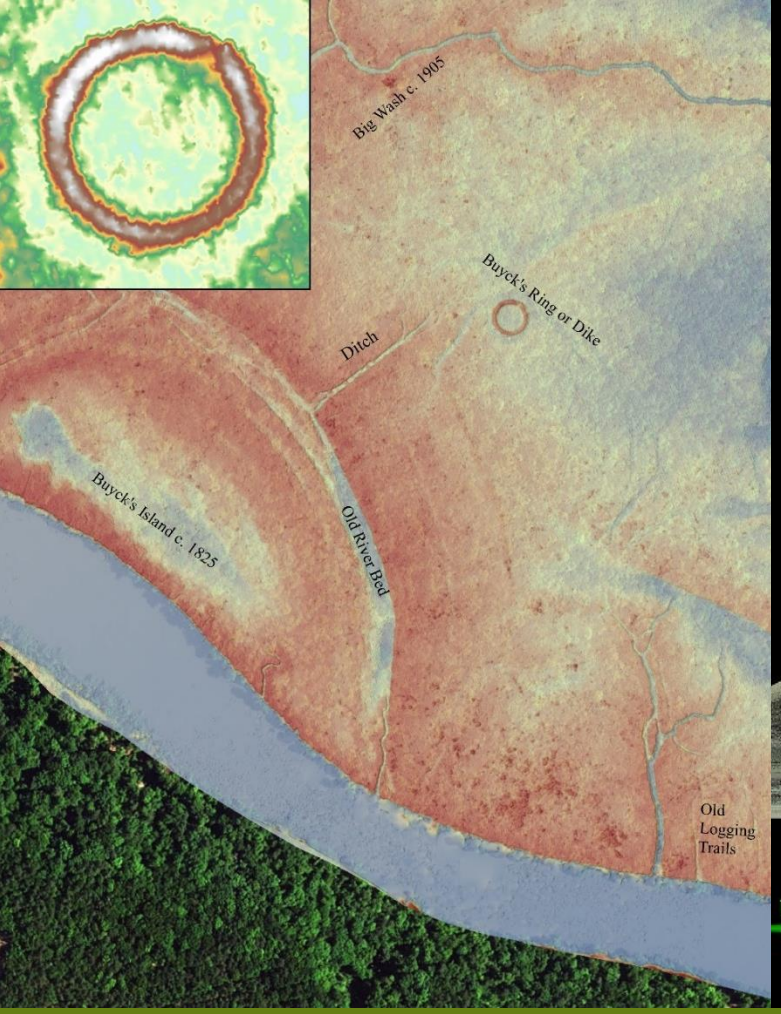

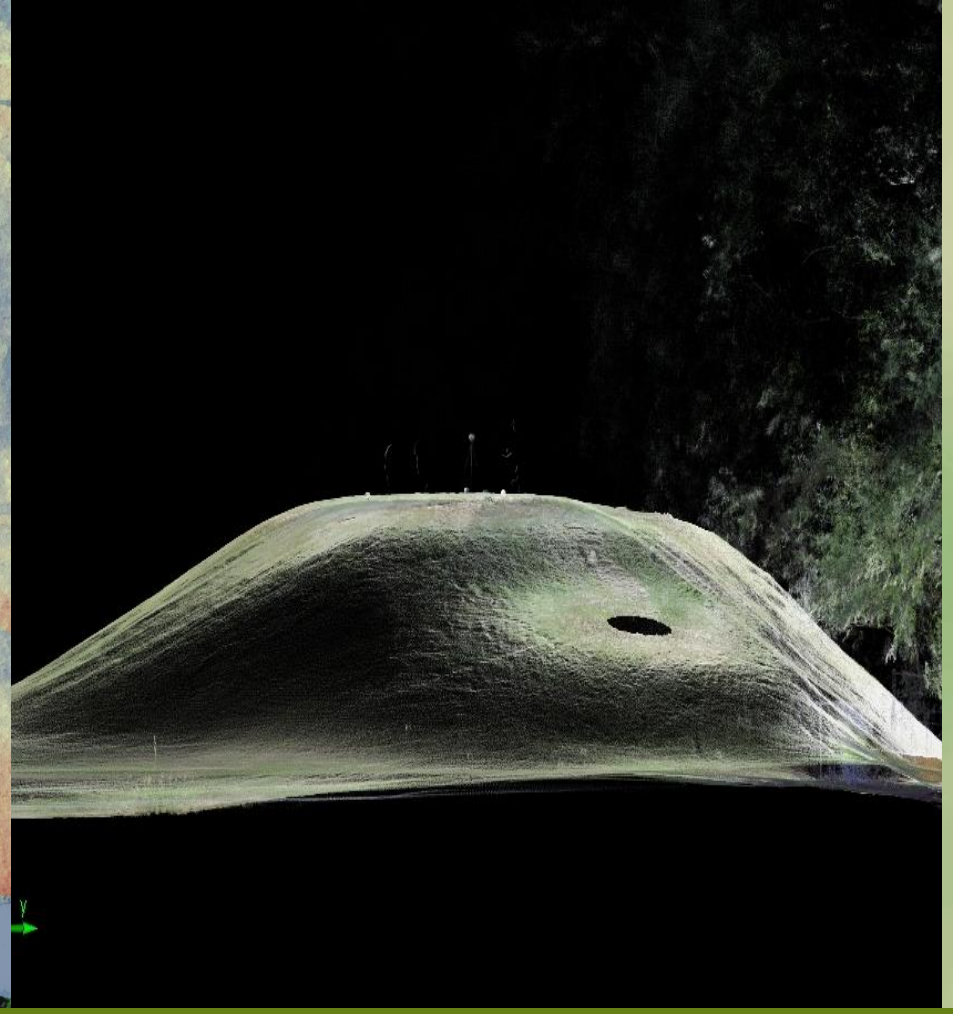

USE OF AERIAL AND TERRESTRIAL LIDAR FOR ARCHAEOLOGICAL PROSPECTION, MAPPING AND MONITORING

LORI COLLINS, RESEARCH ASSOCIATE PROFESSOR
CONTRIBUTIONS BY: RICHARD MCKENZIE AND GARRETT SPEED, DHHC USF LIBRARIES

USF UNIVERSITY OF SOUTH FLORIDA libraries
DHHC DIGITAL HERITAGE & HUMANITIES COLLECTIONS
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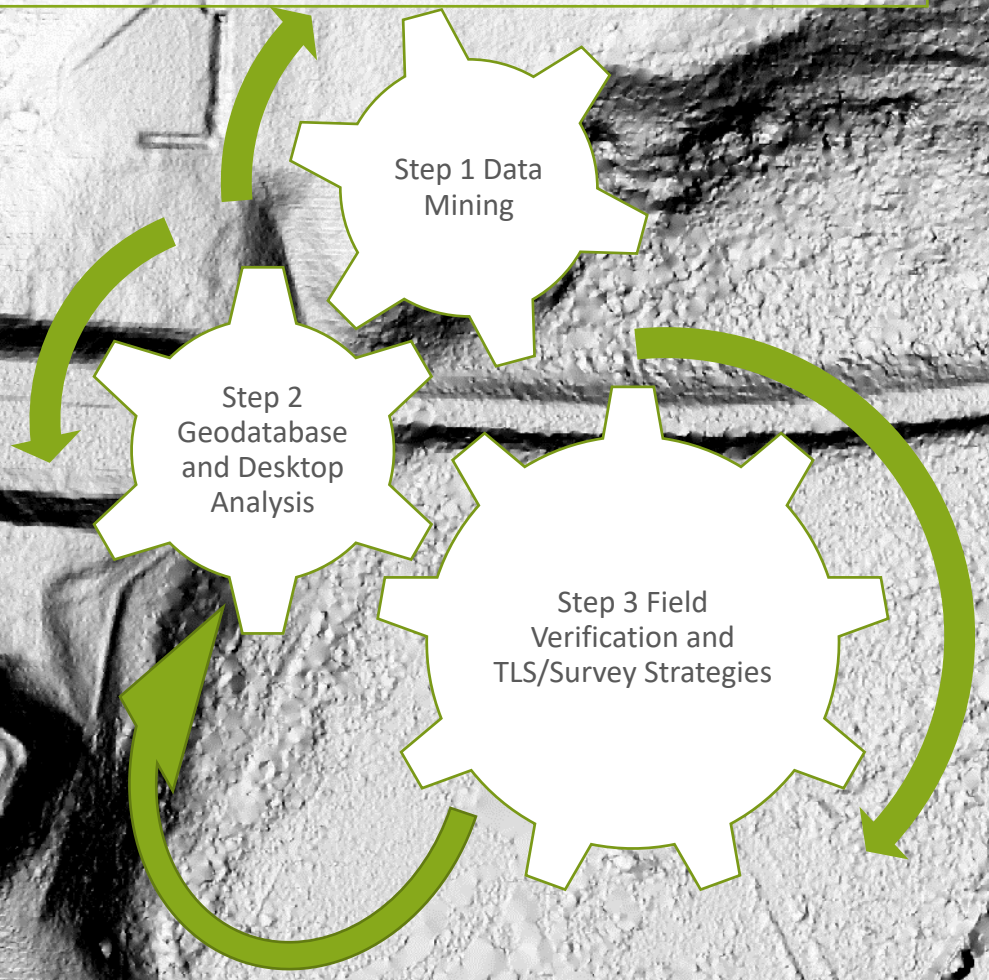
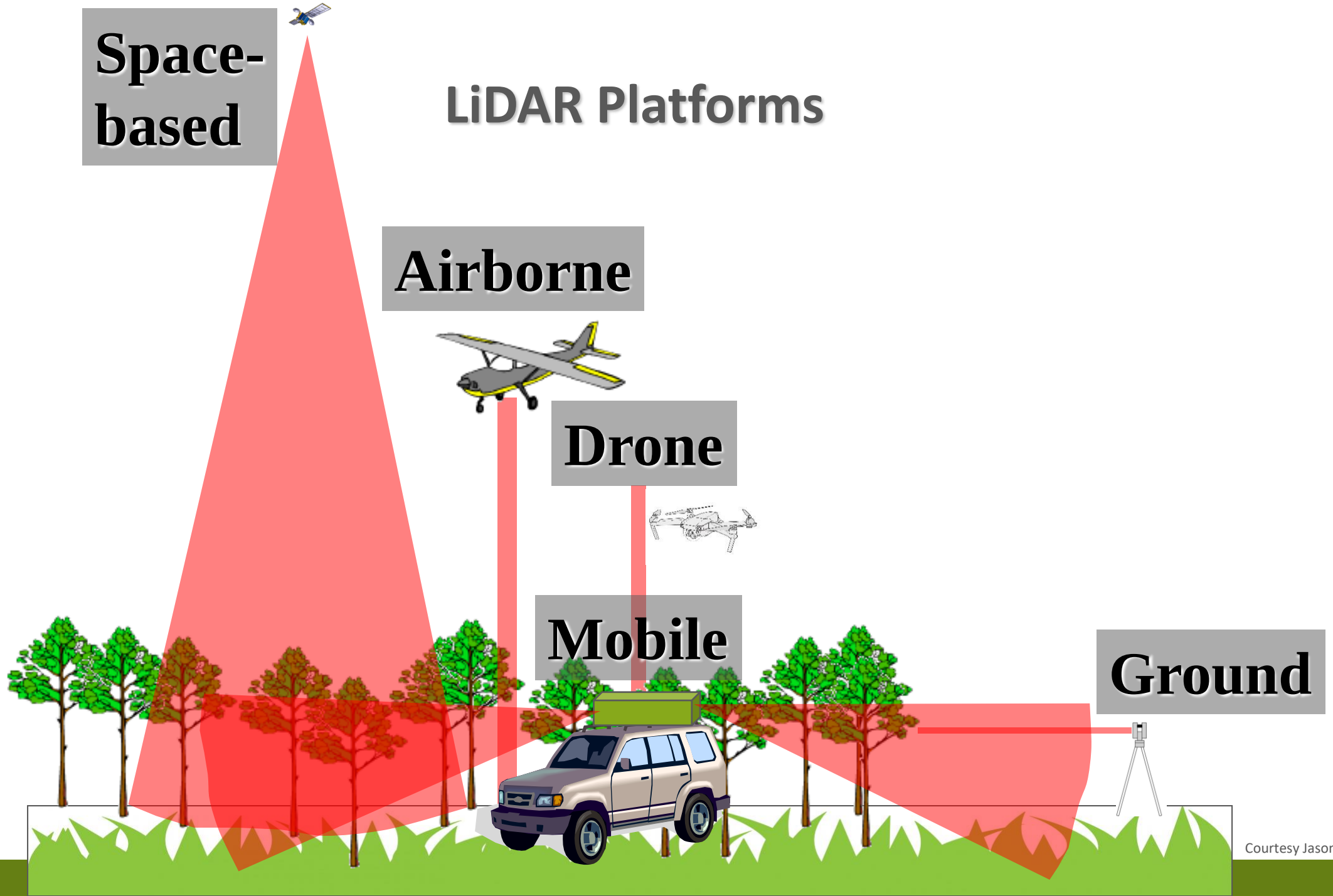
AERIAL AND TERRESTRIAL SURVEY WORKFLOWS

