University of Idaho
College of Natural Resources

INTEGRATING GIS, LIDAR, AND AI TOOLS FOR QUALITY OF INDIVIDUAL TREE SEGMENTATION

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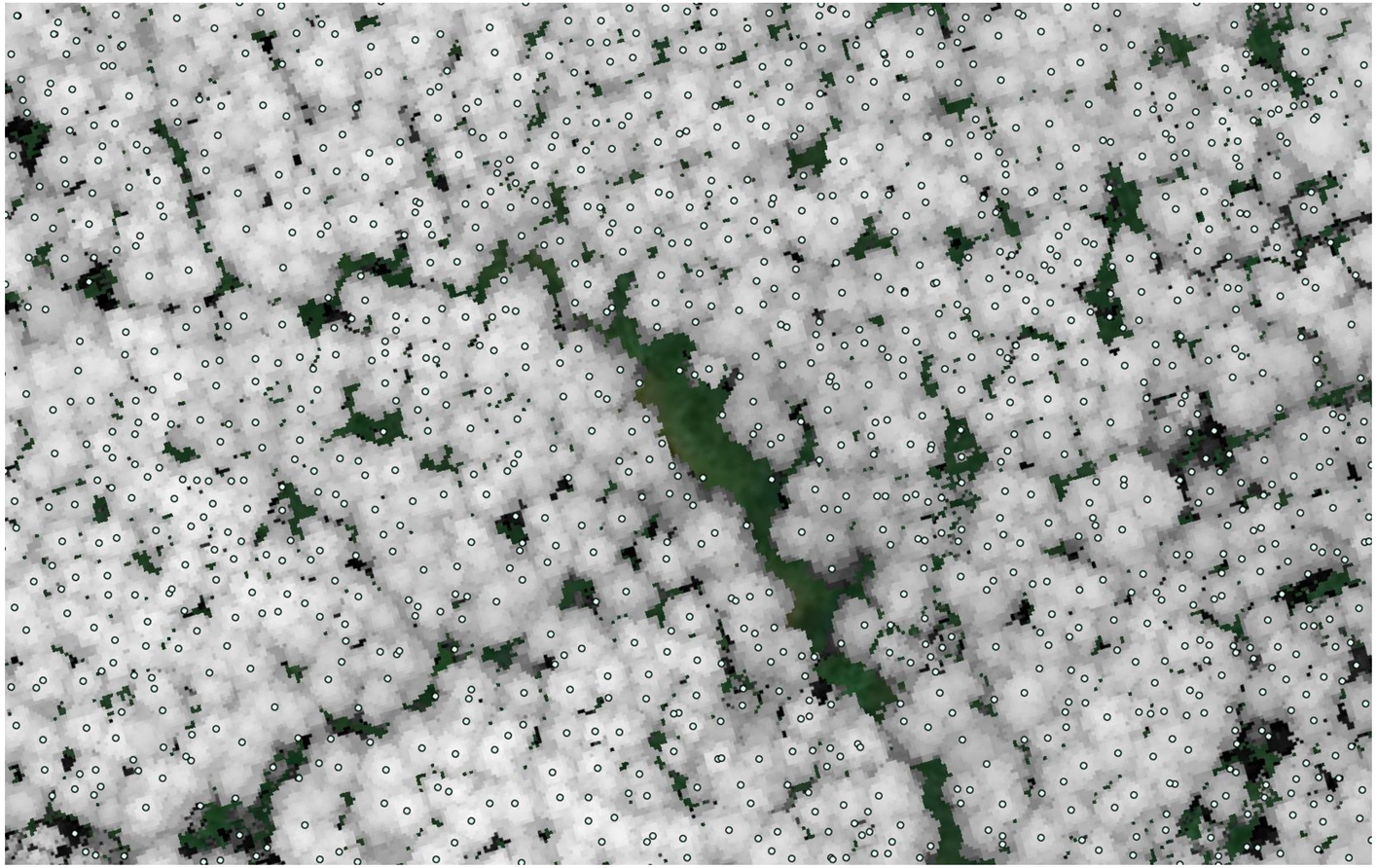
OUR GOAL: INDIVIDUAL TREE LOCATIONS

WHAT DO WE NEED?

