FOREST COMPOSITION ASSESSMENT FROM HIGH-RESOLUTION REMOTELY SENSED IMAGERY

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AGENDA

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INTRODUCTION

Forest monitoring activities are critical to sustainable forest management with emerging concerns over climate change, biodiversity conservation, and ecosystem services. One crucial element of this type of monitoring program is assessing vegetation.

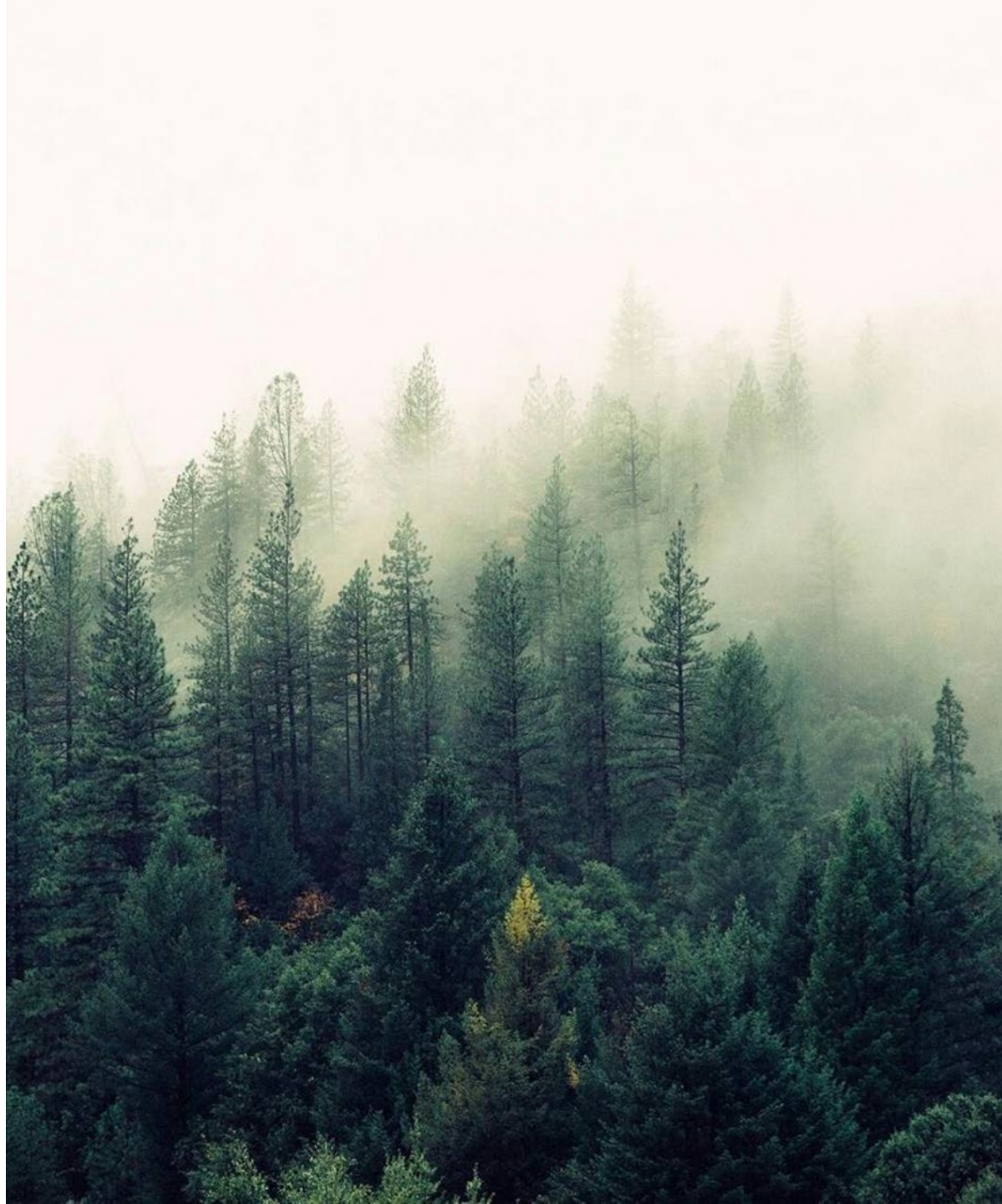
Remote Sensing in Forest Vegetation Assessment