- Workflow from project planning applications to modeling and result dissemination
- Multiple platforms and tools
- Integrated survey strategies
- Scalar and temporal needs are critical factors



LiDAR Platforms

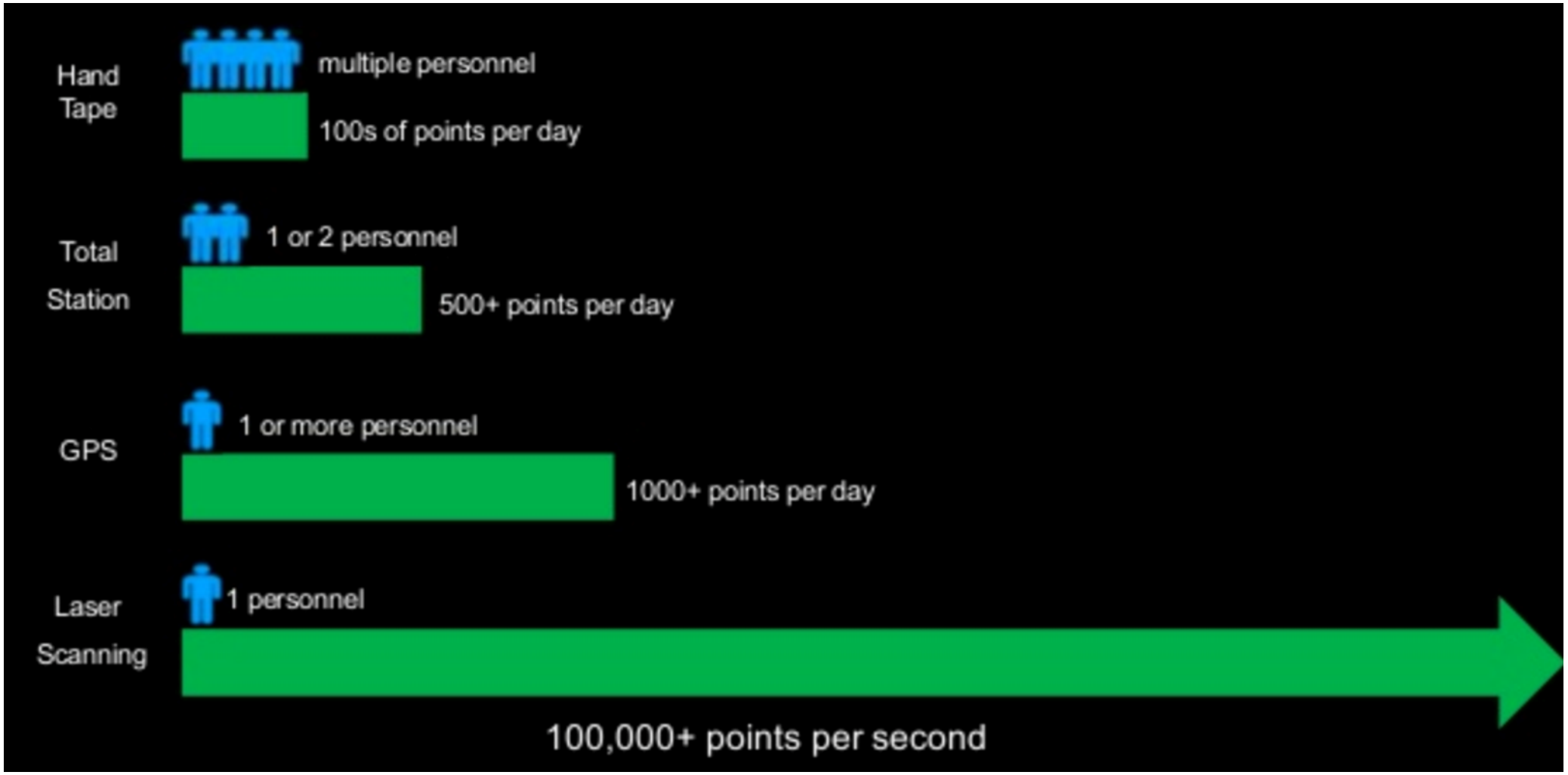


Courtesy Jason Stoker, USGS

Courtesy Jason Stoker, USGS

TRADITIONAL METHODS OF SURVEY

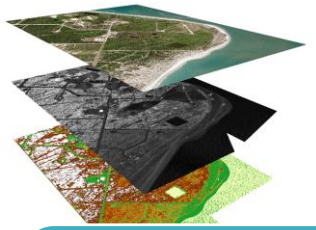
SURVEY PRODUCTIVITY IMPROVEMENTS



ARCHAEOLOGICAL WORKFLOW TO BE DISCUSSED

- Historical map and aerial review
- Processing and use of multiple years and/or available LiDAR datasets
- Combination of field truth verification, drone digital surface modeling, and terrestrial laser scanning with airborne LiDAR

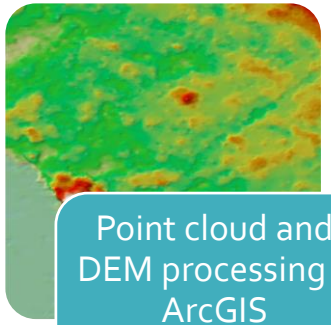
ALS AND TLS WORKFLOWS



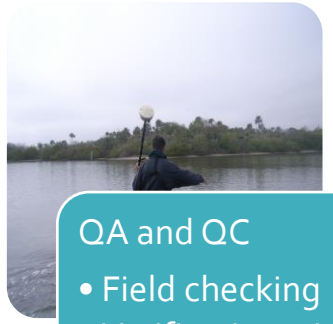
Data Mining, processing LiDAR (ALS), other relevant data, and assessing the gaps and field targets

Control placement

Data Acquisition/Field Survey



Point cloud and DEM processing – ArcGIS interpolation, LAStools, LiDAR Analyst, Cloud Compare



