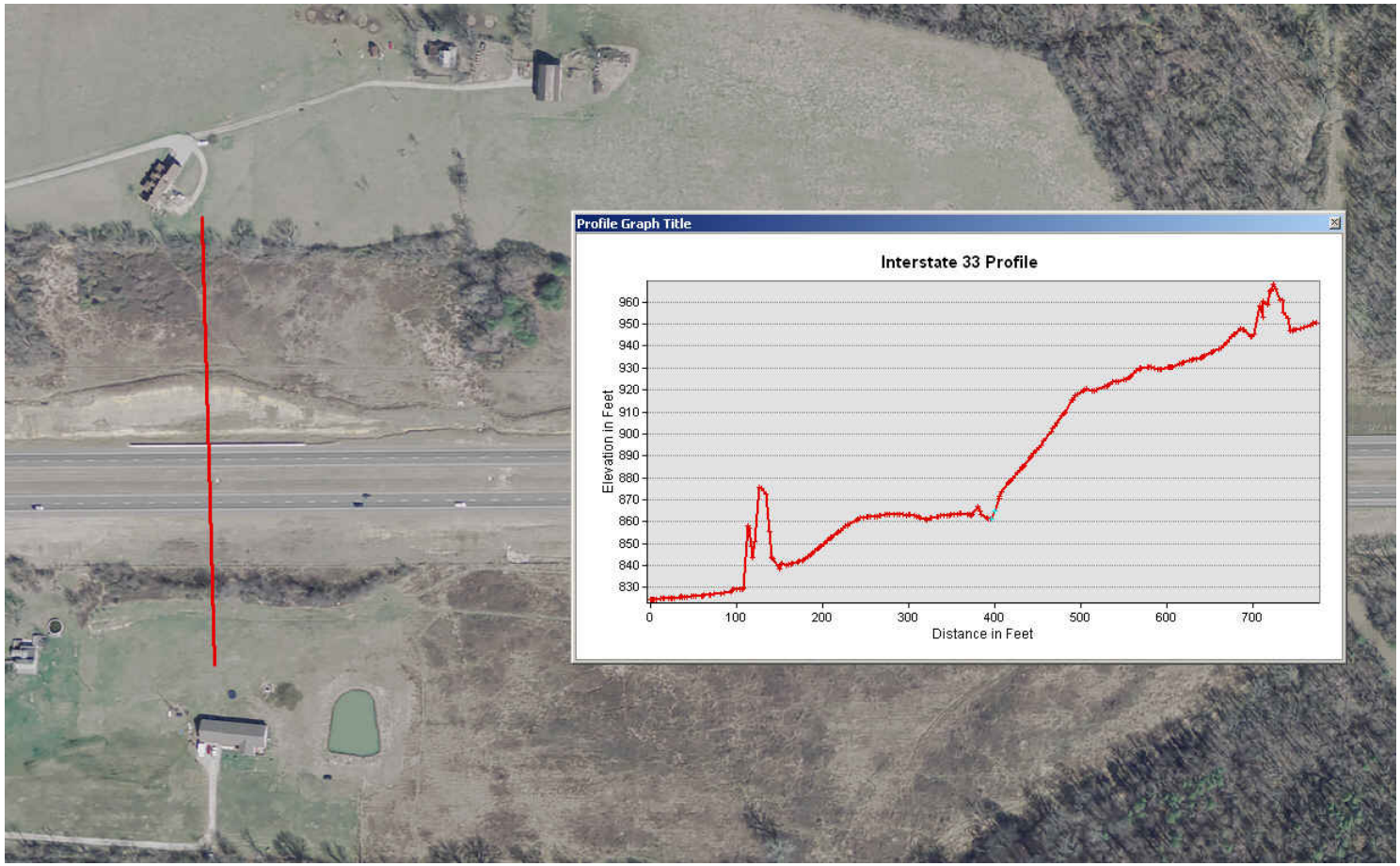
LiDAR for Predictive Landslide Modeling

Fairfield County, Ohio



Interstate Route 33 – Cross Section/Profile View

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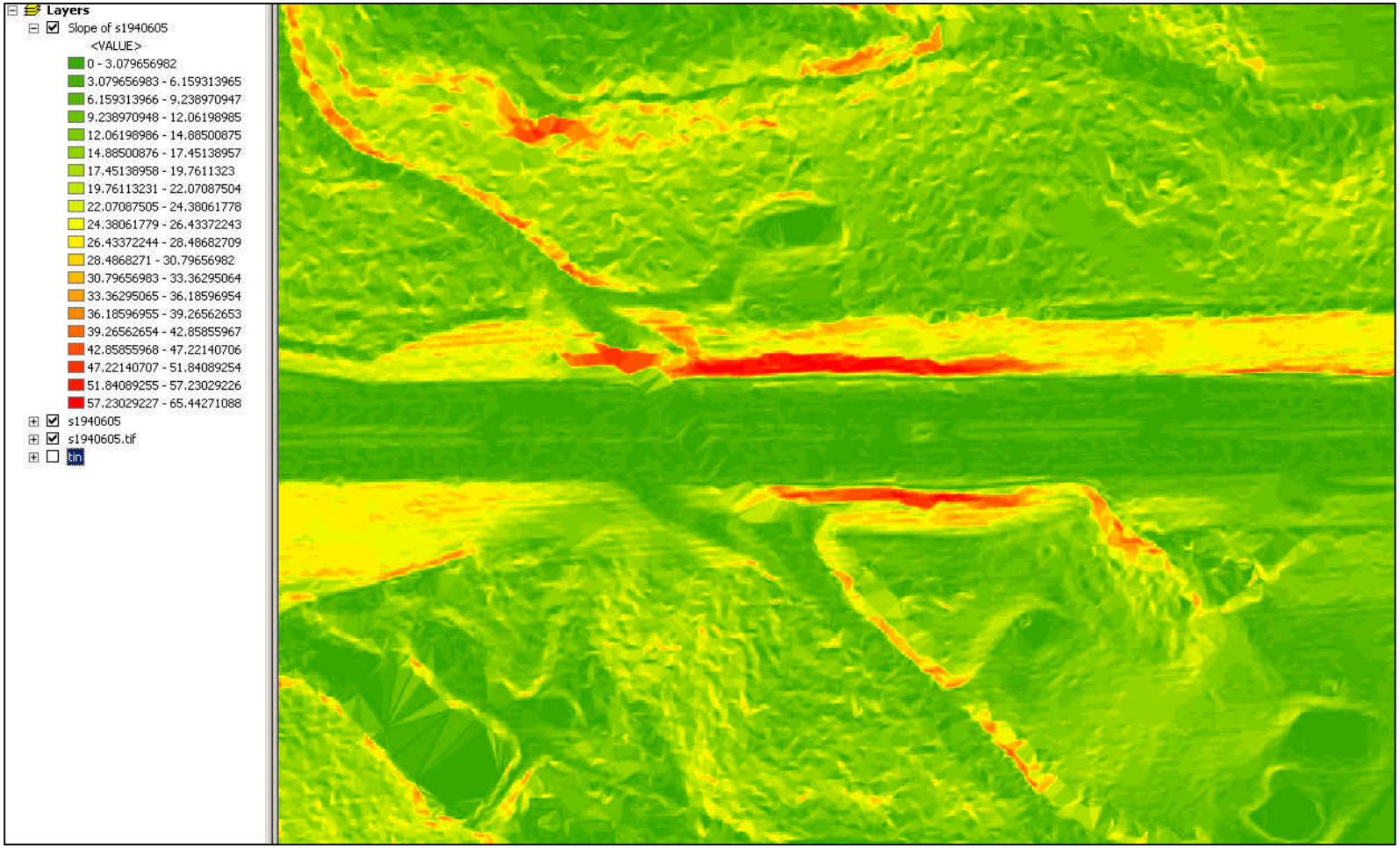
LiDAR for Predictive Landslide Modeling

Fairfield County, Ohio

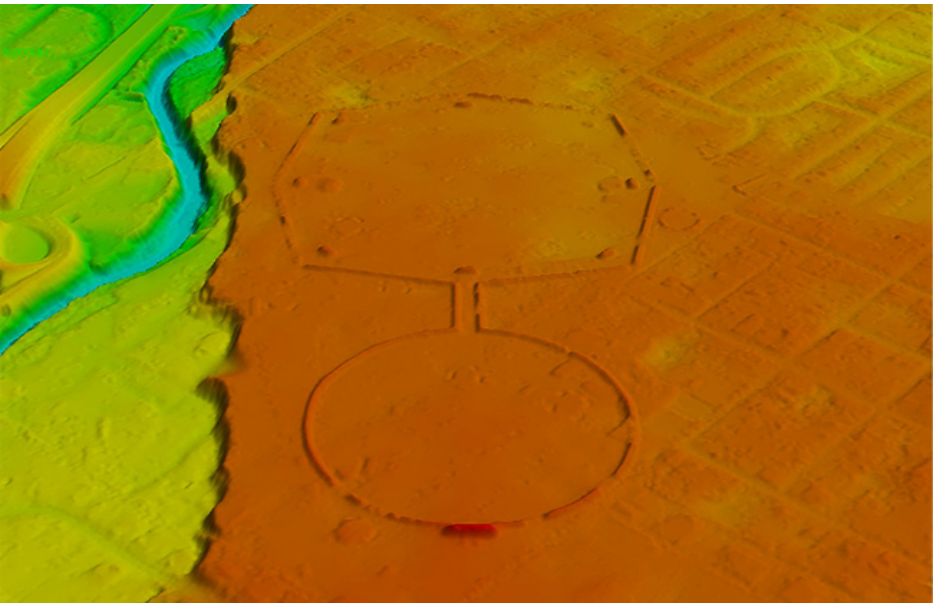


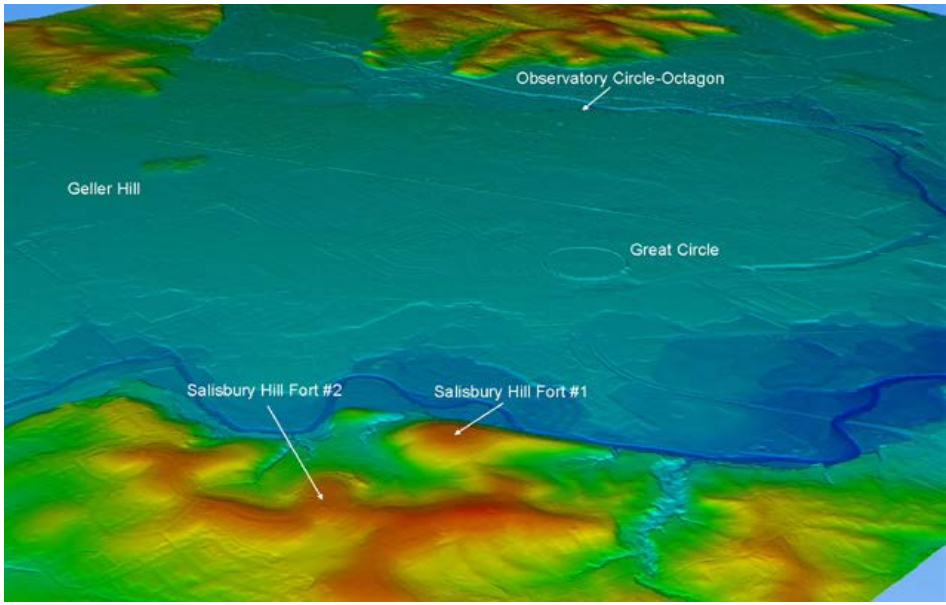
Interstate Route 33 – Color Coded based upon Degree of Slope

LiDAR for Archeological Identification/Discovery

Licking County, Ohio

Octagon and Observatory Circle Indian Mounds





Circle is 20 acres and Octagon is 50 acres
Images courtesy of the Ohio Archeological Council

Shaded Relief Color Coded Model

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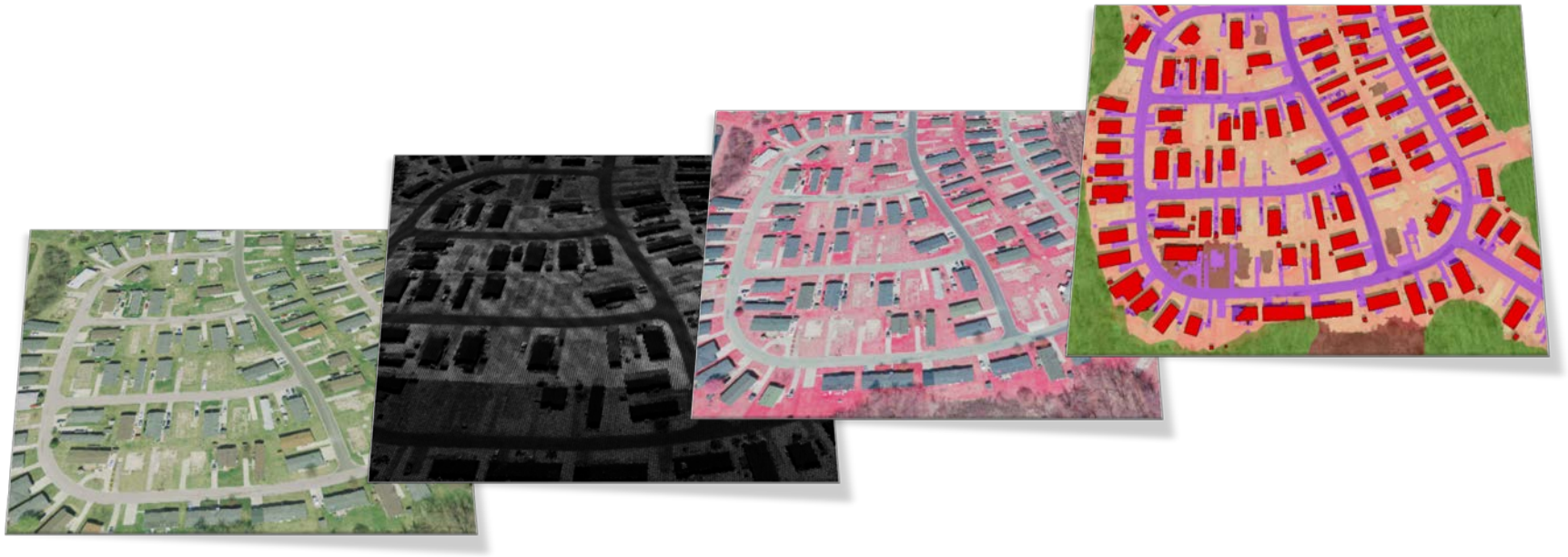
Remote Sensing – every product has a job to do

