Lidar Data Demystified: Harnessing Derivatives and the Impact of Data Democratization

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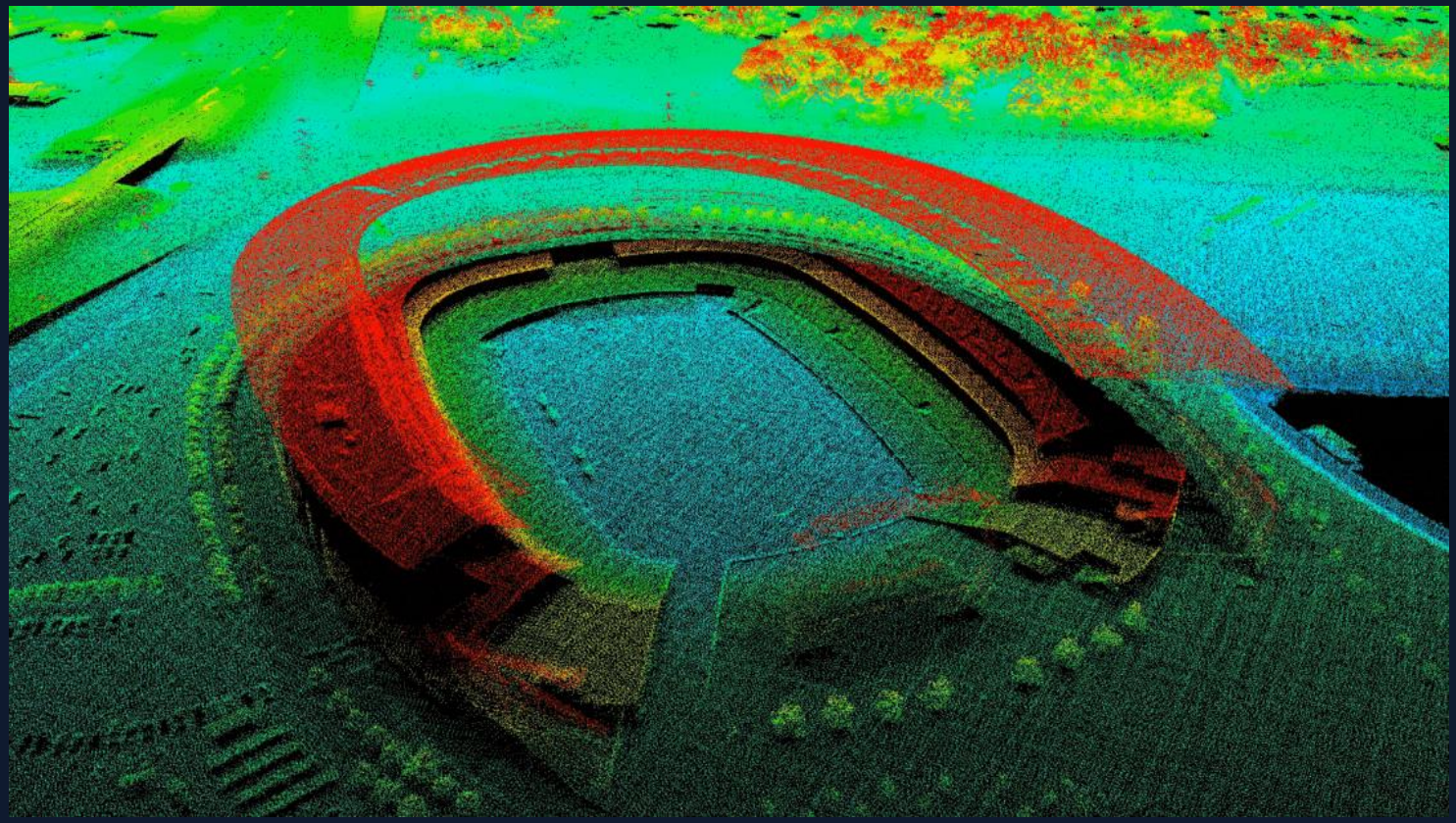
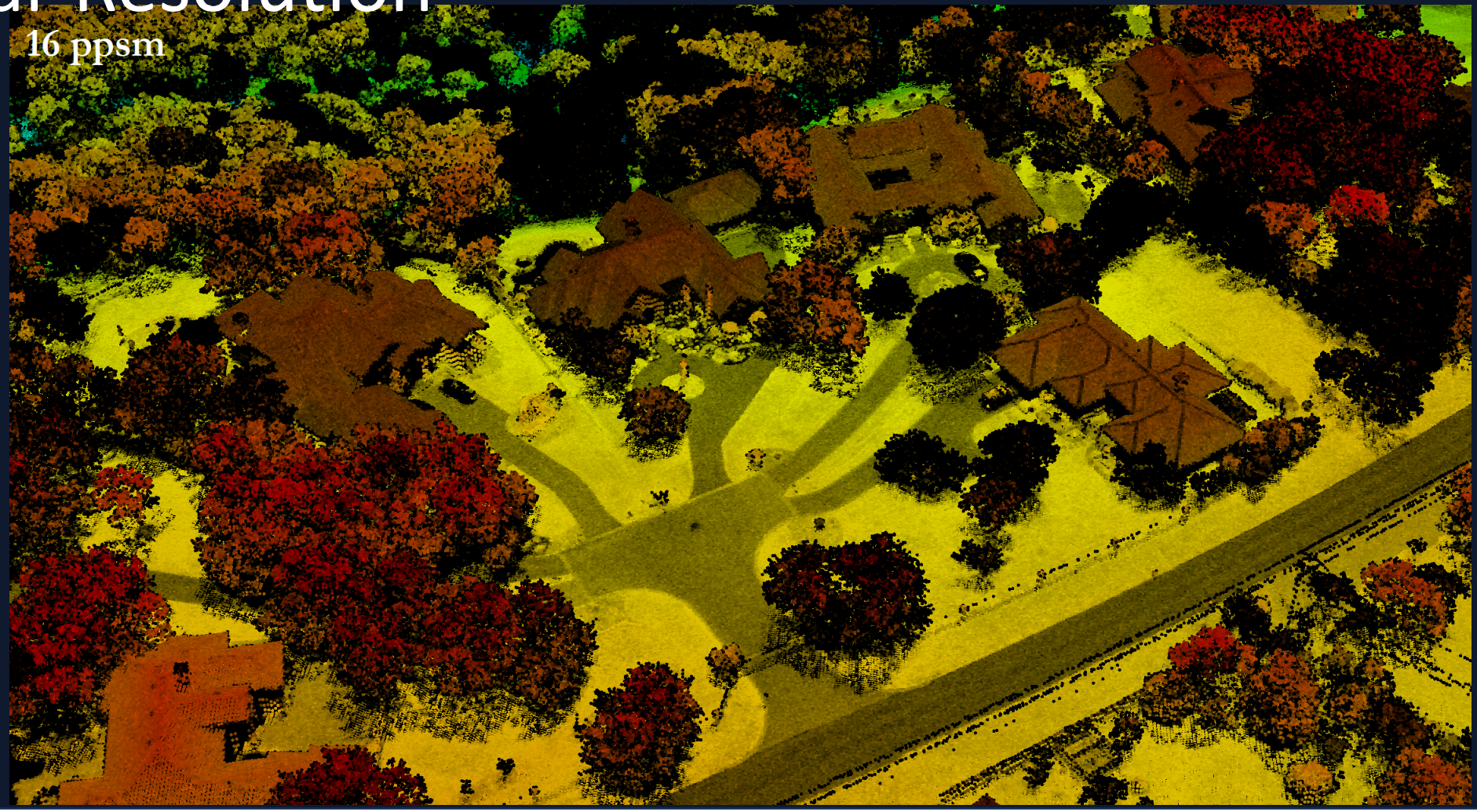
Agenda

- Our Journey to Lidar
- Standard Lidar Data and Uses
- Exploring the Full Range of Derivative Products
- Going Further: Managing and Sharing Lidar Data



Lidar Resolution

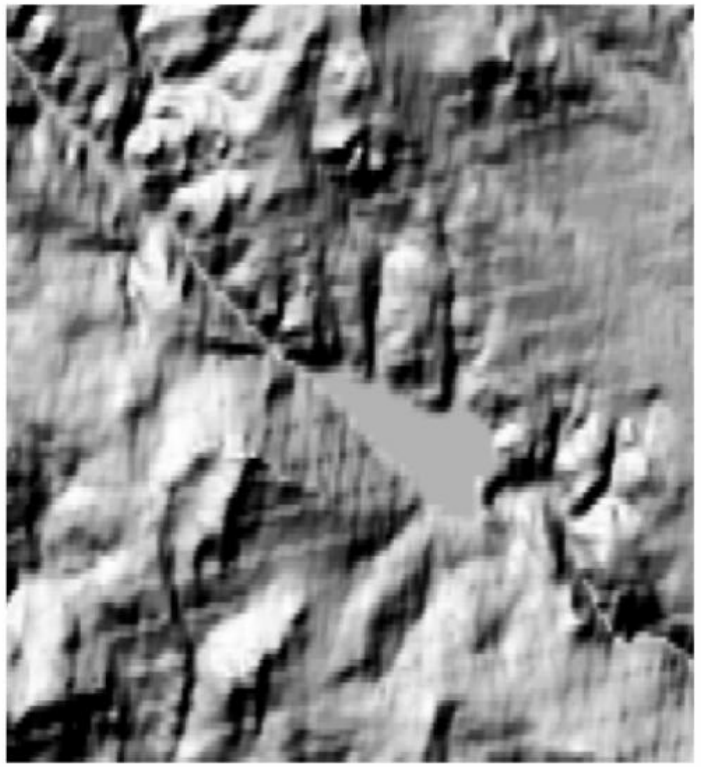


USGS Elevation Program History

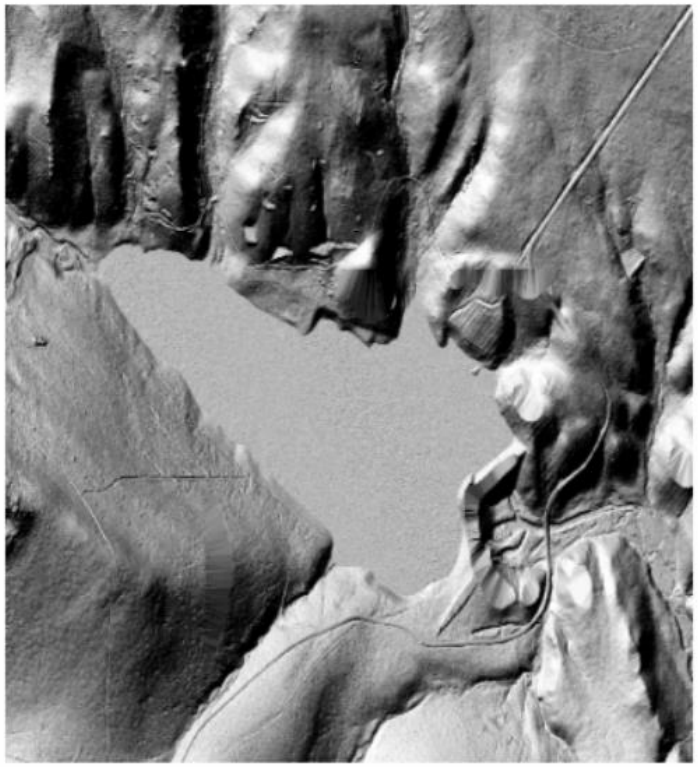
Increased Quality Data Drives Increased Derivative Products

- Over the past 20 years we have seen a significant increase in the quality of elevation data across the US
- Sanborn is one of six prime contract holders under the USGS GPSC contract, which has acquired lidar data covering almost the entire US over the past 7 years.
- The National Enhanced Elevation Assessment (NEEA) reported a 5:1 return on investment for higher density lidar.
- With increased density, we have seen increases to derivative product requirements, as well as the need for reoccurring flights more often.