QA and QC

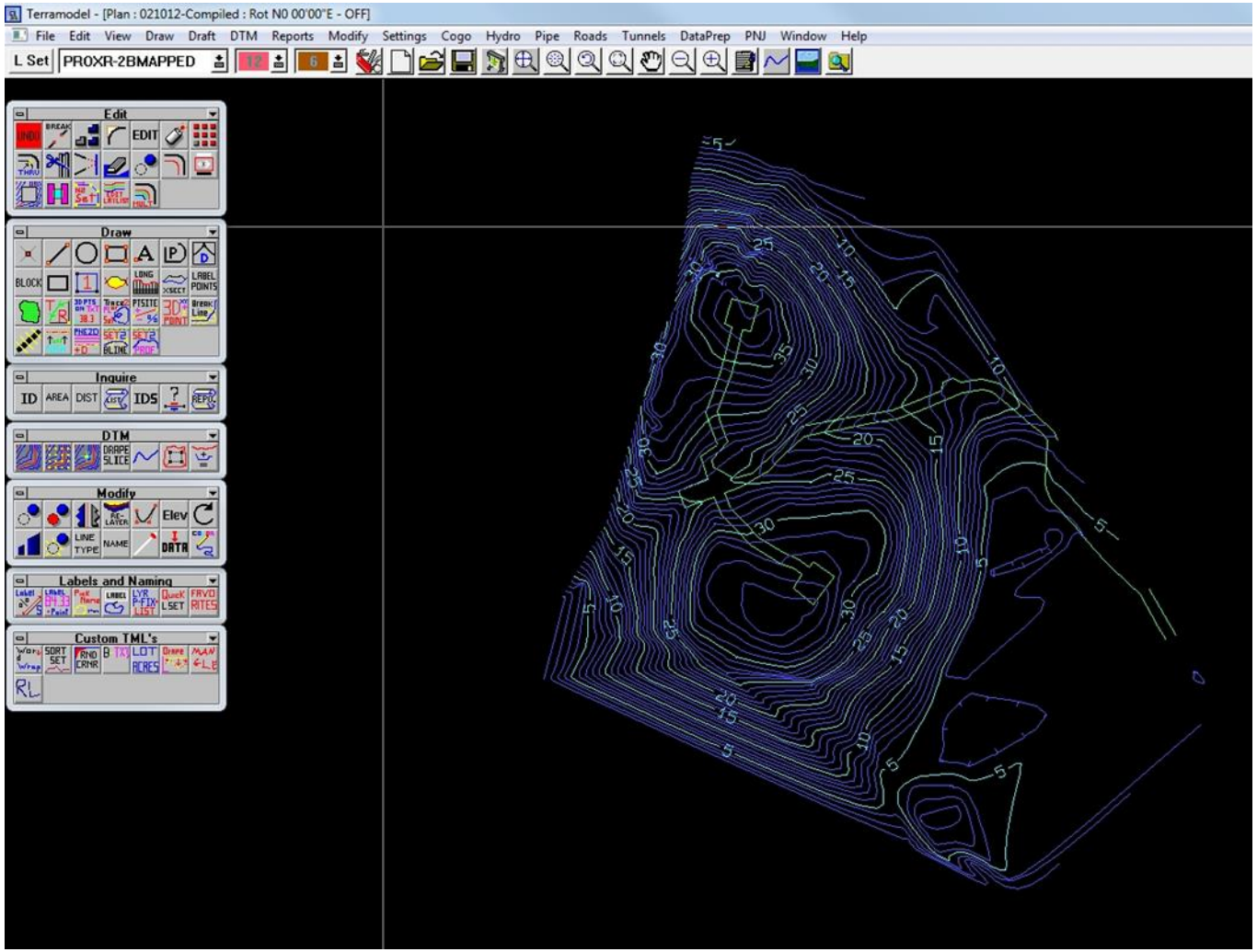
- Field checking
- Verification with previous data

Final Post processing of models and cartographic products

Ground Verification

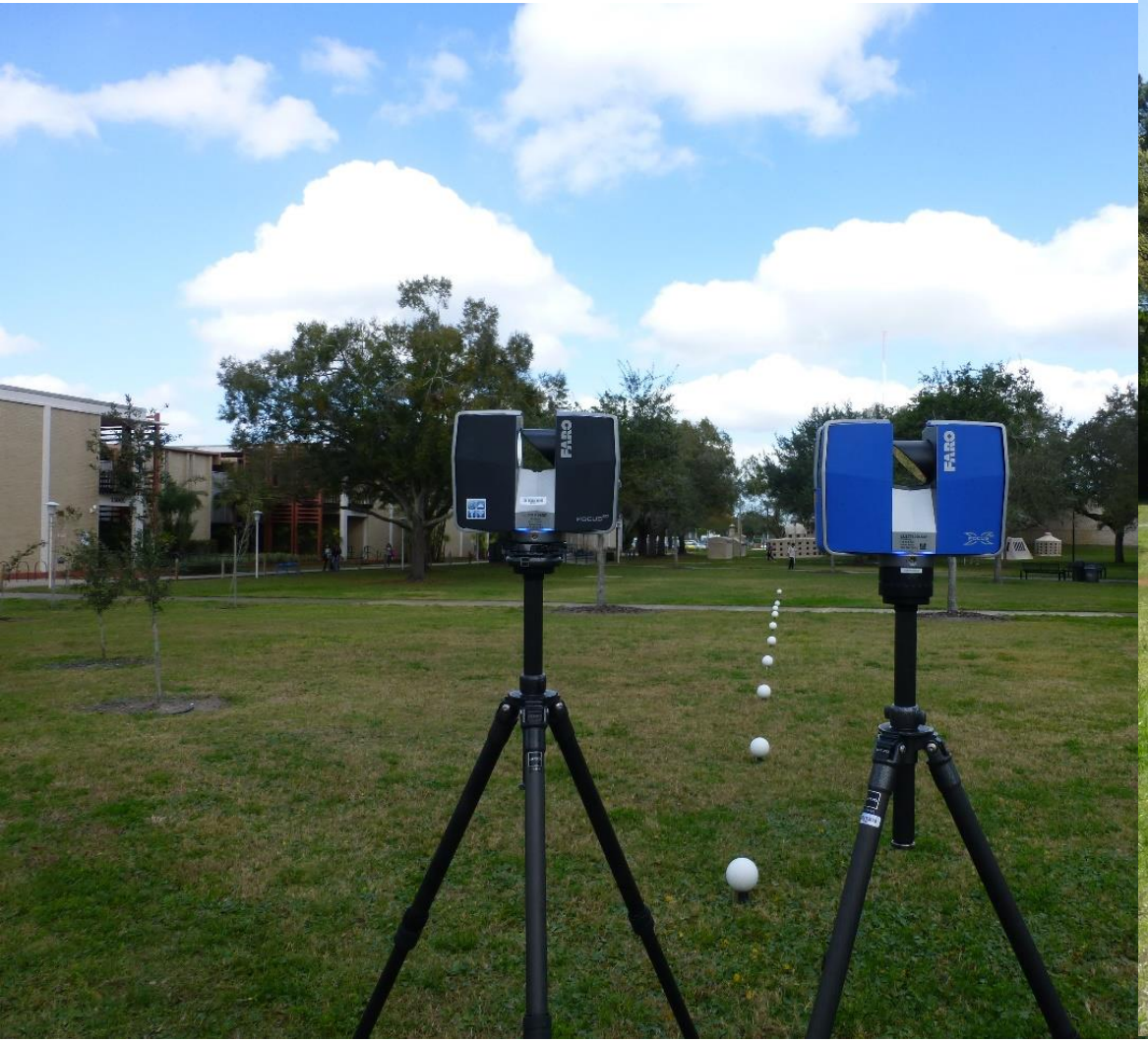
- Ground verification can involve total station, GPS topo work for elevation spot checking, and GPS rover data collection and feature delineation

GPS AND TOPO



- Ground truth aspect
- Ability to gap fill and to bring TLS together with ALS to improve resolution and scalar coverage
- Adding GPS/topo work to improve areas with no coverage and adding feature delineation
- Legacy data, Georeference and Control

INTEGRATED APPROACHES WITH ALS (LIDAR)



BENEFITS OF INTEGRATED SURVEY APPROACHES

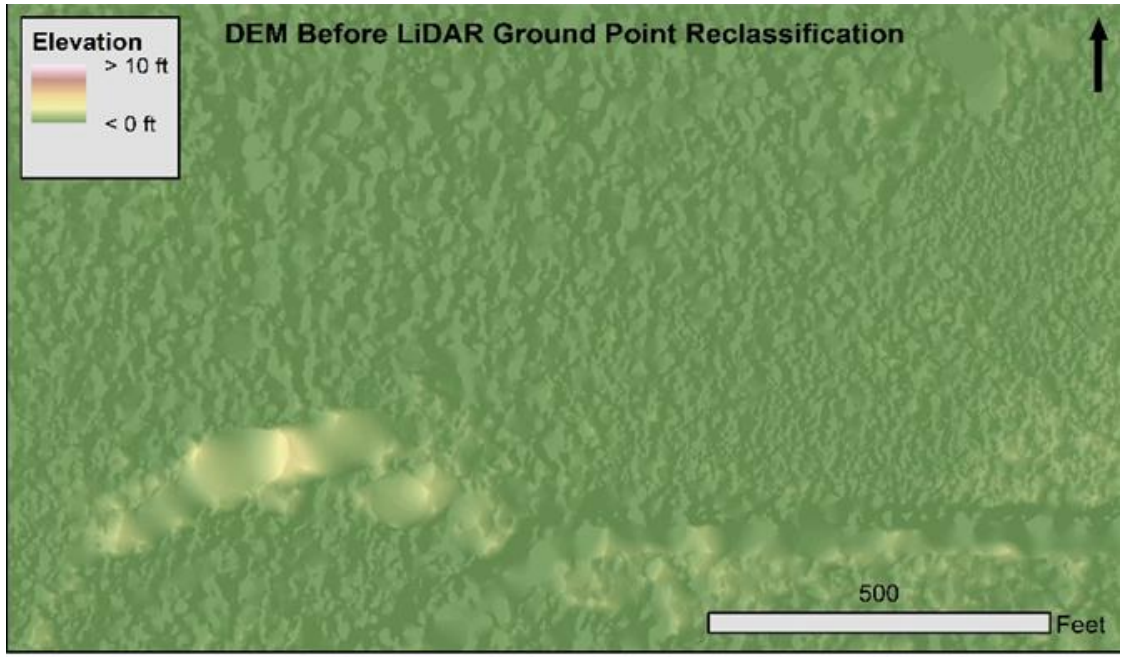
- Data richness
- When brought together with ALS, TLS (and potentially drone derived or other higher resolution platforms) improves representation and scalar potentials