- Transforming data into information
- Reduction of data dimensionality



Value Added LiDAR Derived Datasets

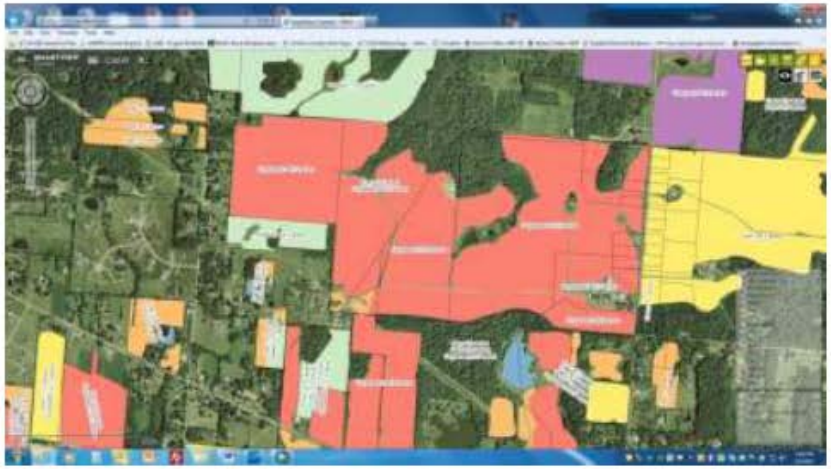
Land-Cover

Change Detection

Building Outlines

Value Added LiDAR Derived Datasets

Impervious Surface Delineation



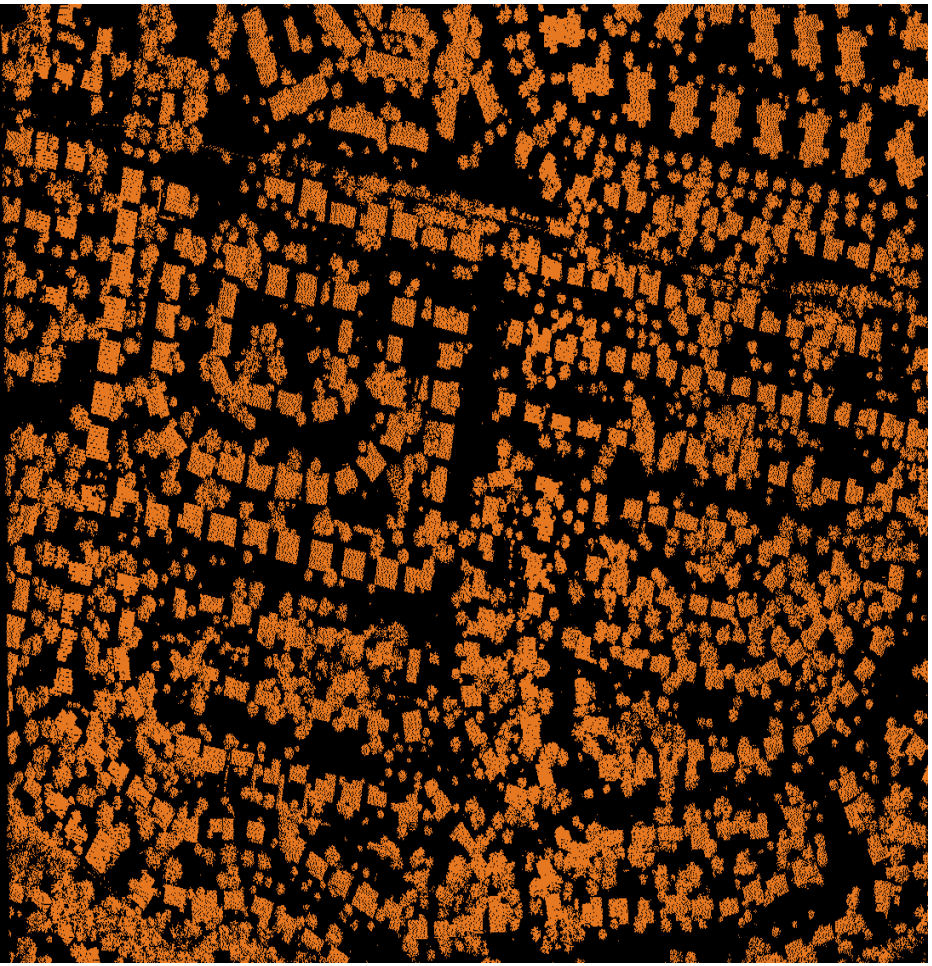
Agricultural Crop Delineation

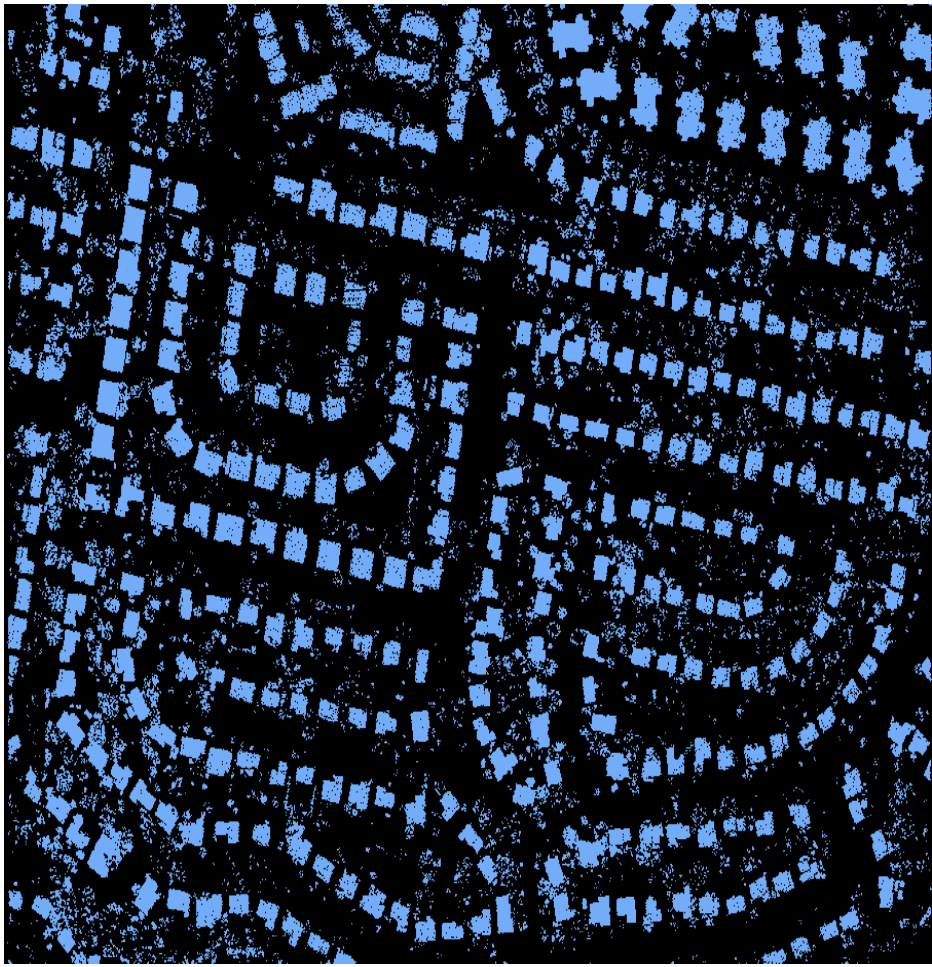
Impervious Surfaces Mapping

- Any material natural or man-made that prevents the infiltration of surface water to the underlying strata
  - Buildings
  - Roads
  - Sidewalks
  - Parking lots
  - Other paved surfaces
- Pervious surfaces
  - Gravel
  - Compacted earth

Value Added Products
Impervious Surfaces (Columbus, Ohio)

Building Footprint Mapping





Building Footprint Mapping

Building Footprint Mapping

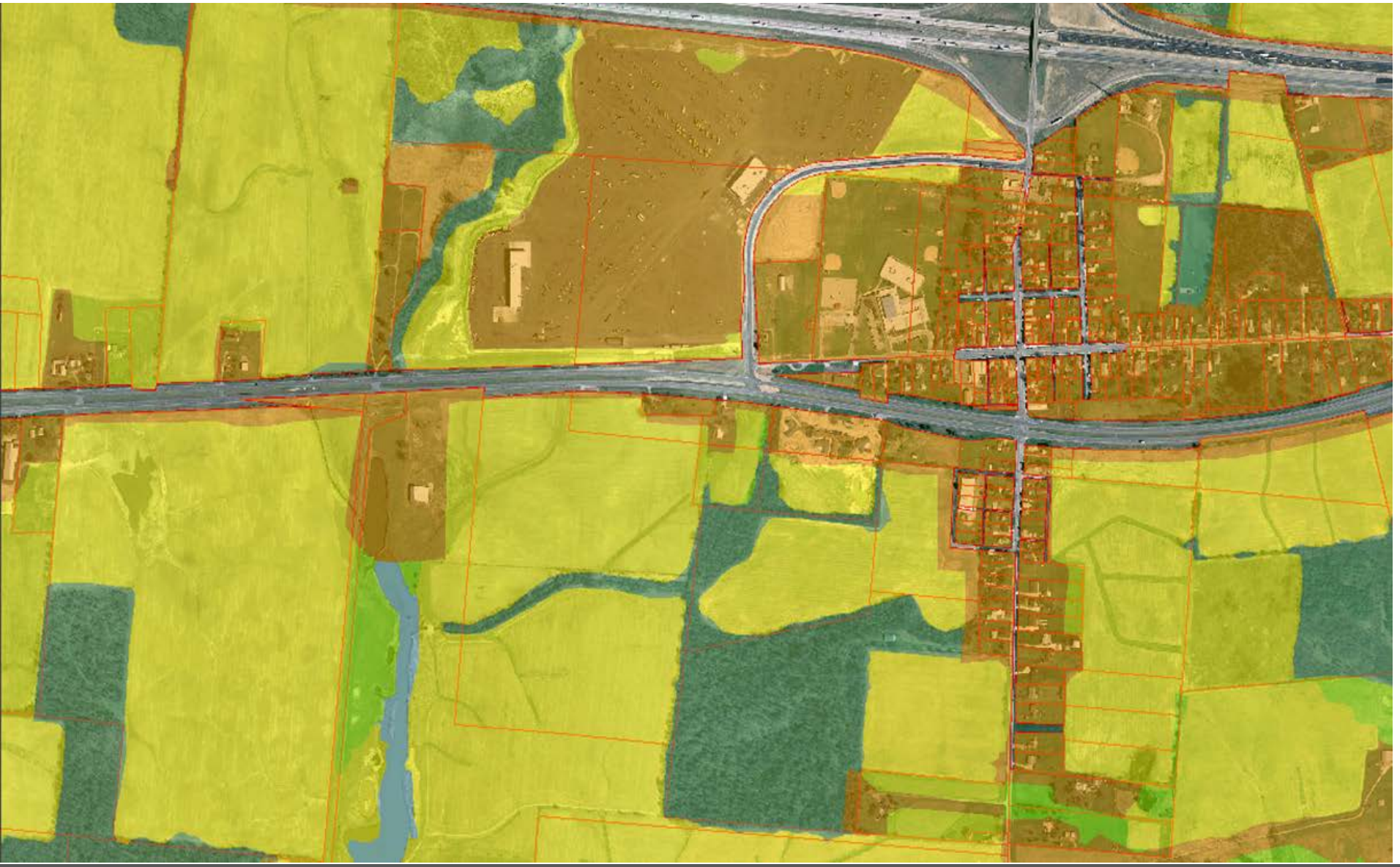
Land Cover Mapping

- Land cover
  - type of feature present on the surface of the earth.
    - Bare Earth (gravel, exposed earth, open space < 25% green cover)
    - Pasture (grassland, open space >75% green cover)
    - Tillable (agriculture)
    - Water (rivers, lakes, ponds, waterways)
    - Woodland (forest, trees – high vegetation, shrubs – low vegetation)
    - Developed (commercial and residential)
    - Transportation (all right-of-way)
    - Wasteland (all the rest)

Land Use Mapping

- Land use
  - human activity and economic function
    - Agricultural
    - Residential
    - Commercial and industrial
    - Transportation
    - Recreational (parks, golf courses)
    - Open areas (vacant areas)
    - Water (rivers, ponds, lakes)
    - Undeveloped (all the rest e.g. forests)