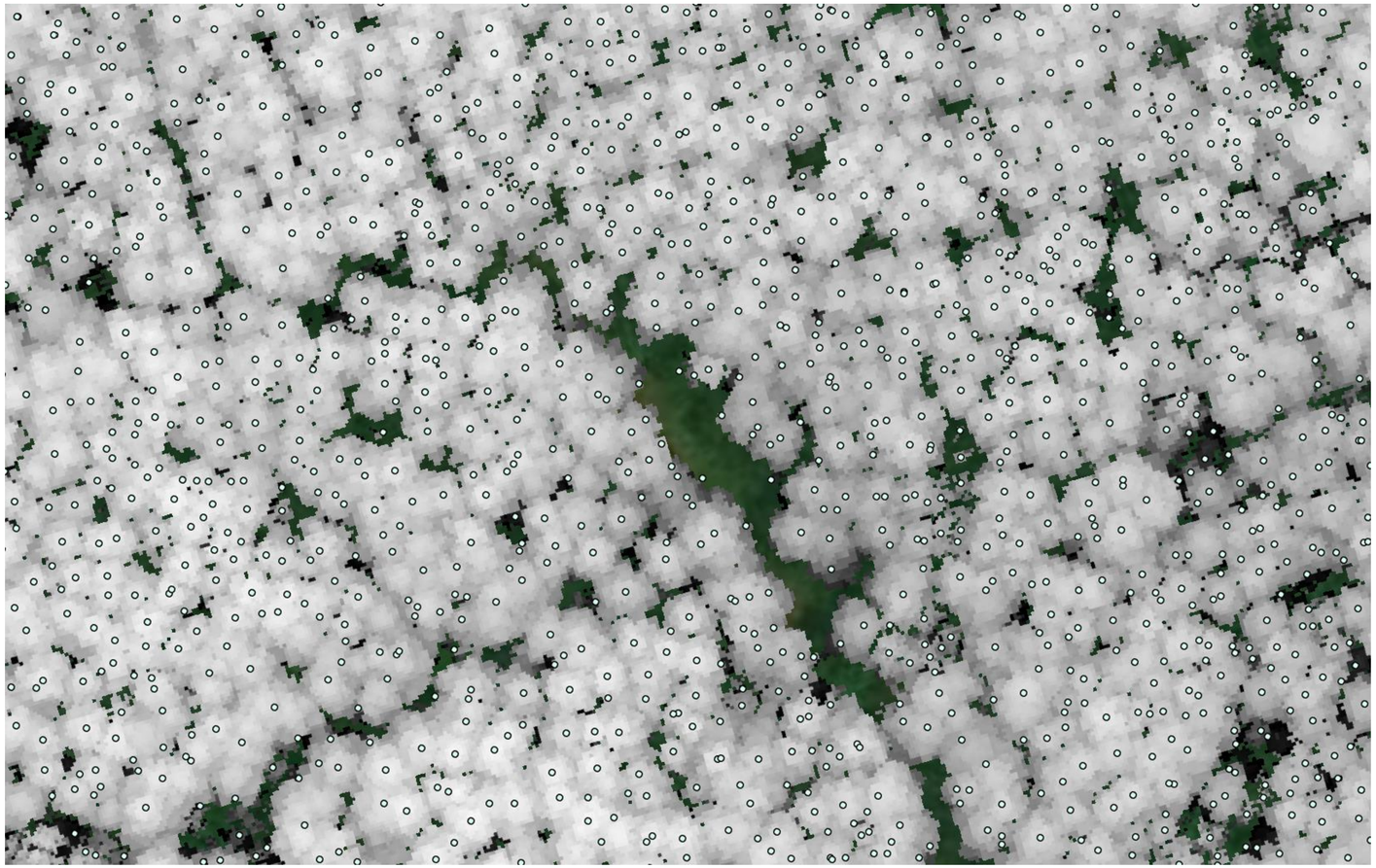
- A point vector layer representing individual trees within the area of interest
- Basic attributes
  - Centroid
  - Height
  - Crown area
  - Number of LiDAR points



THE PROCESS

HOW DO WE GET THERE?