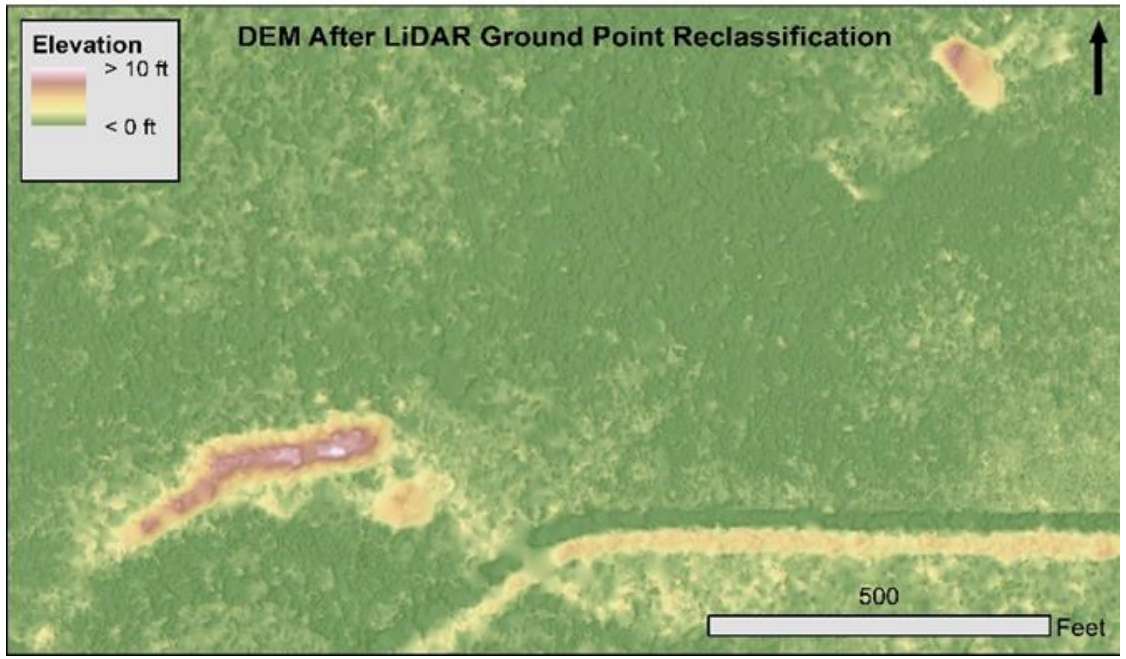
TLS BENEFITS

- Representative
- Accurate
- Elevation details for areas lacking aerial coverage
- Immersive and modeling potential and use with other platforms

ALS GEOPROCESSING IN ARCGIS PRO

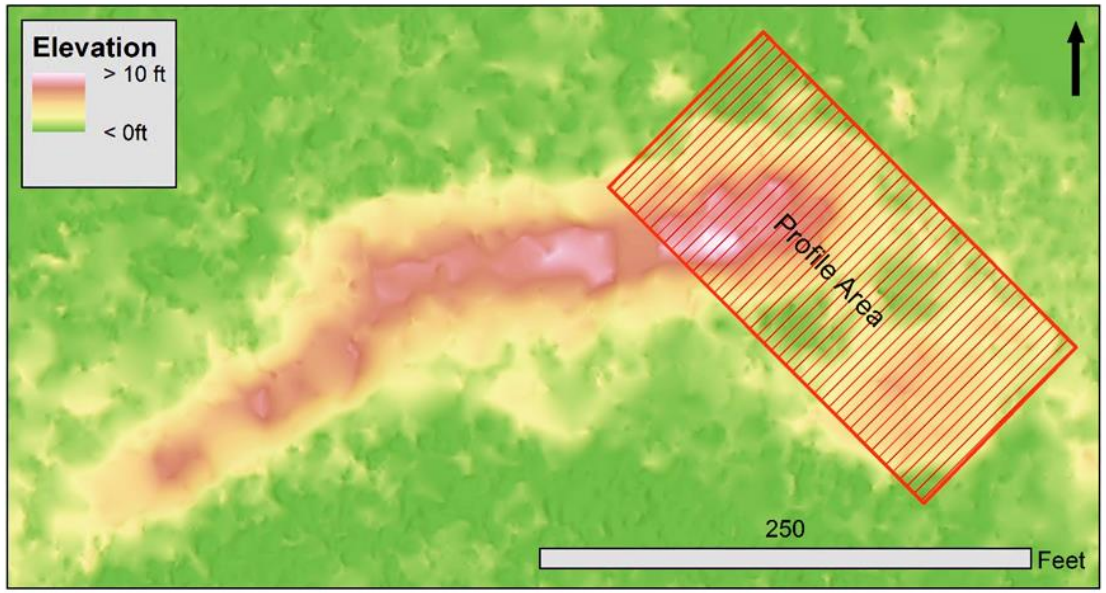
- LAS ground data were reclassified using the Classify LAS Ground geoprocessing tool in ArcGIS Pro Version 1.4.1.
- The tool uses last return LAS points with class codes 0, 1, 2 (ASPRS LAS file classification scheme version 1.4) when reclassifying LAS data as ground.
- Of the three available classification methods (Standard, Conservative, or Aggressive), the Aggressive method was used and existing ground points were also subject to reclassification.
- All other tool parameters were set to their defaults. It is important to note that although Esri does not recommend doing so on relatively flat surfaces, we had the most success using the Aggressive classification method on individual sites when compared other scenarios of tool usage.
- Furthermore, we had more success running the Classify LAS Ground tool on individual sites when compared to using the tool over a large area encompassing all of the sites.

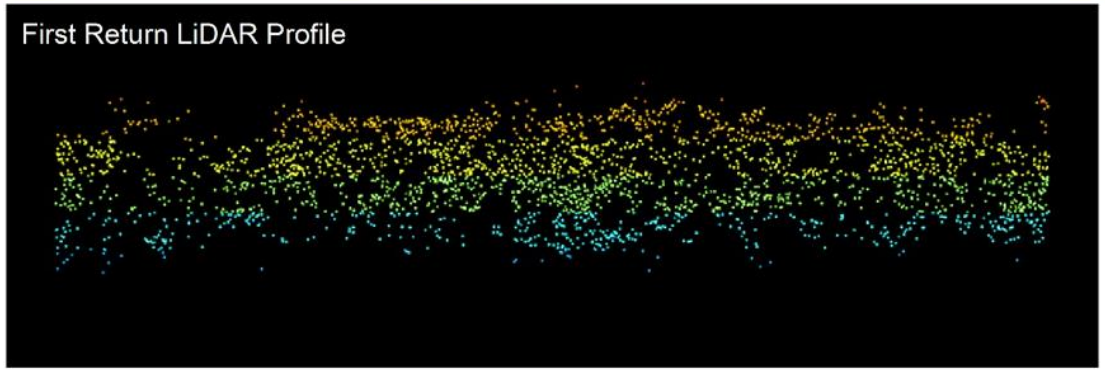


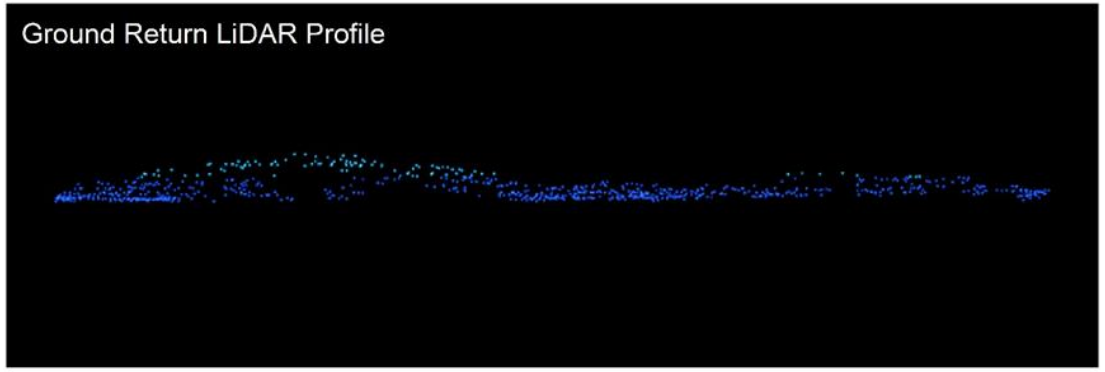


LIDAR PROCESSING DIFFERENCES

- Profiling tools in ArcGIS allow for elevation information to be analyzed in cross section (here showing an area between Mounds 1 and 2).
- The difference between examining first return data that is “noisy” with vegetation, and data processed to select ground return values are demonstrated.