- Large scale photographs:
- UAV -High resolution imagery: low altitude, cm level resolution, local level applicability
- UAV-Multi-spectral, Hyperspectral, LiDAR
- Open-source Imagery Products
- Remote sensing techniques provide comprehensive and accurate information and enable researchers to collect information on forest composition at high spatial and temporal resolution.

Purpose of Study

- This study involved a suite of remote-sensing data to estimate, classify, compare, and visualize spatial patterns of forest in study sites managed by Molpus Woodlands Group.

- Remotely sensed data, USDA National Agricultural Imagery Program (NAIP), and (2) New York State (NYS) orthoimagery, are used to quantify and classify forest vegetation.



MATERIAL AND METHODS

Study Area

- Conducted in north-western Adirondack on forest properties managed by Molpus Woodlands Group, a timberland investment management organization (TIMO).
- Includes 231392 acres of forested land distributed mostly on the central and western part of Adirondack Park in New York.
- Area comprise of wide variety of species, forest classes, and stand structures.

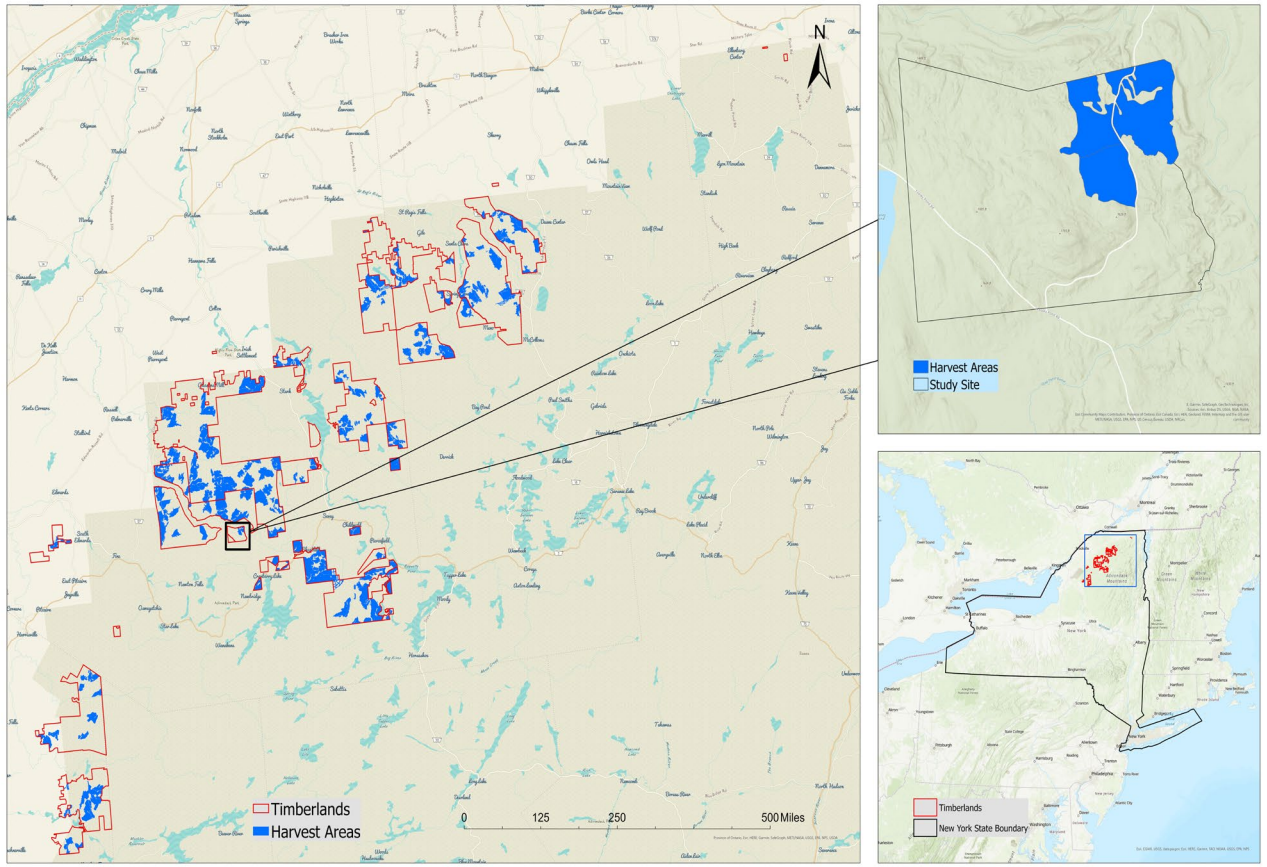


Fig 1: Study Area

MATERIAL AND METHODS

Data Products

- National Agriculture Imagery Program (NAIP) high-resolution aerial photographs from 2021
- Resolution; 0.6 meter
- The NAIP data are 4-band multispectral imagery with spectral bands of near-infrared (Band 4), visible red (Band 1), visible green (Band 2), and visible blue (Band 3) with 8 bits radiometric resolution.