30 meter DEM vs. 1 meter LIDAR-Derived DEM

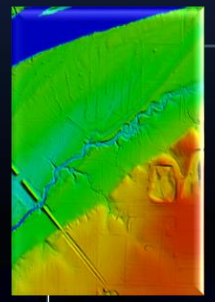


Traditional hillshade derived from 30-meter DEM

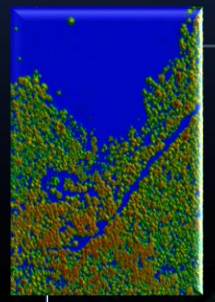


LIDAR-created hillshade derived from 1-meter DEM

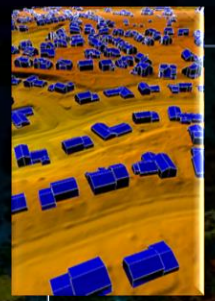
Lidar Derived Products



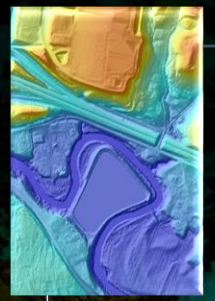
Topographic



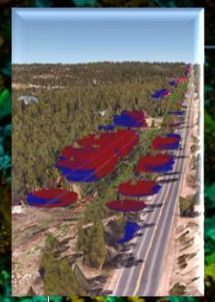
Vegetation



Buildings



Hydrographic

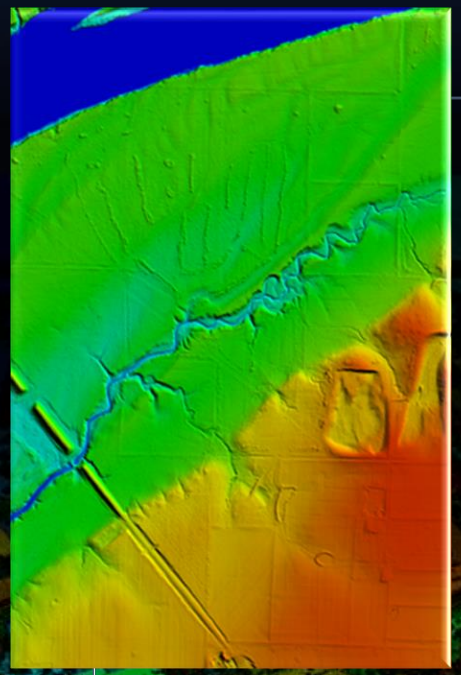


Utilities

Synergistic

Lidar Classes

ASPRS/USGS Standard Lidar Point Classes			
Class 0	Created, never classified	**Class 14**	Wire – Conductor (Phase)
Class 1	Unclassified	**Class 15**	Transmission Tower
Class 2	Ground	**Class 16**	Wire-structure Connector (e.g. Insulator)
Class 3	Low Vegetation	**Class 17**	Bridge Deck
Class 4	Medium Vegetation	**Class 18**	High Noise
Class 5	High Vegetation	**Class 19**	Reserved
Class 6	Building	***Class 20**	Ignored Ground (breakline proximity)
Class 7	Low Point (noise)	***Class 21**	Snow
Class 8	Reserved	***Class 22**	Temporal Change
Class 9	Water	**Class 23-63**	Reserved
Class 10	Rail	**Class 64-255**	User definable
Class 11	Road Surface	**Flags**	Overlap and withheld
Class 12	Reserved		
Class 13	Wire – Guard (Shield)		
***USGS Specific Point Data Record Formats 6-10**			

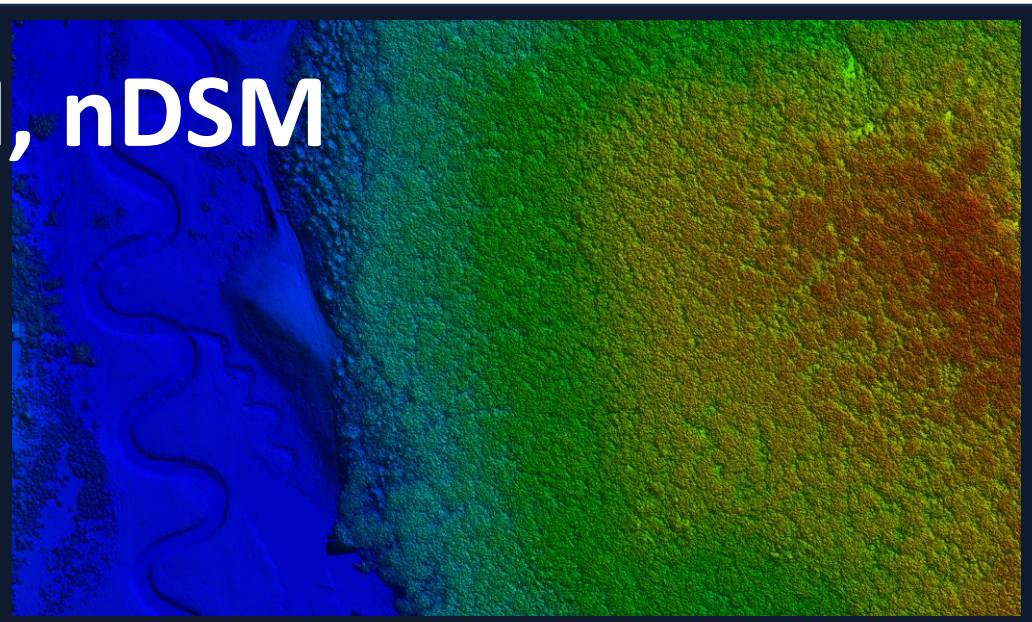


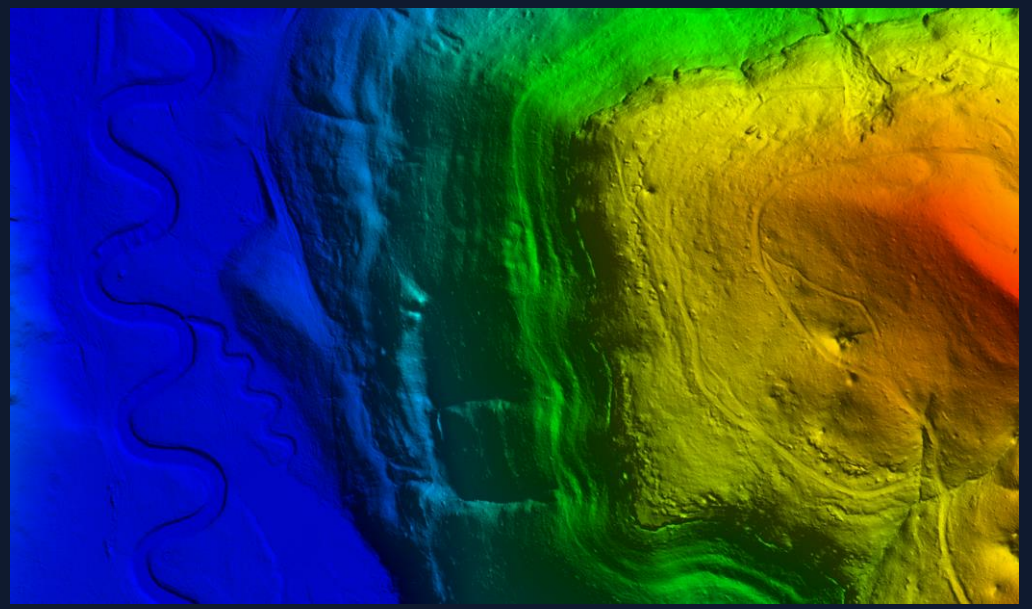
Topographic

Topographic Products

- Digital Elevation Model (DEM)
- Digital Surface Model (DSM)
- Normalized DSM (nDSM)
- Contours
- Slope
- Aspect
- Bare Earth Hillshade
- Highest hit Hillshade

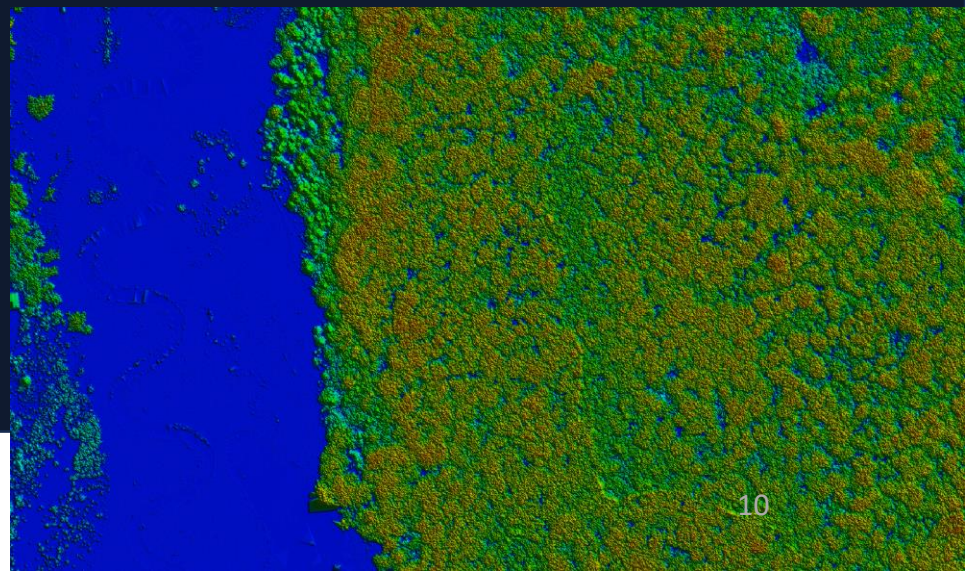
DEM, DSM, nDSM





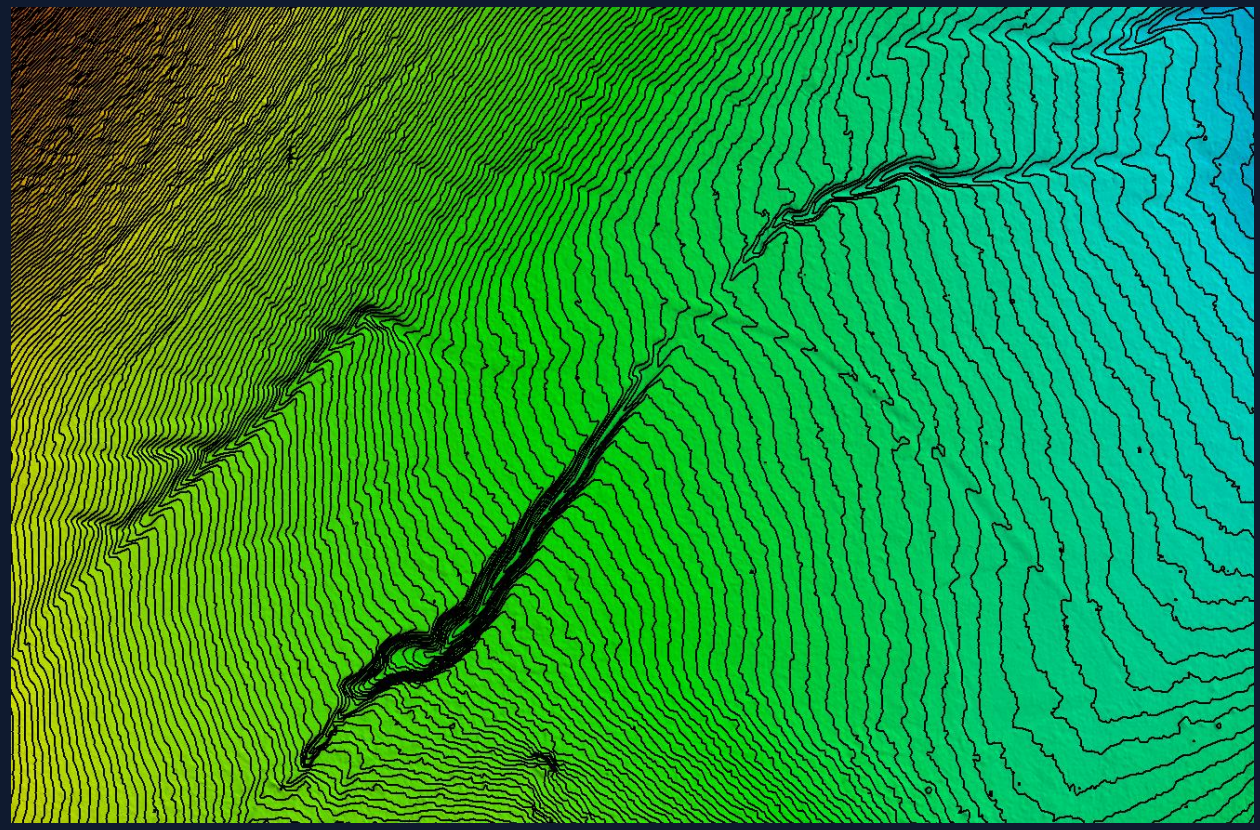
- An nDSM represents the height of features above ground, rather than the elevation of features relative to mean sea level or an ellipsoid.
- Provides the height of all man-made and natural objects

↑DSM - ↑DEM = nDSM↓



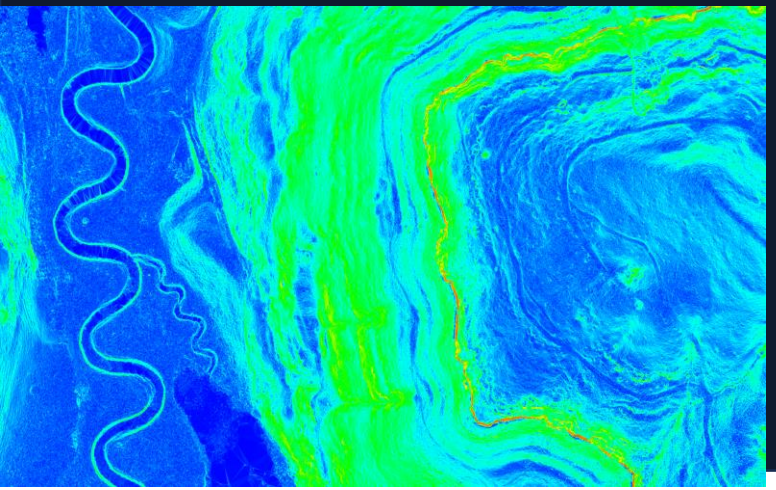
Contours

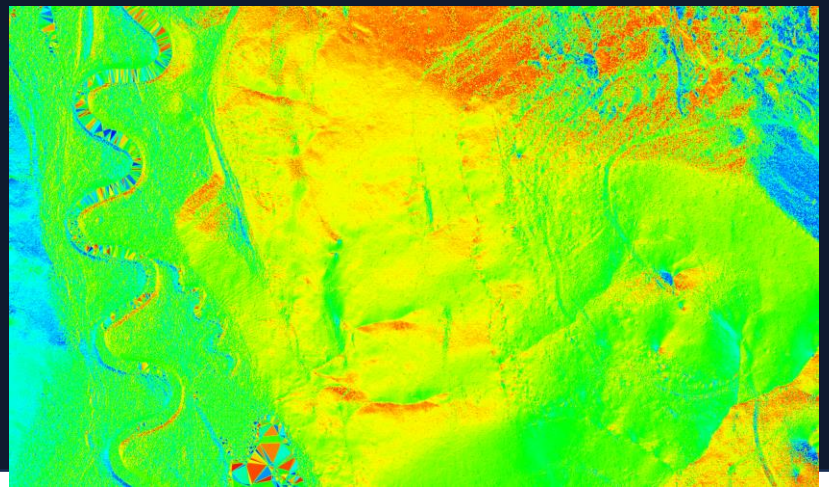
- A contour is an imaginary line that connects points of equal value.
- LiDAR data usually model the ground better than photogrammetry due to greater point density. As a result, fewer break lines are required, often resulting in a more rapid, cost-effective solution.
- USGS QL2 LiDAR data supports the creation of accurate 1-foot contours
- Lidar-derived contours are not smooth as derived from Photogrammetry.