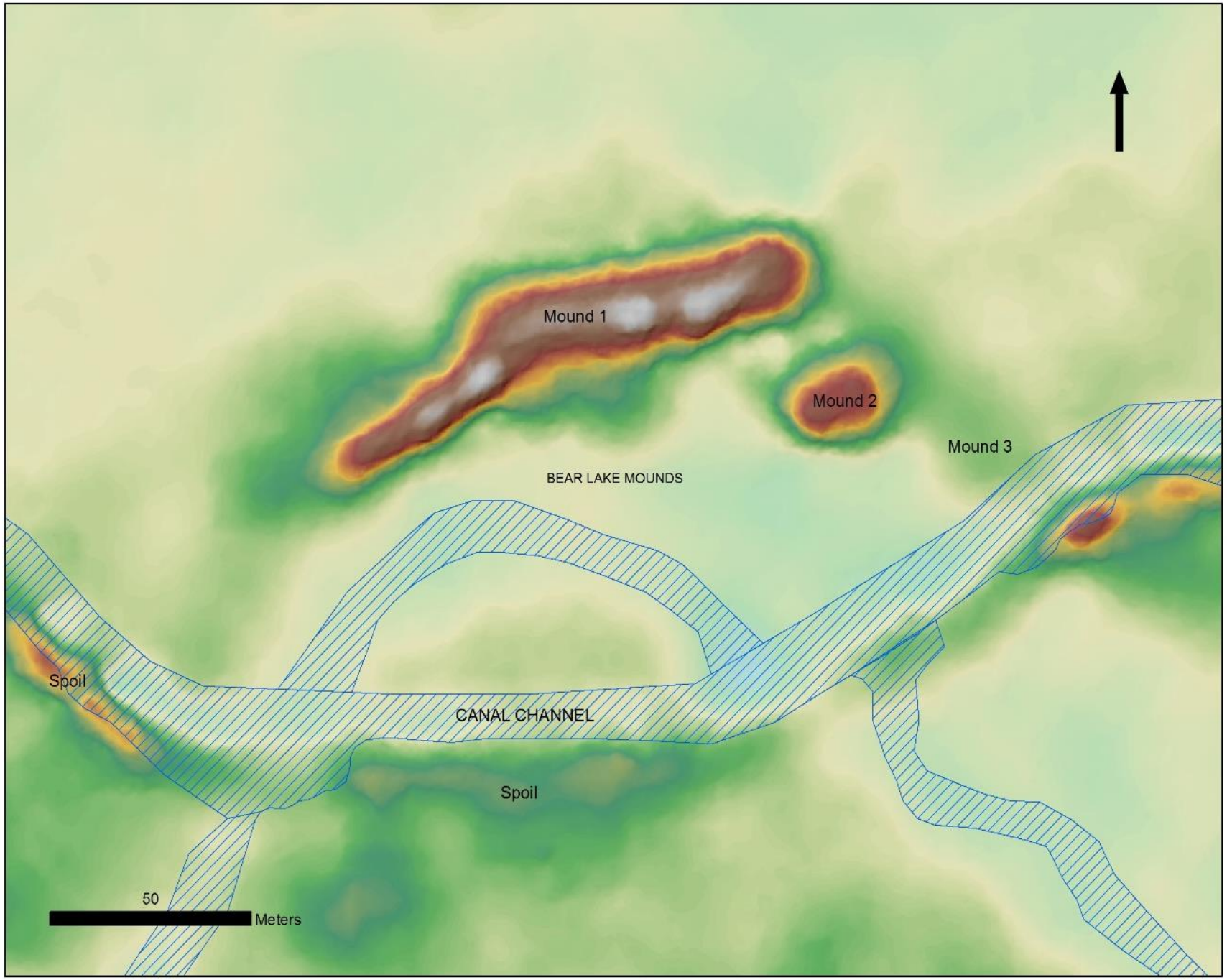






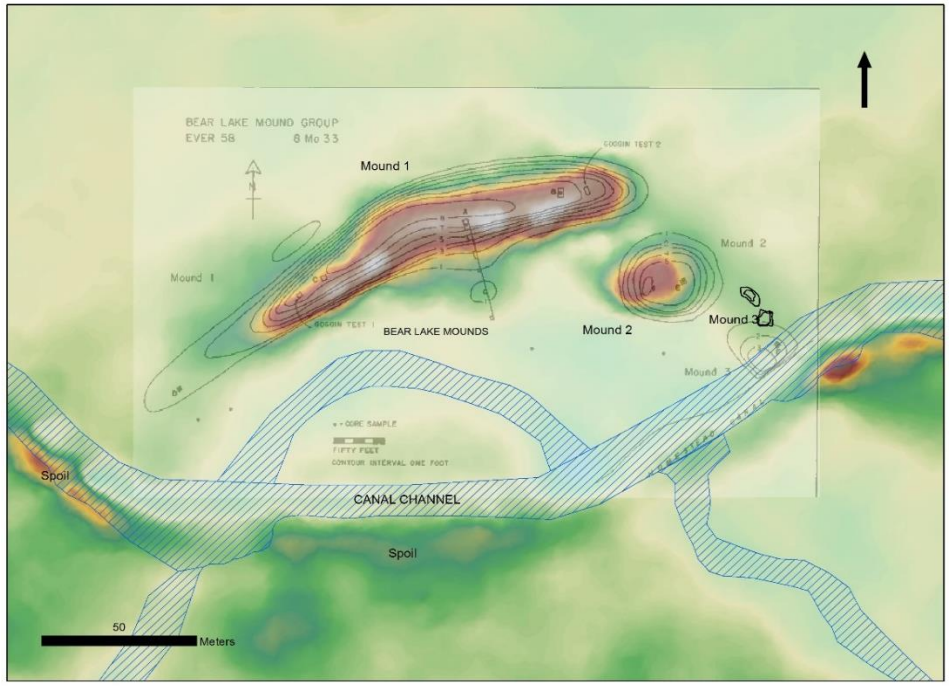
MODELING DIFFERENCES

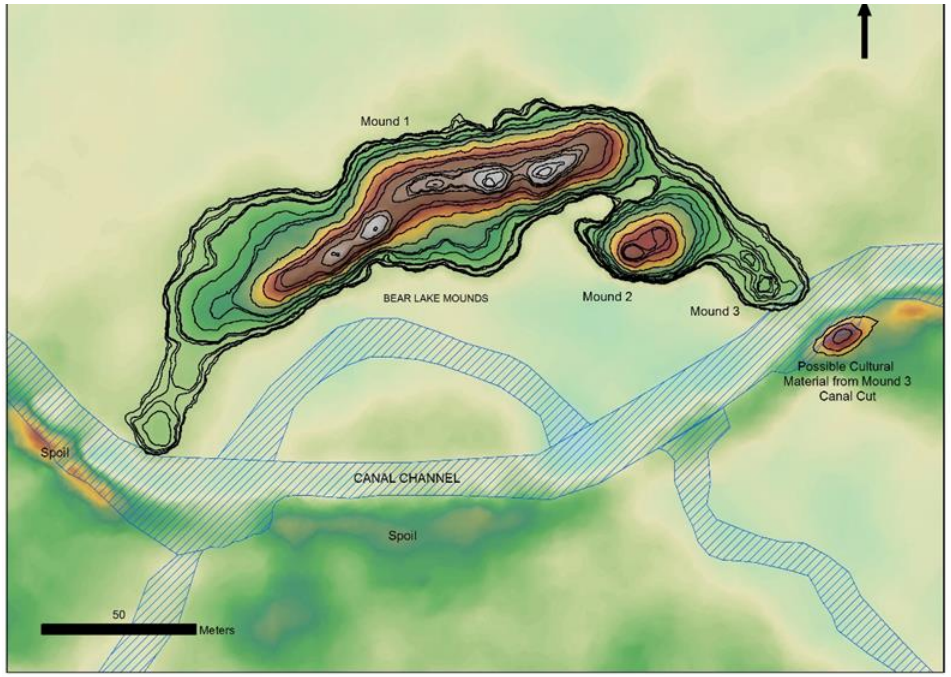
- 3D point cloud software was used to select outliers and also to manually clean “noisy” data from the aerial LiDAR.
- Allowed a cleaner ground surface model to emerge
- Imported back to ArcGIS for the creation of a DEM and shaded relief surface raster for more representative visualization.
- Multidirectional lighting to enhance terrain details



MODELING DIFFERENCES

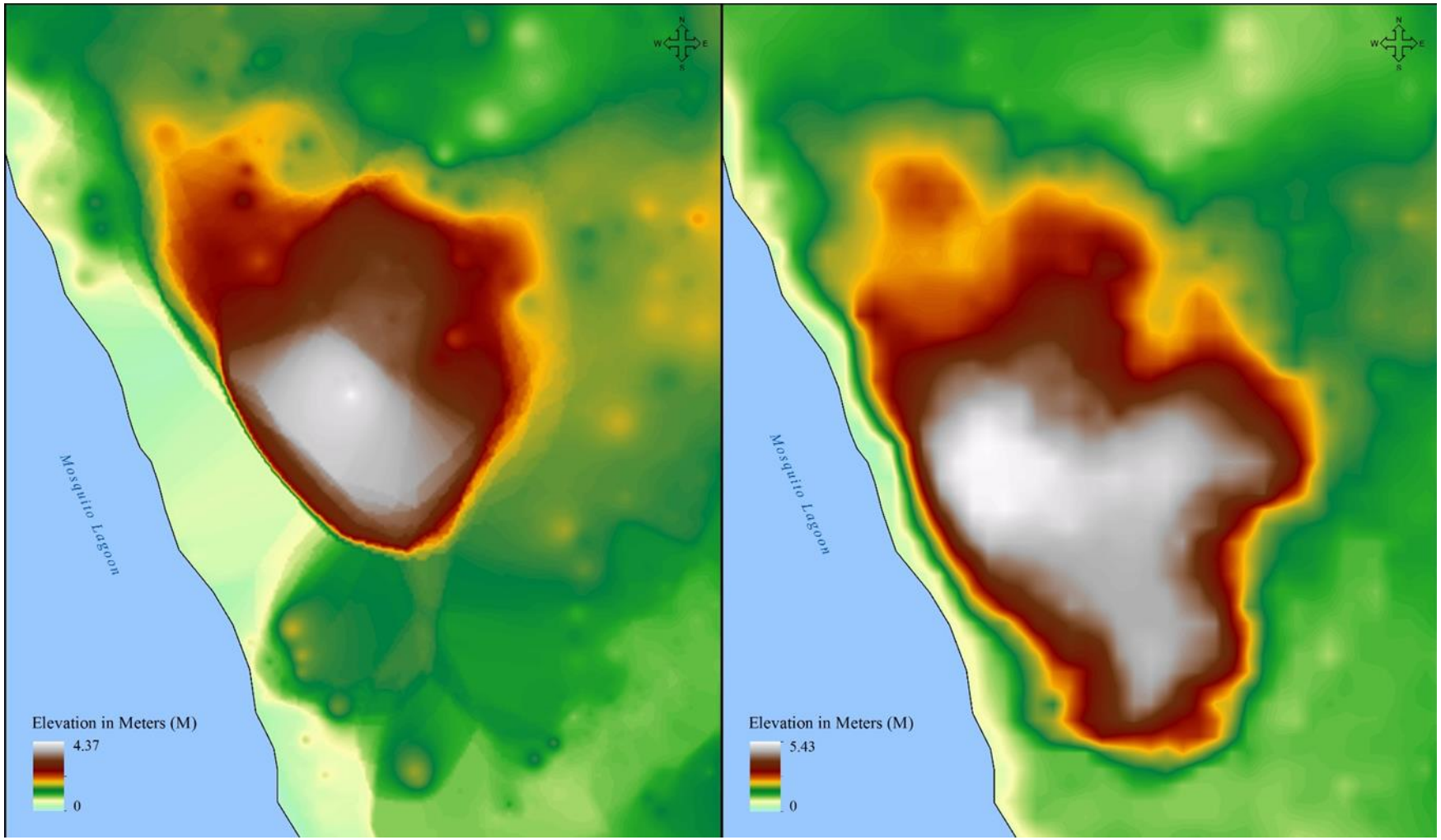
- Historic map overlain on the DEM shaded relief surface raster (above) shows slight differences in mound position and shape, as well as micro-topographical differences noted (below), with the aerial LiDAR providing a more robust and accurate model of the extant mound features.