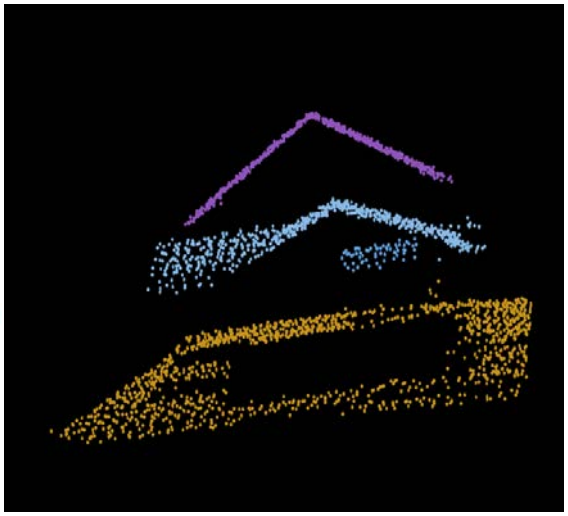
Value Added Products Land-Cover

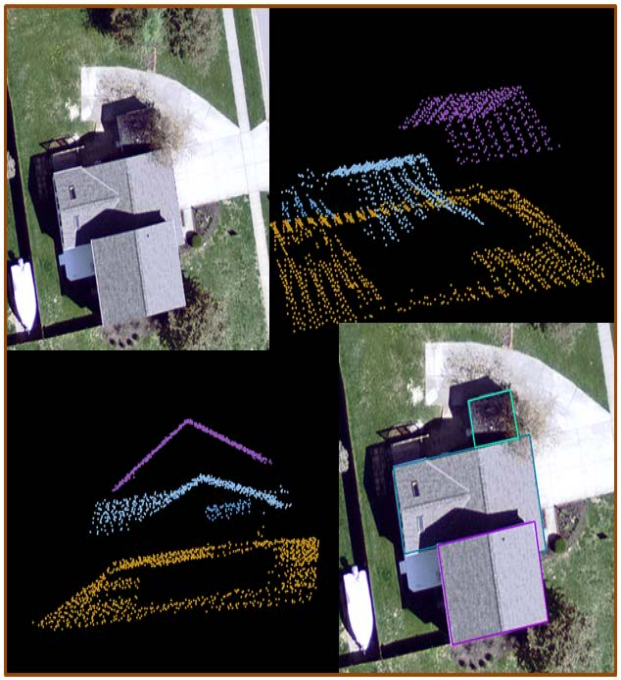


Solar Potential

Data

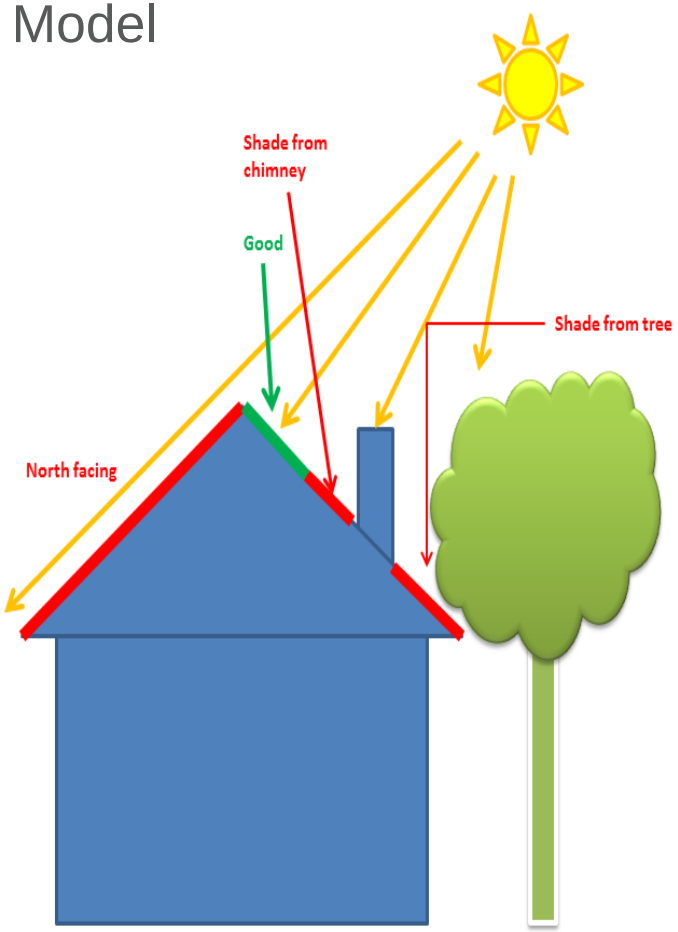
- QL2 LiDAR
- Building rooftop (derived from LiDAR)