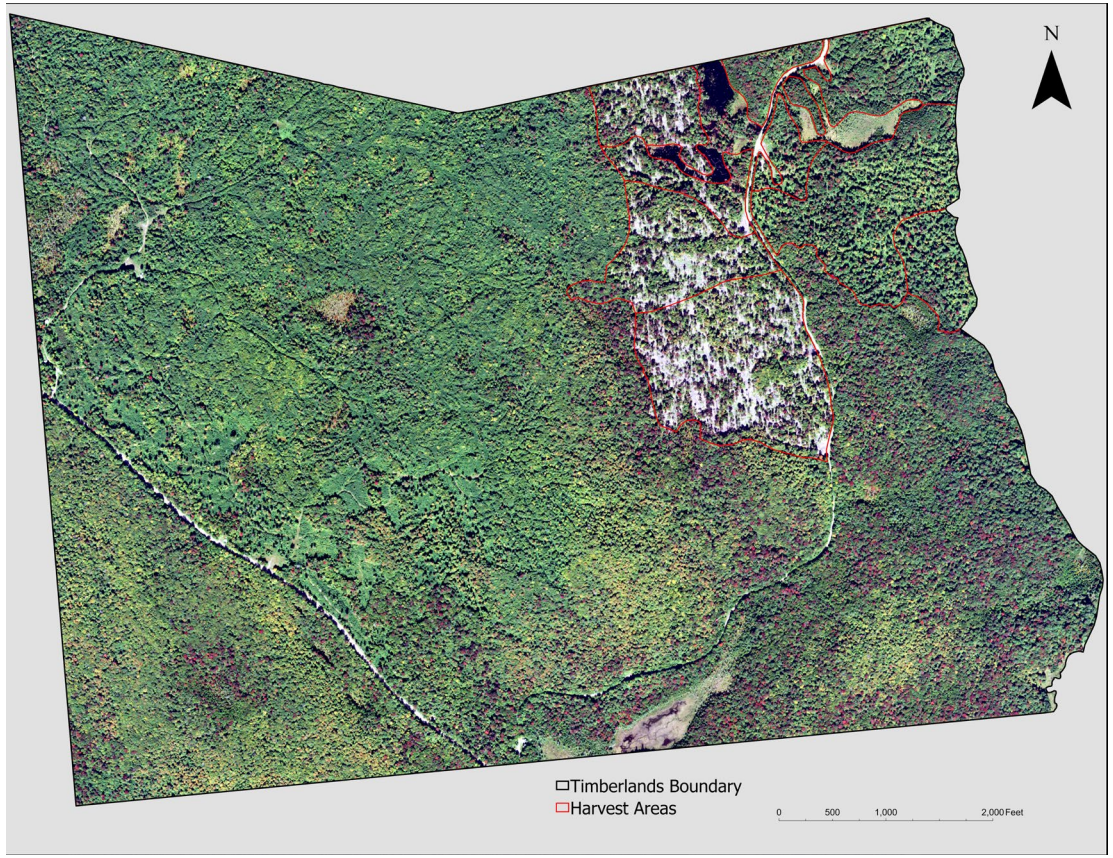


Fig 2: Study Site and Harvest Area

MATERIAL AND METHODS

Data Products

- LiDAR data are downloaded from NYS GIS Clearinghouse
- Raw Lidar data are height normalized using Digital Terrain Model (DTM).
- lidR package (Roussel and Auty, 2020; Roussel et al., 2020) was used in R to process and generate Canopy Height Model (CHM) of 1-meter resolution.