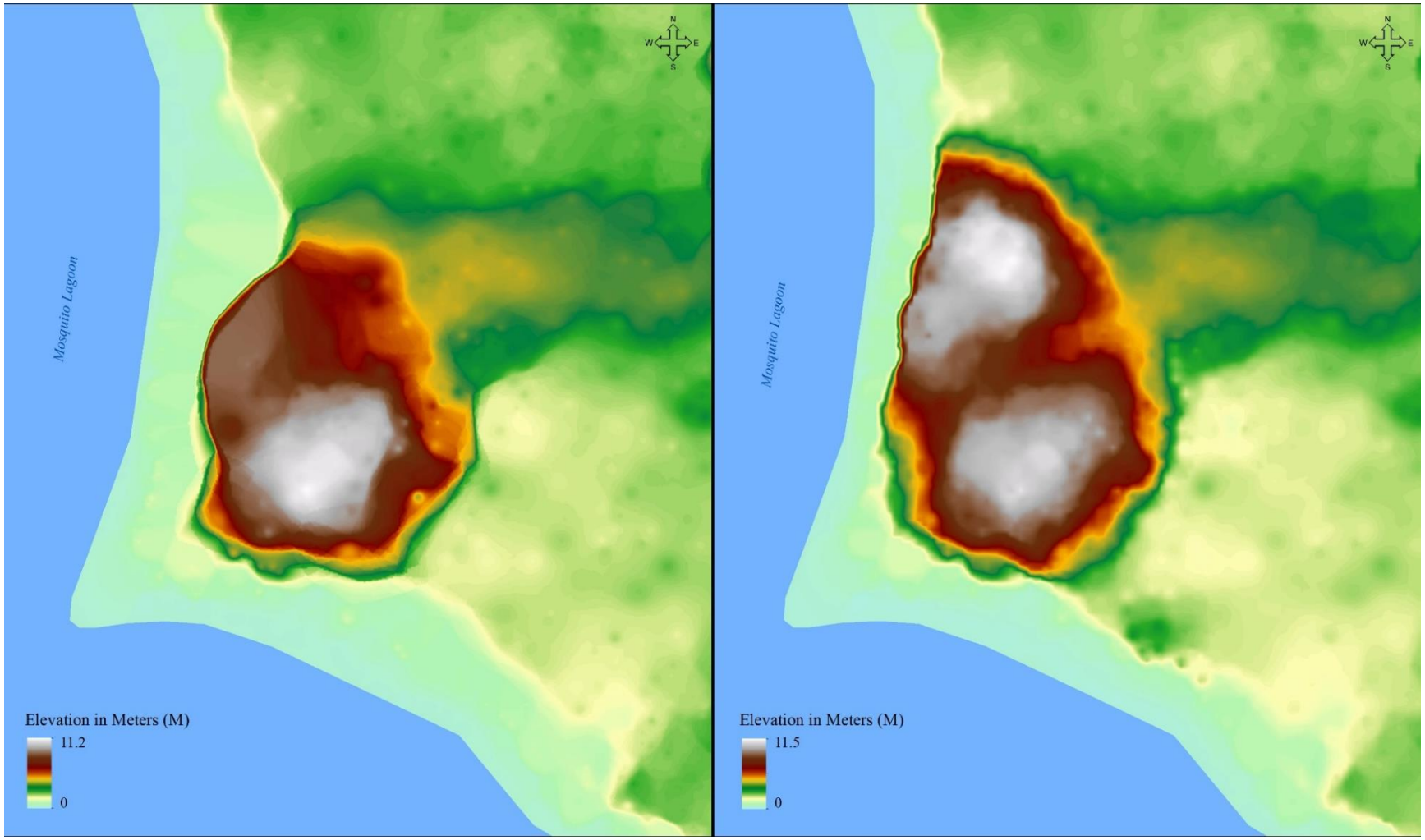


USE OF INTEGRATED DATA

- DEM from ALS data only (left)
- DEM from ALS integrated with TLS and GPS and total station topo data (right)

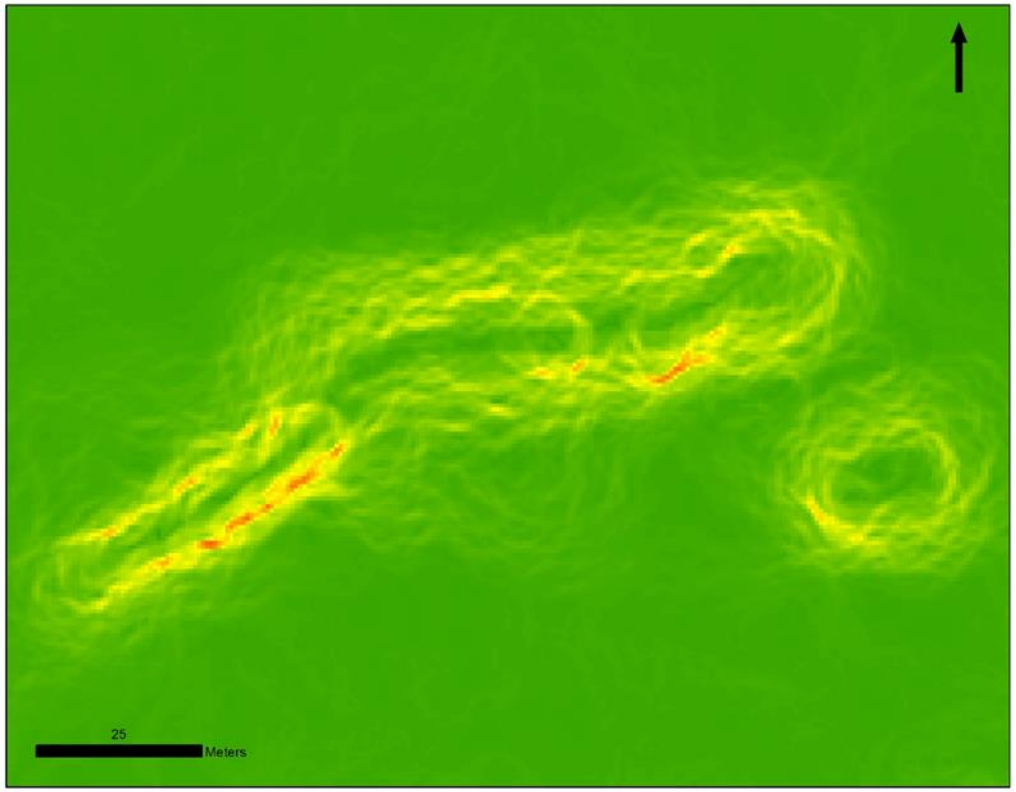


ALS VS. INTEGRATED SURVEY RESULTS



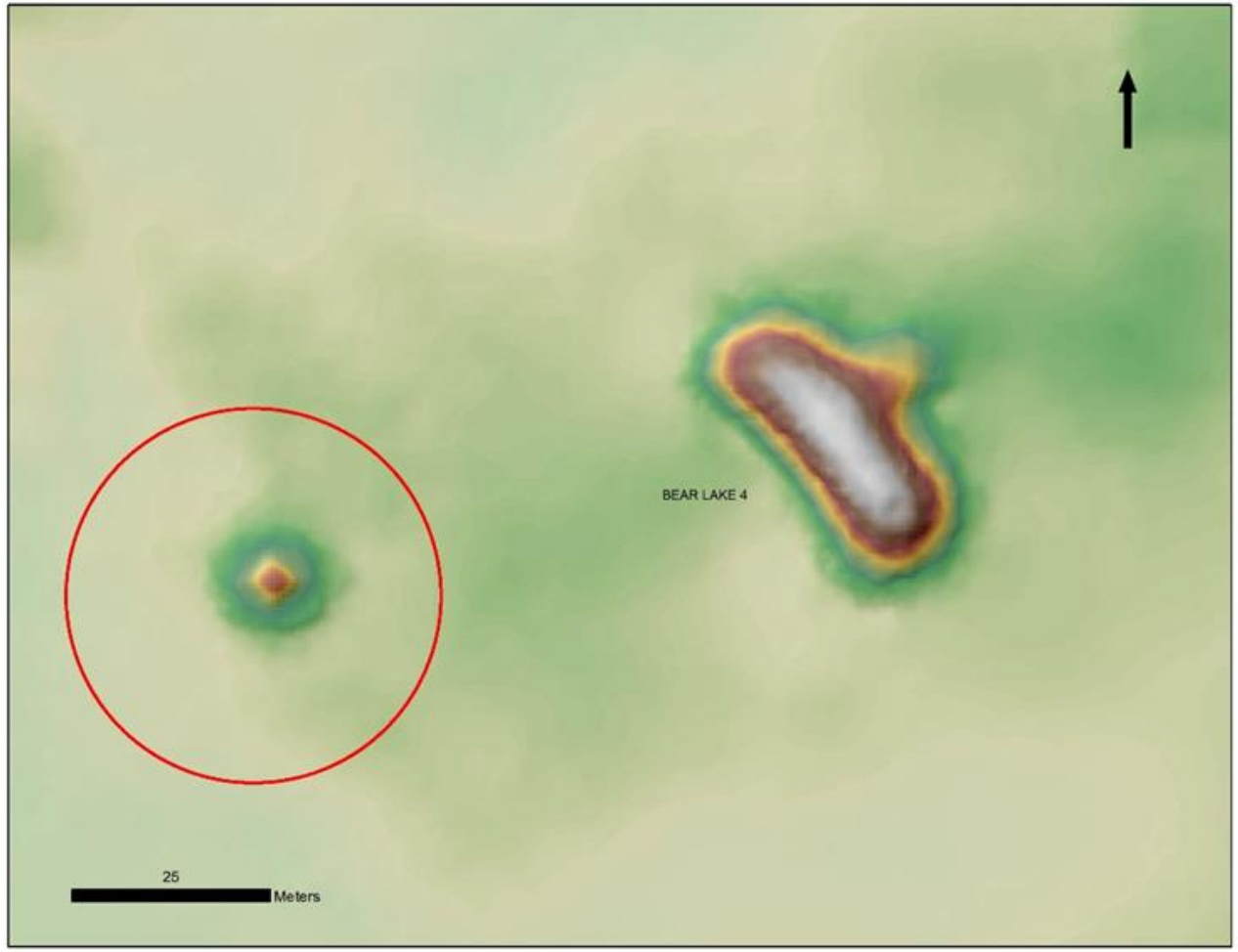
MANAGEMENT APPLICATIONS

- Slope modeling with the improved ALS model
- Examination of areas more susceptible to erosion (reflected with red coloration)
- Better delineation of existing conditions and use with historic maps and documentation to examine issues of loss through time



