Sanborn Presentation at National Digital Orthophoto Program Meeting

Date: **October 7th, 2008**
Location: **Boulder, CO**

Presented by: Jason Caldwell, Director of Strategic Accounts

Agenda

- Sanborn Overview
  - Services, Acquisition Resources, Experience

- Project Overviews
  - 2008 Forest Service Contracts
    - Area of Interest, Scope of Work, Issues
  - 2008 NAIP
    - Area of Interest, Scope of Work, Issues
    - Imagery Analysis Added Value
  - 2008 Denver DNC
    - Area of Interest, Scope of Work, Product Examples
    - Applications

- Imagery and LiDAR data integration for decision support systems

Sanborn Overview

End-to-end Geospatial Solutions

DMGT
Daily Mail and General Trust plc

DMG Information

SANBORN Total Geospatial Solutions
1.866.SANBORN | www.sanborn.com

18,000 employees

Associated Newspapers
Northcliffe Newspapers Group
Euromoney Institutional Investor
DMG Broadcasting
DMG Television
DMG World Media
DMG Radio
DMG Information

3,500 employees

Dolphin Software
E Data Resources (EDR)
Genscape
Hobsons
Landmark Information Group
Lewtan Technologies
Property & Portfolio Research (PPR)
Real Capital Analytics
Risk Management Solutions (RMS)
RMSI
Sanborn
Trepp

330 employees

Advanced Systems
LiDAR Services
Imagery Services West
Imagery Services East
Imagery Services Central
Sanborn Solutions

Sanborn Overview

Locations

Geospatial Solutions Begin with Sanborn

- Data Acquisition
  - Aerial Imagery and LiDAR
  - Emergency Response
  - Ground Survey
  - Static and kinetic ground laser surveys
- Photogrammetry
  - Aerial Triangulation
  - Digital Terrain Modeling
  - Planimetric & Topographic
  - 3-D Modeling
- Data Conversion
  - Utility Conversion/survey
  - Cadastral Conversion/survey
- GIS
  - Consulting
  - Needs Assessment
  - Database Design
  - Implementation
  - Software Application Development
  - Data distribution
- Decision support systems
  - Habitat Management
  - Forestry Management
  - Command and Control Center
  - Wildfire Hazard Assessment
- Imagery Analysis
  - Vegetation mapping
  - Impervious Surface Extraction
  - Change Detection

Data Acquisition Resources

Sanborn owned and operated

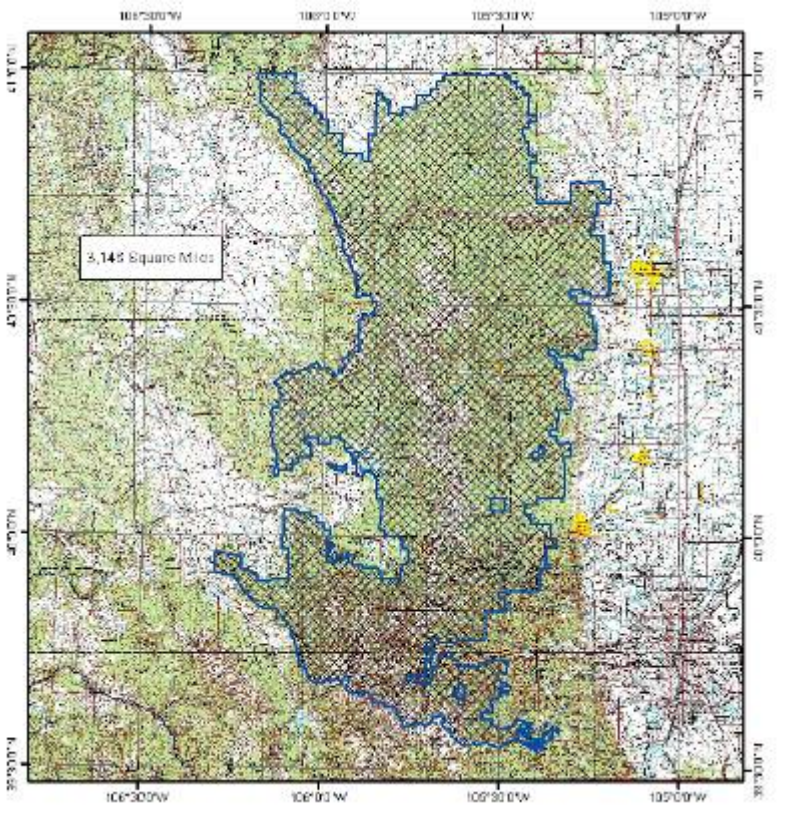
- 350 Employees / 4 primary production facilities
- Fixed wing aircraft (9)
- UltraCam Digital (2)
- Z/I DMC (4)
- Leica Analogue RC30/20 (2)
- Optech LiDAR-50 Hz (1)
- Leica LiDAR ALS 50 II (2)
- Trimble Ground-Based LiDAR (1)
- Airborne GPS systems (7)
- Inertial Navigation Systems (6)
- Trimble GPS survey equipment
- Storage (300 TB)

Experience and Contracts

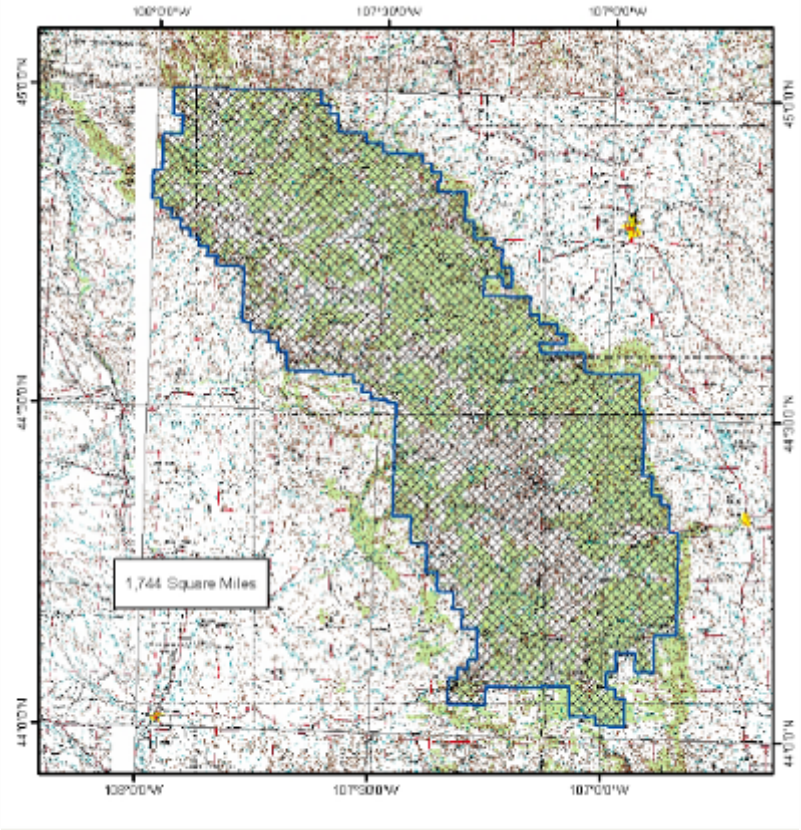
- Sanborn's Experience in Federal Programs
  - USGS DOQQ
  - GAP, RE-GAP, NLCD
  - USDA National Agricultural Imagery Program
  - USDA NRI Remote Sensing Labs
  - Army Corp of Engineers, St. Louis
  - NOAA Coastal Services Contract
  - USGS GISP-C
  - Forest Service Contracts