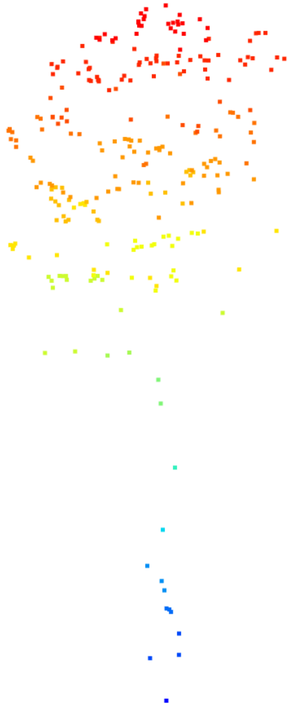
- Collect LiDAR data
- Raster generation
  - DTM, DSM, CHM, Density
- Tile clipping boundaries
- Segmentation
- Post processing
- Vector generation



LIDAR DATA COLLECTION

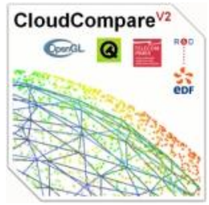
LIDAR POINT DENSITY

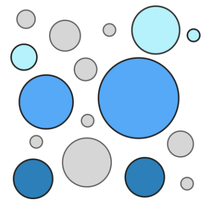
- Traditional airborne LiDAR (400 points)
- Geiger LiDAR (15,000 points)
- Ground-based SLAM LiDAR (1,000,000 points)



PROCESSING TOOLS

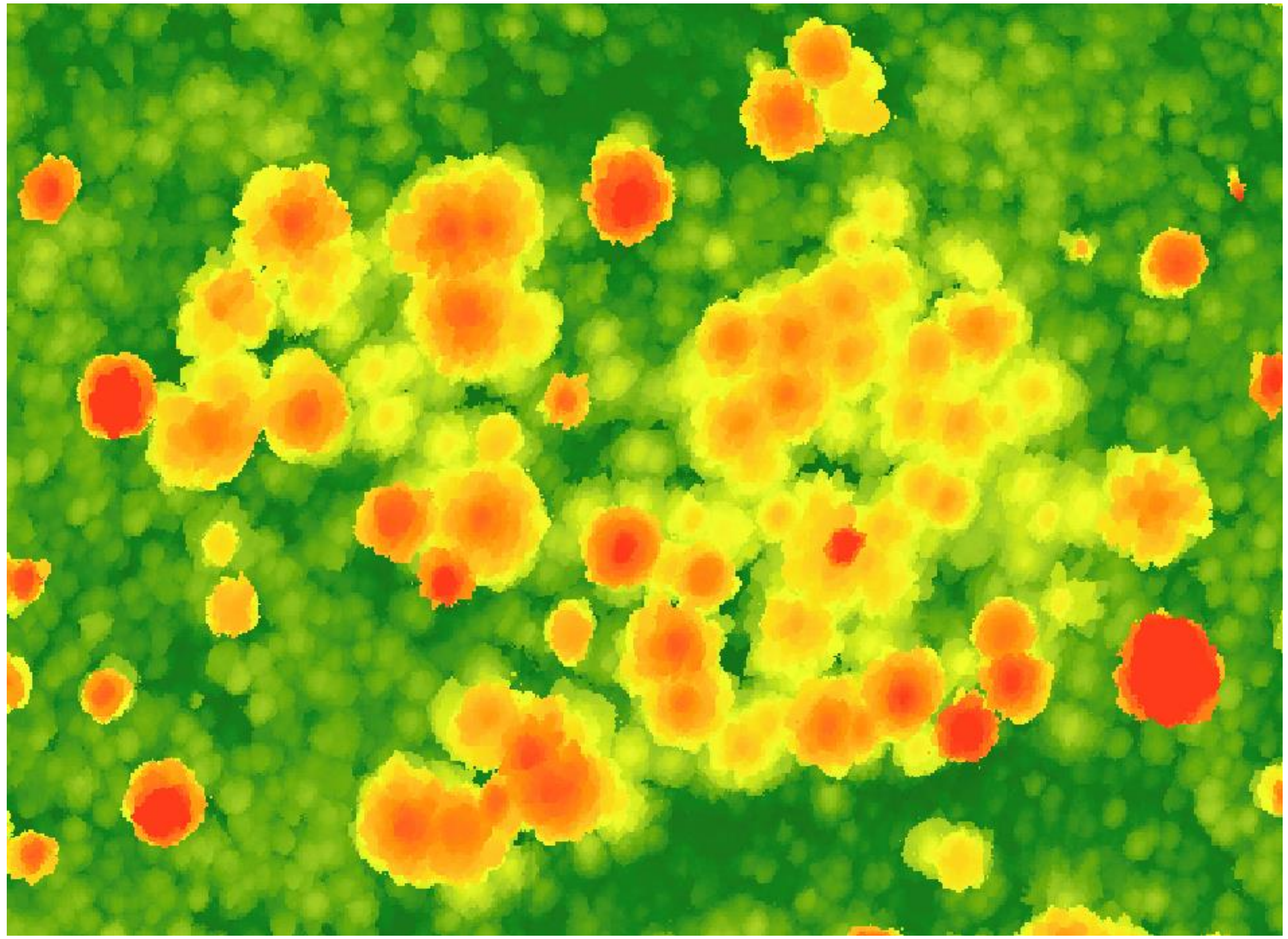
- Existing tools tend to be designed for either ALS or TLS
- Custom tools allow for better tuning
  - R, Python, SegmentAnyTree, lidR, lasR, ArcGIS Pro, CloudCompare, PDAL
- Requires significant computing resources
  - RCDS fortyfive cluster
  - Falcon supercomputer