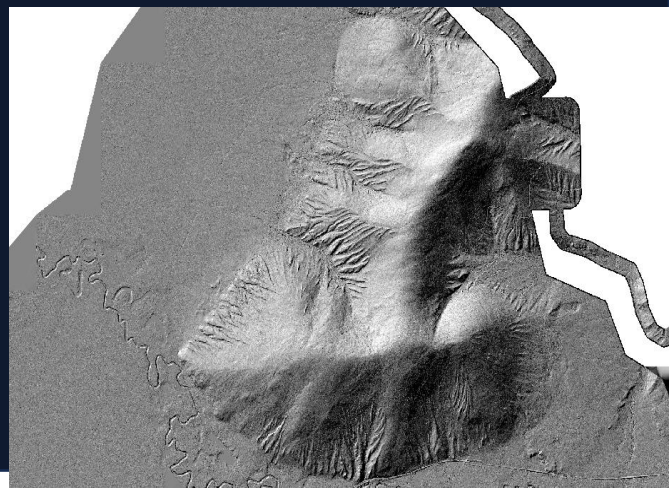


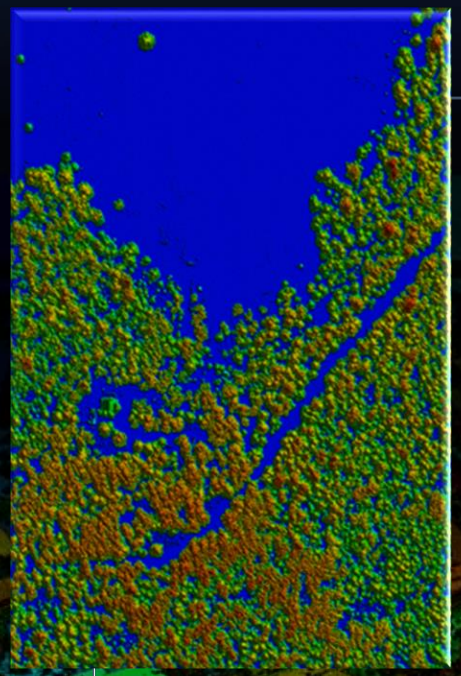
Topographic Products – Slope, Aspect, Hillshade

- Slope represents the elevation change rate for each digital elevation model (DEM) pixel.
- Aspect is the orientation of slope, measured clockwise in degrees from 0 to 360, where 0 is north-facing, 90 is east-facing, 180 is south-facing, and 270 is west-facing.
- Site selection, erosion, 5G and solar planning, and microclimate are areas where slope and aspect are used.
- Shaded relief, or hillshading, is a technique where a lighting effect is added to a map based on elevation variations within the landscape. Used to interpret surface deposits, drainage, wetlands, etc.





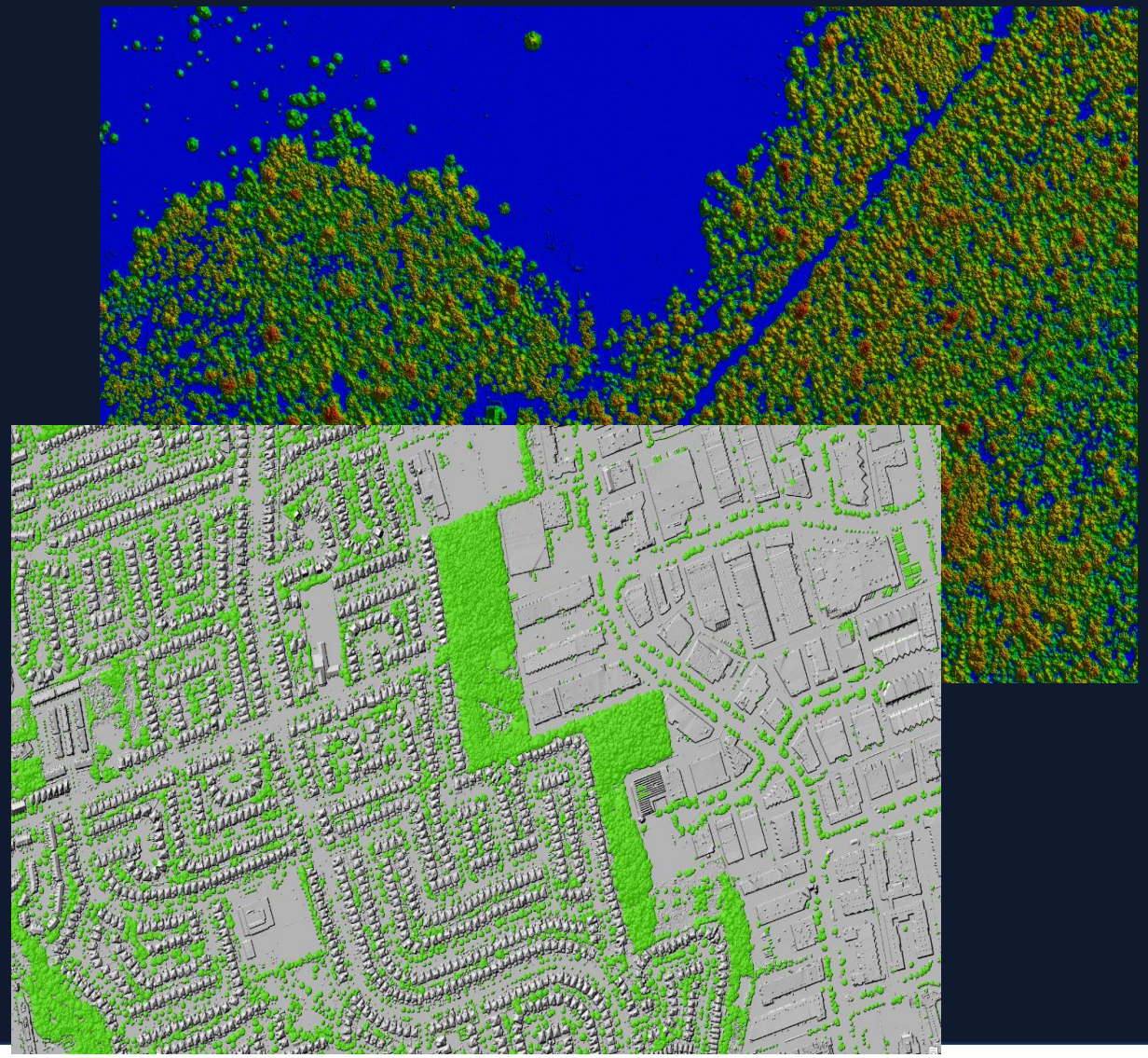




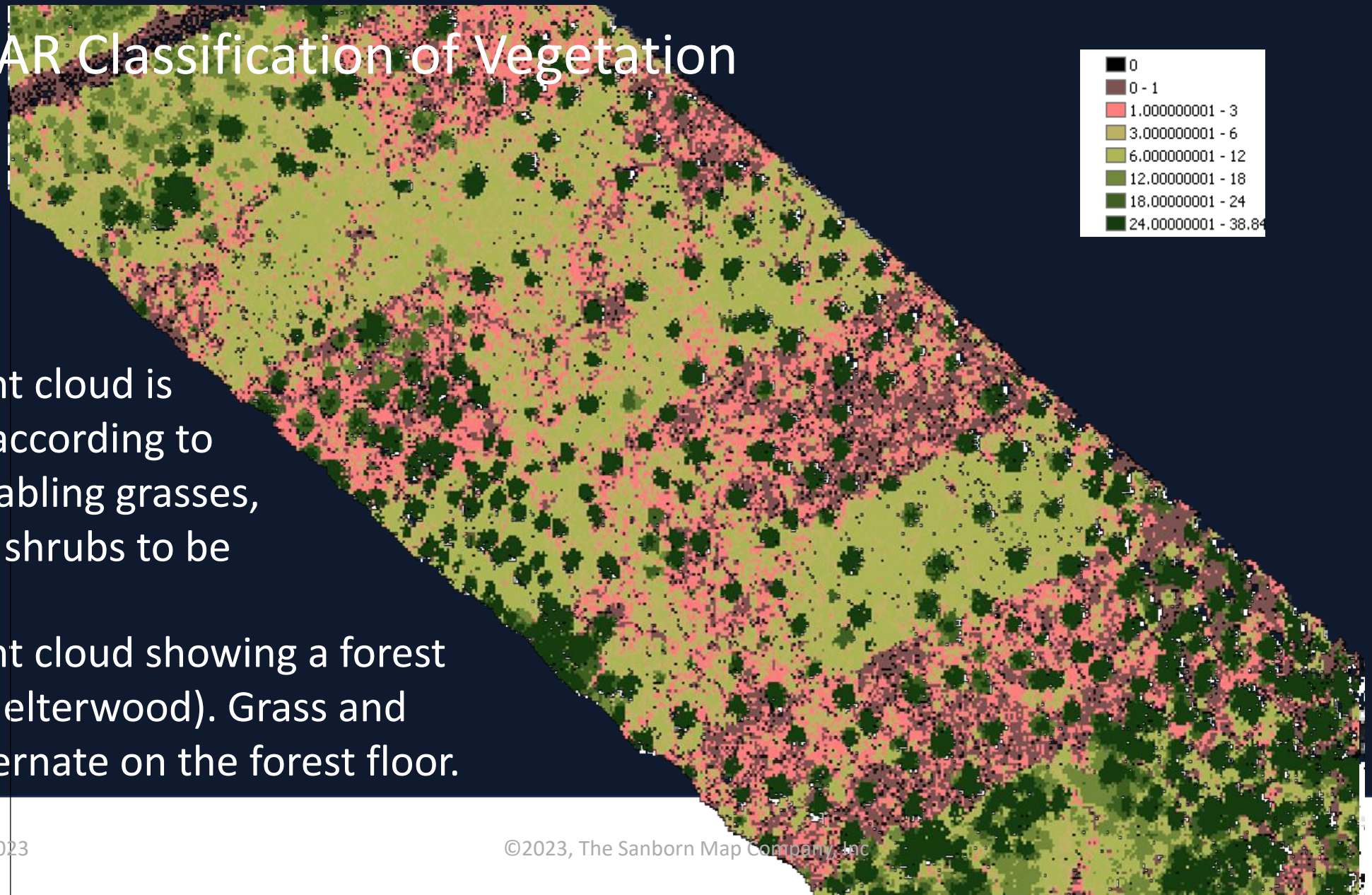
Vegetation

Vegetation Products

- Canopy Height Models
- Height Above Ground
- Tree Canopy Cover
- 3D Vegetation Polygons
- Vegetation Height Raster



LiDAR Classification of Vegetation

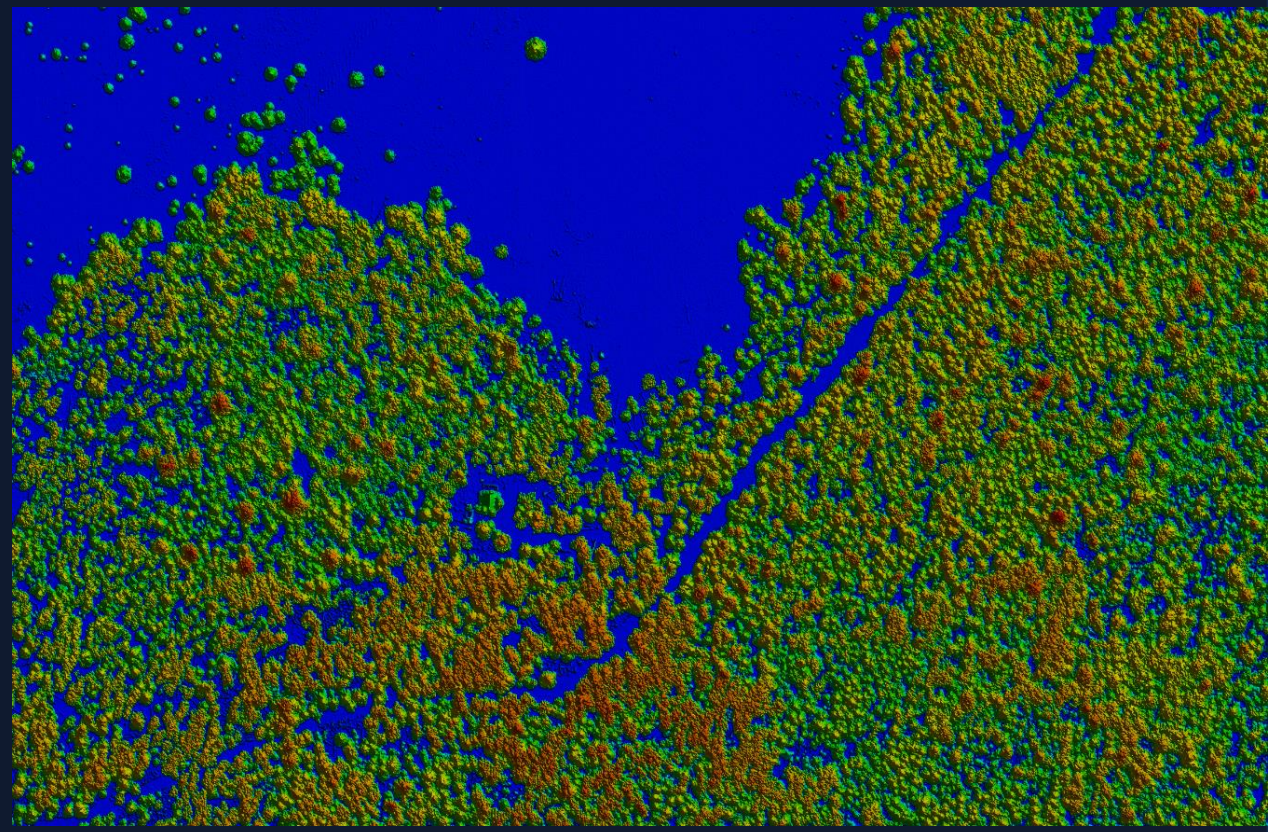


LiDAR point cloud is classified according to height, enabling grasses, trees, and shrubs to be separated

LiDAR point cloud showing a forest cutting (shelterwood). Grass and shrubs alternate on the forest floor.