Sanborn Support for Forest Service Imagery Contracts

- Area of Interest



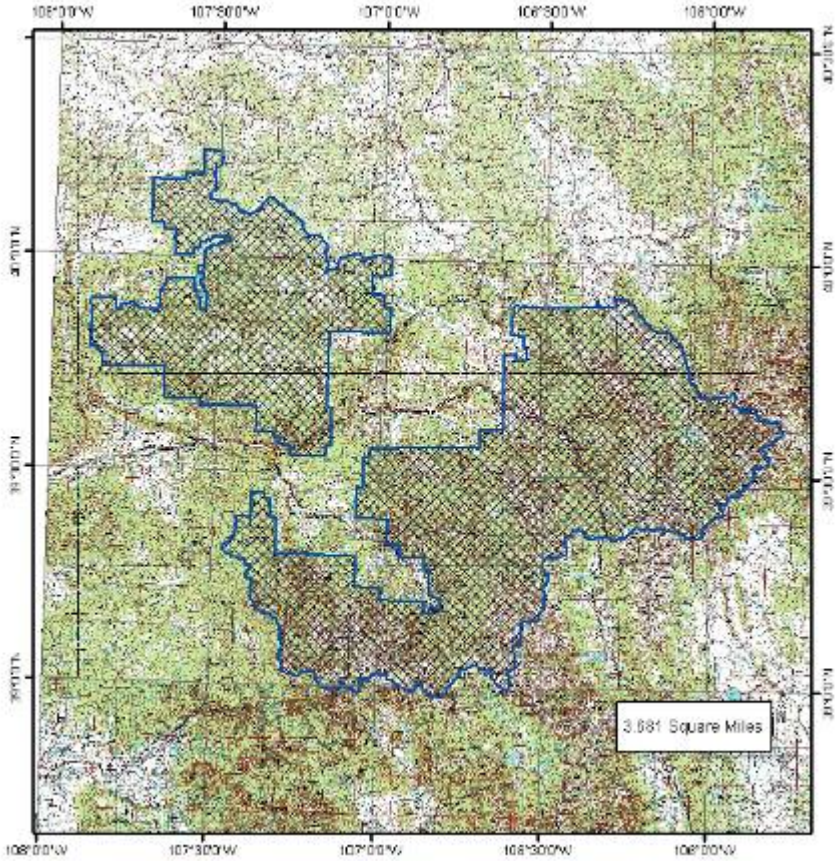
Arapahoe-Roosevelt National Forest, CO



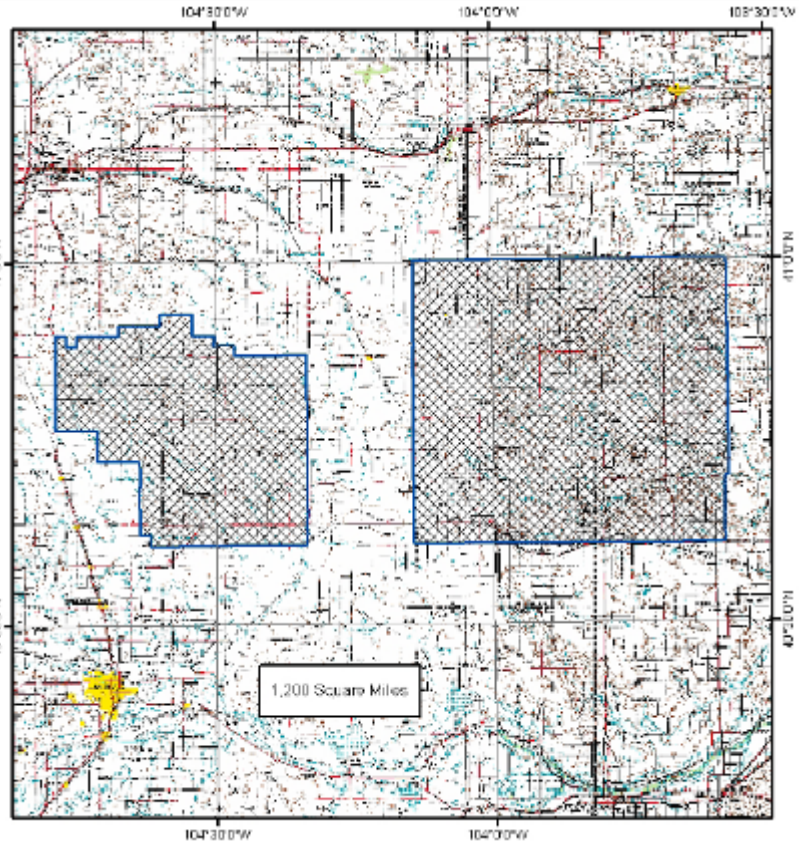
White River National Forest, CO

Sanborn Support for Forest Service Imagery Contracts

- Area of Interest



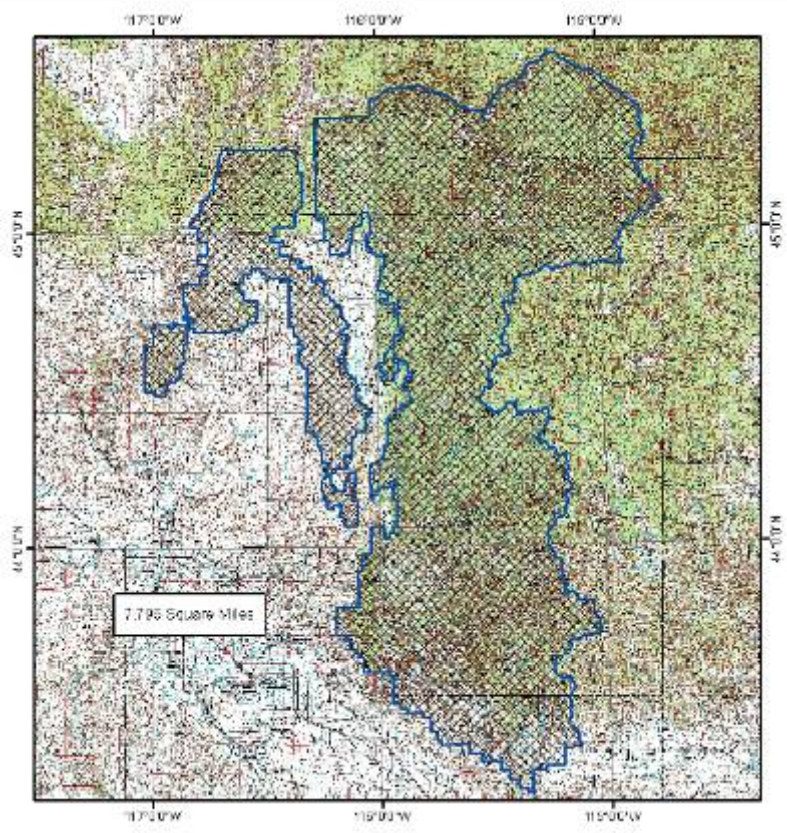
Big Horn National Forest, WY



Pawnee National Grasslands, CO

Sanborn Support for Forest Service Imagery Contracts

- Area of Interest

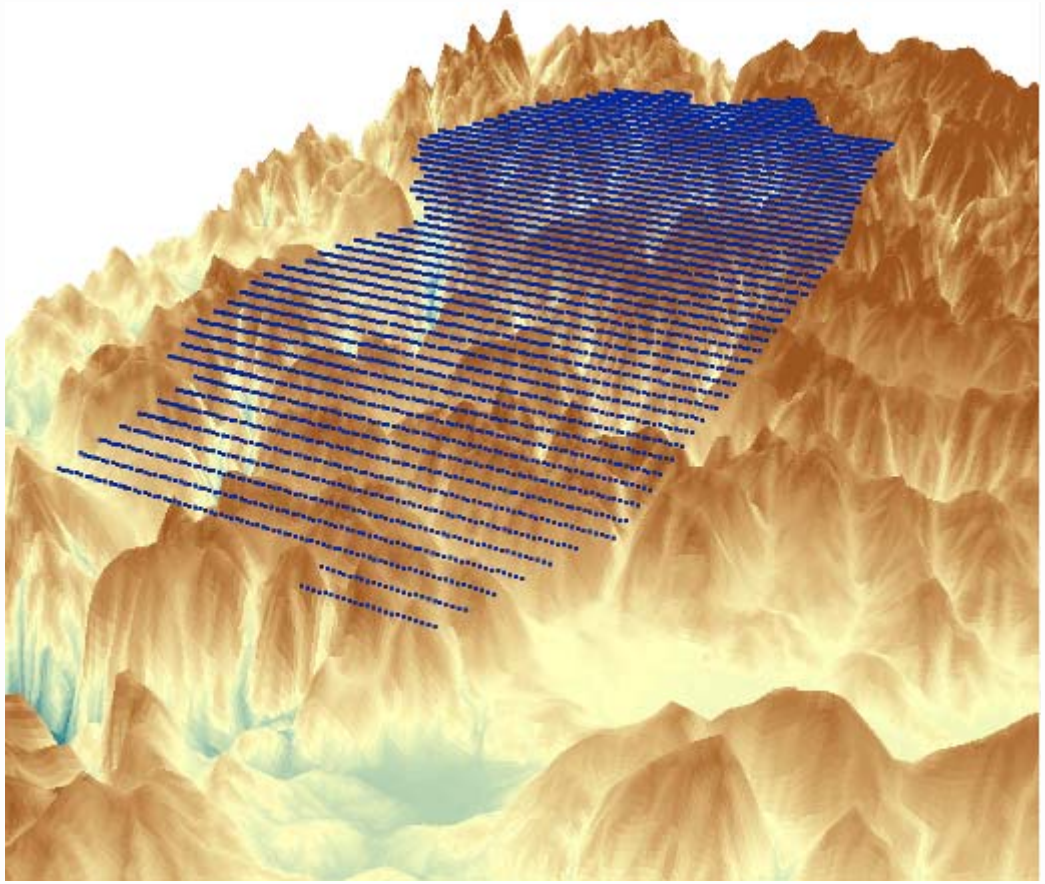


Boise & Payette National Forest, ID

- Scope of Work
  - Scope included ~18,000 square miles
  - 4-Band,1-foot Pixel Resolution Imagery
  - Utilized up to Five DMC sensors
  - Delivered uncompressed 4-band 12-bit imagery
  - Collection completed “leaf on” with greater than 40% sun angle.
- Performance
  - All acquisition complete with the exception of few re-flights

Sanborn Support for Forest Service Imagery Contracts

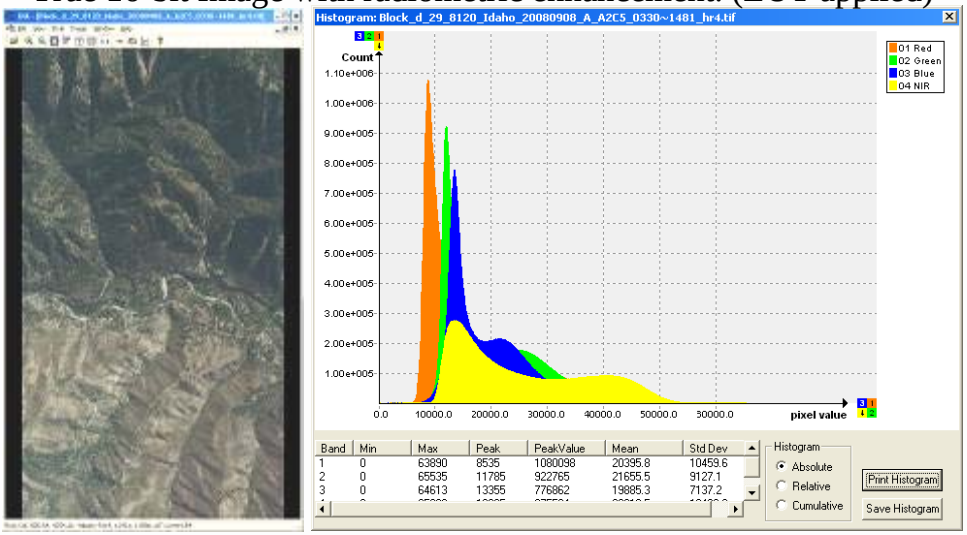
- Issues
  - Terrain Relief
    - To maintain stereo coverage compliance, flight plans took in account the terrain elevation
    - Due to the significant terrain more than 50% additional exposure were shot.



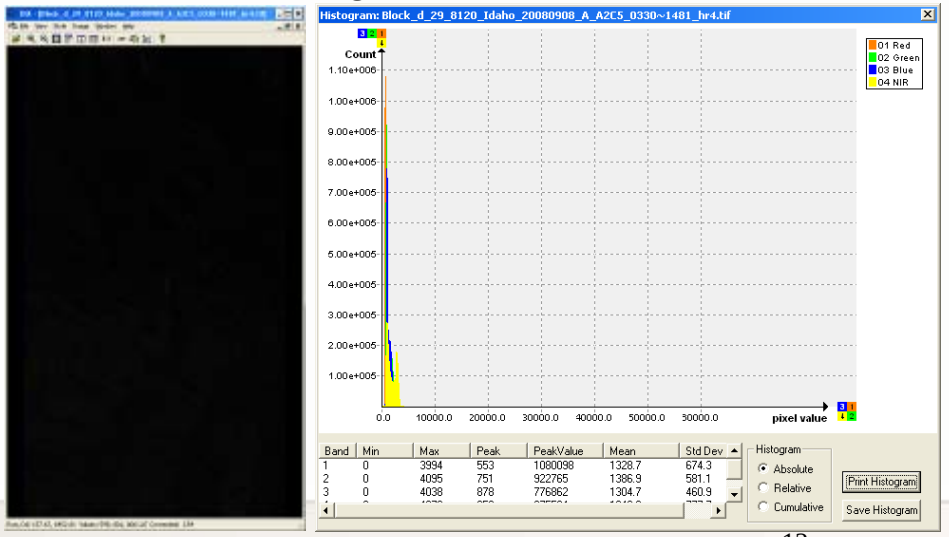
Sanborn Support for Forest Service Imagery Contracts

- Issues
  - 8-bit, 12-bit or 16-bit?
  - Client desired as little imagery manipulation as possible
  - It was determined that a 16-bit delivery with the original 12-bit depth was preferred
  - Some software (e.g. ArcMap) will not be able to view imagery without stretching.
  - Additional process was required to complete data review.