RESEARCH AND MANAGEMENT APPLICATIONS

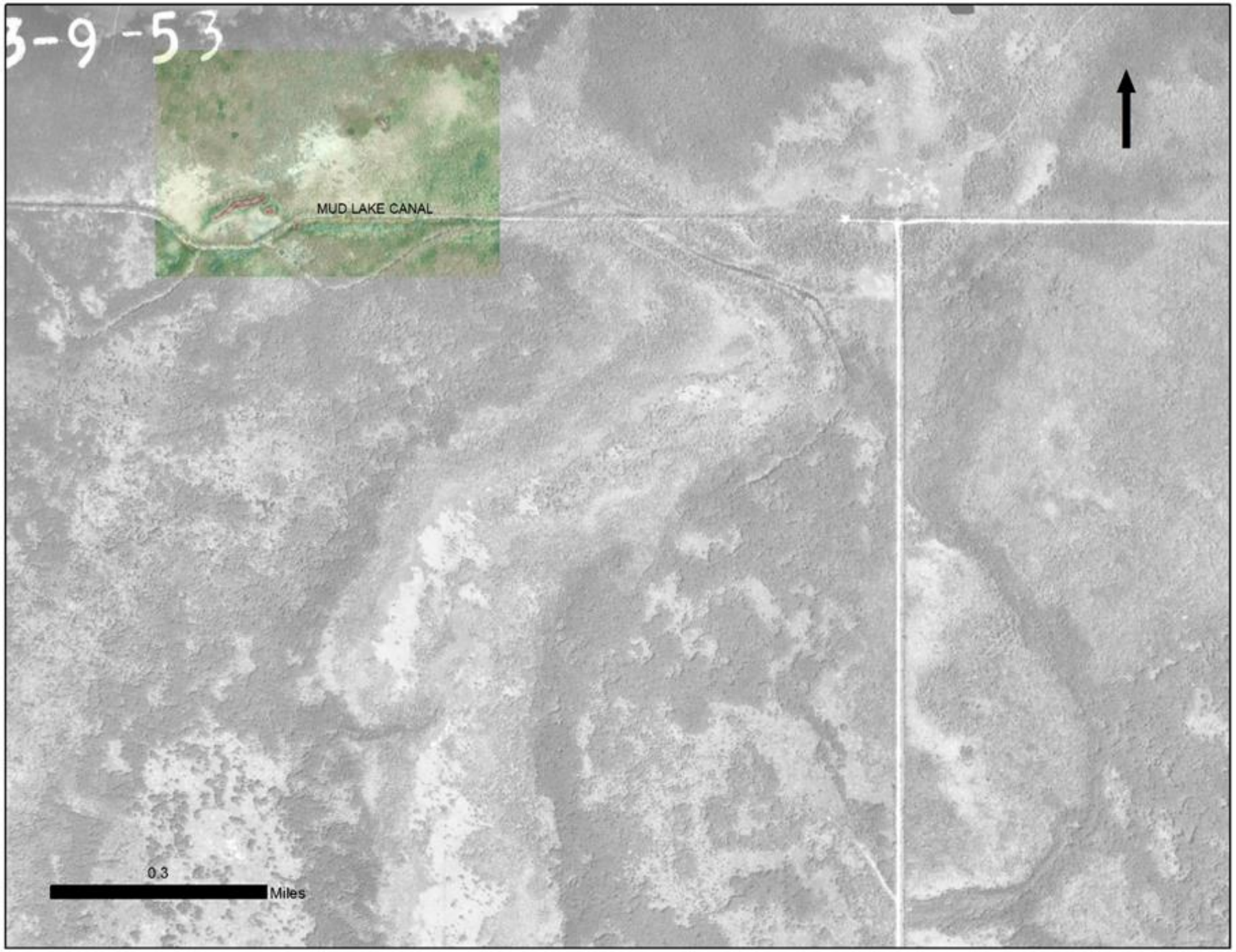
- Use with prospection and remote detection of as yet unrecorded resources or relocation of sites
- Use for better delineation and understanding of site extents and morphologies

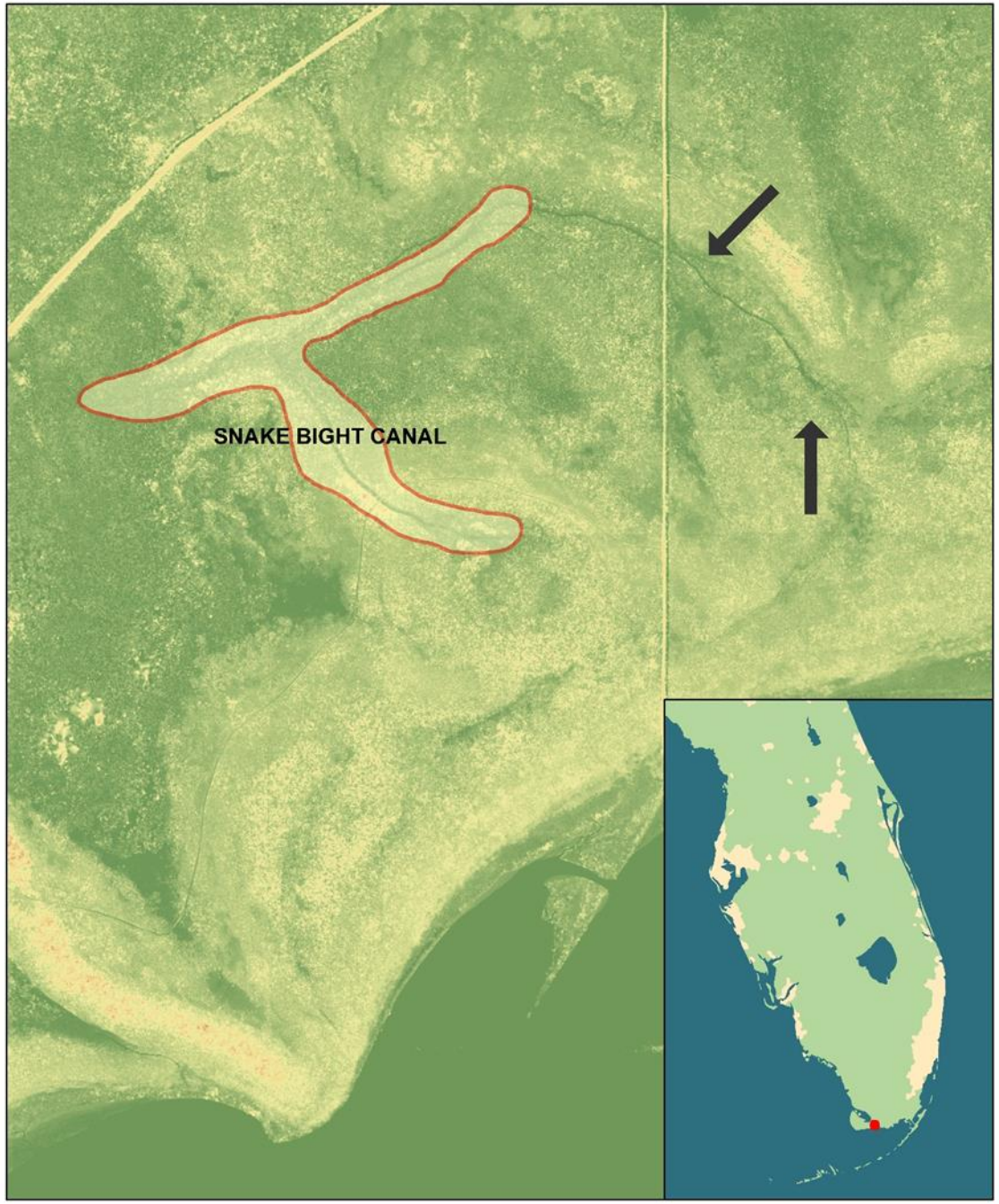


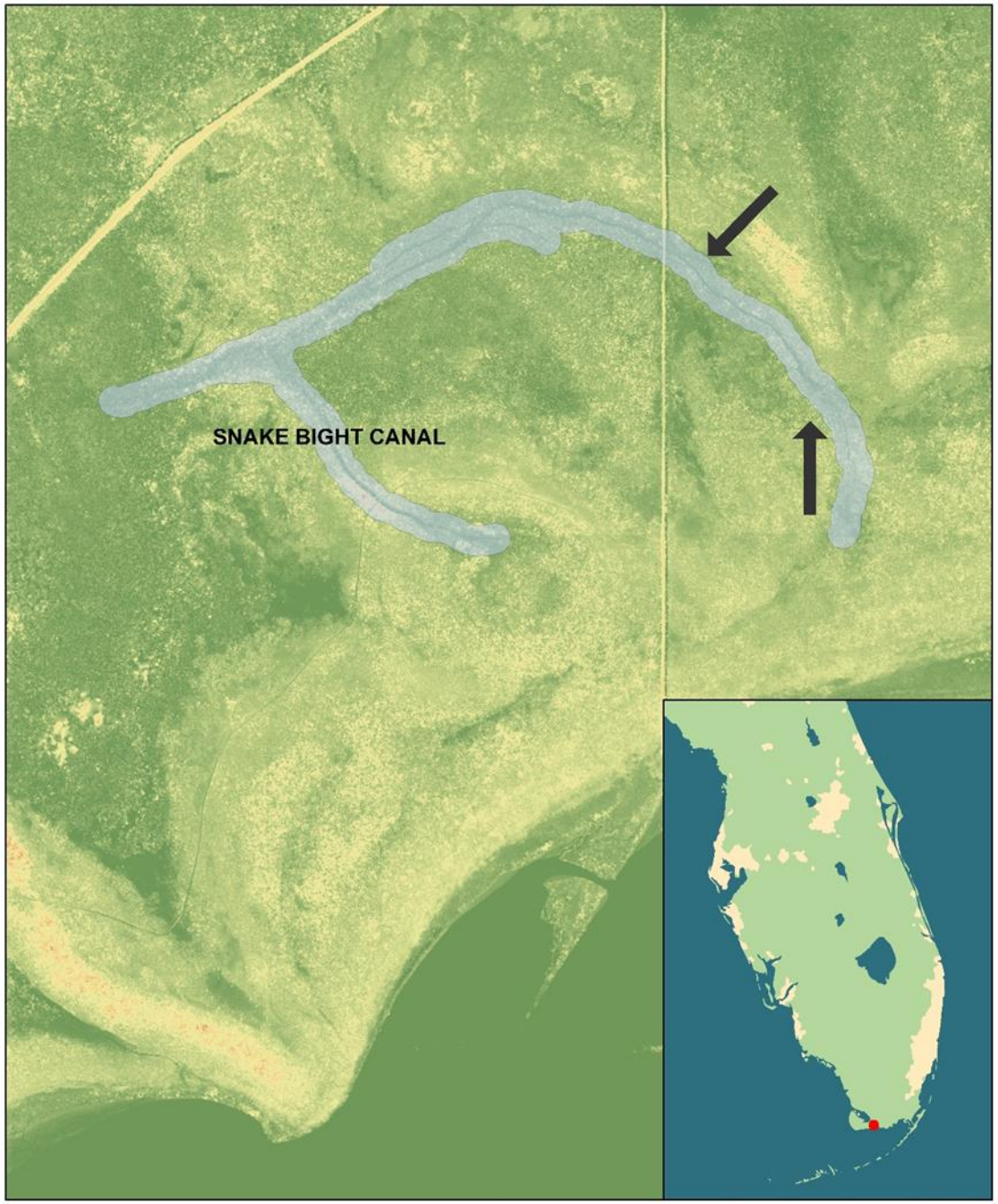

BEAR LAKE 4
BEAR LAKE MOUNDS
MUD LAKE CANAL
100
Meters

IMPROVED INTERPRETATION & UNDERSTANDING

- Early aerials, such as this 1953 aerial, were georeferenced and considered in relation to our DEM.
- Digitizing visible water features that appear in these aerials and correlating with LiDAR and modern aerials, allows a better understanding for features such as the Mud Lake Canal.