Solar Potential

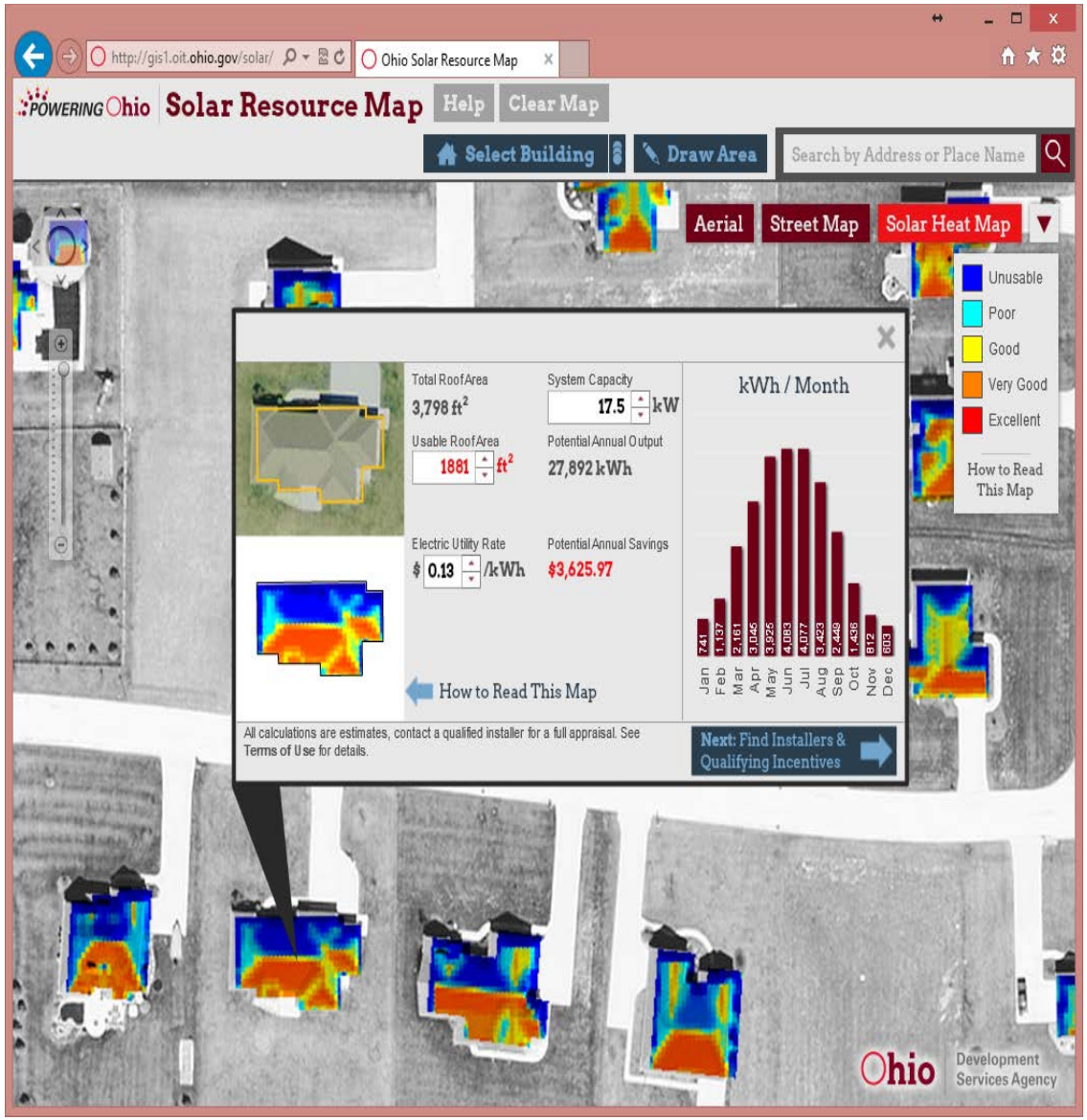
Surface Model



Solar Potential

Solar irradiance model

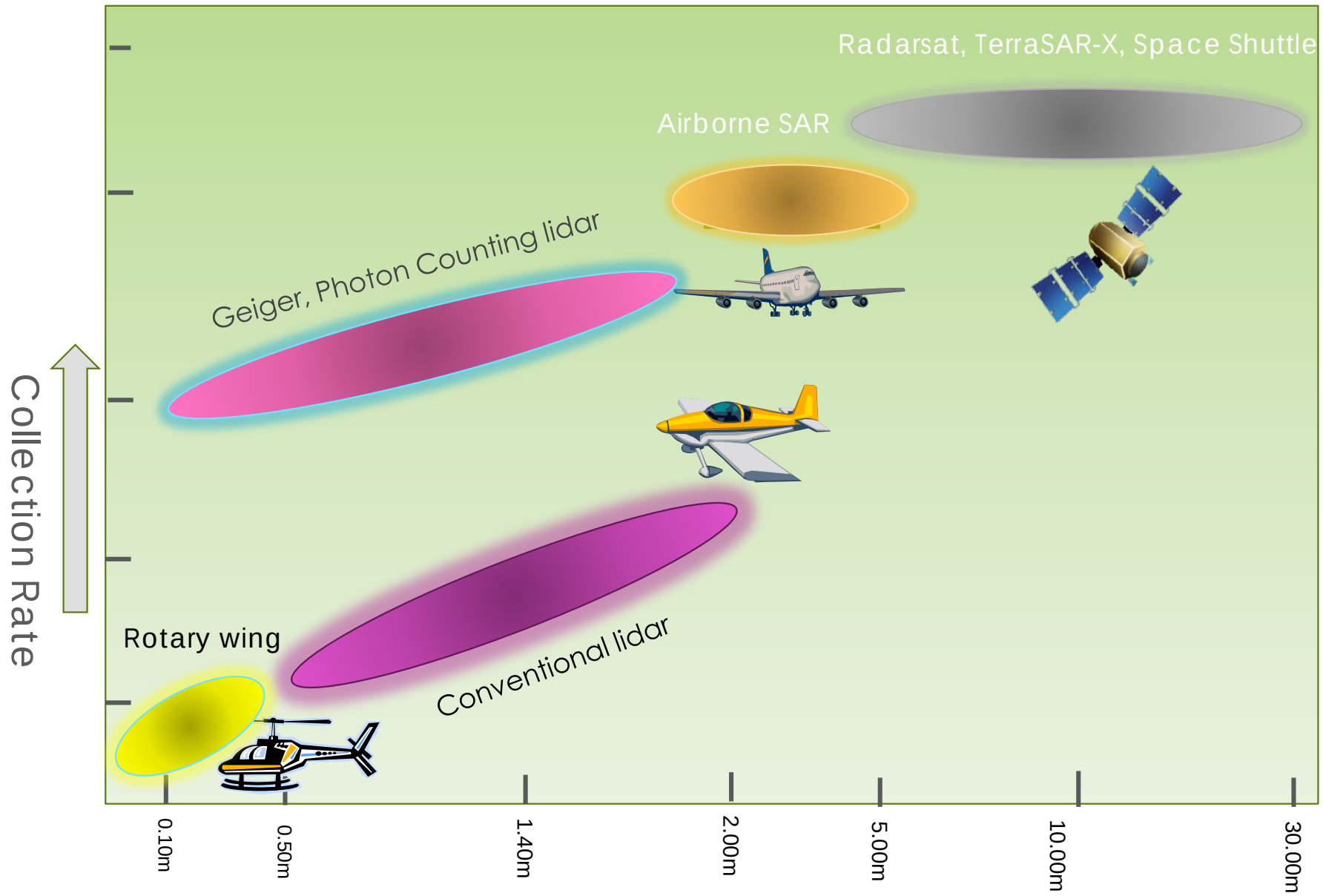
Solar Potential



Website

Trends

Gaps Analysis of Point Cloud Technologies



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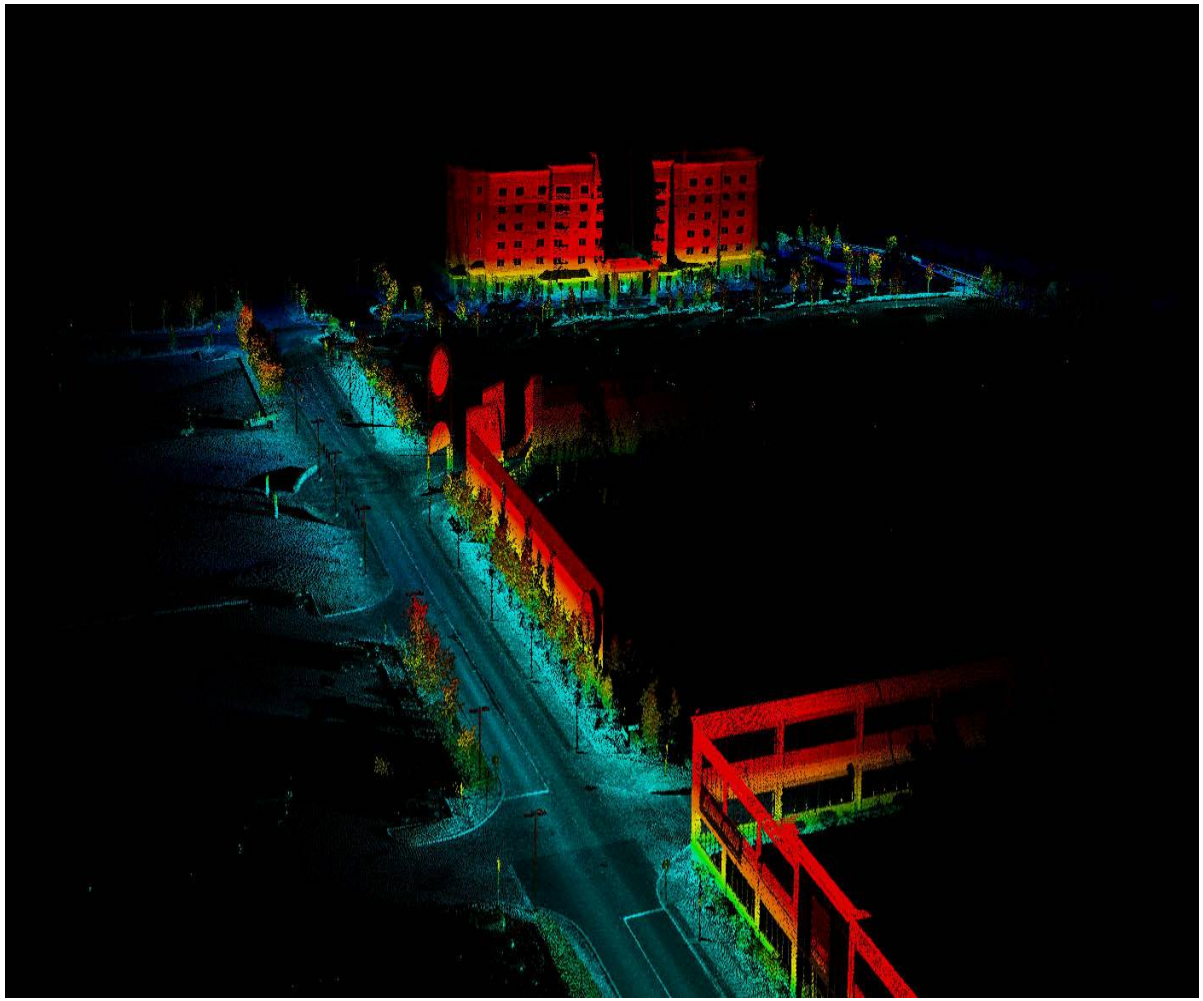
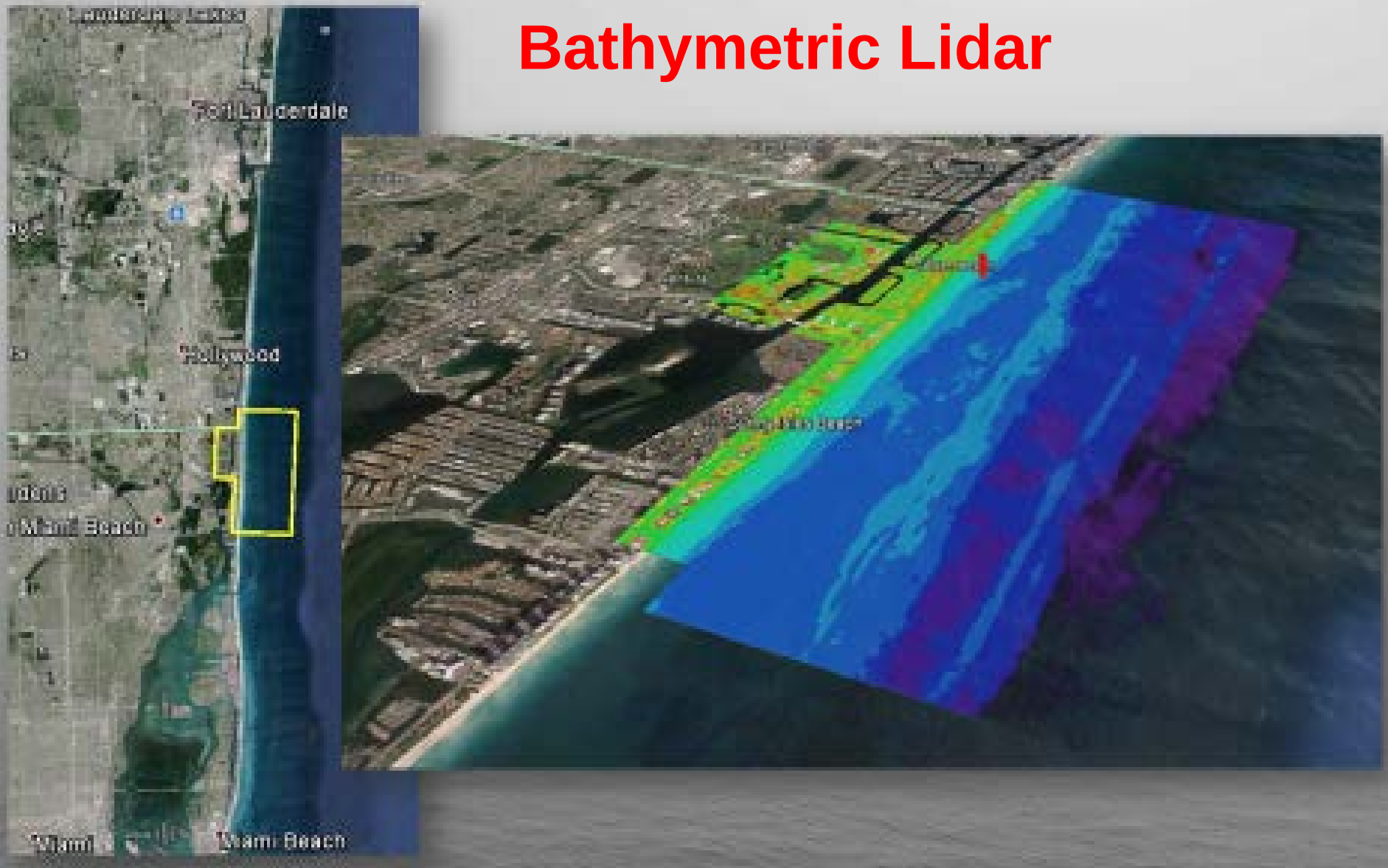
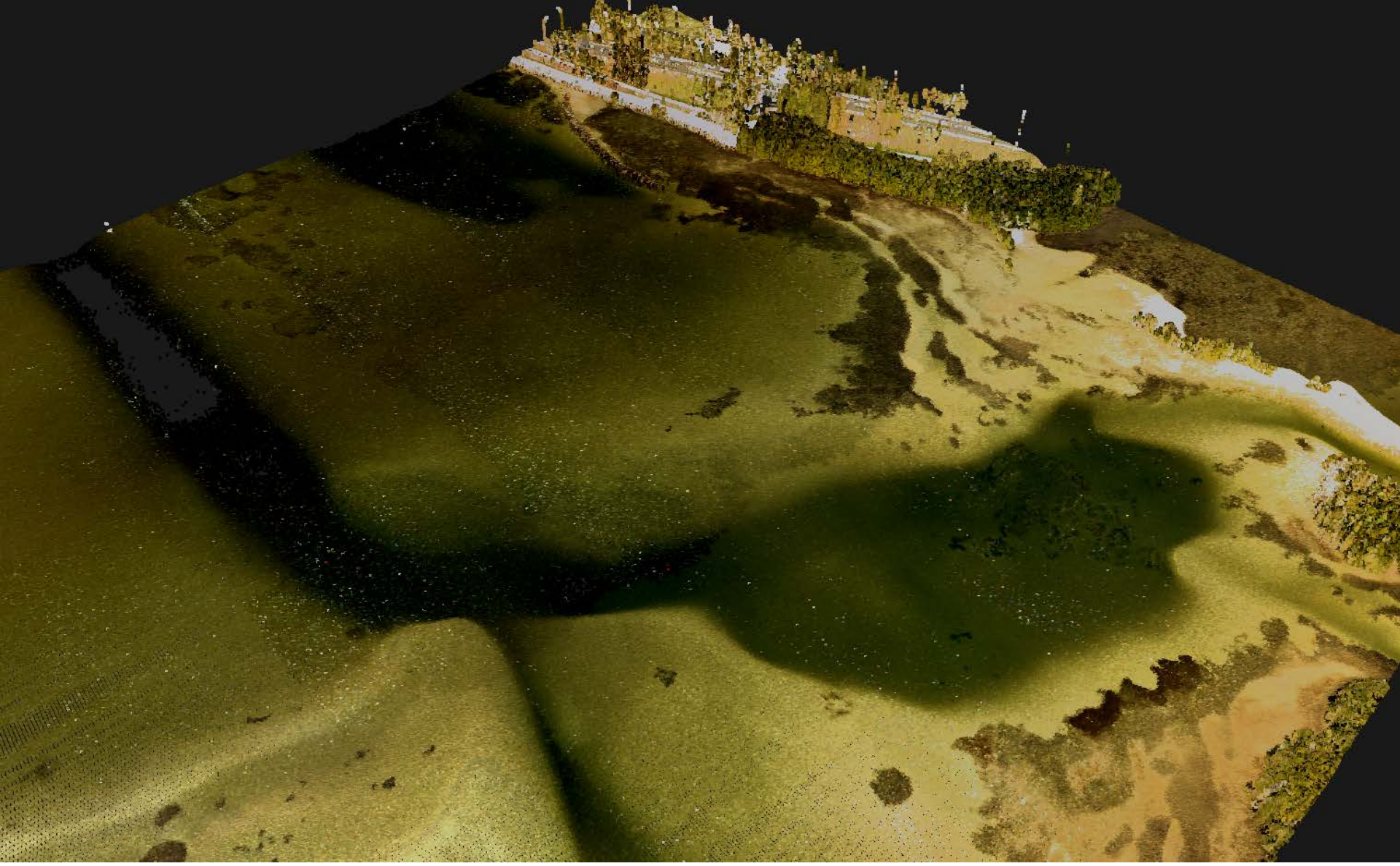
Mobile Mapping



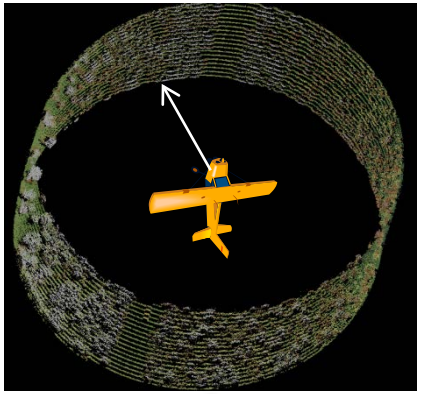
Bathymetric Lidar

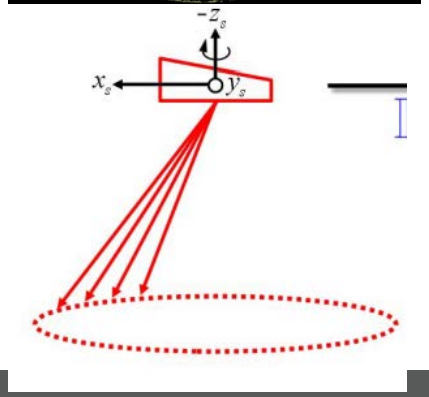




HRQLS (High Resolution Quantum Lidar System)

Specifications:





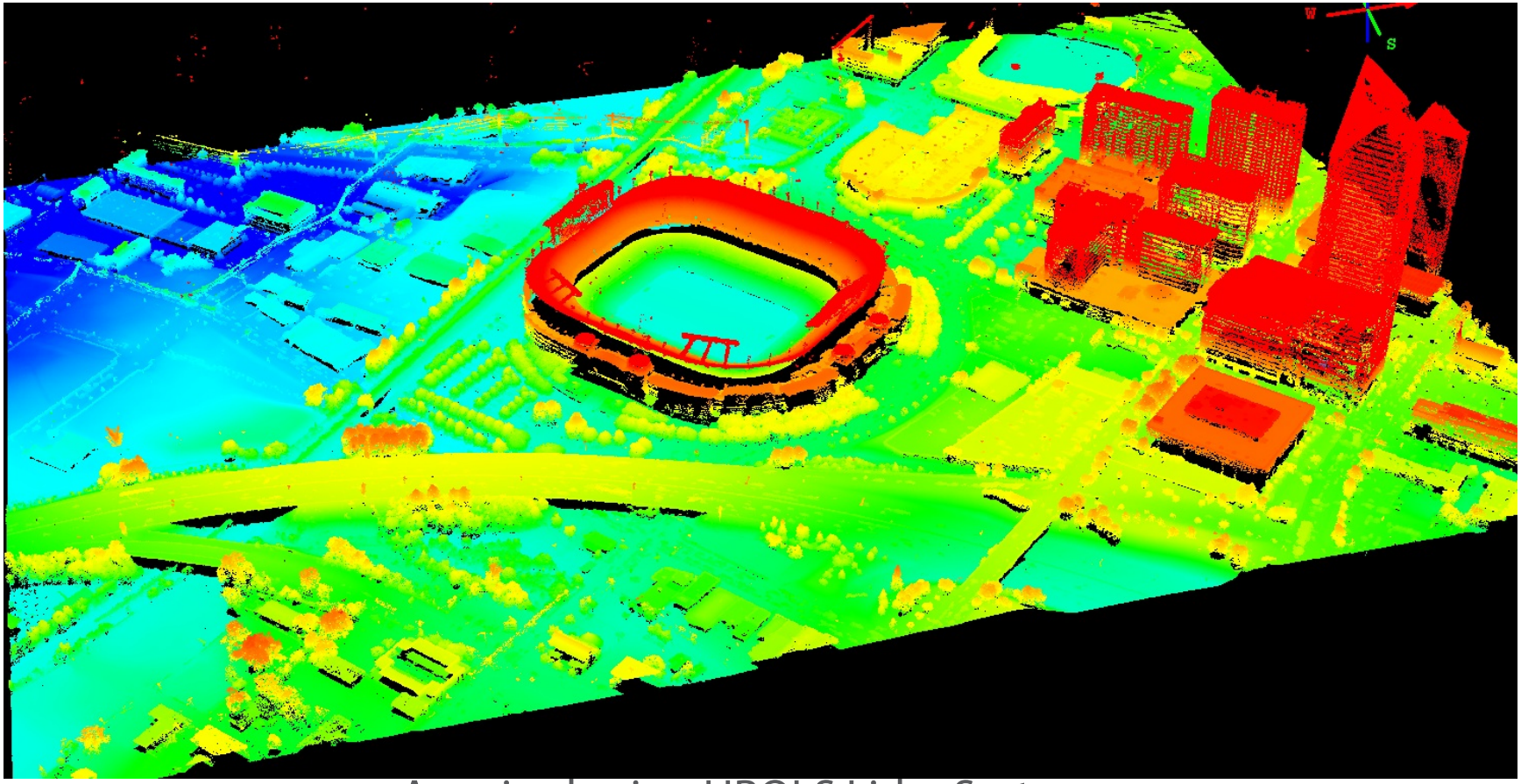
Parameter	Specification
Beams	100
Wavelength	532 nm
Laser Repetition Rate	25 kHz
Lase Pulsewidth	700 psec
Laser Output Power	1.5W
Pixels/sec	2.5 Millon
Eye safety	Eye safe by FAA standards
Multiple Return Capabillity	Yes
Pixel Recovery Time	1.6 nsec
RMS Range Precision	± 5 cm
Scan Patterns	linear, conical
Scan Width	0 to 40 degrees (selectable)
Operational Altitude Range *	6.5 - 10 kft
Swath vs AGL** (at maximum scan angle)	1.3 to 2 Km
Areal Coverage vs AGL ** (at maximum scan angle and 200 Knots)	400 to 640 Km2 / hr single pass
Mean Point Density	12 to 8 per sq meter, single pass, with 15% reflectivity
Size	19 W x 25 D x 33 H inches
Weight	50 lbs
Prime Power	555 W