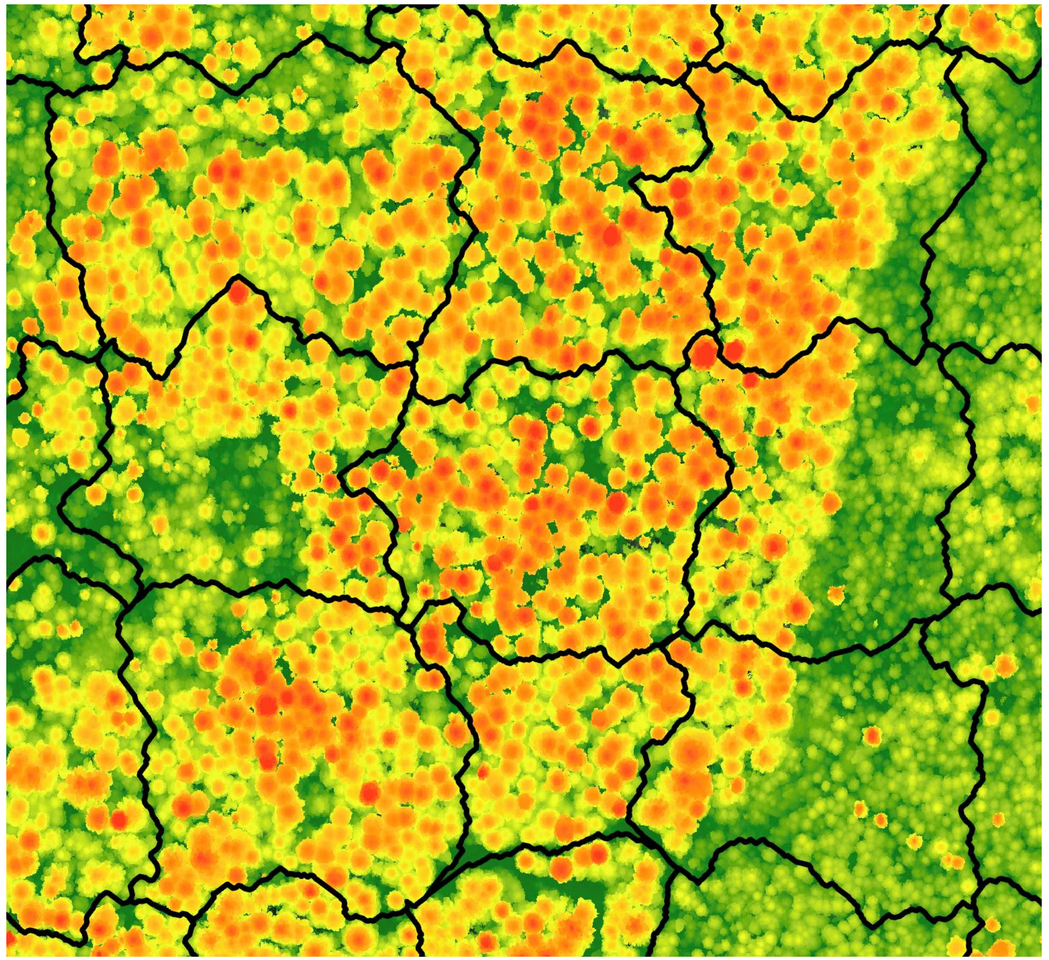
RASTER GENERATION

- We generate basic rasters:
  - Digital surface model (DSM)
  - Digital terrain model (DTM)
  - Canopy height model (CHM)
    - CHM = DSM – DTM