True 16-bit Image with radiometric enhancement. (LUT applied)



True 12-Bit Image with no radiometric enhancement



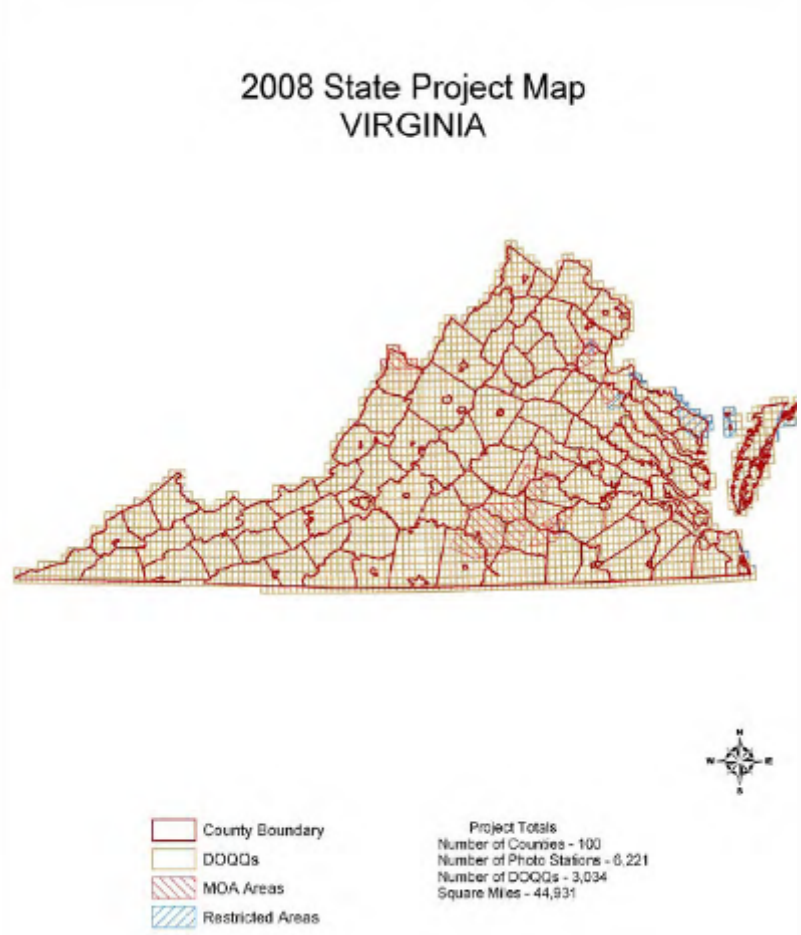
Sanborn Support for Forest Service Imagery Contracts

- Issues
  - Data Management

Data Management: Digital Versus Film Comparison				
Digital Exposures	Digital File Size	Film Exposures	Film File Size	Total
~40,000	~32-terrabytes	~16,000	~12-terrabytes* *Assumes 8-bit, 14-micron scan	32-terrabytes vs. 12-terrabytes

Sanborn Support for NAIP

- Area of Interest

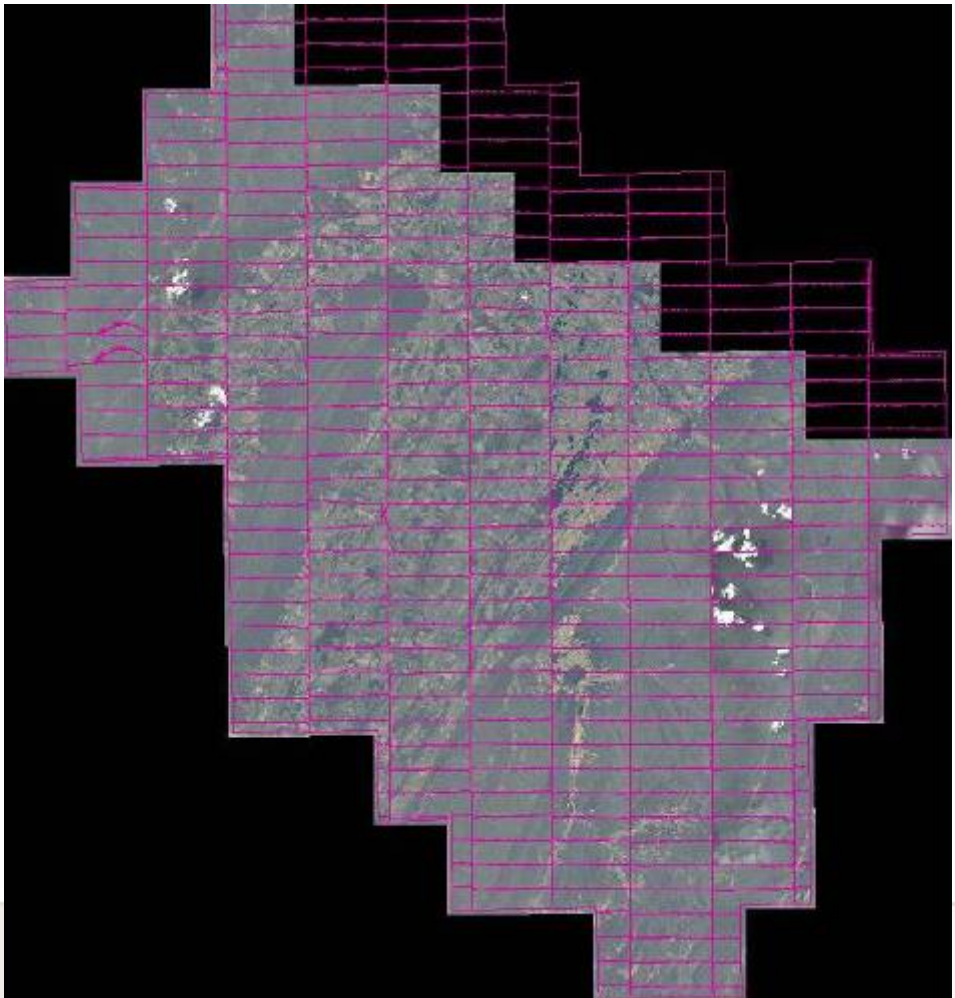


- Scope
  - 4-band collection and delivery
    - Total of five Z/I DMC used
  - Absolute Control
    - AGPS/IMU and existing ground control used within aerial triangulation adjustment
  - Seamline Polygon Shapefile
  - DOQQ and CCM mosaic deliveries

- Performance
  - Completed all acquisition with no extensions
  - Delivered all imagery within required time frame.