* higher altitude possible, but with lower mean points/m2 density

Photon Counting Lidar

Mecklenburg County, NC Pilot,

1.6 Km swath, 15 points/sq m, 180 Knots, single pass

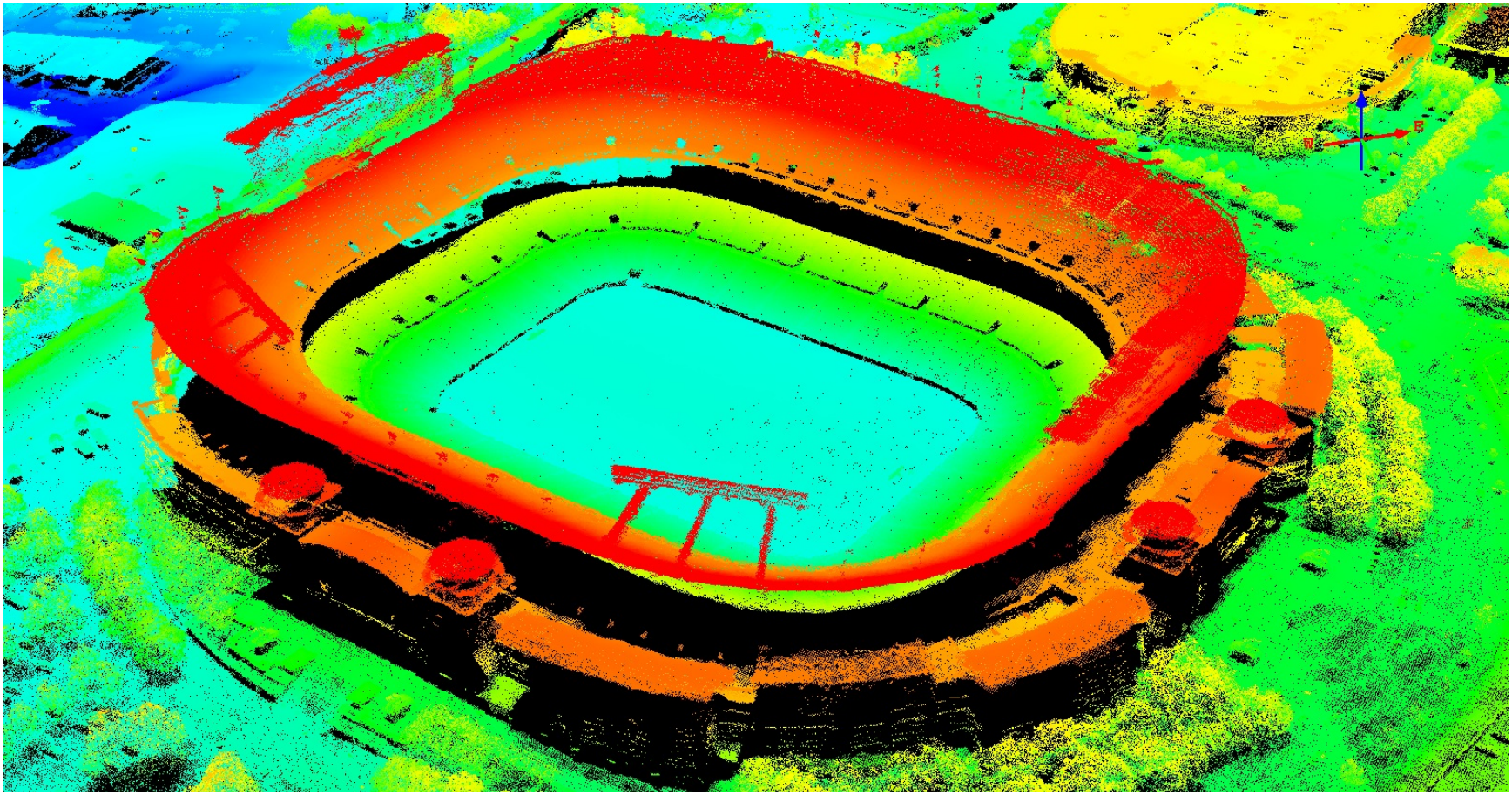


Acquired using HRQLS Lidar System

Photon Counting Lidar

Mecklenburg County, NC Pilot,

1.6 Km swath, 15 points/sq m, 180 Knots, single pass

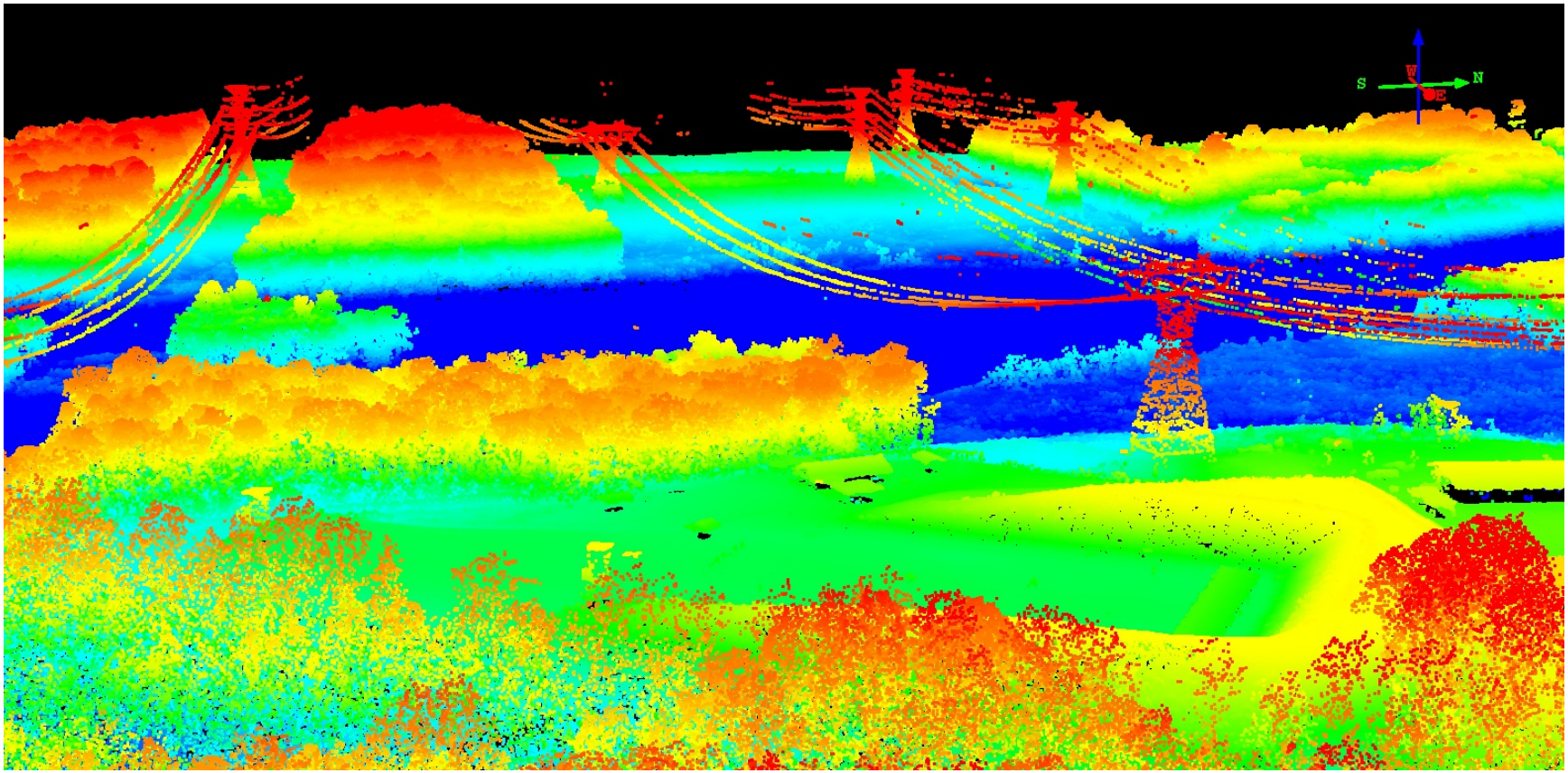


Acquired using HRQLS Lidar System

Photon Counting Lidar

Mecklenburg County, NC Pilot,

1.6 Km swath, 15 points/sq m, 180 Knots, single pass

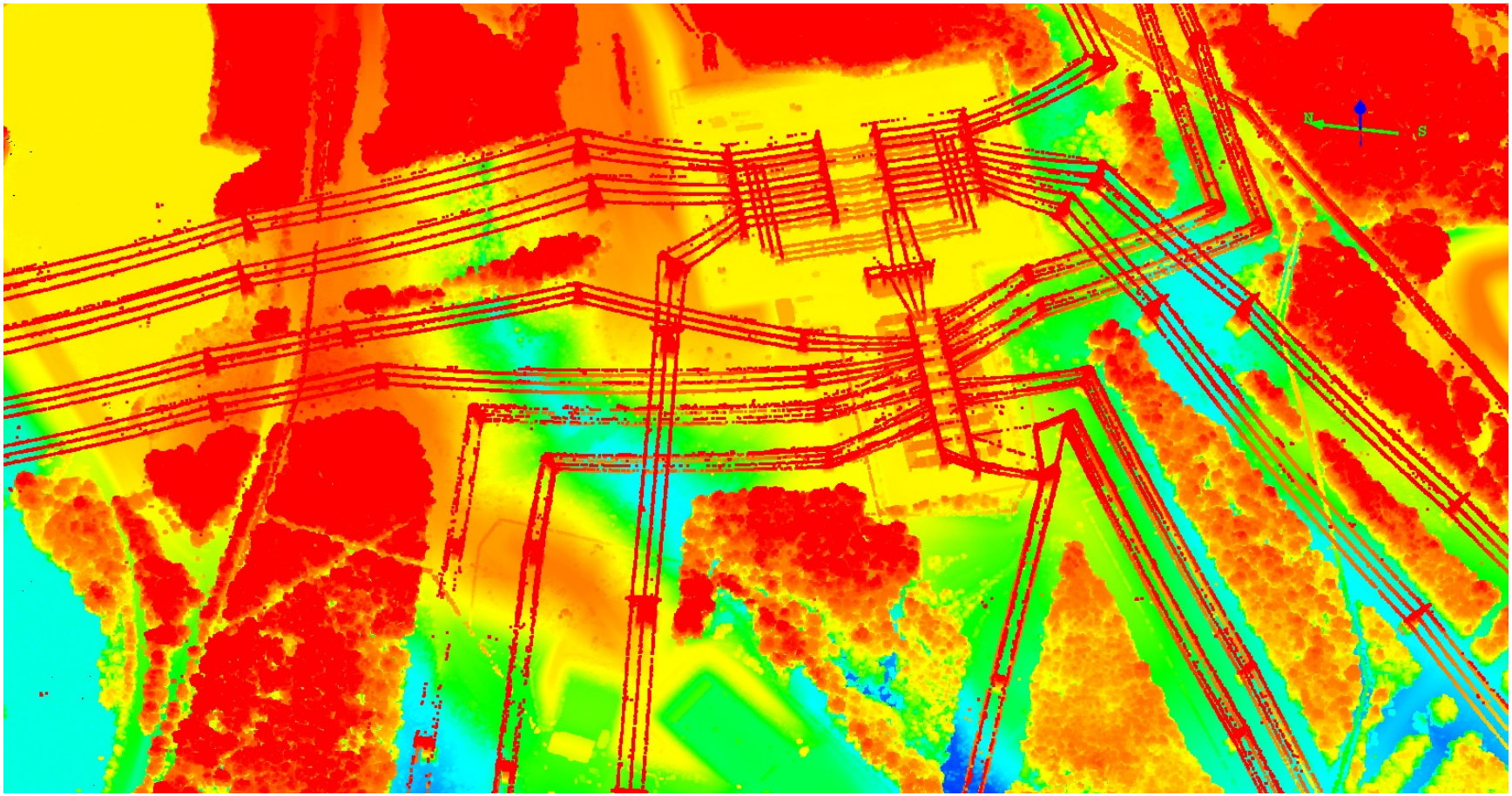


Acquired using HRQLS Lidar System

Photon Counting Lidar

Mecklenburg County, NC Pilot,

1.6 Km swath, 20-30 points/sq m, 180 Knots, single pass



Acquired using HRQLS Lidar System

Questions


WOOLPERT

Remote Data Collection: Finding a Way

NCTCOG Regional GIS Meeting

December 1, 2015

WOOLPERT

Overview

- Remote Data Collection
  - Advantages
  - Challenges
- Case Study Solution

- Shelley Hill – Application Developer

Advantages of Remote Data Collection

- Avoid the log jam of paper information
- Help subject matter experts manage their own data
  - Minimize lost information
  - Minimize redundant efforts
  - Minimize confusion
  - Get better information out faster

Challenges of Remote Field Collection

- Things are too complicated
- All of the technology pieces don't work together
  - ESRI Disconnected Editing requires ArcMap
  - ESRI Field Collection App requires ArcGIS Online
  - Web application won't work
    - Your local network is not available
    - NO network is available!

Assessing Available Technology

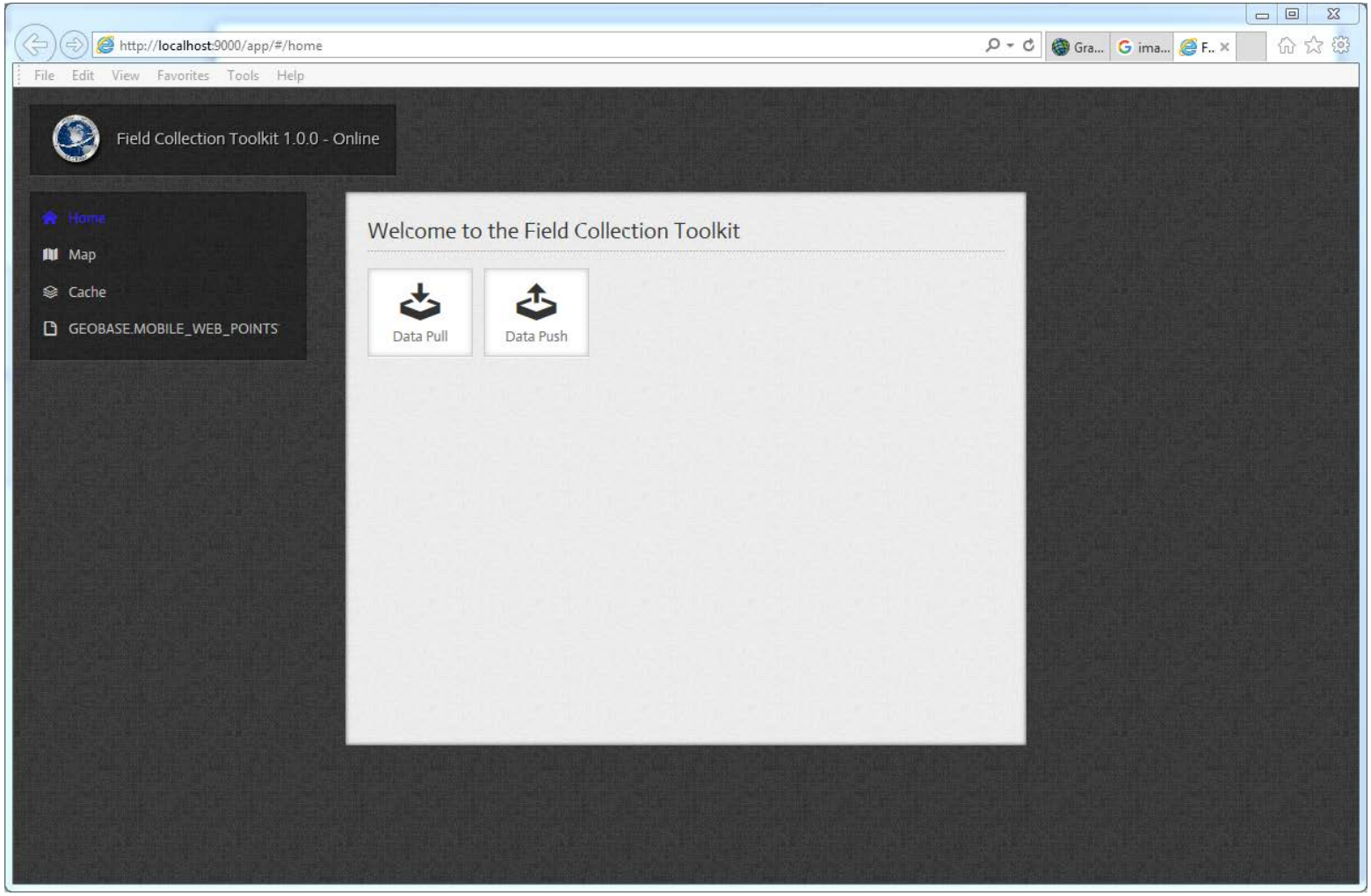
- Most organizations have an investment in ArcGIS Server
- Most organization have some type of laptop with Windows OS

What if that was enough?