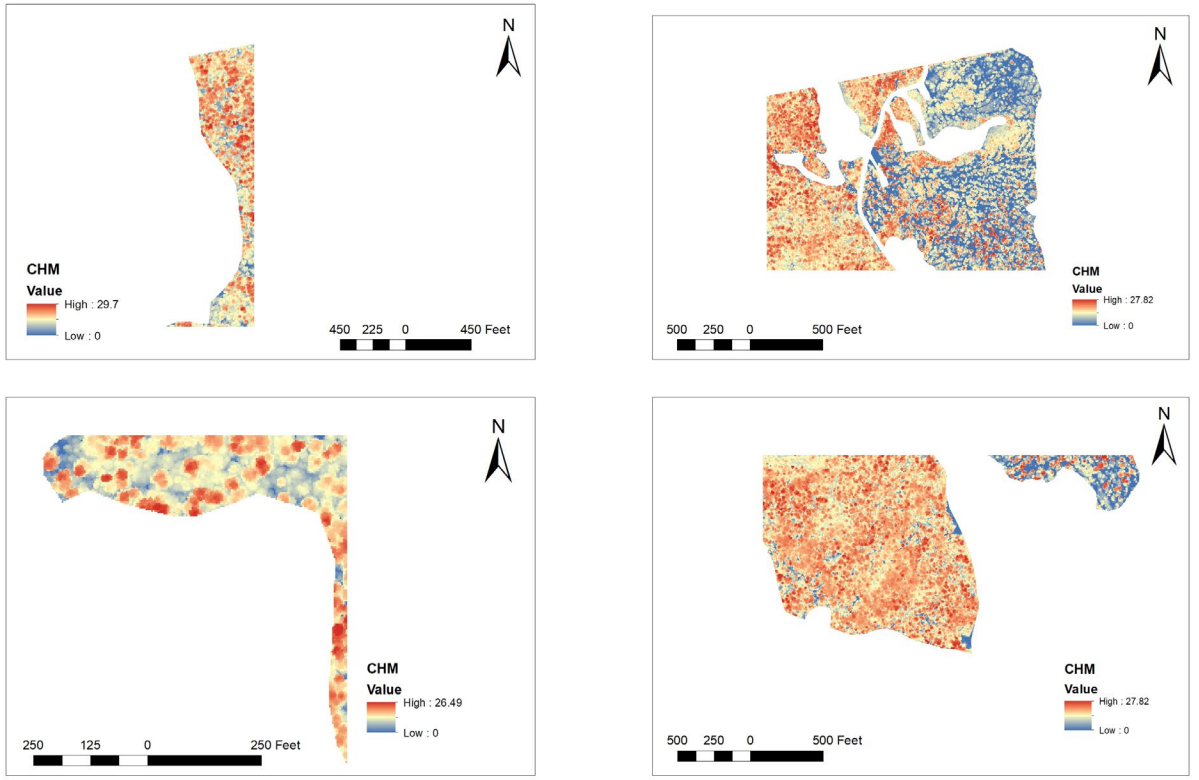


Fig 3: LiDAR derived CHM for Harvest Area

MATERIAL AND METHODS

Training Data for Image Classification

- Image segmentation was performed on NAIP Imagery.
- Default spectral, spatial detail, and minimum segment size was setup.
- Training data was created on segmented NAIP imagery.
- ArcGIS Pro Training Sample Manager
- Created polygons for five different land cover classes.