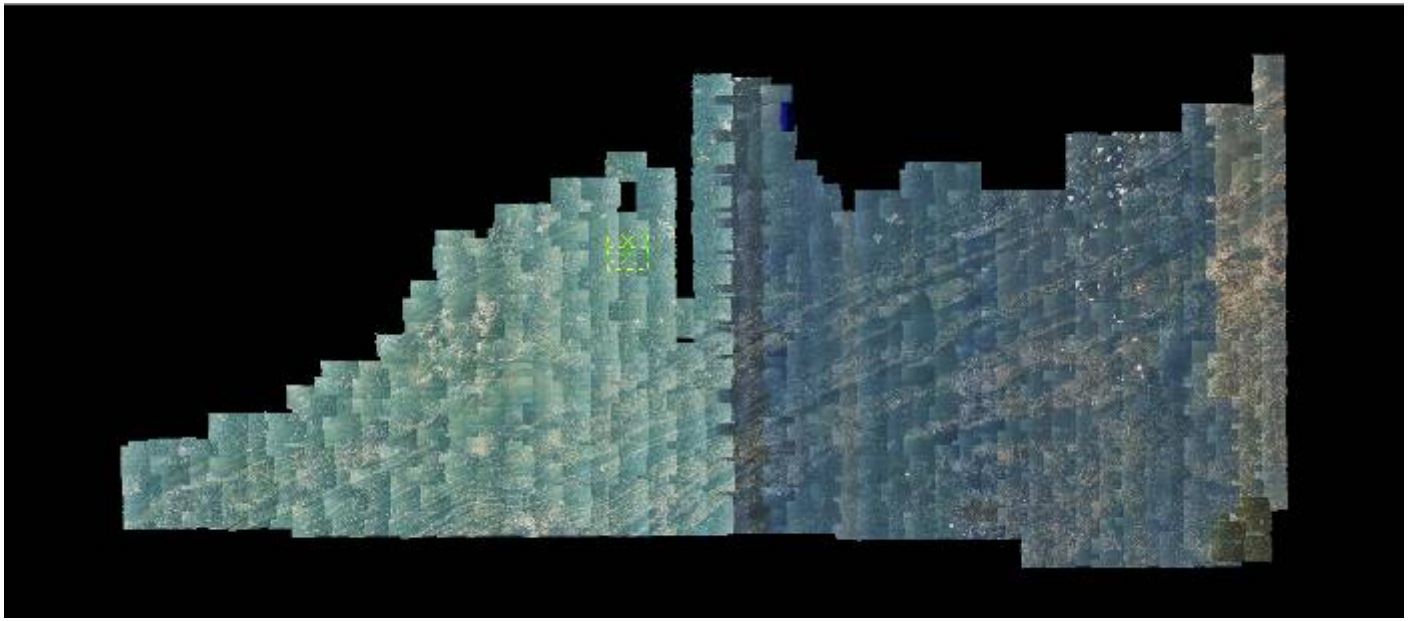
Sanborn Support for NAIP

- New Requirements
  - Absolute Ground Control
  - Seamline Shapefile

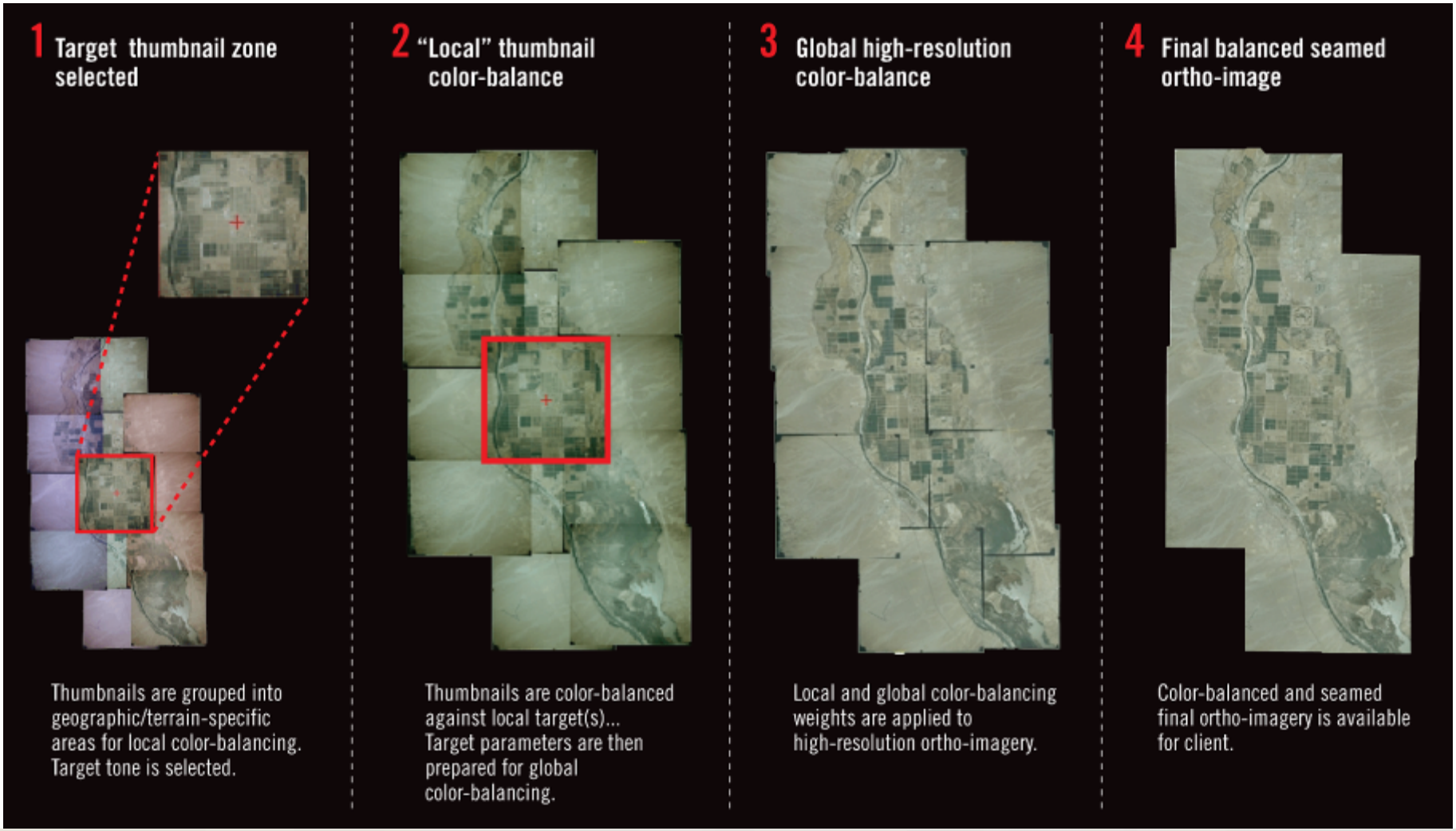


Sanborn Support for NAIP

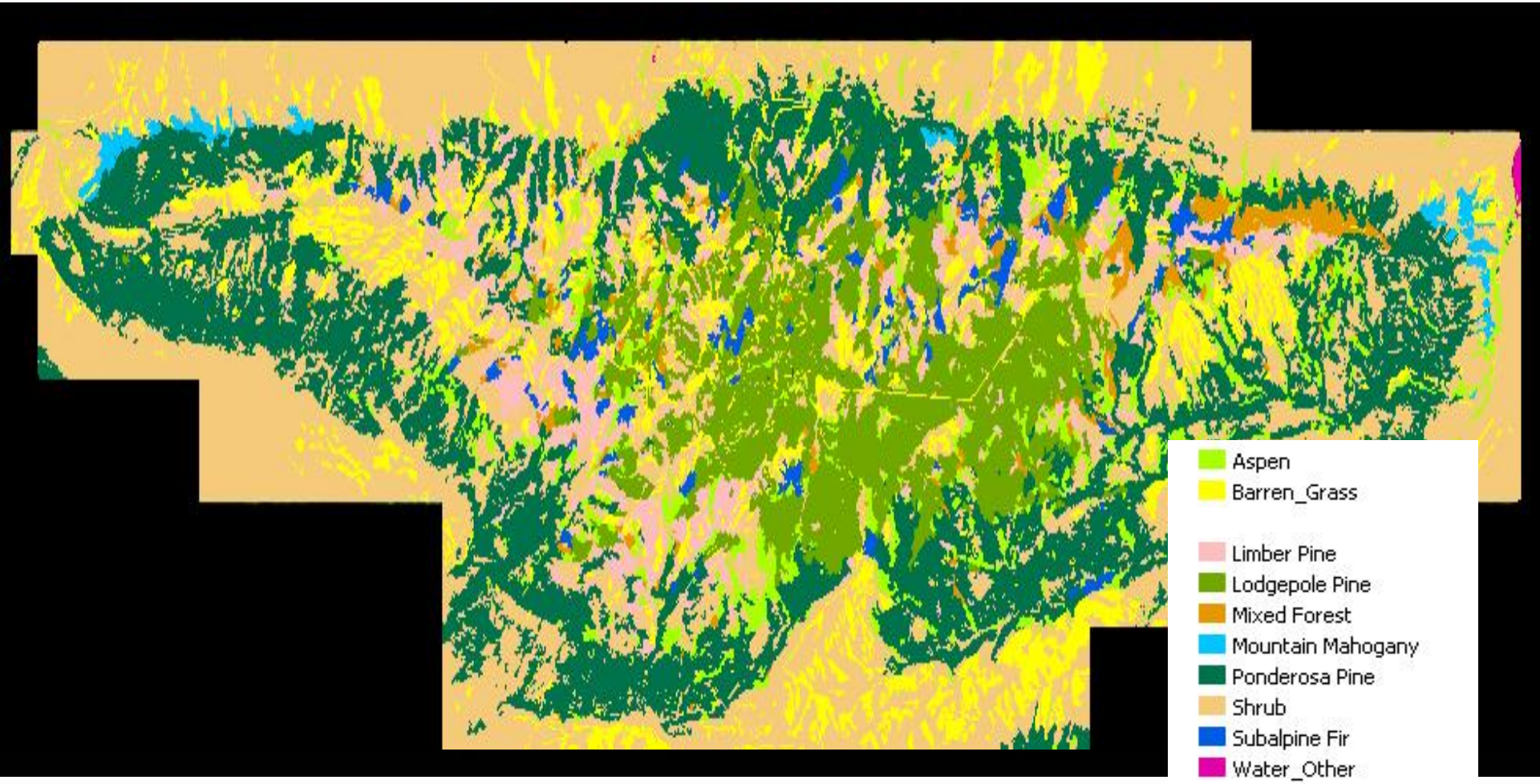
- Issues
  - Color Balancing



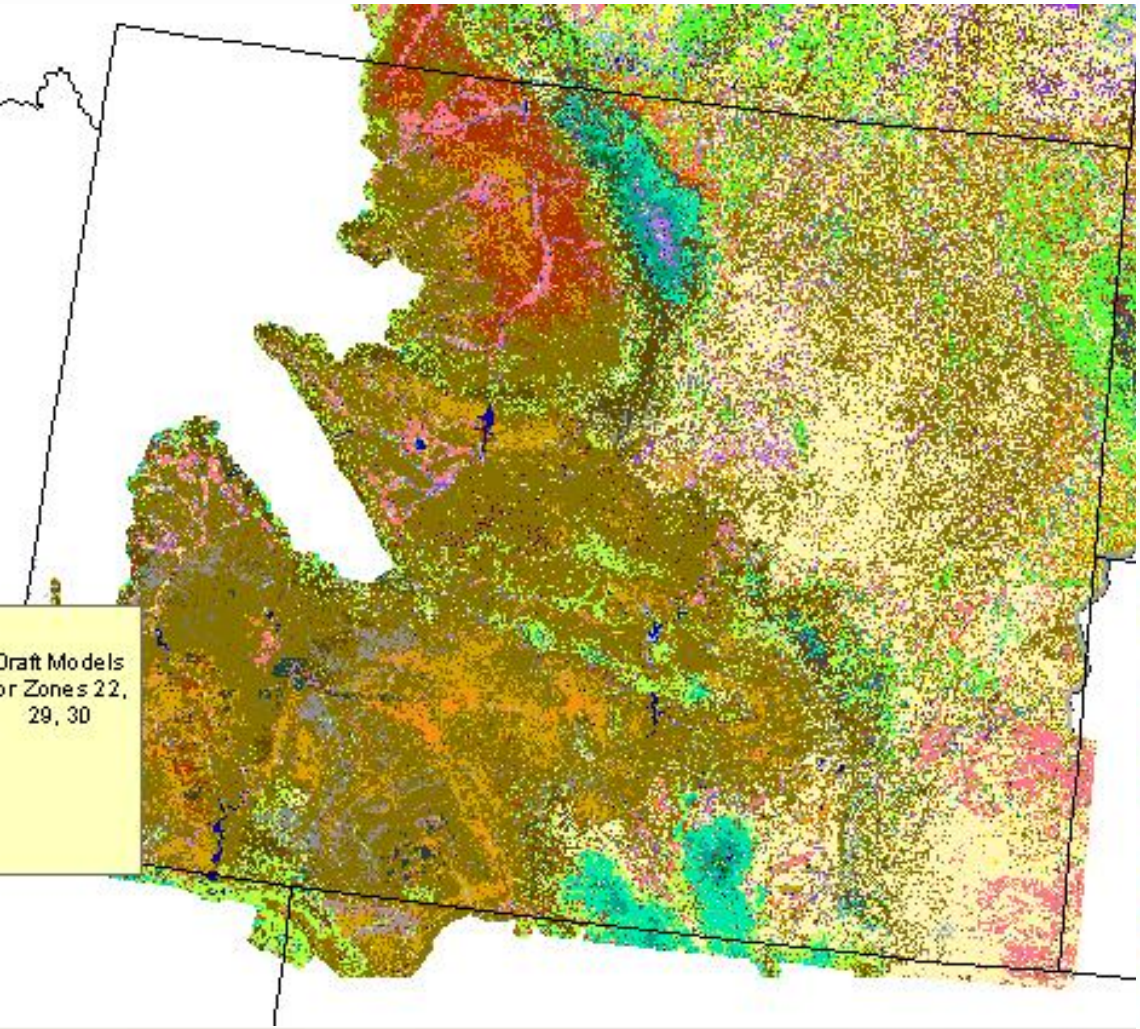
Sanborn's Color Balancing Process Flow



Vegetation Mapping with MultiSpectral Imagery



Ecological Systems Classification



Legend

- Rocky Mountain Aspen Forest and Woodland
- Inter-Mountain Basins Aspen-Mixed Conifer Forest and Woodland
- Western Great Plains Dry Bur Oak Forest and Woodland
- Colorado Plateau Pinyon-Juniper Woodland
- NRM Dry-Mesic Montane Mixed Conifer Forest
- NRM Foothill Conifer Savanna Wooded Steppe
- Middle RM Montane Douglas-fir Forest and Woodland
- Rocky Mountain Lodgepole Pine Forest
- RM Subalpine Dry-Mesic Spruce-Fir Forest and Woodland
- RM Subalpine Mesic Spruce-Fir Forest and Woodland
- Northern Rocky Mountain Subalpine Woodland and Parkland
- Rocky Mountain Foothill Limber Pine-Juniper Woodland
- Southern RM - Great Plains Ponderosa Pine Woodland
- Southern Rocky Mountain Ponderosa Pine Savanna
- Northwestern Great Plains Highland Spruce Woodland
- Inter-Mountain Basins Mountain Mahogany Woodland and Shrubland