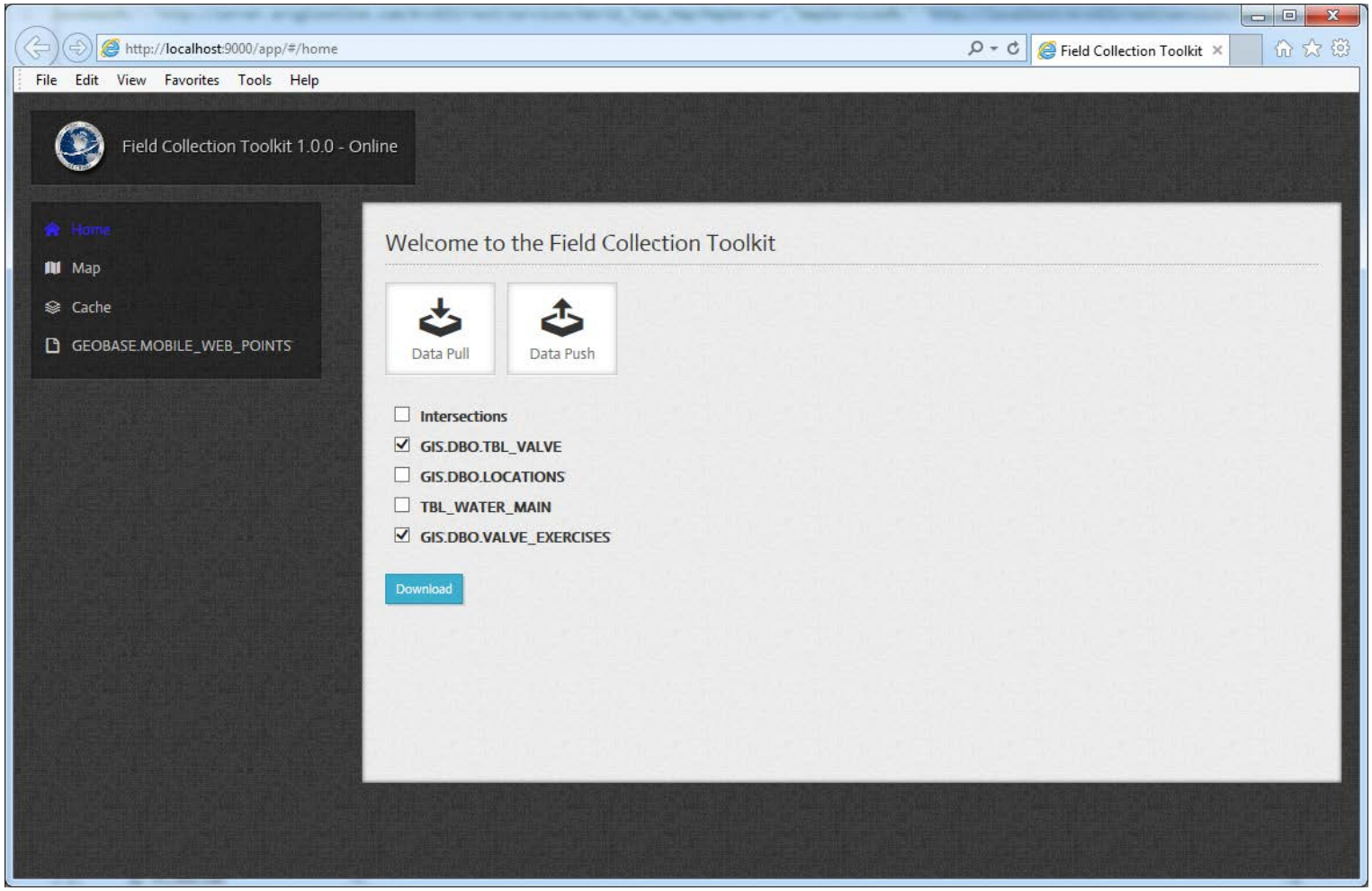
What if there was an easy way?

- Download vector data from ArcGIS Server
- Save an image cache of base map tiles
- Run a web application without a server
- Make edits in a simple form
- Update information in related tables
- Then, upload everything back into the enterprise GIS with a few clicks.