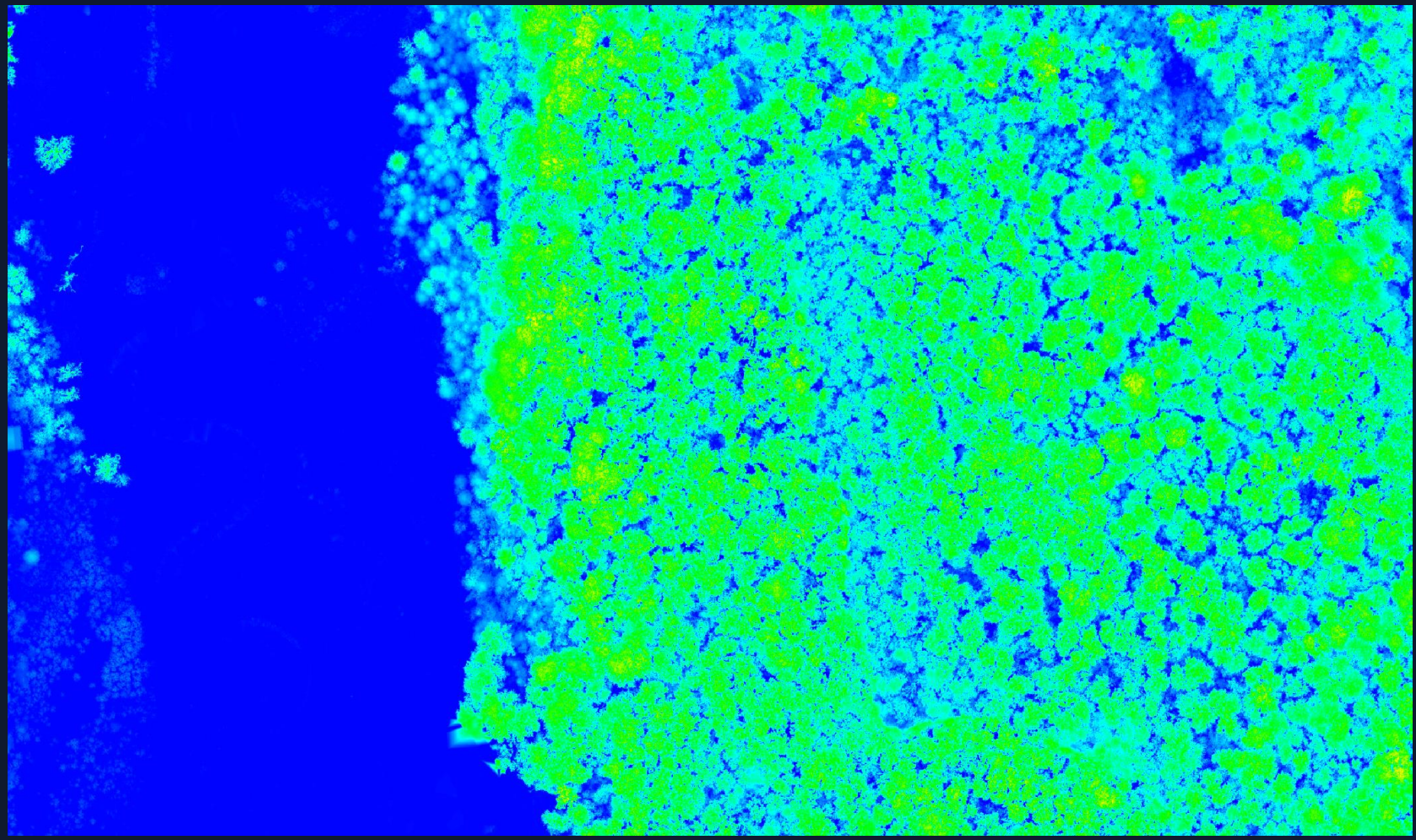
Canopy Height Model

- Maps the tree height as a continuous surface. Each pixel in the CHM represents the tree overstory height above the underlying ground topography.
- Evaluating tree shade for a solar energy assessment
- Assessing vegetation risk to power lines and other utility infrastructure
- Modeling of forest metrics like tree size class, basal area, volume, etc., in conjunction with suitable field data
- Assessing fuel load and fire risk
- Evaluating the condition of forests in recreational areas
- Improving line-of-sight radio wave propagation modeling for wireless planning



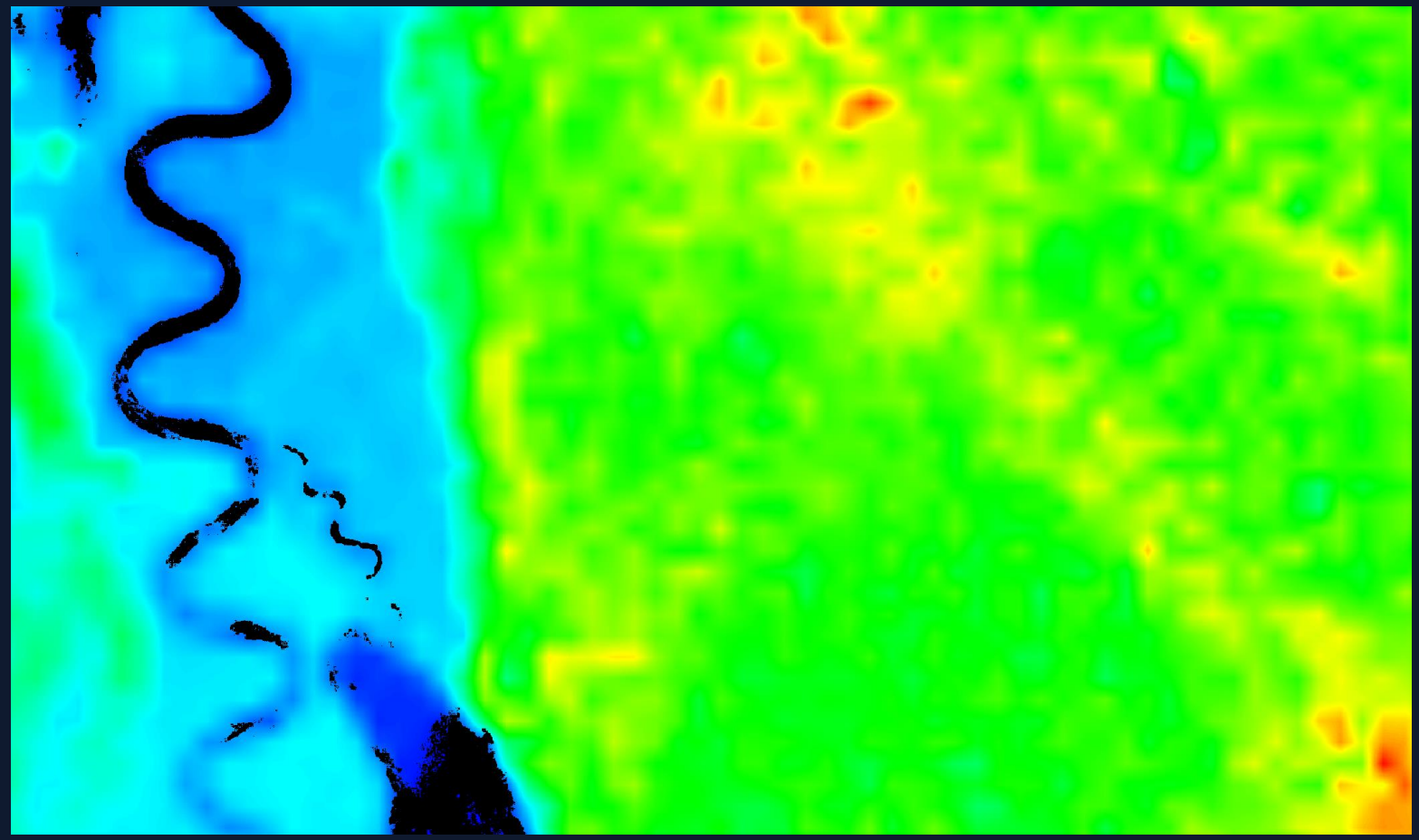
Height Above Ground

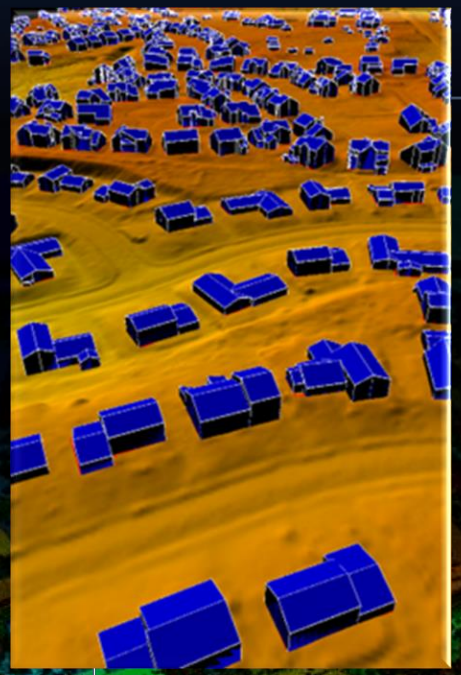
- Height Above Ground (HAG) models show the difference between the first return surface and the last return surface.



Tree Canopy Cover

- Tree Canopy Cover (TCC) models identify the density levels of forested areas for targeted canopy thinning operations to reduce wildfire risk