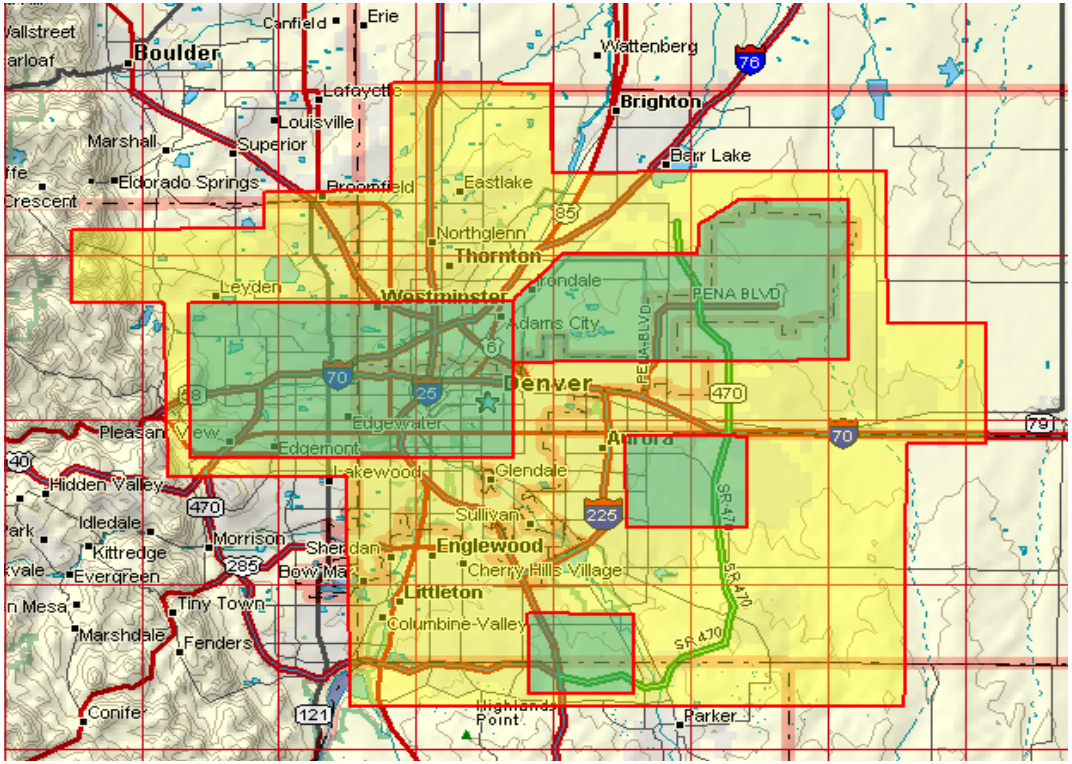
- Rocky Mountain Lower Montane-Foothill Shrubland
- Wyoming Basins Low Sagebrush Shrubland
- Inter-Mountain Basins Big Sagebrush Shrubland
- NRM Lower Montane-Foothill Mesic Deciduous Shrubland
- Northwestern Great Plains Shrubland
- Inter-Mountain Basins Greasewood Flat
- Great Plains Sagebrush Steppe
- Inter-Mountain Basins Montane Sagebrush Steppe
- Inter-Mountain Basins Big Sagebrush Shrubland
- Inter-Mountain Basins Mat Saltbush Shrubland
- Inter-Mountain Basins Mixed Salt Desert Scrub
- NRM Lower Montane, Foothill and Valley Plateau Grassland
- Northwestern Great Plains Mixedgrass Prairie

- Inter-Mountain Basins Playa
- Great Plains Salt Flats
- Inter-Mountain Basins Cliff and Canyon
- Western GP Badlands- Shale Barrens
- Western Great Plains Cliff and Outcrop
- Rocky Mountain Cliff, Canyon, and Massive Bedrock
- Inter-Mountain Basins Shale Badland

- Western Great Plains Saline Depression Wetland
- Northwestern Great Plains Floodplain
- Northwestern Great Plains Riparian
- Western Great Plains Riparian Woodland and Shrubland
- Western Great Plains Wooded Draw and Ravine
- NRM Lower Montane Riparian Woodland and Shrubland
- RM Lower Montane Riparian Woodland and Shrubland
- Rocky Mountain Subalpine-Montane Riparian Shrubland
- Western Great Plains Riparian Woodland and Shrubland
- Western Great Plains Closed Depression Wetland
- Western Great Plains Open Freshwater Depression Wetland

Sanborn's Support for the Democratic National Convention

- Area of Interest

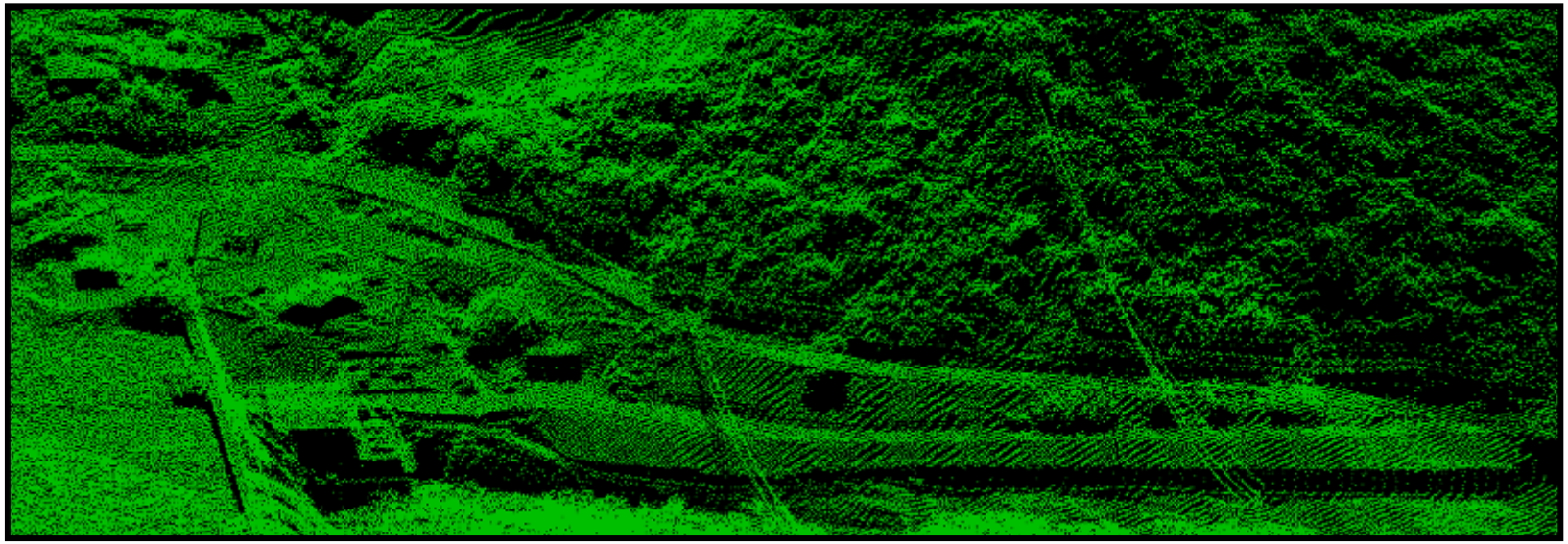


- Scope
  - ~1000 square miles
  - High Density LiDAR
  - 2 – 4 points per square meter
  - Classified (unclassified, ground, overlap) LAS 1.1
  - Ground LAS 1.1
  - Intensity GeoTIFFs
  - ArcTINs – Arc Exchange Format
  - 2ft Contours – DWG
  - FGDC Metadata

LiDAR

National Research Council *of the National Academies*

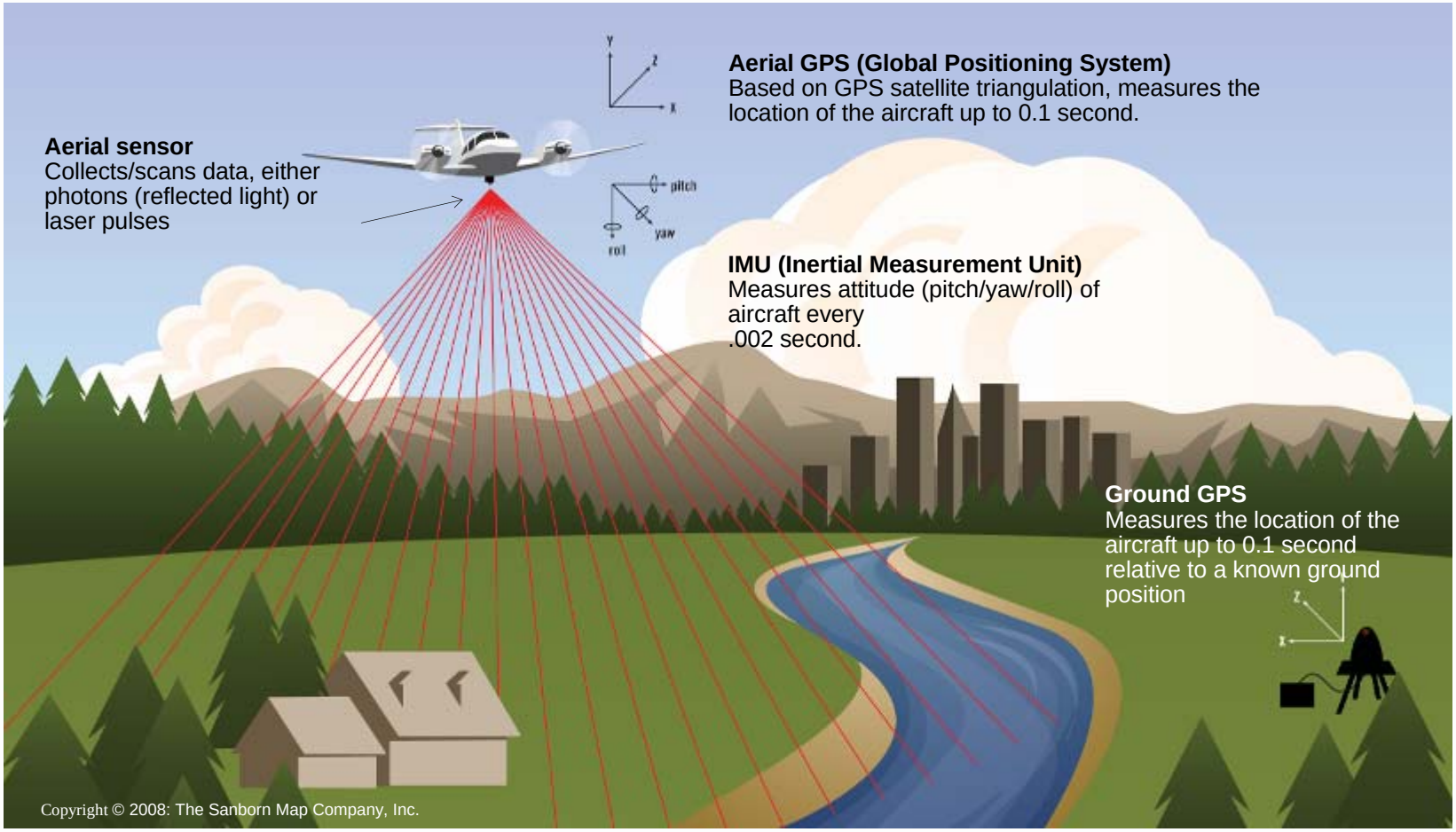
- *"LiDAR produces very-high-resolution three-dimensional point clouds in a wide variety of land cover types at accuracies equivalent to or better than photogrammetry…"*
- *"LiDAR can be acquired day or night, in cloudy conditions, leaf on or leaf off and no sun angle limitation…"*
- *"LiDAR is able to penetrate to the bare earth in vegetated area better than either IFSAR or photogrammetry…"*
- *"LiDAR data processing and feature extraction can be incorporated seamlessly into the production environment designed for photogrammetry…"*