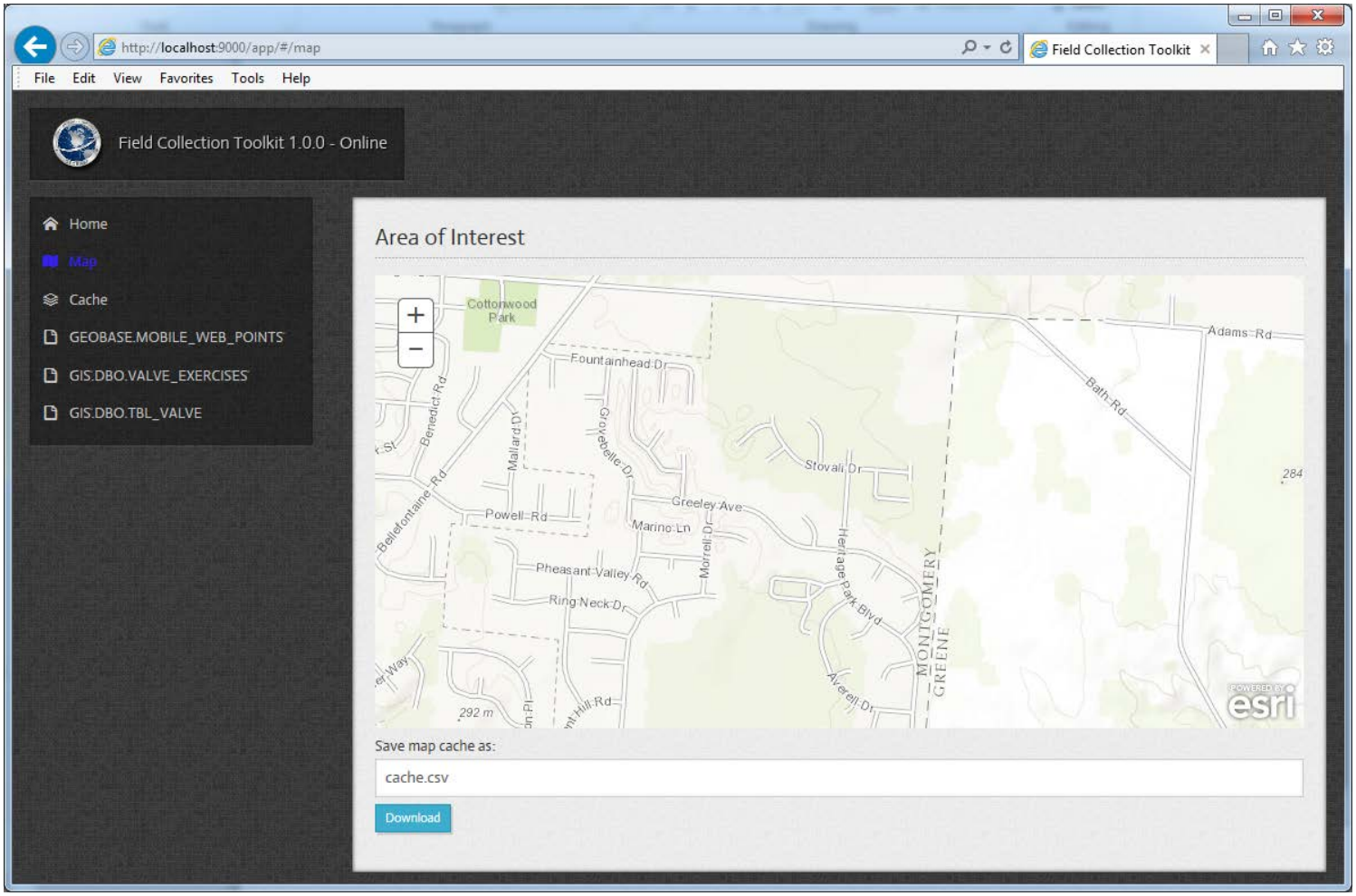
The Field Collection Toolkit



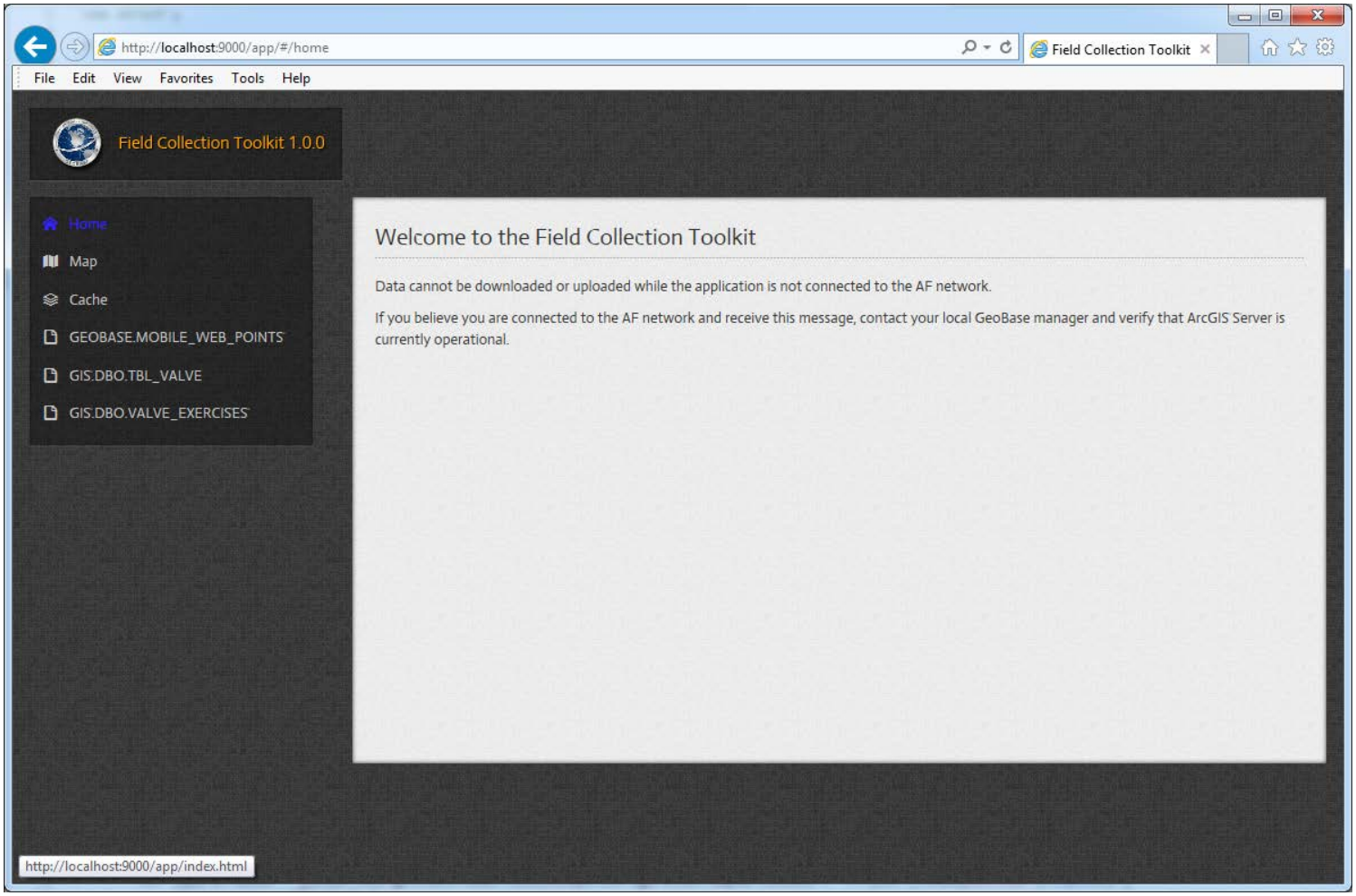
Getting Started: Data Pull



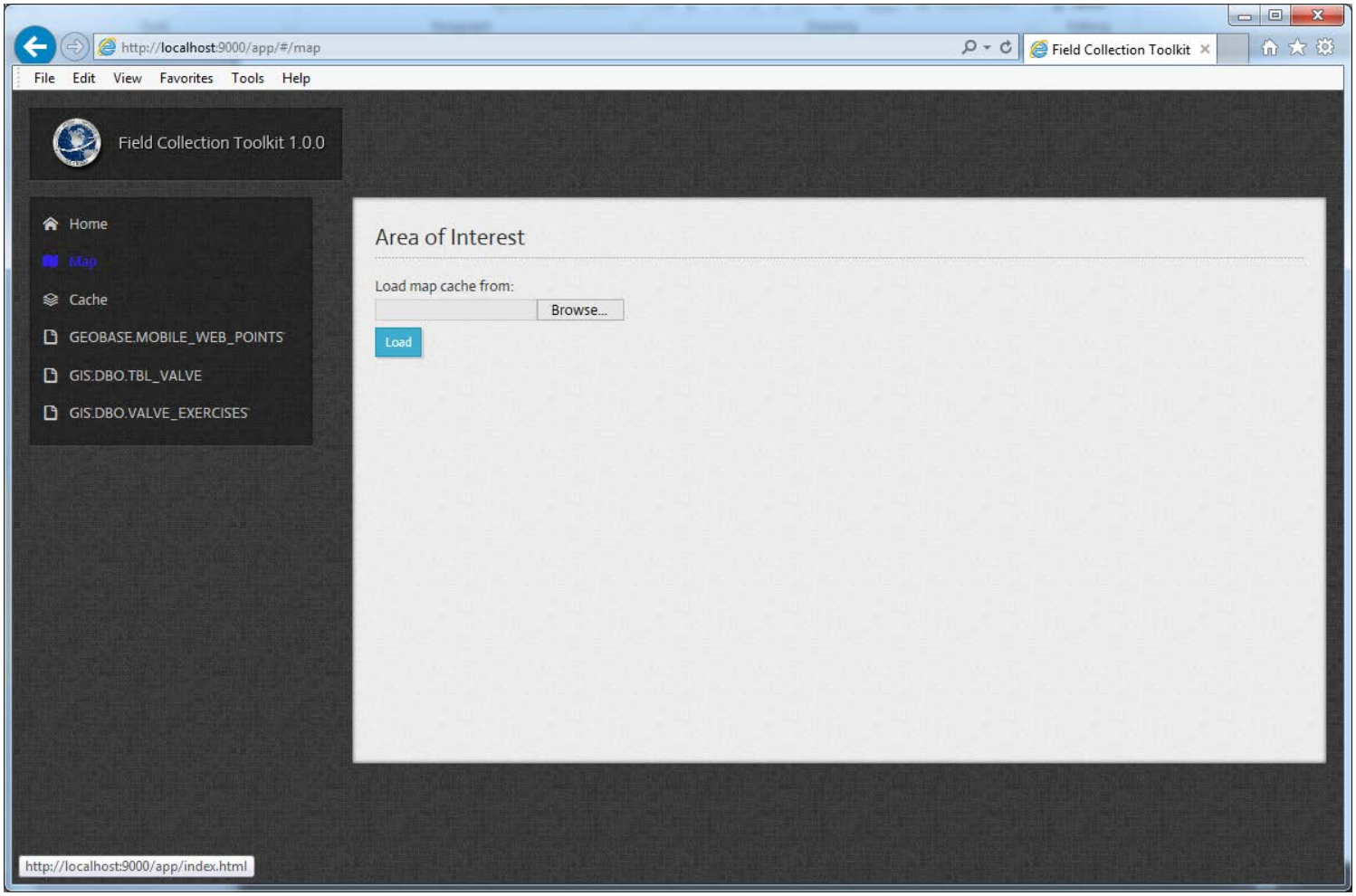
Gather Area of Interest



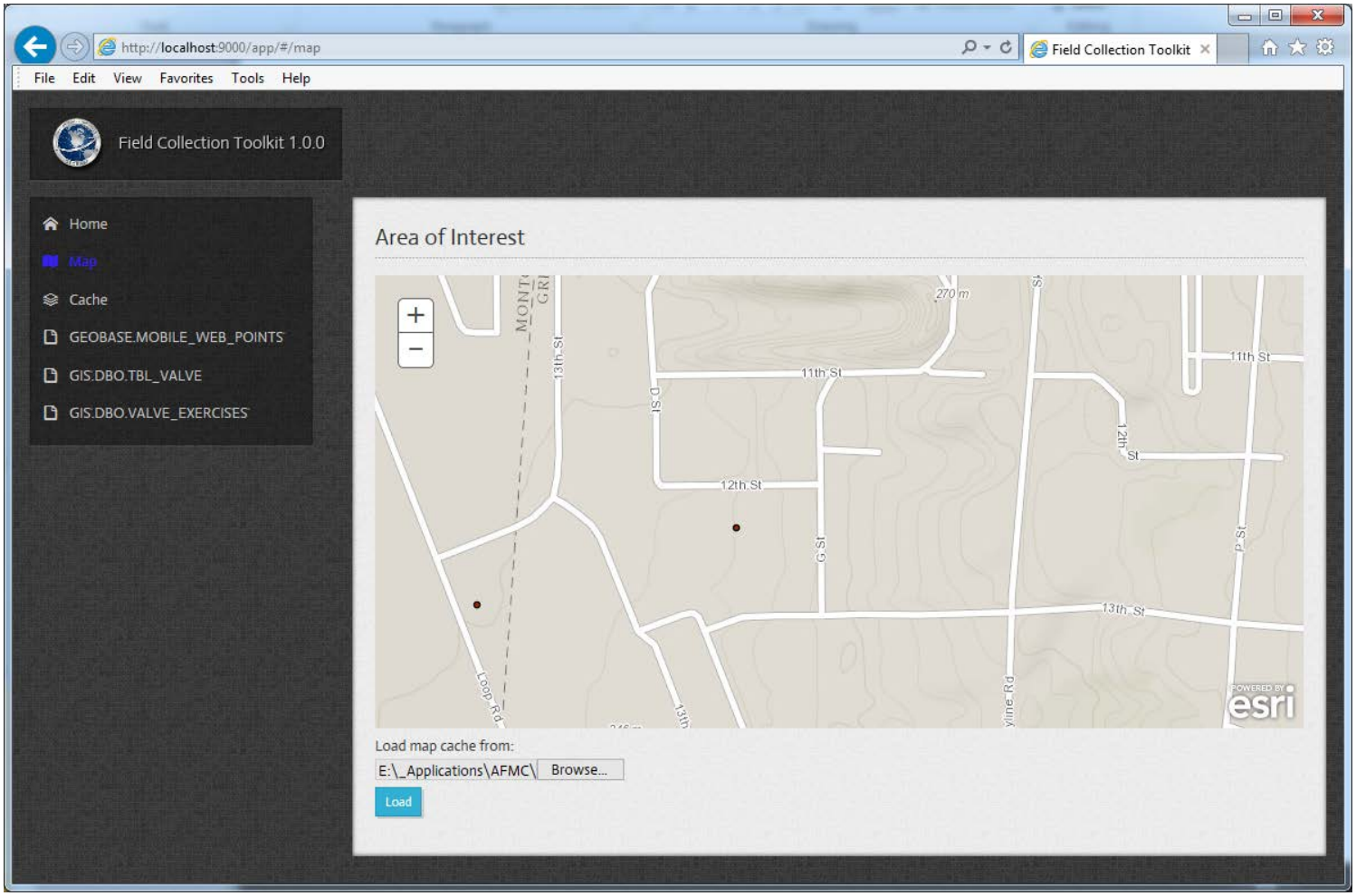
Working Off-line



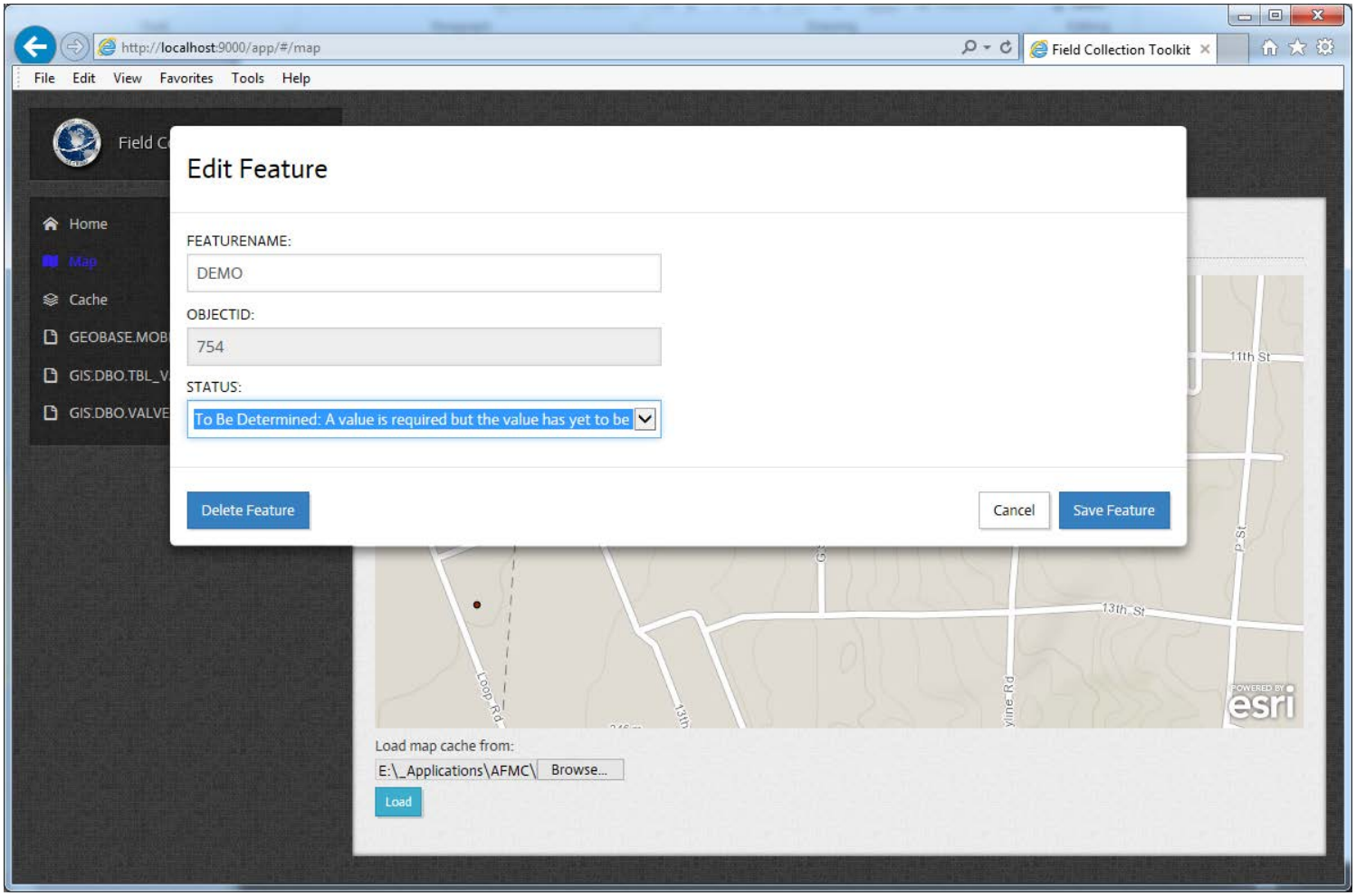
Working Off-line: Load the Map



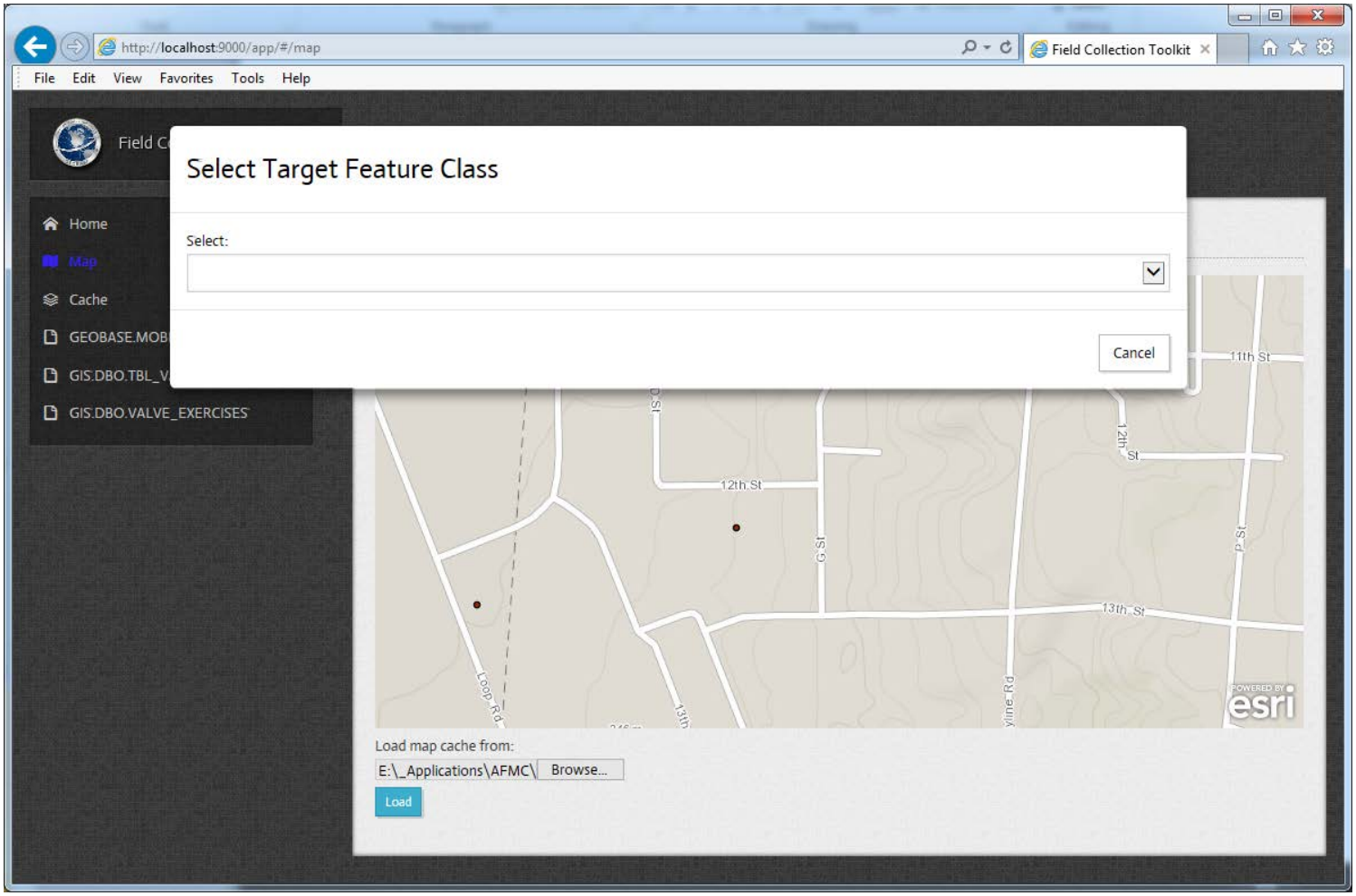
Working Off-line: GIS Loaded



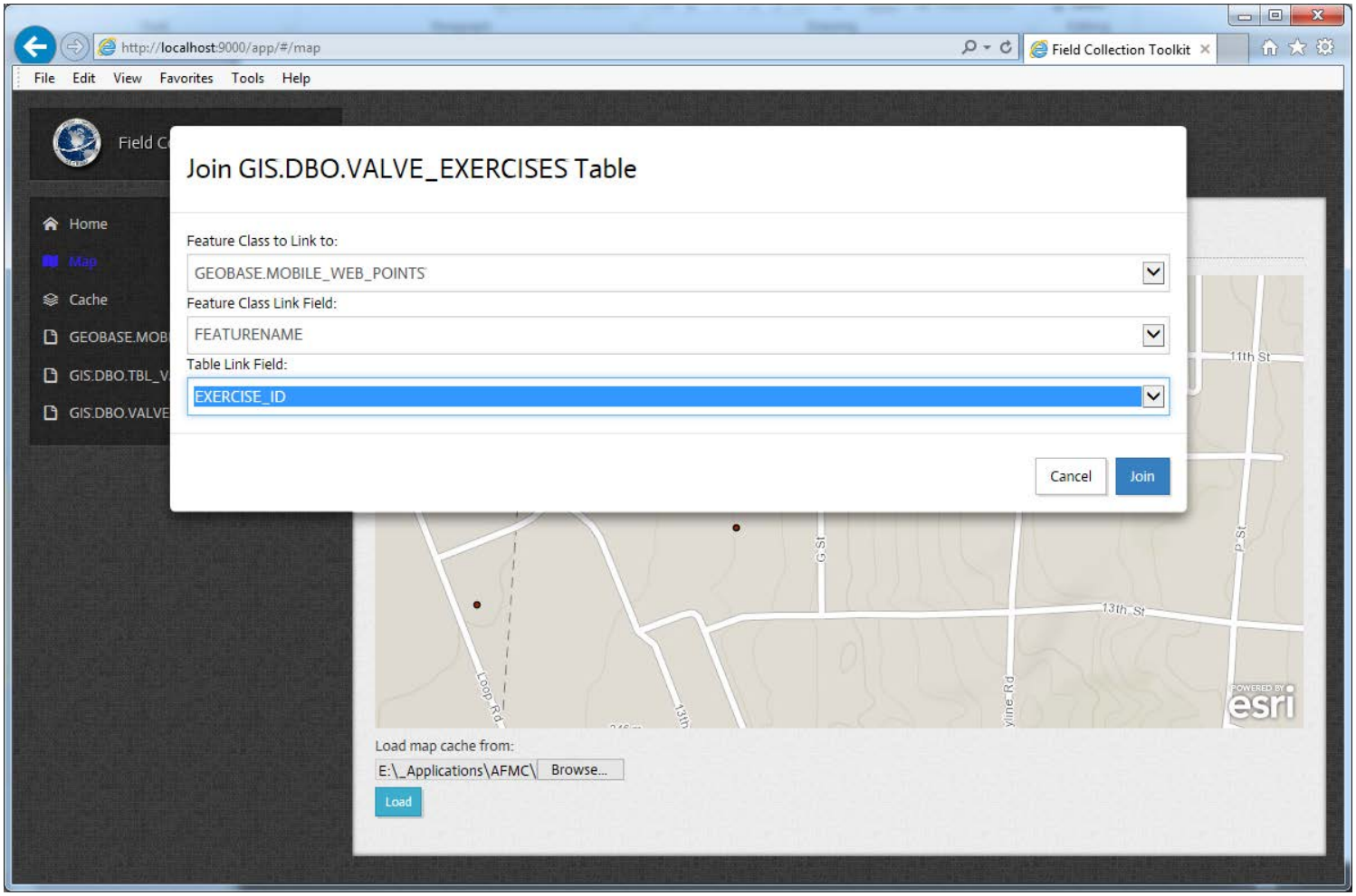
Working Off-line: Edit Feature



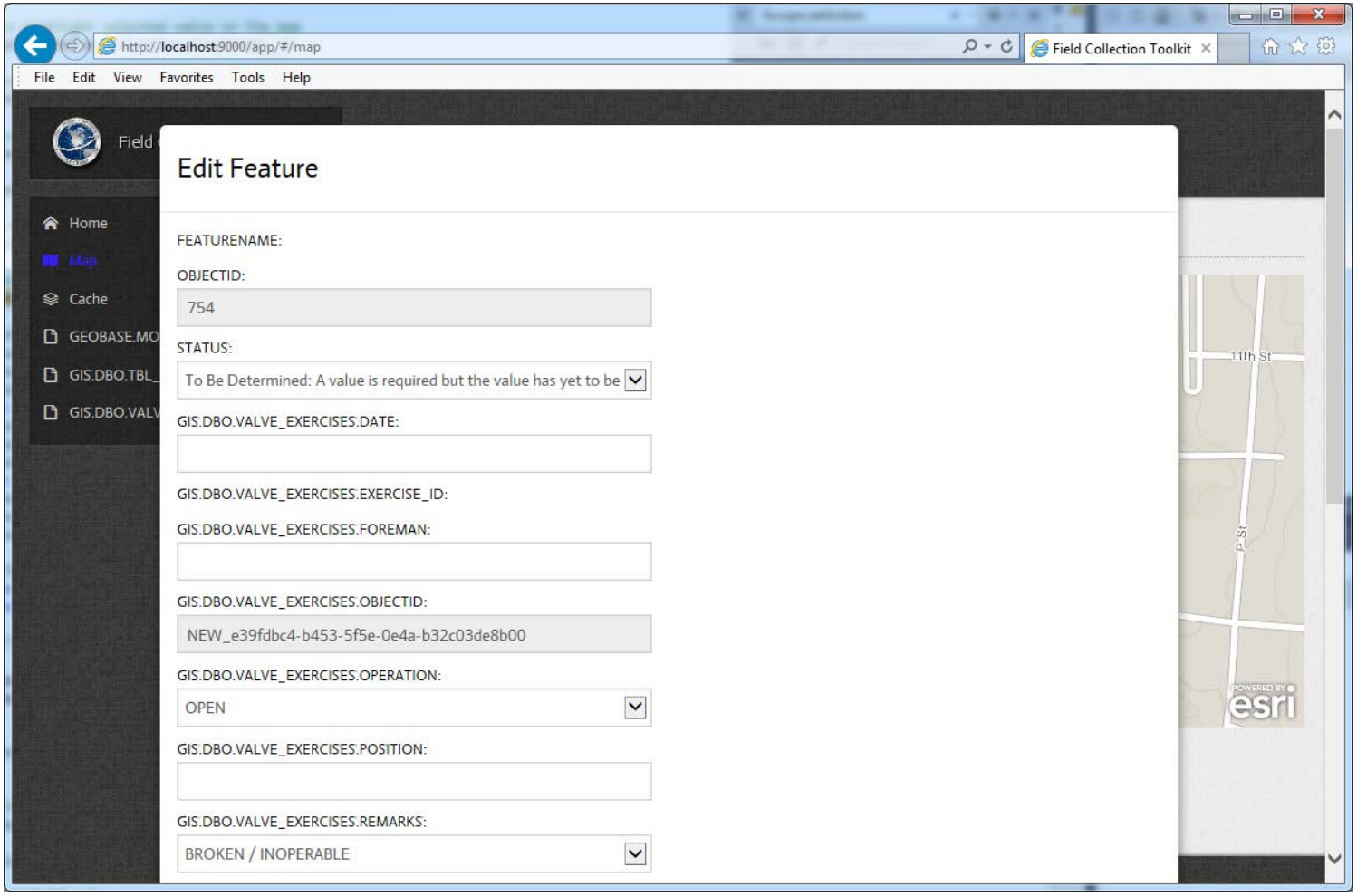