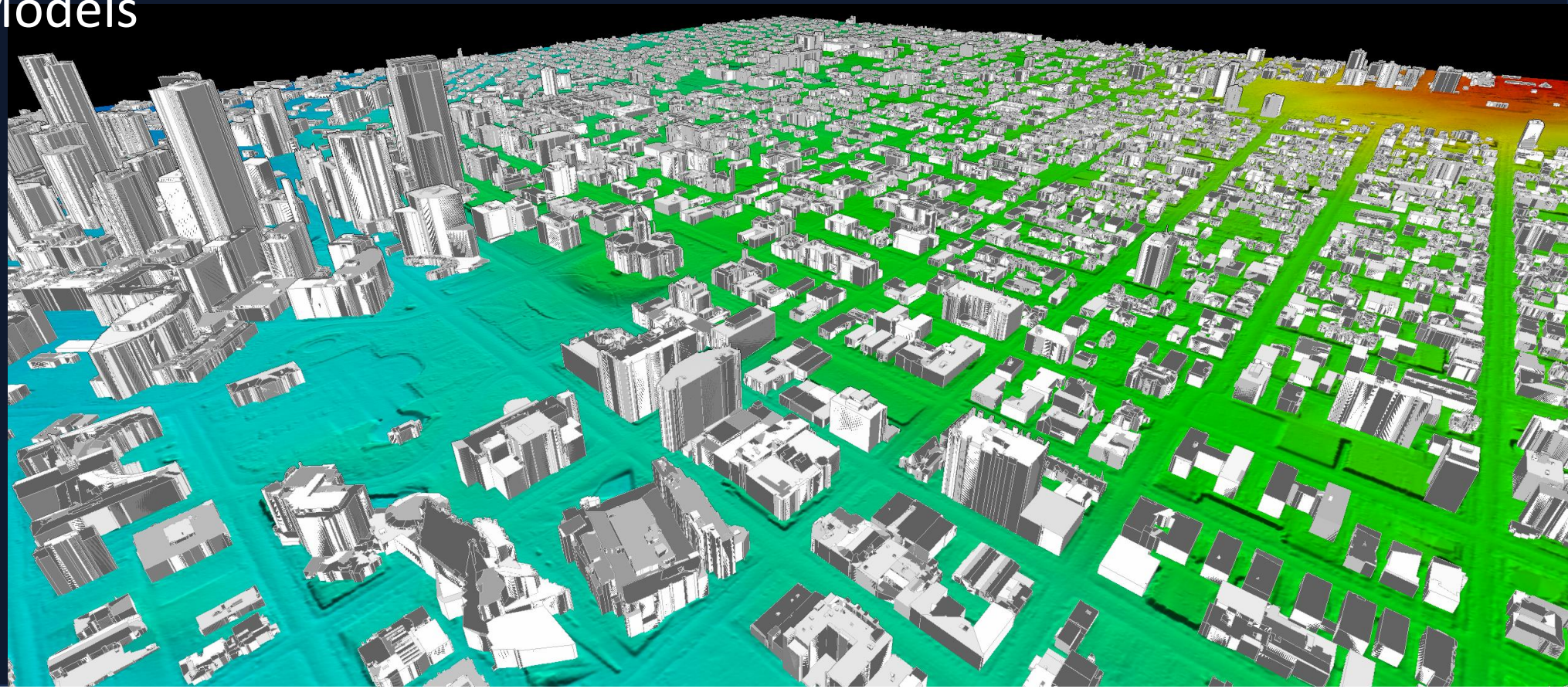




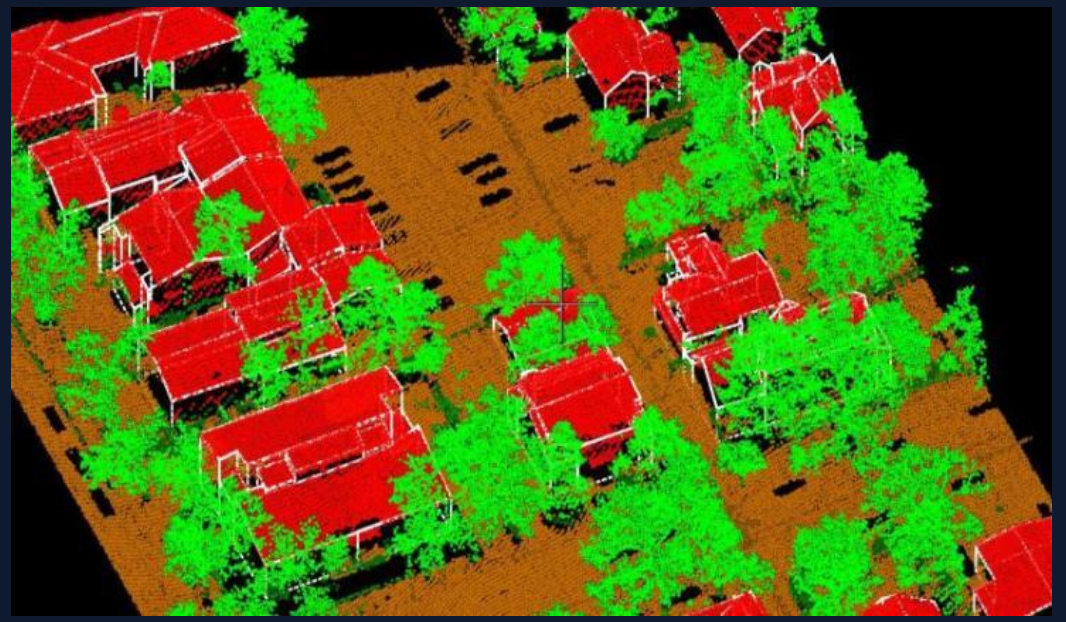
Buildings

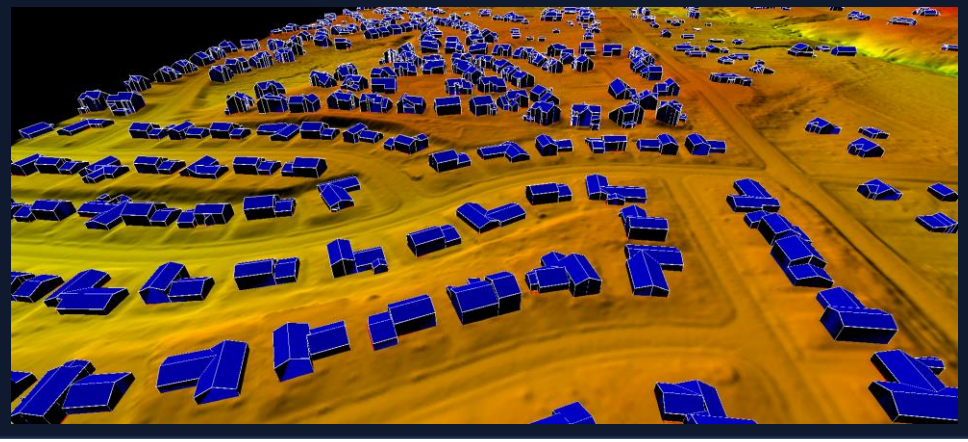
Buildings

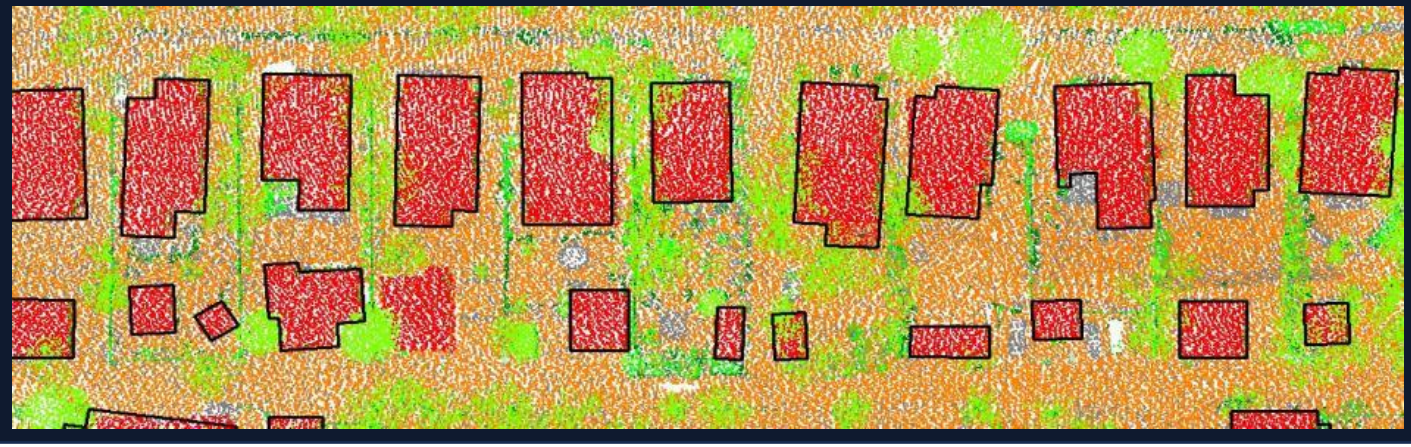
- Buildings Outlines
- 3D Building Models

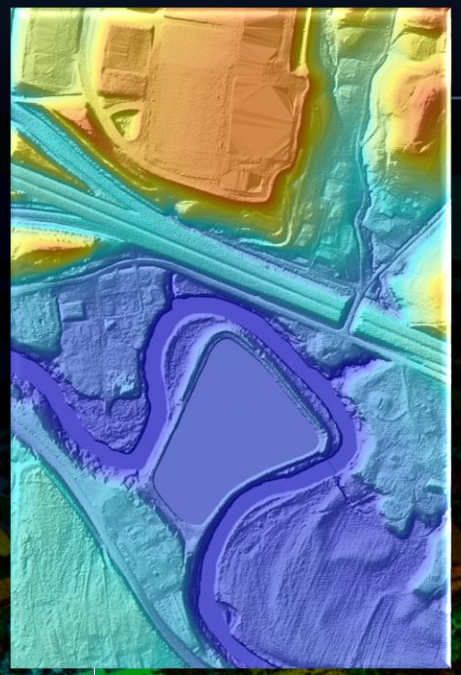


- Can be 2D/3D outlines or 3D wireframes
- Rapid and cost-effective compared to imagery-based stereo photogrammetric or heads-up digitizing techniques
- Semi-automated process
- 80-90% geometric accuracy
- GIS and CAD formats
- Impervious mapping, Storm water studies







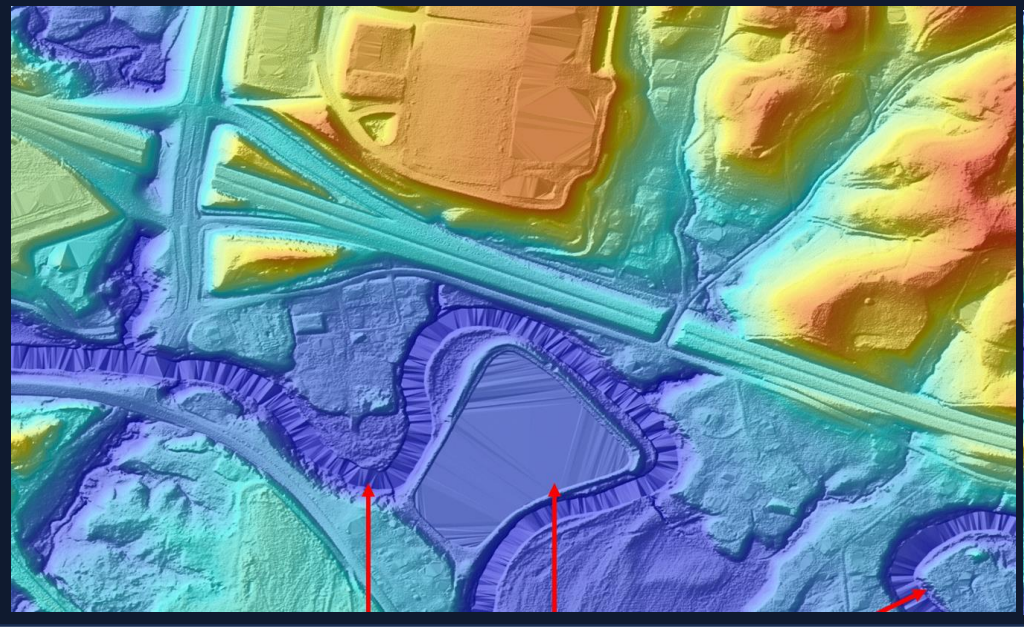


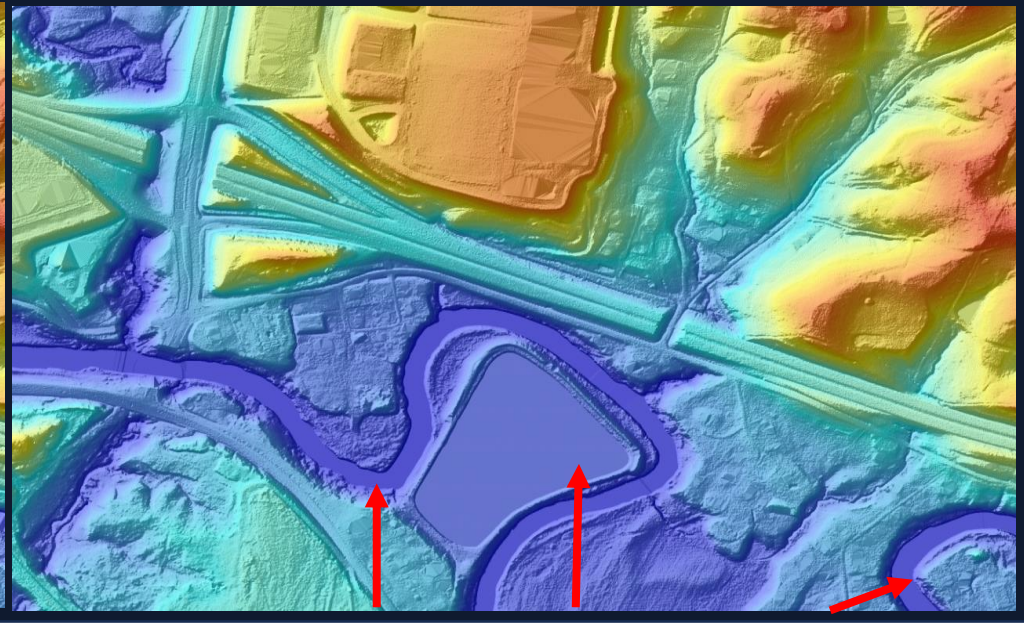
Hydrographic

USGS Base Standards

- Hydro-flattened breaklines
  - > 30m wide Rivers and Streams
  - > 2-acre Lakes and Ponds
- Hydro-flattened Bare-earth DEM