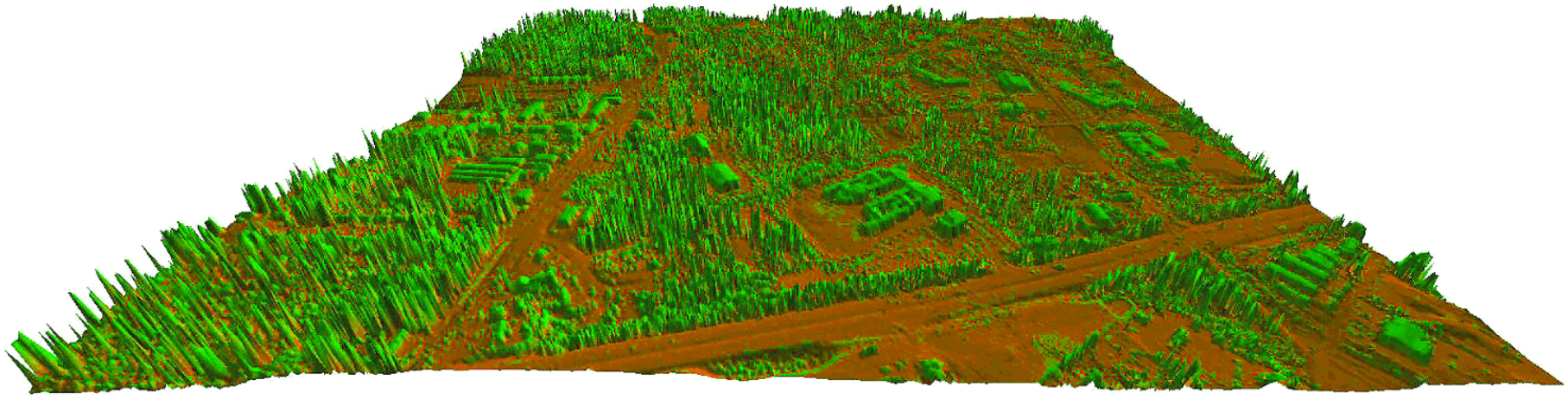
Hydro-electric dam, Puerto Rico

LiDAR: Light Detection and Ranging

What it is?

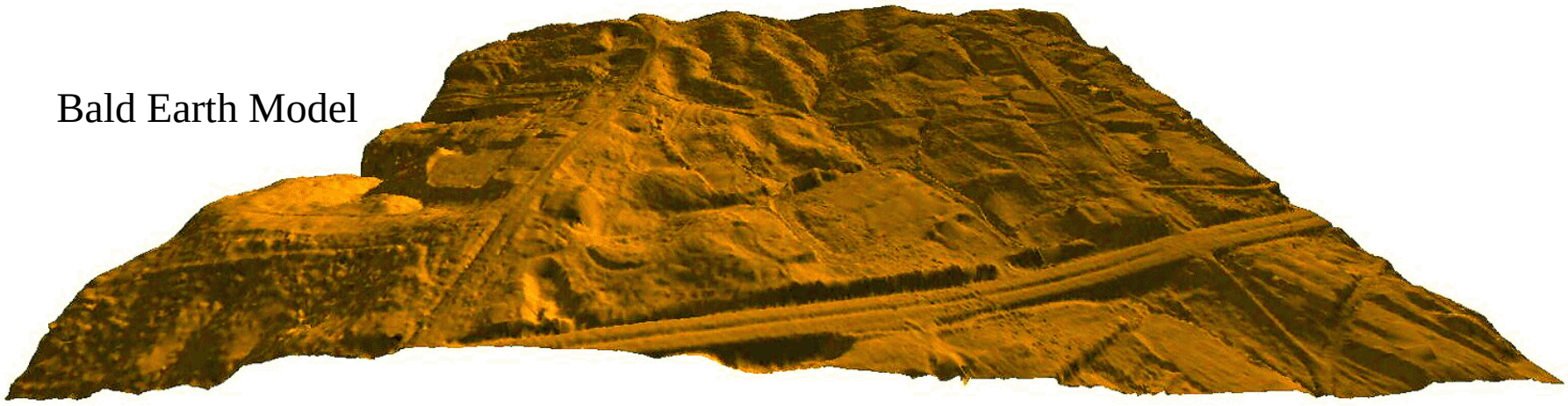


Automatic Filtering/Classification

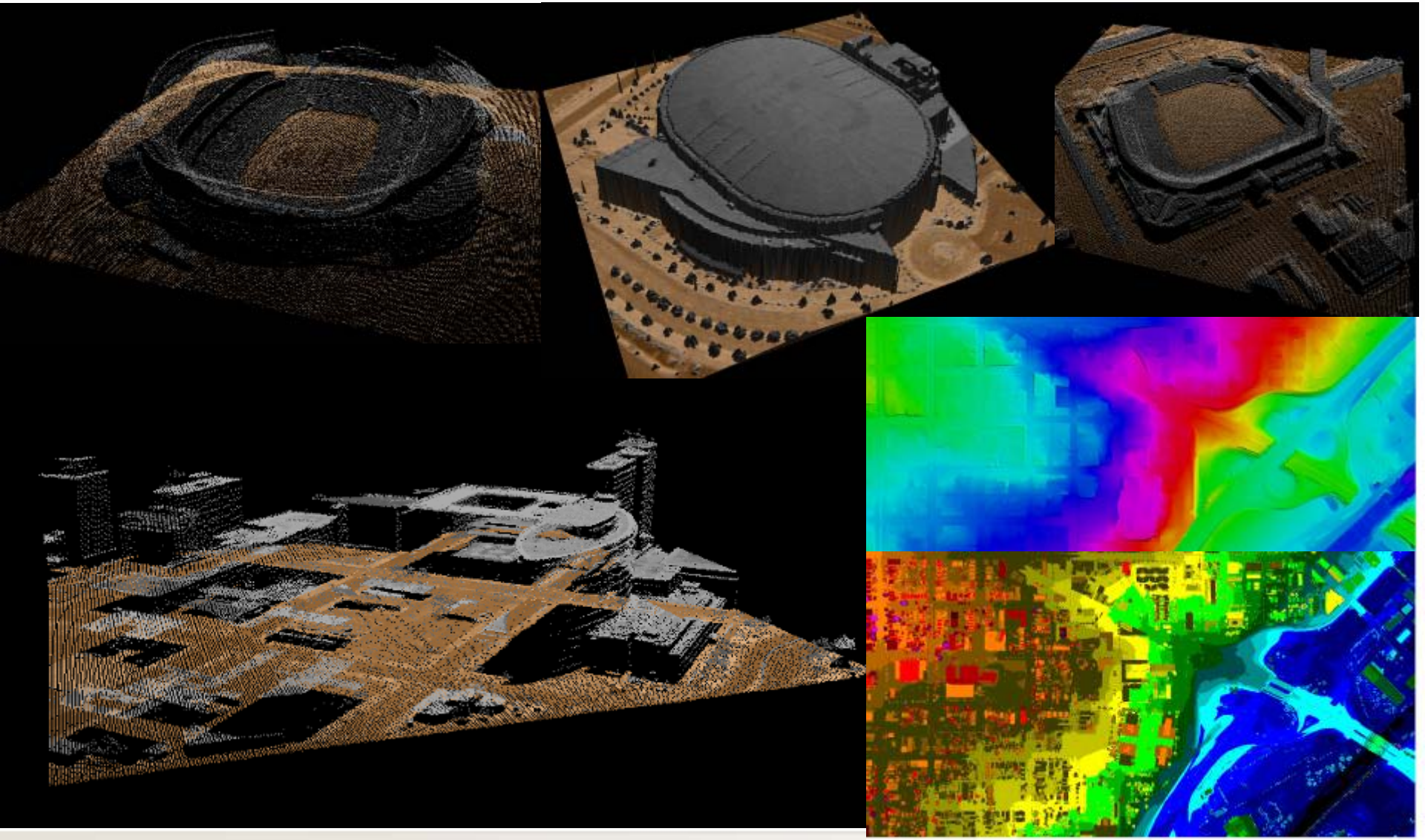


Note Vegetation, Buildings & Other Artifacts (in Green)