Working Off-line: Create Feature



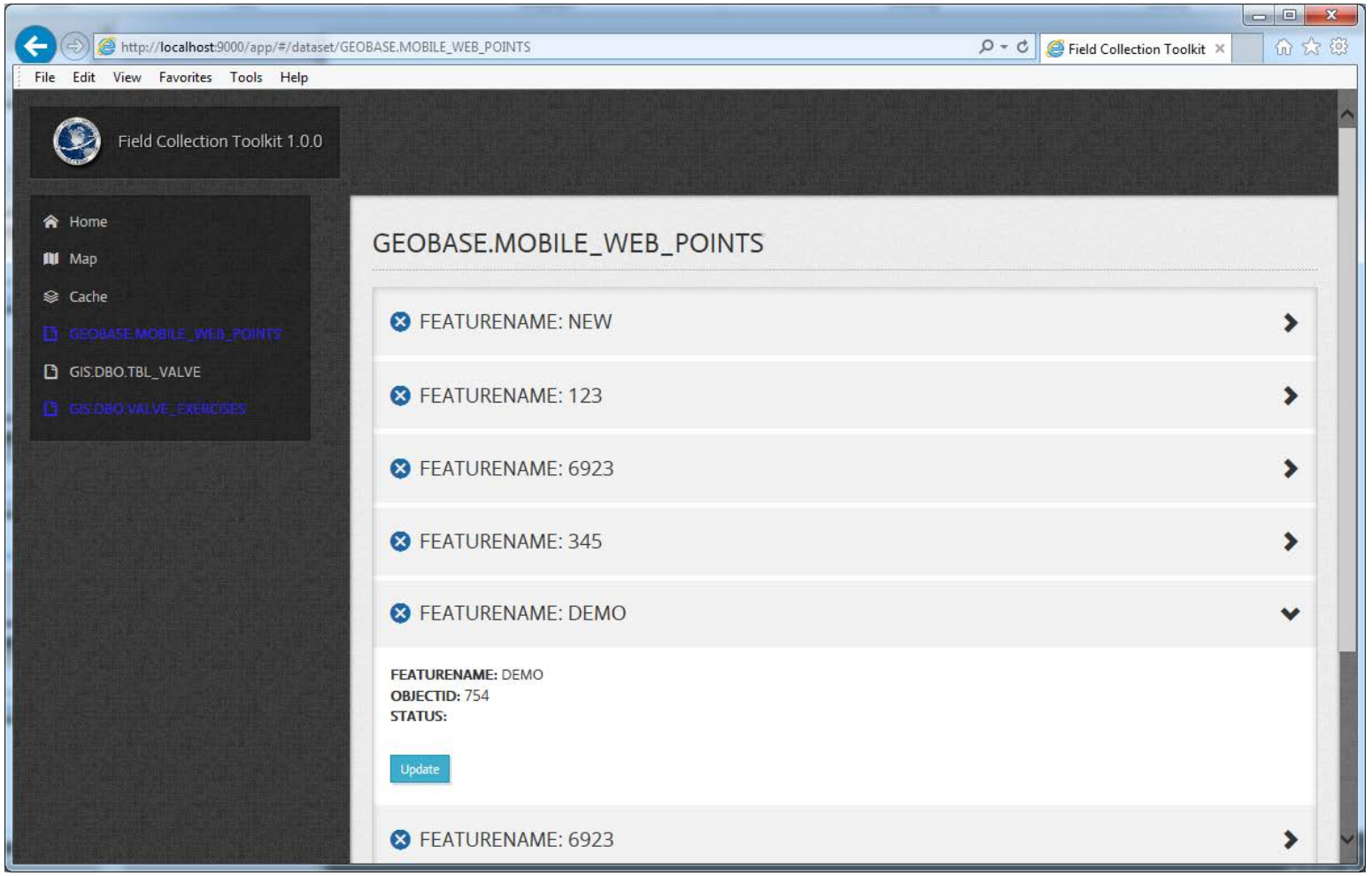
Working Off-line: Join Table



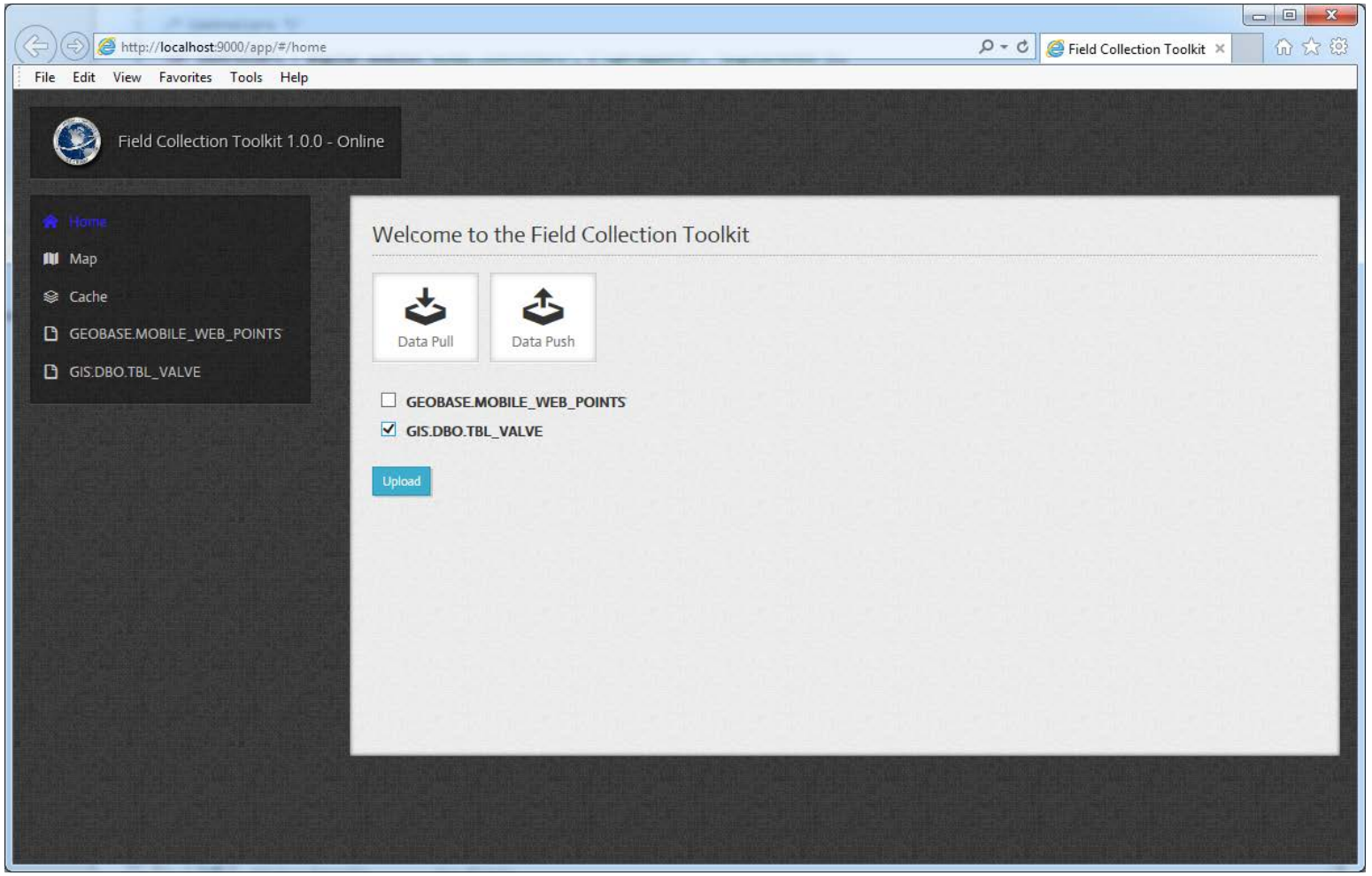
Working Off-line: Edit Related Data



Working Off-line: Edit without Map



Back On-line Again: Data Push



How's It All Done

- Uses AngularJS library to manage data as objects
- Leverages ArcGIS REST API
- Runs Node.js component to perform "server-side" operations
  - Hosting the application
  - Saving data pulled from ArcGIS server as JSON files
  - Saving map cache as CSV file
  - Updating JSON files

Questions?