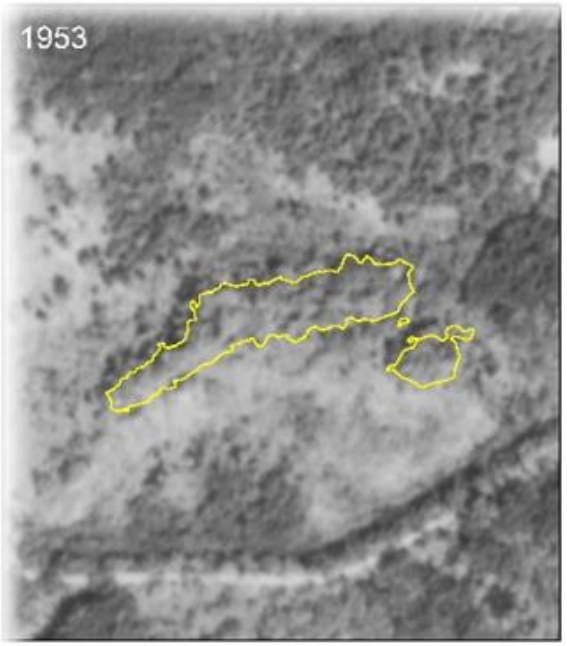


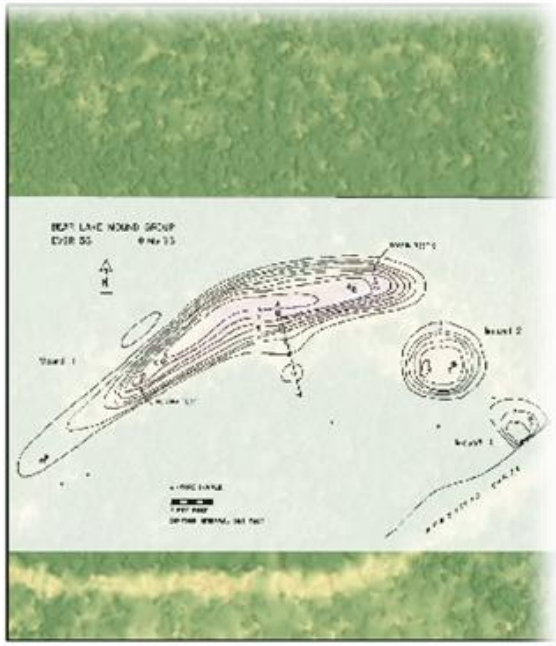

SNAKE BIGHT CANAL

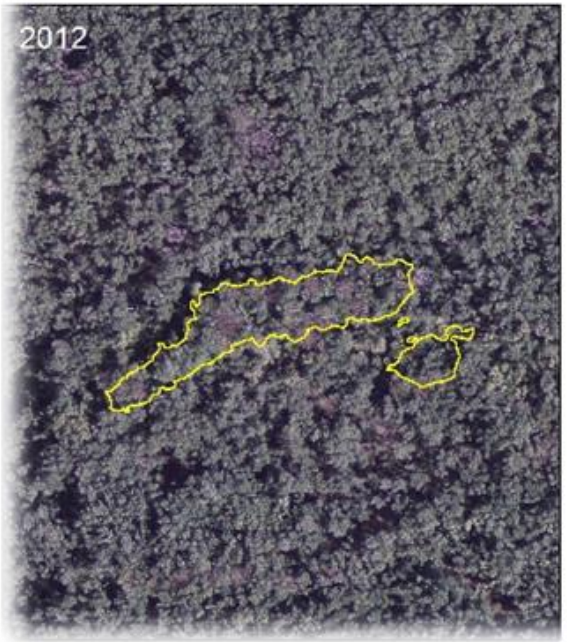

SNAKE BIGHT CANAL

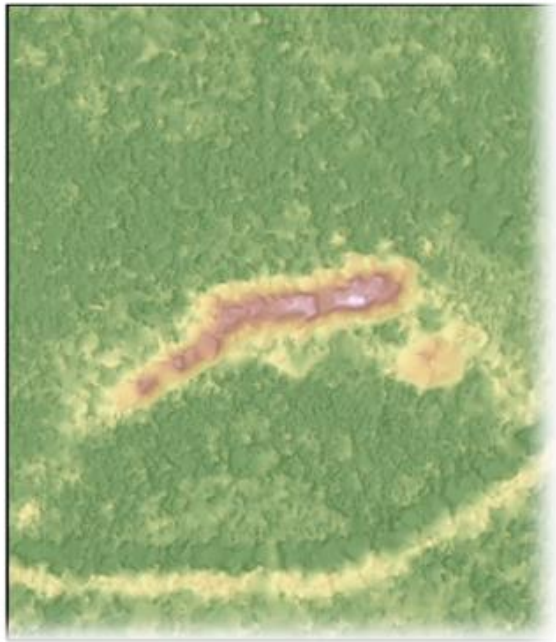
BRINGING IT ALL TOGETHER

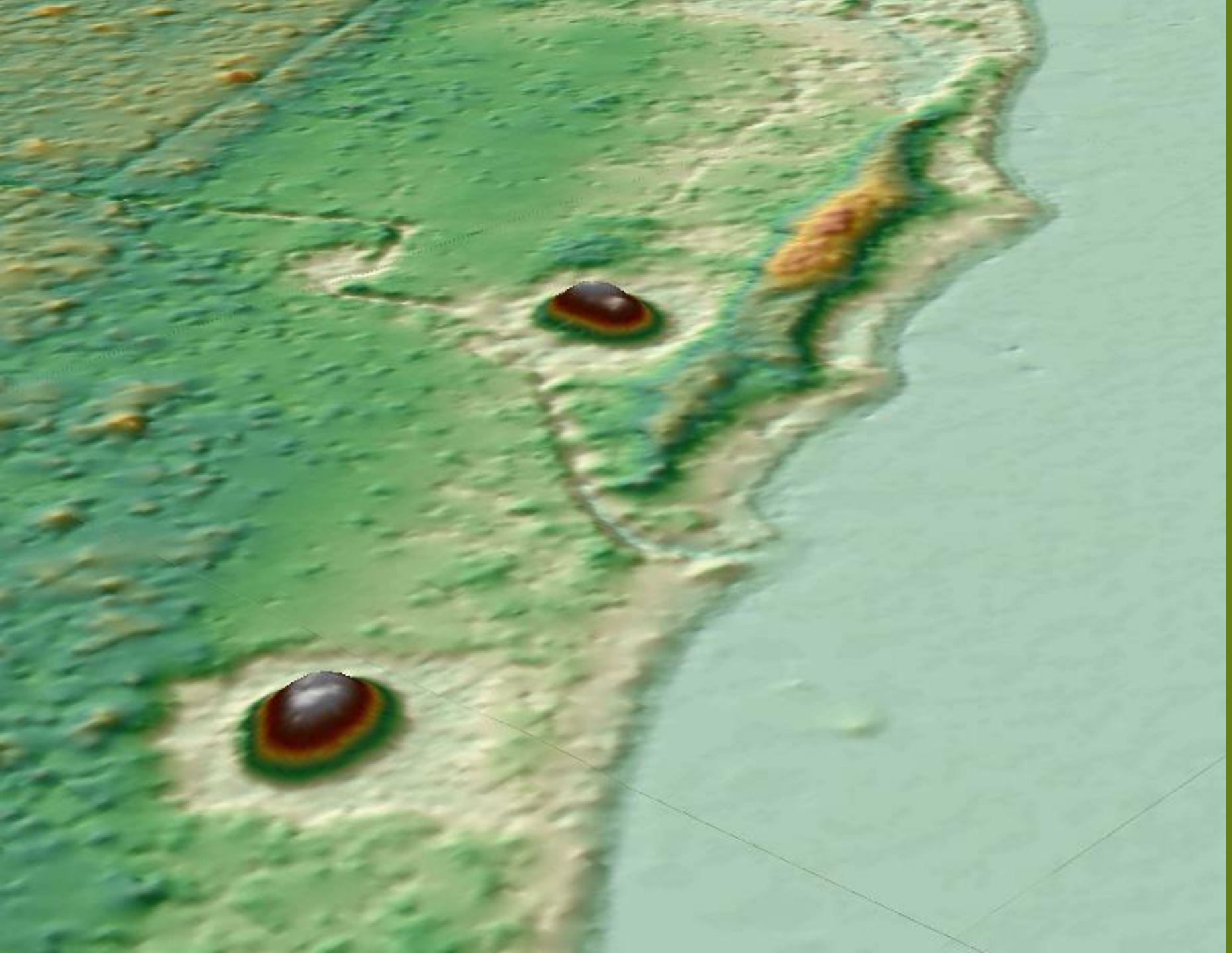
- Ability to remotely assess and evaluate
- Comparison to historic data
- Targeted approaches to fieldwork
- Ability to produce more accurate modeling for site prediction and management











Questions?

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Special Thanks to:
Richard McKenzie, GIS Analyst with the USF Libraries Digital Heritage and Humanities Collections.