Bald Earth Model

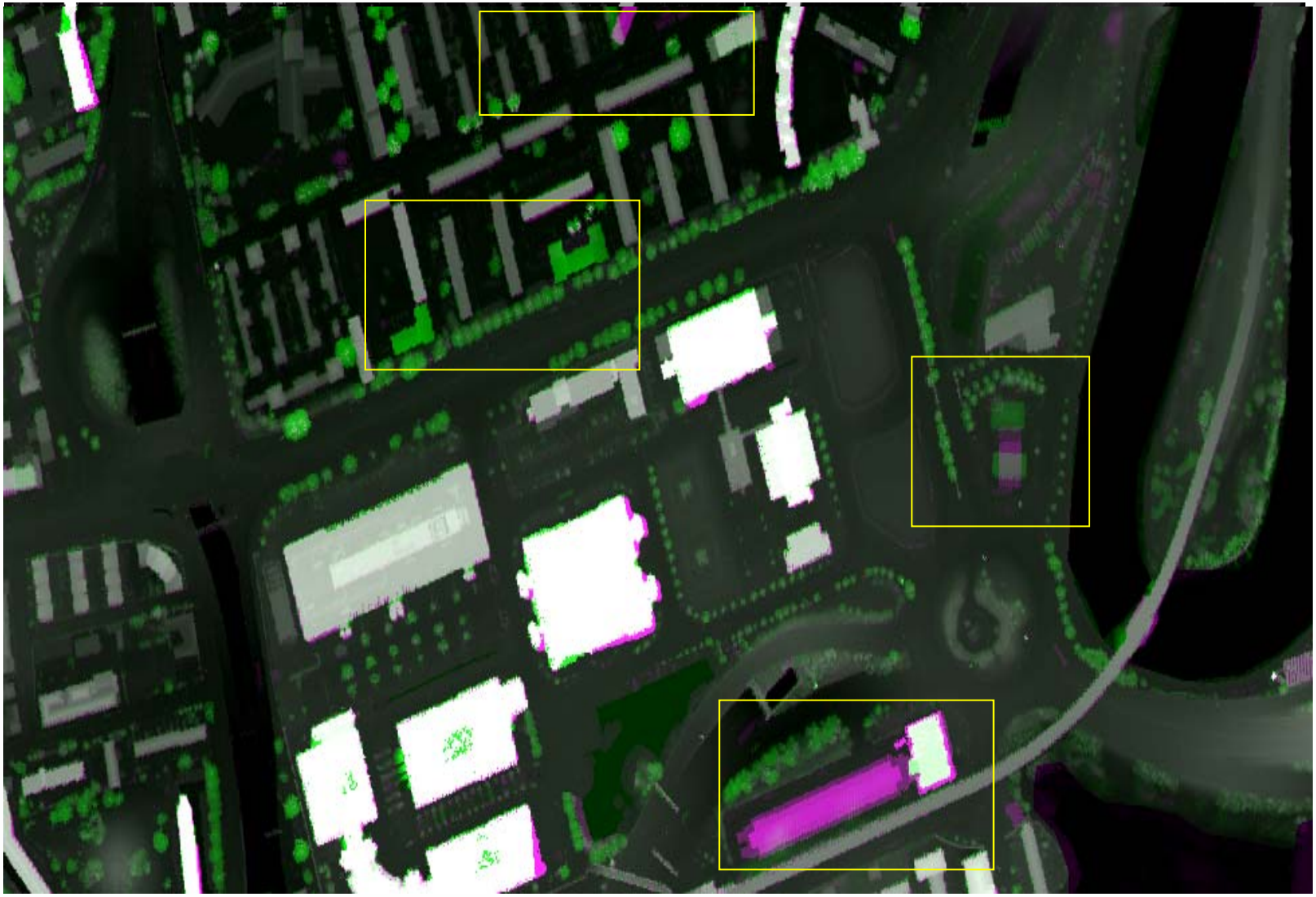


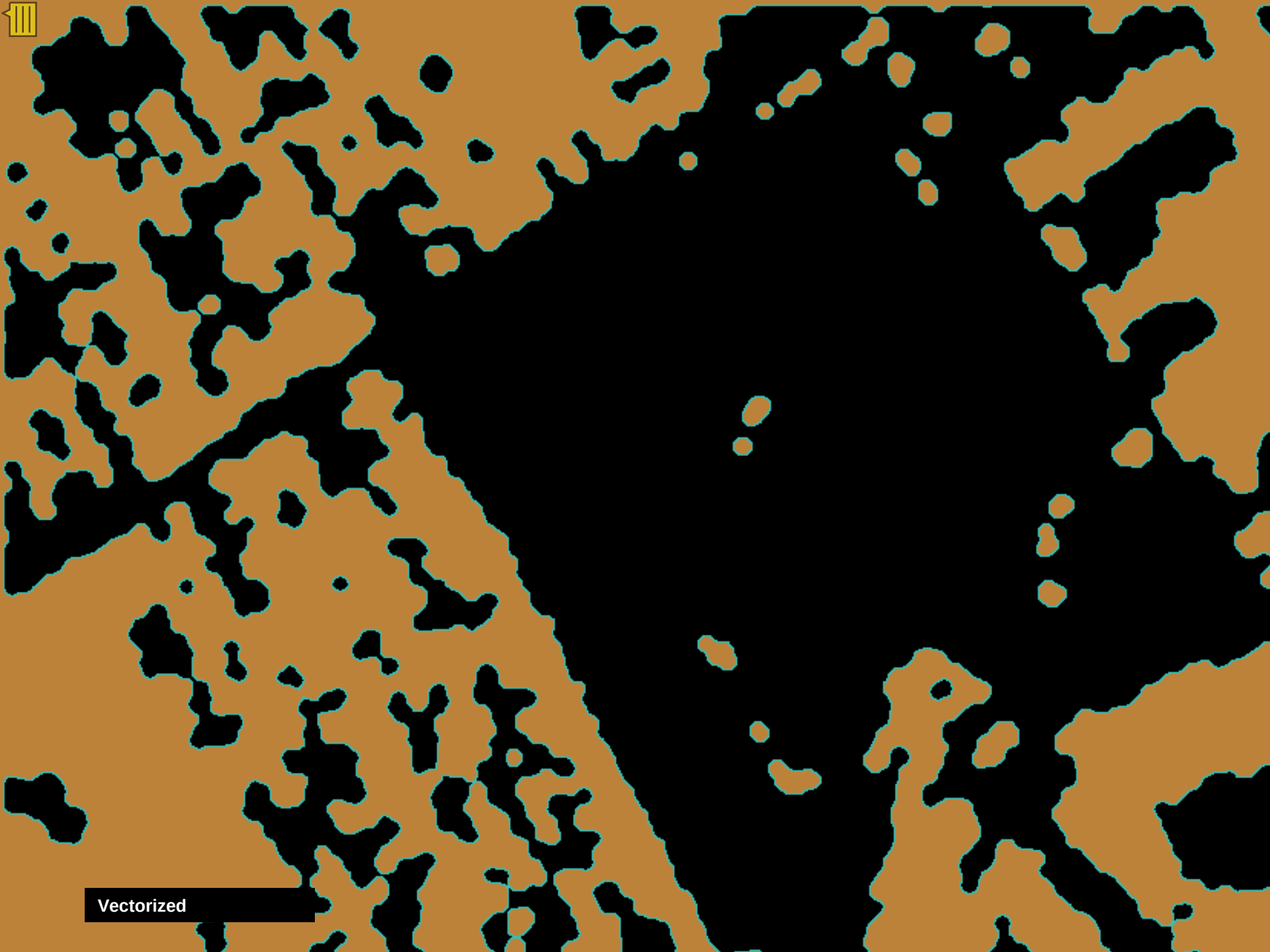
Data Samples



Application Trends for LiDAR

Change Detection




Vectorized

Application Trends for LiDAR

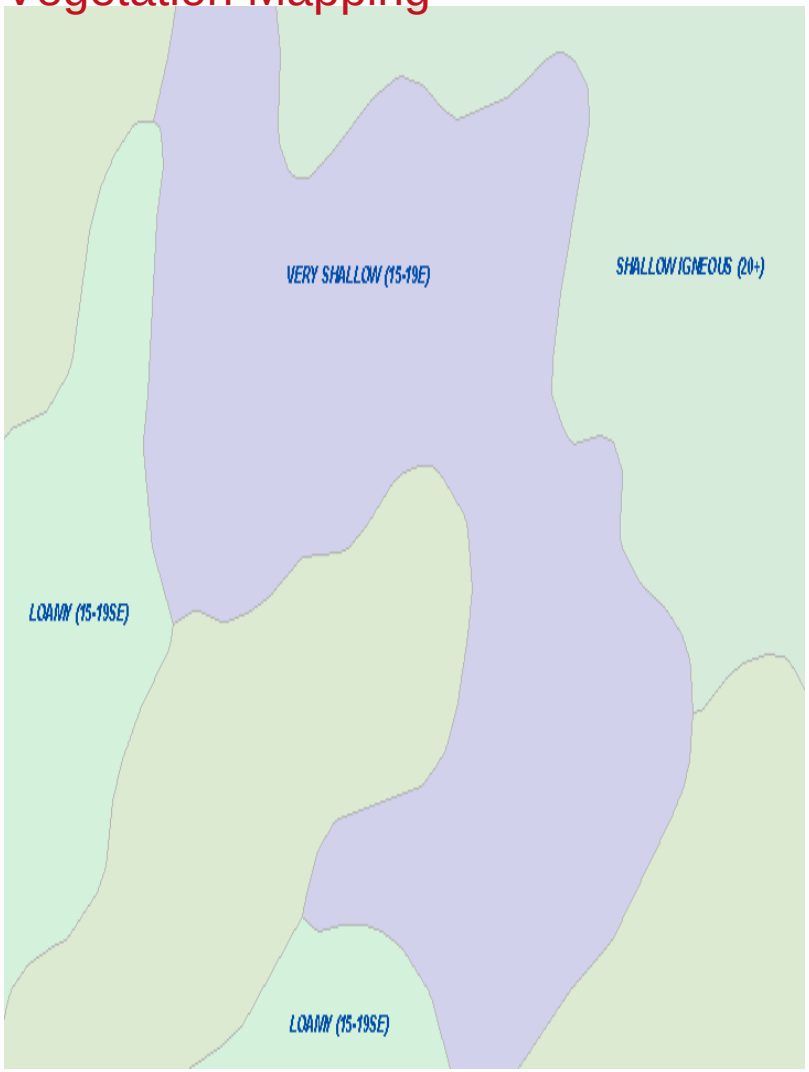
Building Extraction

Digital Surface Model

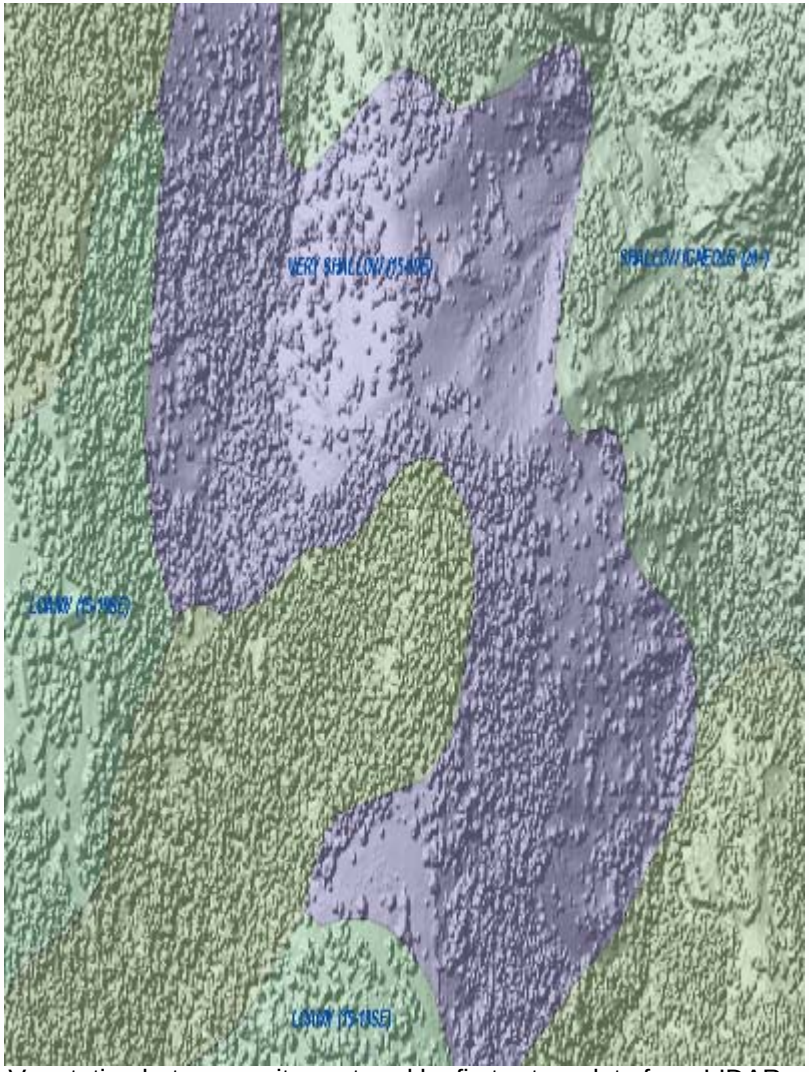
Building Footprints

Application Trends for LiDAR

Vegetation Mapping



Traditional polygons (from SSURGO)



Vegetation heterogeneity captured by first-return data from LIDAR

Slide provided by USDA Natural Resources Conservation Service
Wyoming State Office GIS