- NYS GIS Clearinghouse1-feet Orthoimagery was used as reference.
- NLCD2011 Training Schema was adopted in ArcGIS Pro.

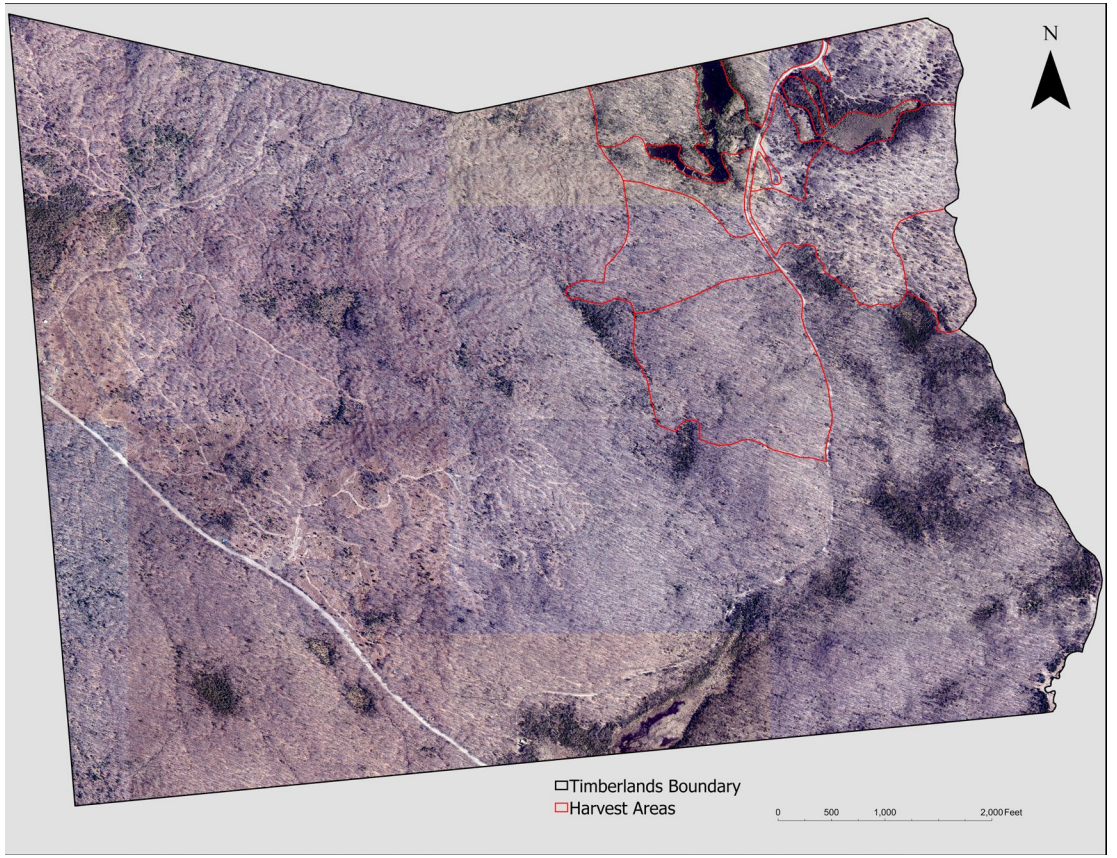


Fig 4: 1-Feet Orthoimagery

RESULTS

Image Classification

- Random Forest Classification was used to classify forest composition.
- Classification was performed in ArcGIS Pro.
- Classified deciduous forest reasonably well but barren and water were misrepresented.
- Shadows were classified as water.