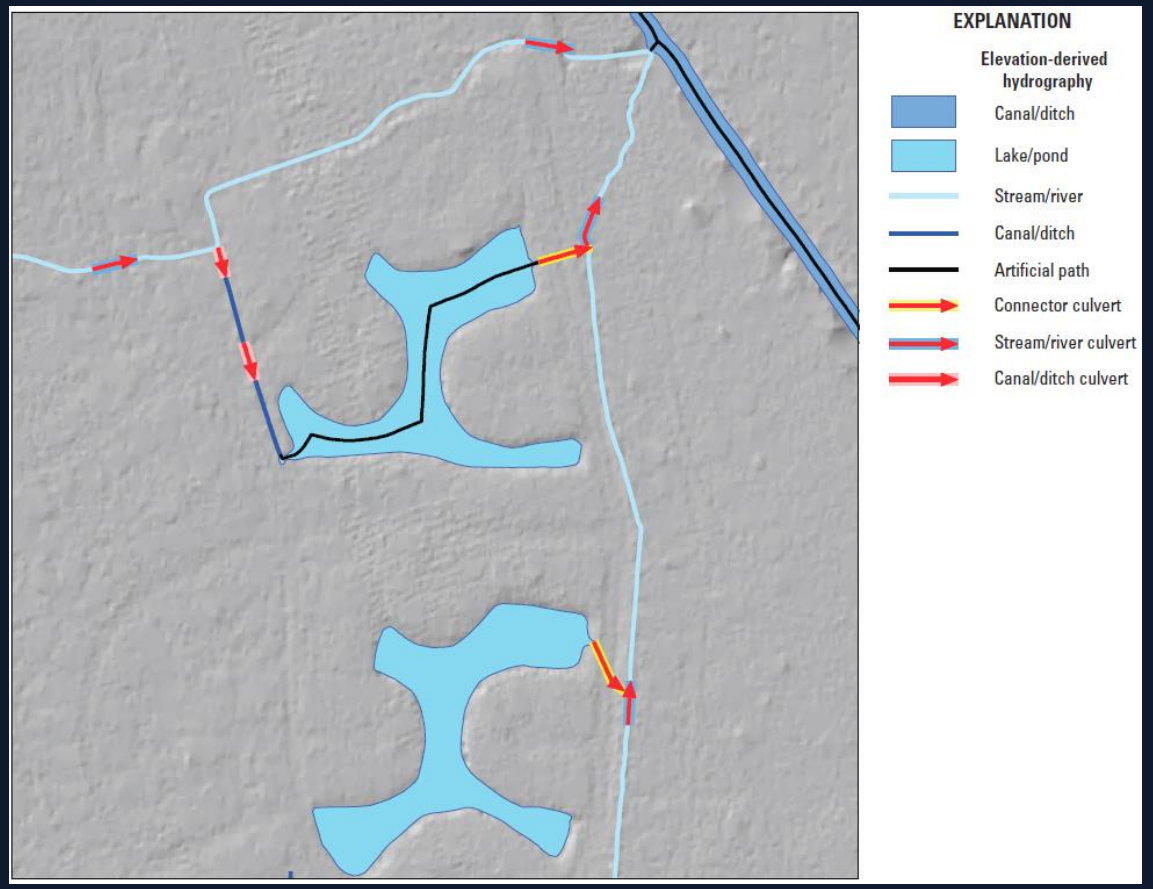
Without hydro breaklines



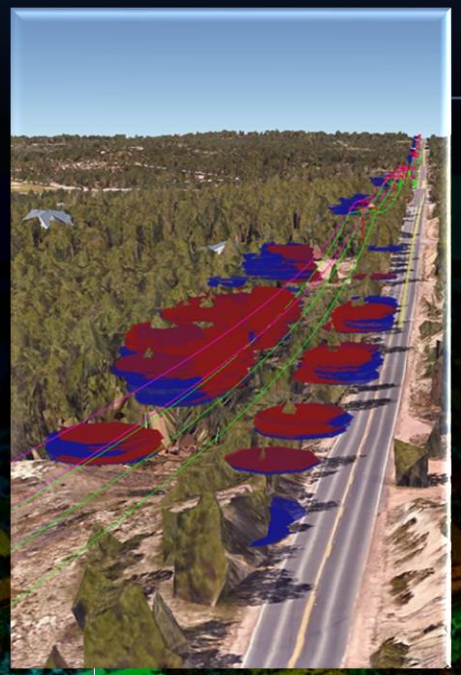


With hydro breaklines

- Increased Resolution of Hydro Features
  - Lakes, Ponds, Rivers, and Streams
  - Can include Dry Riverbeds
- Hydro-enforcement
  - Cut through Culverts
- Elevation Derived Hydro (EDH)
  - Hydrographic Flowlines
  - Feature Connectivity
  - Drainage Network and Water Tables



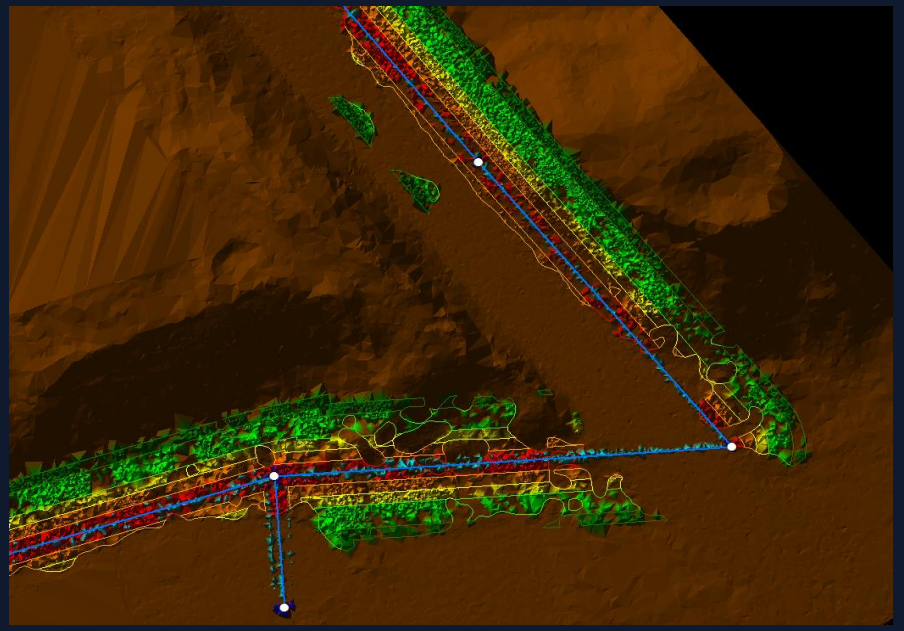
- Hydrography Modeling through the watershed and stream delineation can be designed to create flow models, predict risk, and estimate the probability of events.

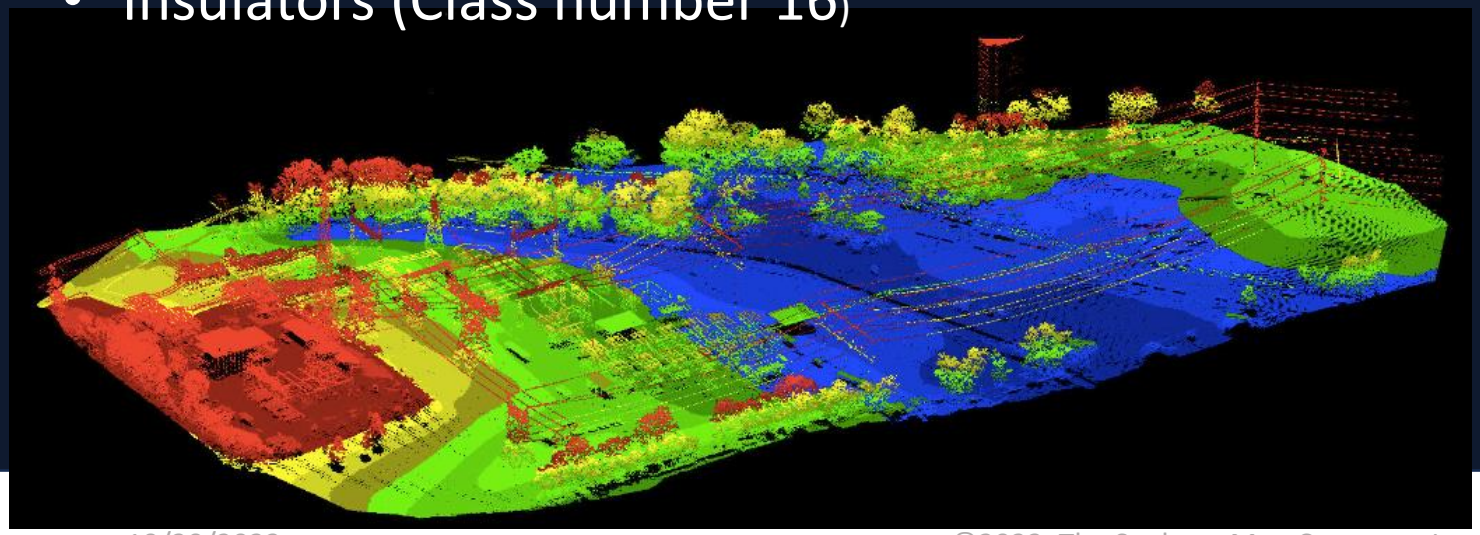


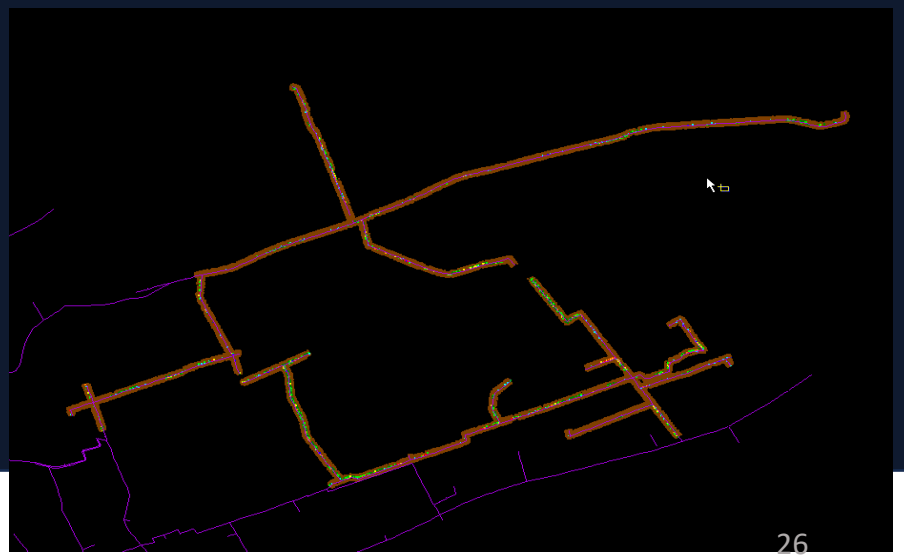
Utilities

Additional Classification

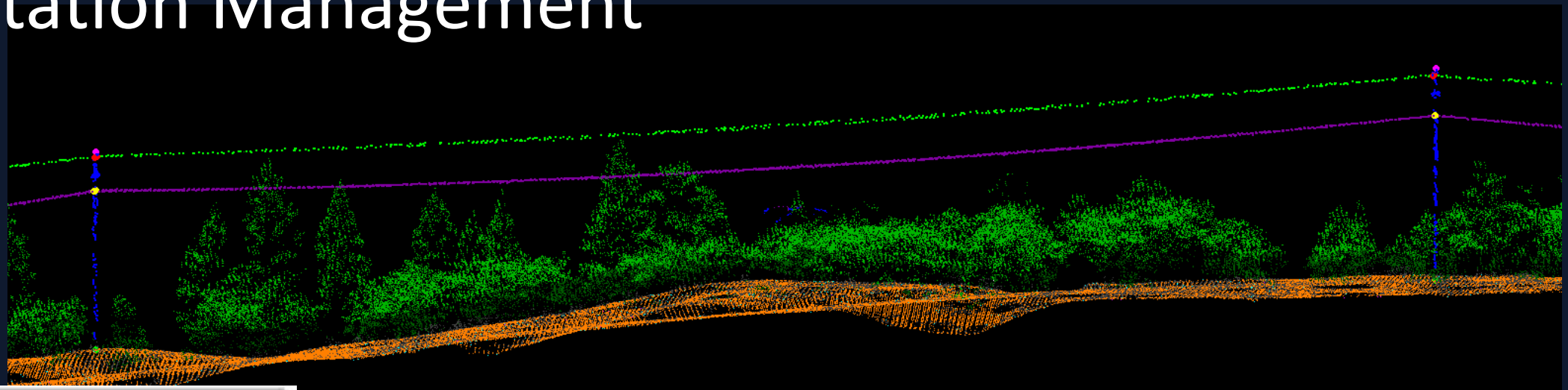
- Never Classified (Class Number 0)
- Ground (Class Number 2)
- Wires (Class Number 14)
- Poles (Class Number 15)
- Wire – Guard (Shield) (Class number 13)
- Wire – Conductor (Phase) (Class number 14)
- Transmission Tower (Class number 15)
- Insulators (Class number 16)