Integration of LiDAR and Imagery for Decision Support Systems

LiDAR

3-D Point Cloud
Bald Earth Models
Applications

Multi-Spectral Imagery

Digital Sensors
4 Band Color / Infrared
Ortho's geo-referencing

Remote Sensing Products

Land Cover
Invasive Species
Fuels Modeling

Geographic Information System Analysis

Fire Risk Assessment
Ecosystem Management
Forest Management

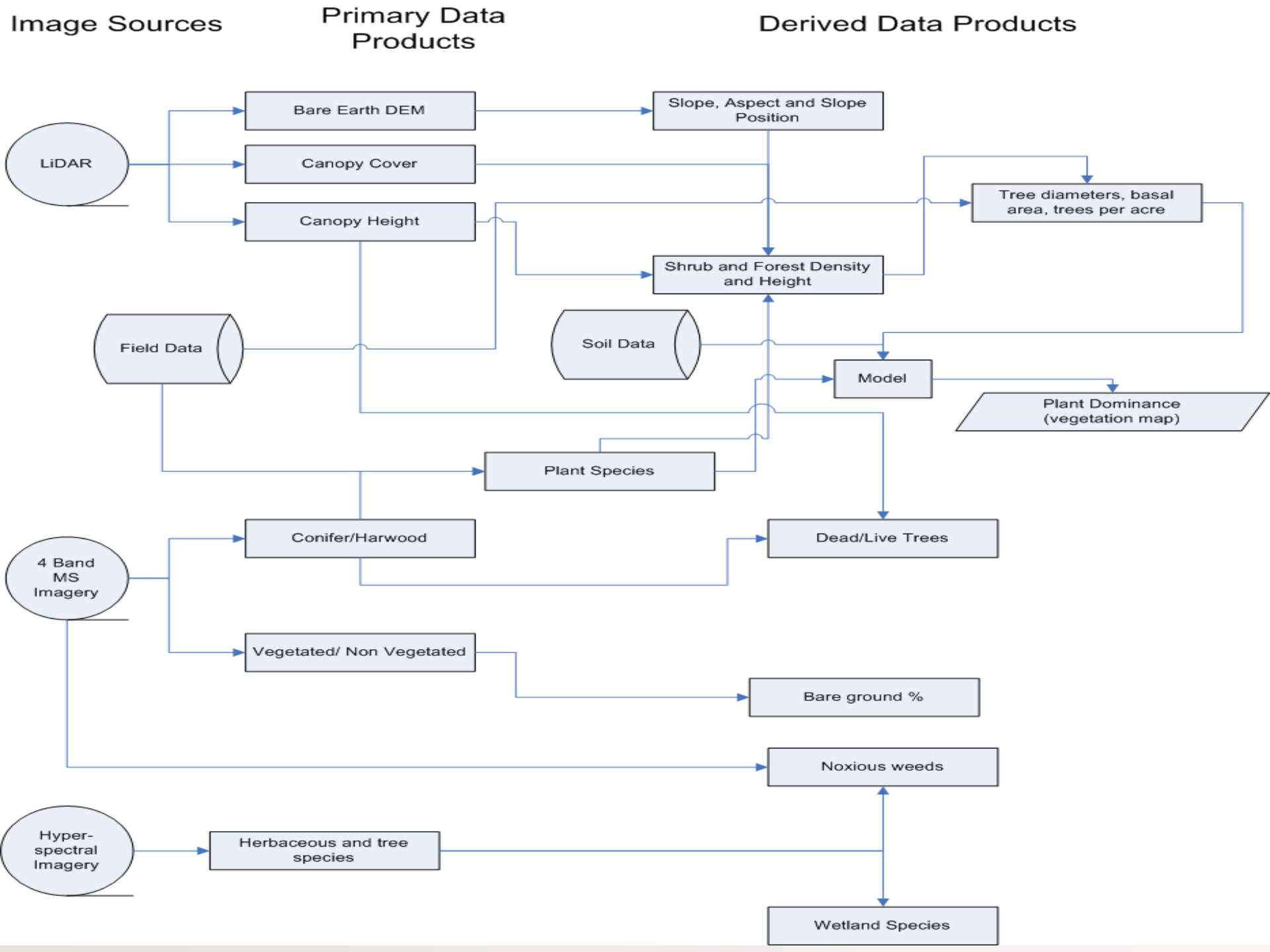
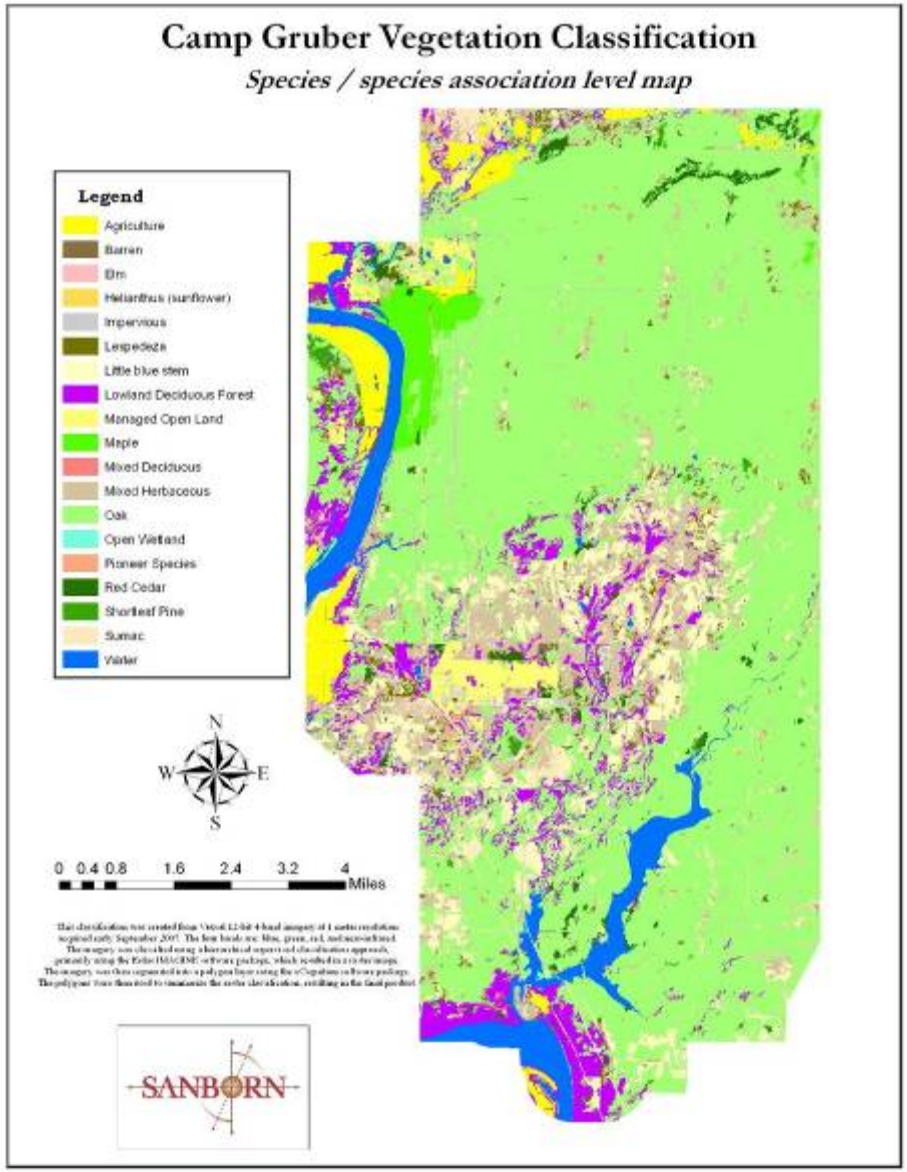


Image Sources
Primary Data Products
Derived Data Products
LiDAR
Bare Earth DEM
Canopy Cover
Canopy Height
Slope, Aspect and Slope Position
Tree diameters, basal area, trees per acre
Shrub and Forest Density and Height
Field Data
Soil Data
Model
Plant Dominance (vegetation map)
Plant Species
Conifer/Harwood
Dead/Live Trees
4 Band MS Imagery
Vegetated/ Non Vegetated
Bare ground %
Noxious weeds
Hyper-spectral Imagery
Herbaceous and tree species
Wetland Species

Forest Habitat Mapping

- Sanborn uses imagery and LiDAR data to distinguish certain vegetation species level classifications can be done
- Forest Density can be derived from canopy closure, tree size can be derived from LiDAR information
- Fuels mapping can be built from the land cover maps
- Habitat types maps can be built from the soils, land cover and field work

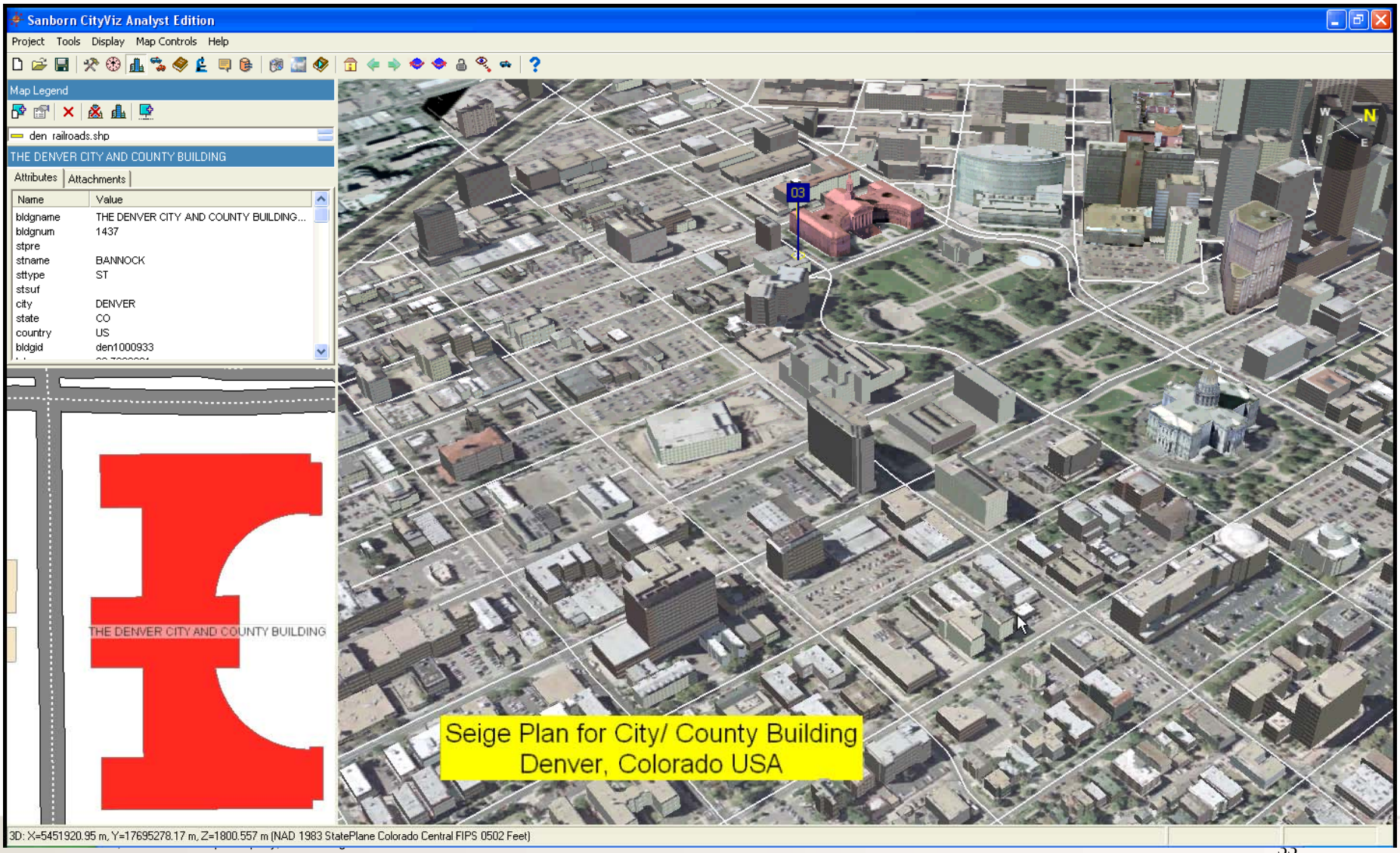


Project Profile

Emergency Planning: Taum Sauk Reservoir

CityViz - Common Operating Picture

SANBORN



Questions