Fig 5: Random Forest Classification

RESULTS

Tree Location and Height Estimation

- ArcGIS Pro
- CHM
- Focal Statistics
- Circular radius 5 meter
- Matching CHM and Local Maxima, (Con function)

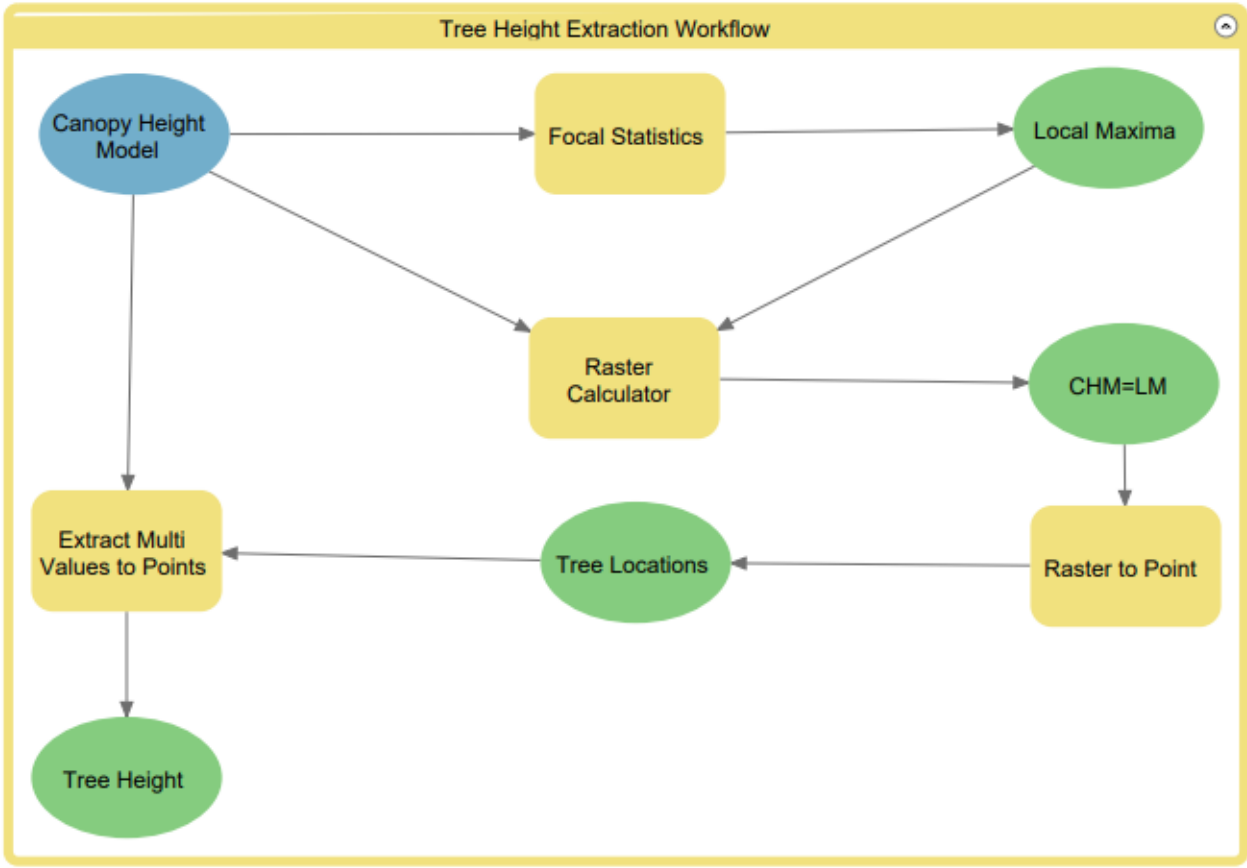


Fig 6: Tree Height Extraction Workflow

RESULTS

Tree Location and Height Estimation

- 13110 trees were located
- Maximum height in harvested area was 30-meter

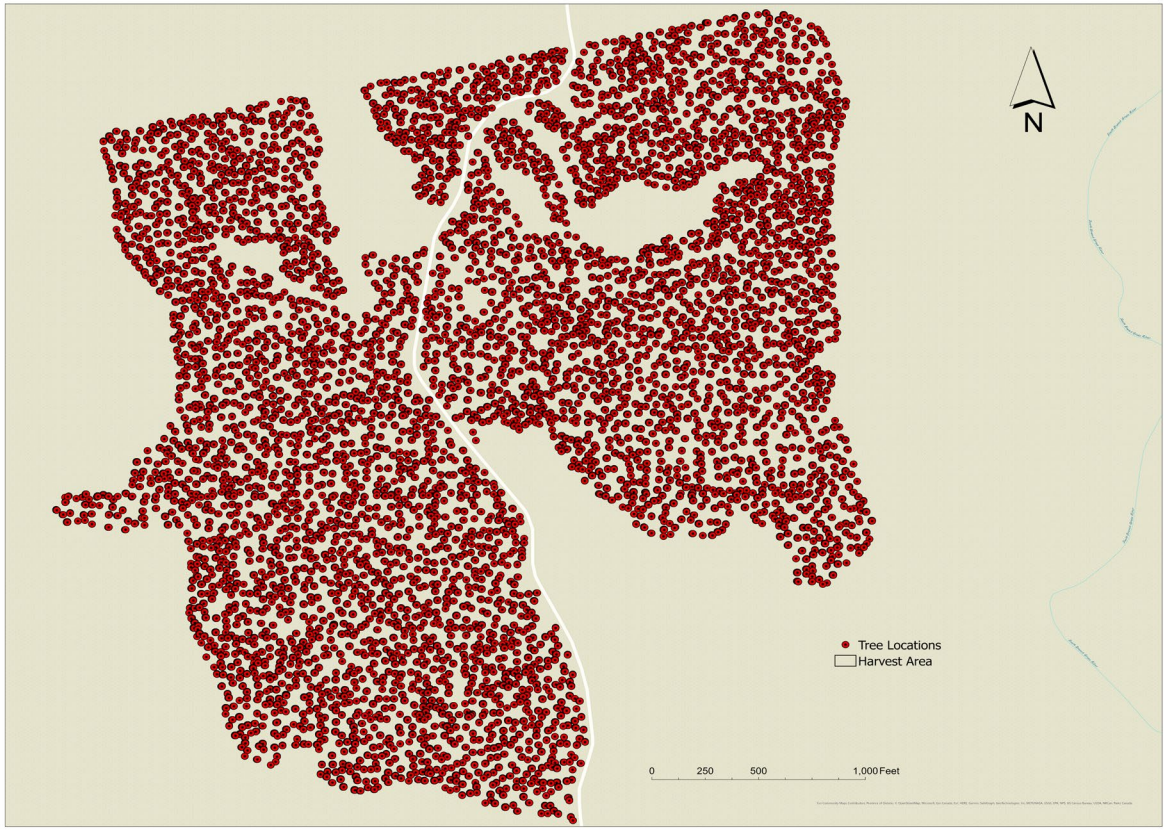


Fig 7: Tree Location in Harvest Area

DISCUSSION AND CONCLUSION

- The forest composition assessment procedures required a significant amount of time downloading and processing NAIP imagery and NY state orthoimagery.
- Pre-processing raster datasets for whole study areas consumed a considerable amount of time. It led to pre-processing only one of the recently harvested forest properties only.
- Current results shows that remote sensing imagery such as NAIP imagery and NY state orthoimagery have the potential for forest vegetation classification and assessment and can perform better if additional data is utilized for image classification.
- Field based reference data would have provided validation and helped in map accuracy assessment.

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THANK YOU

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