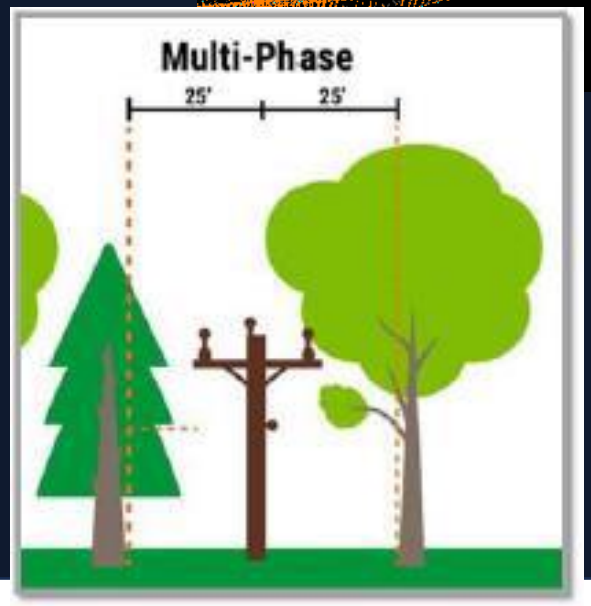


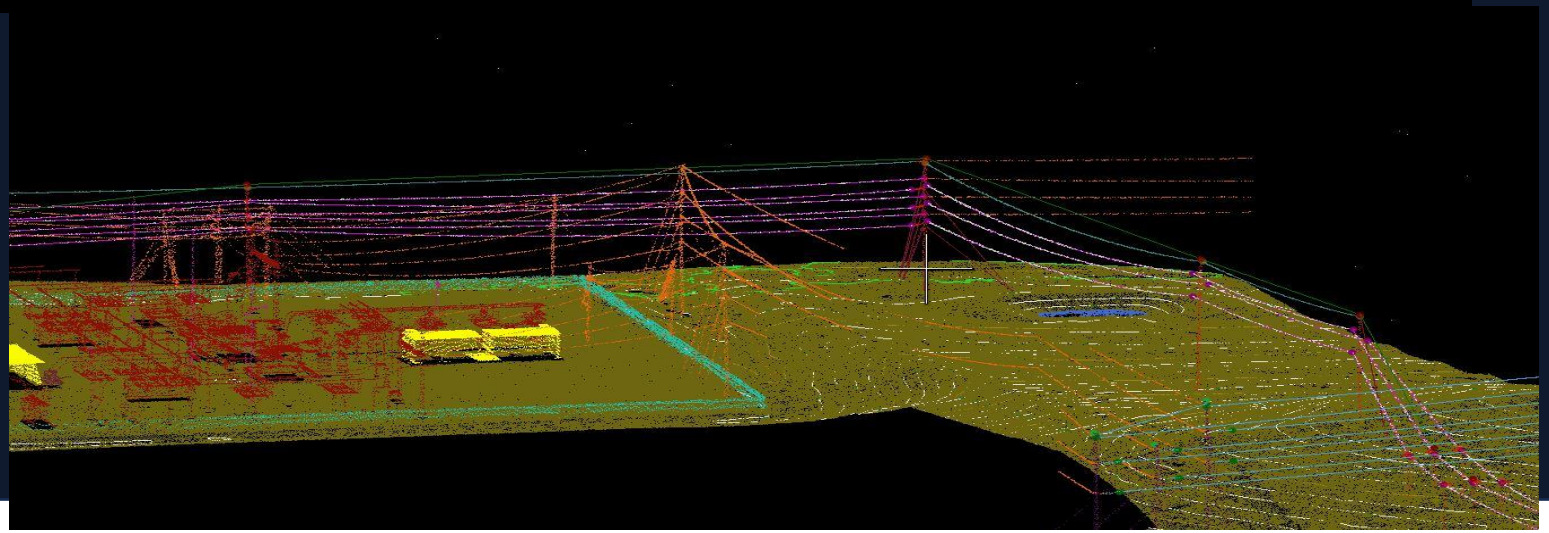




Vegetation Management



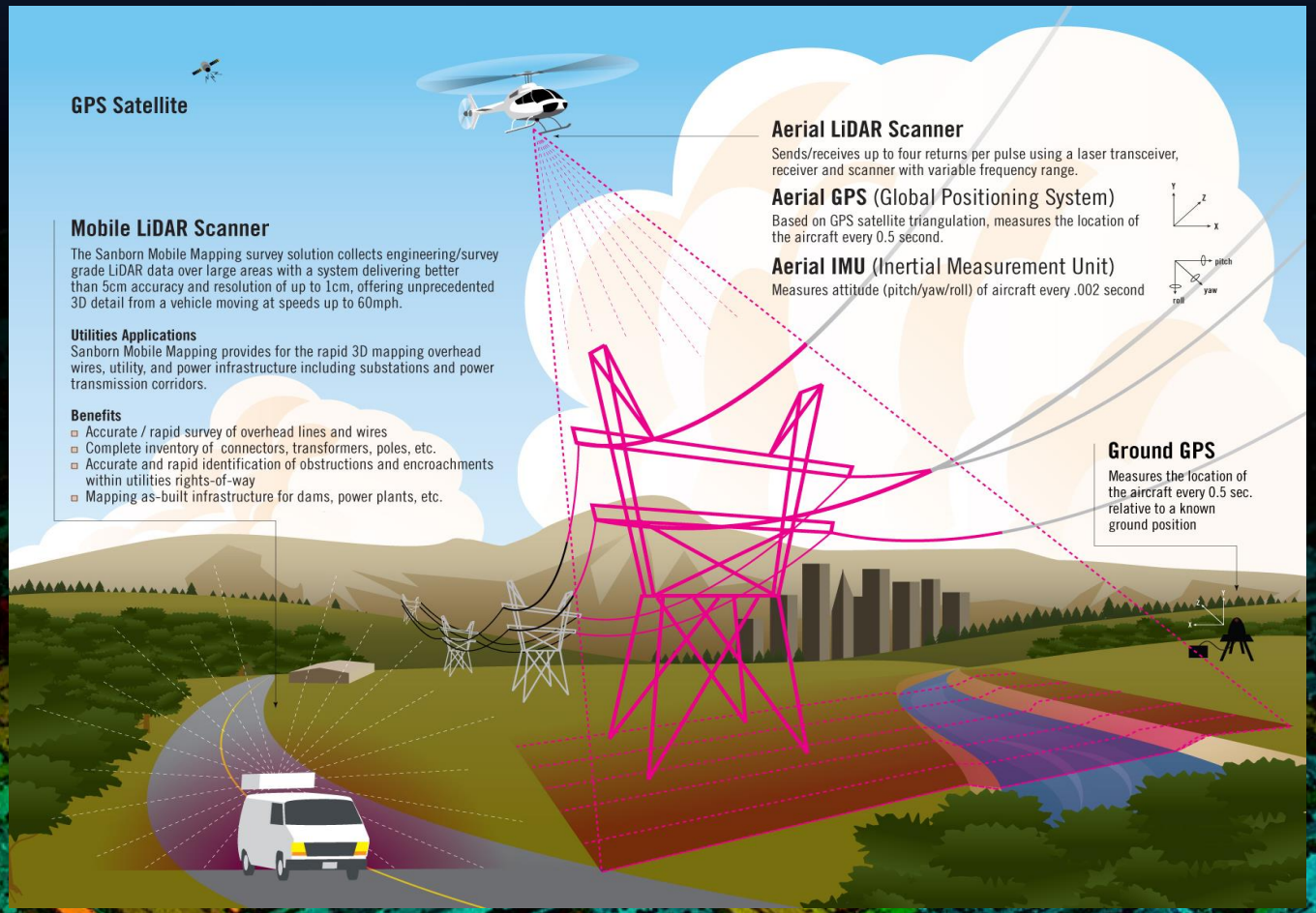




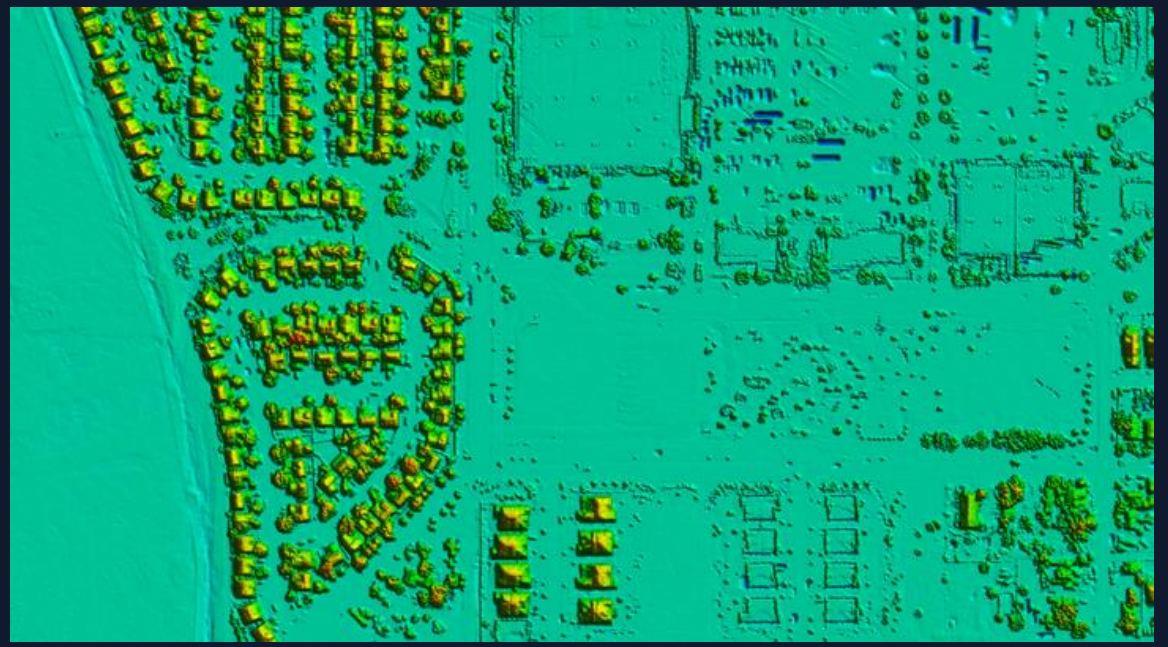
Synergistic

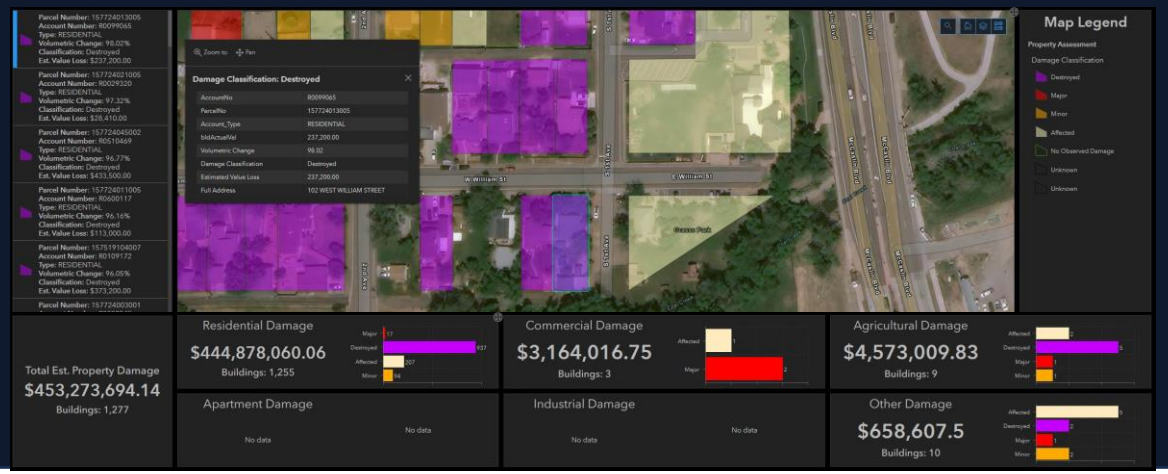
Synergistic Data Integration

- Clients continue to request the coordination of multiple data sets as a method to increase data quality, such as adding imagery to a lidar collection.
- Mobile and terrestrial lidar data collections merged with airborne collections can enable better data quality under tree canopies.
- Other examples include sonar, indoor lidar, and IOT



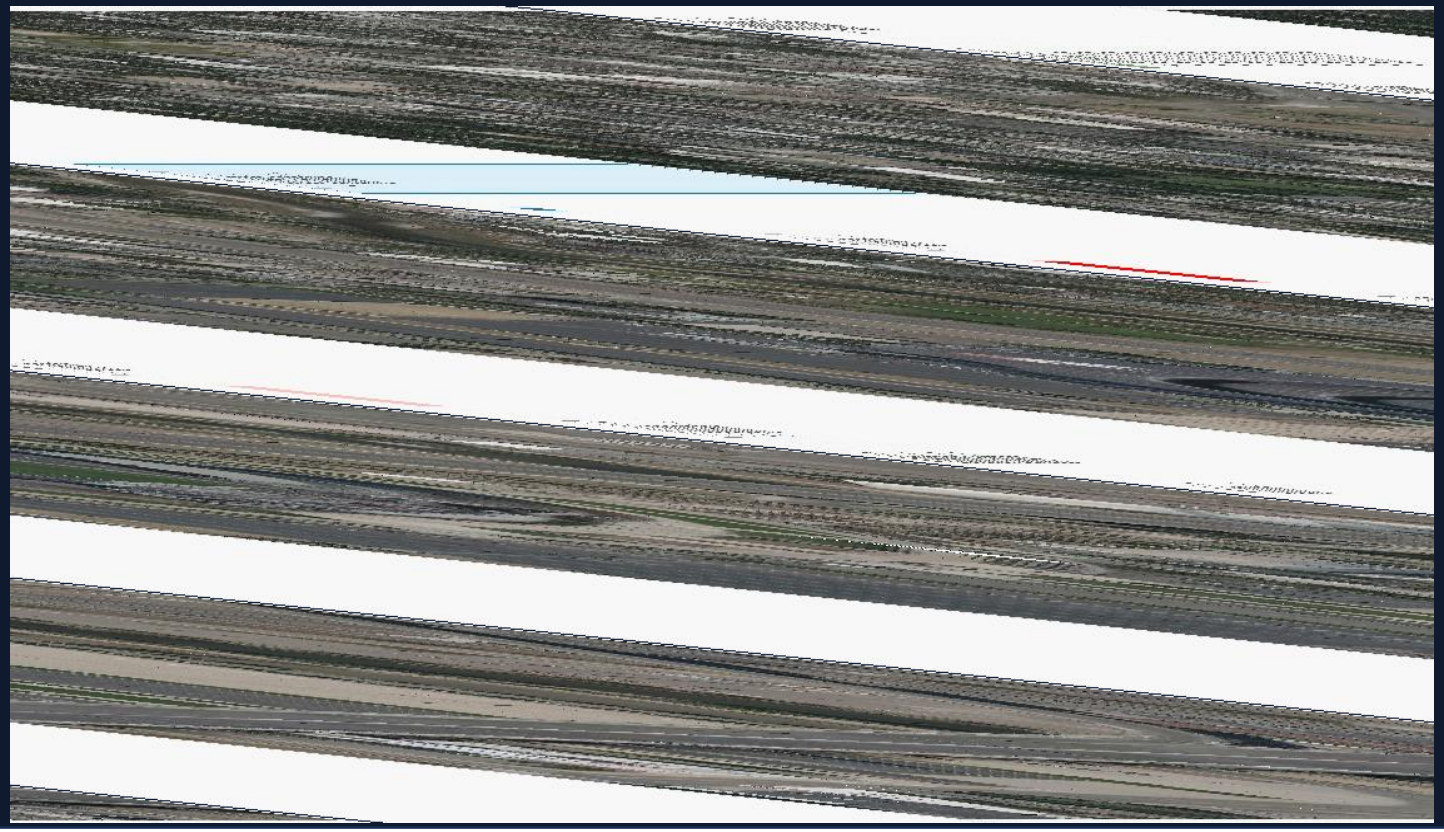
- Baseline data
  - 3DEP (QL1 and QL2)
  - Additional classification required
  - Feature extraction required
  - Created AI based building footprints
- New data (QL1)
  - Normalized data to baseline
  - Automated change detection
- Volumetric change from 2020 vs 2022 building footprints
- Data Integration - Property Information
  - Allowed for damage valuation assessment





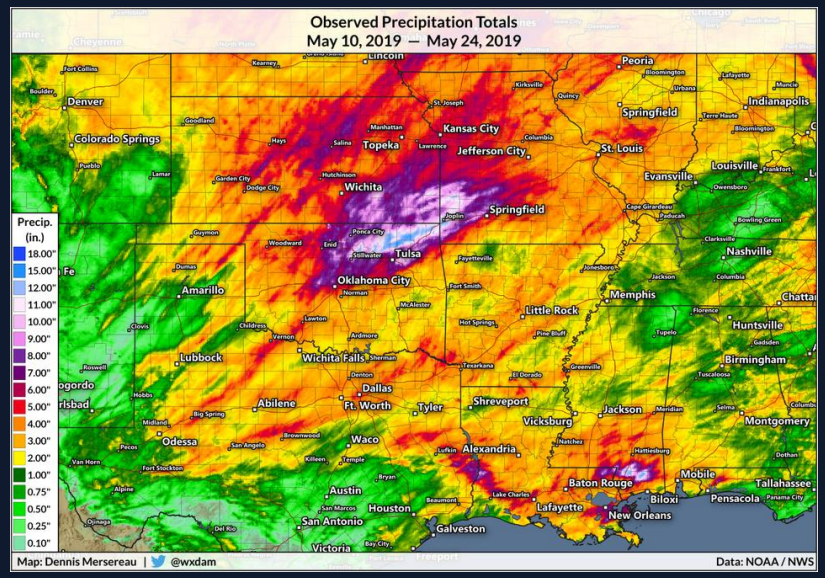
Synergistic Imagery, Lidar and Vector

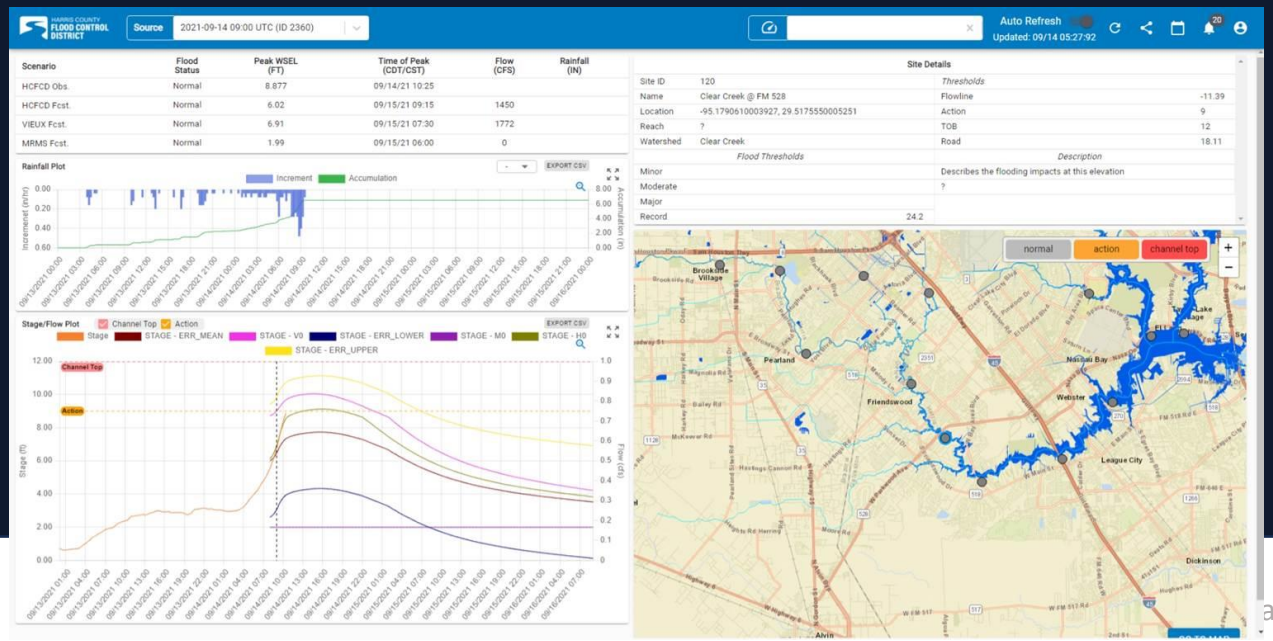
- RGB fusion and Digital Twins of the collected imagery and lidar point cloud can add perspective and real-world representation of the data

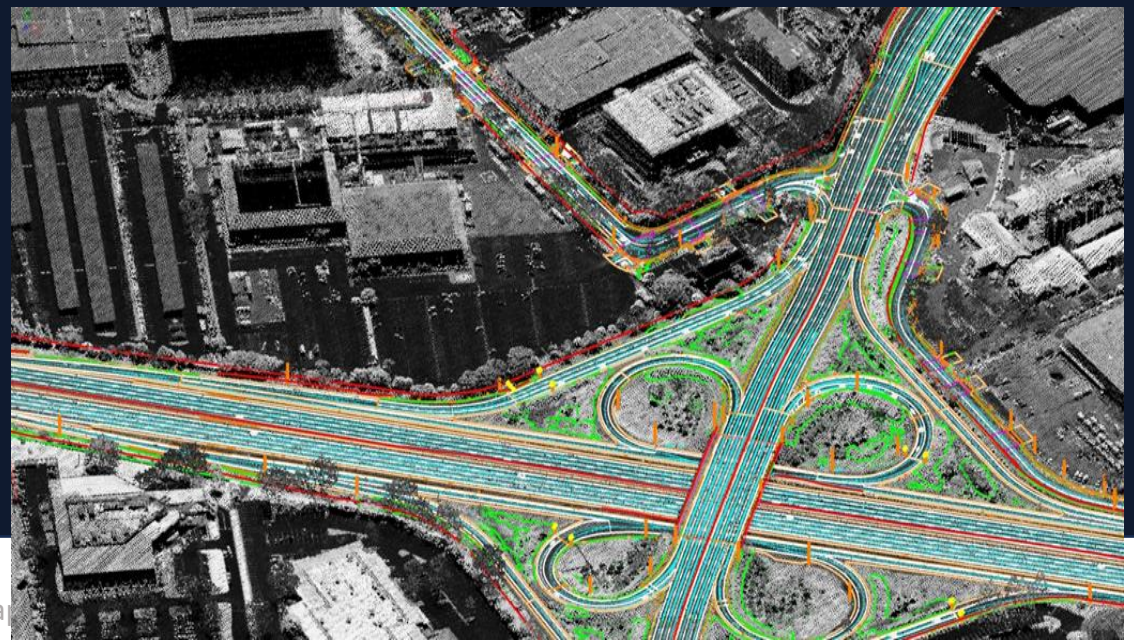


IOT Integration

- Real time disaster monitoring
- Real time weather monitoring
- Real time traffic monitoring and connected vehicle applications.

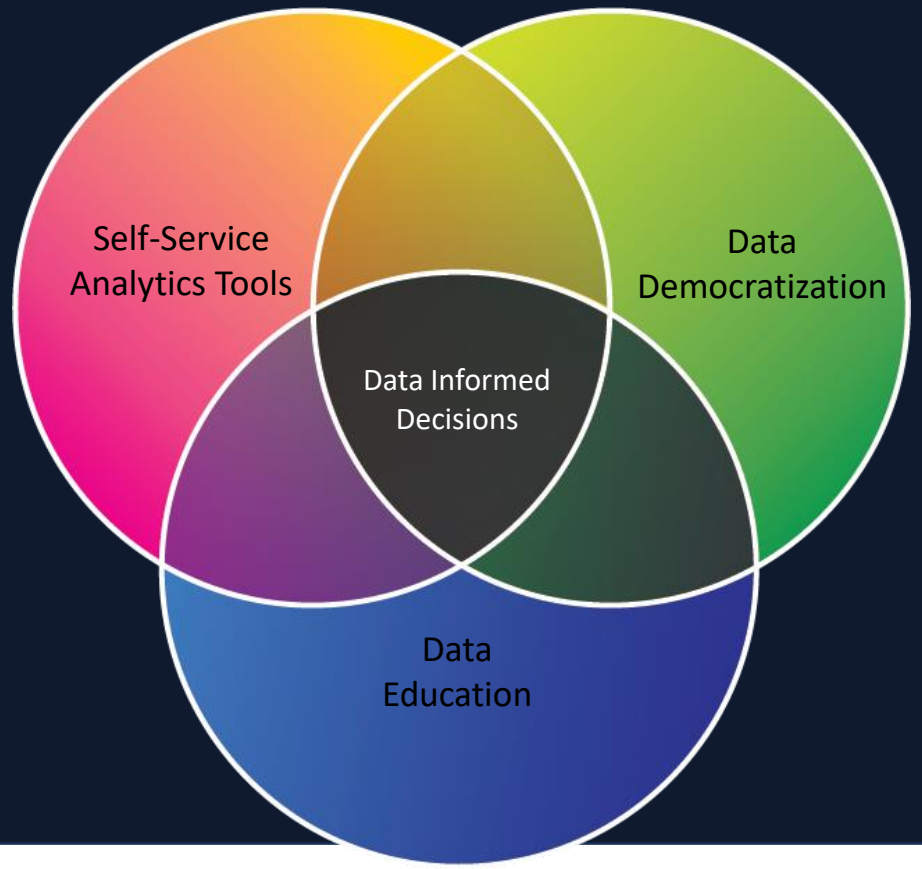






Democratization Challenges

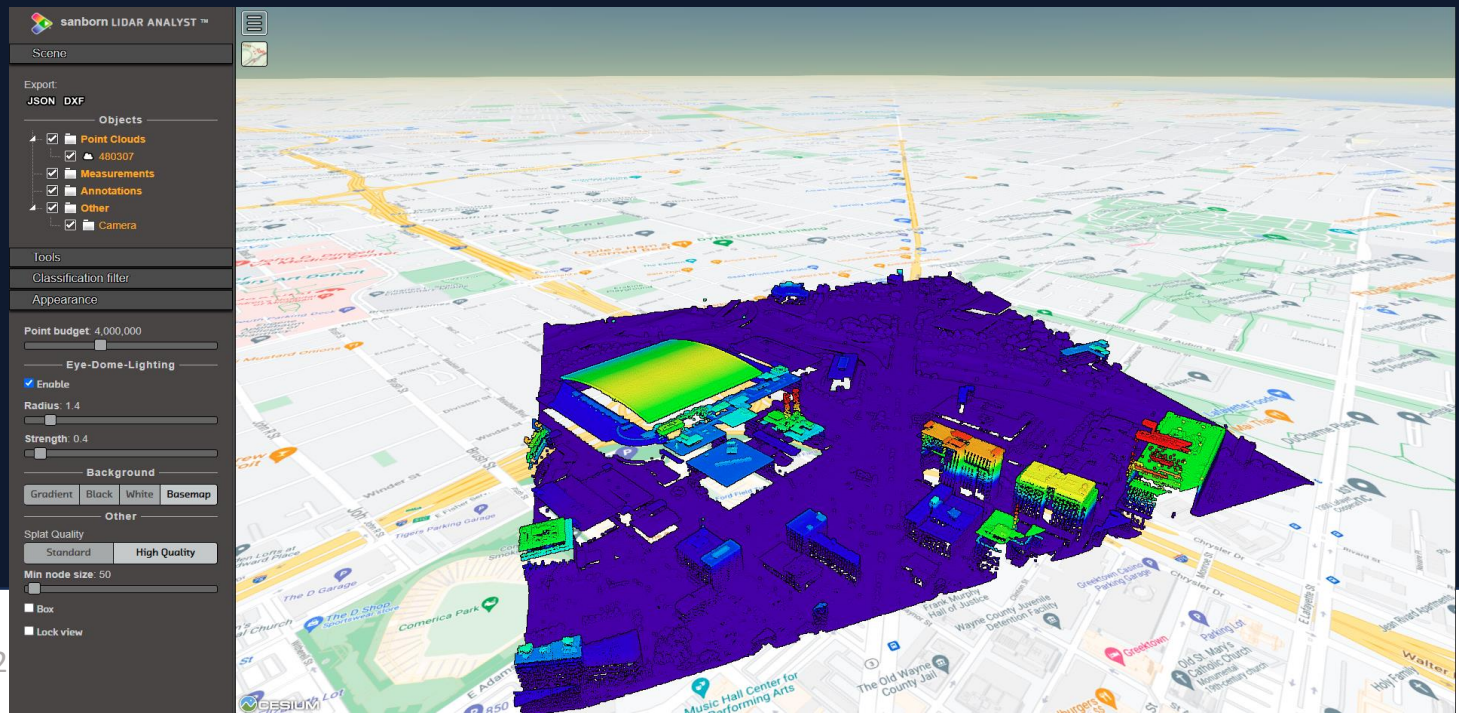
- Significant challenges exist when managing data discovery and dissemination for geospatial data sources:
  - Data storage
  - Data discovery
  - Data visualization
  - Data analysis
- Self-service analytics, data democratization, and data education can control the data tsunami and take collaboration to a whole new level.



Examples of Tools for Data Democratization

GIZA and Sanborn GeoData Explorer™

- Provides metrics to understand where data is used and by whom
- Data can be raster or vector types
- Data can be created by Sanborn or can be existing data from the client
- Provides functionality to users:
  - Cloud based storage of data
  - User Credentialling
  - Data Cataloging
  - Data Analysis
  - Download Curation



Conclusions

- Lidar can support Government and Commercial Use Cases
- Lidar data has been captured for most of the United Sates
  - Foundational data will support many needs
  - Additional data processing on existing data can increase utilization and ROI
- Collect once and use many
  - Understand your user community and what specifications and derivatives are needed
    - Different use cases require different densities, accuracy and seasonal requirements
  - Creation of multiple derivatives will empower a larger user base
  - Synergistic Data Integration allows for additional value and larger user community
- Plan for easy to access and easy to use tools to support larger user base
- Work with a vendor like Sanborn to develop baseline requirements, derivative products, and dissemination solutions

Thank you!

Feel free to drop by the booth or contact us. We look forward to talking with you.

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