CLIPPING BOUNDARIES

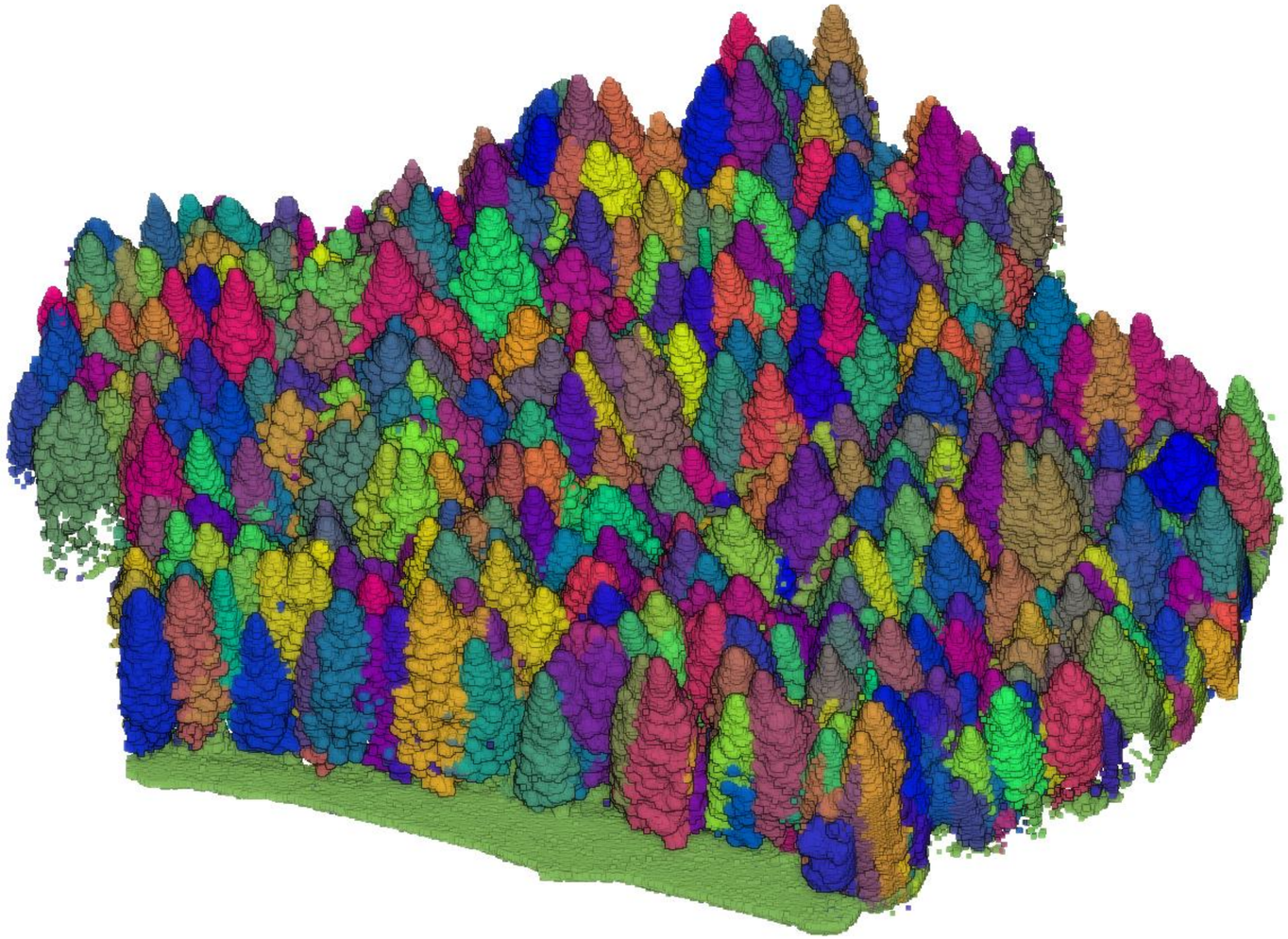
- LiDAR data are typically distributed as square tiles
- Tiles are smaller on disk, take less resources to process
- Tile boundaries can cause issues later
- We re-tile with irregular boundaries
  - Start with a regular square grid and adjust edges to avoid splitting tree crowns



SEGMENTATION

INSTANCE SEGMENTATION

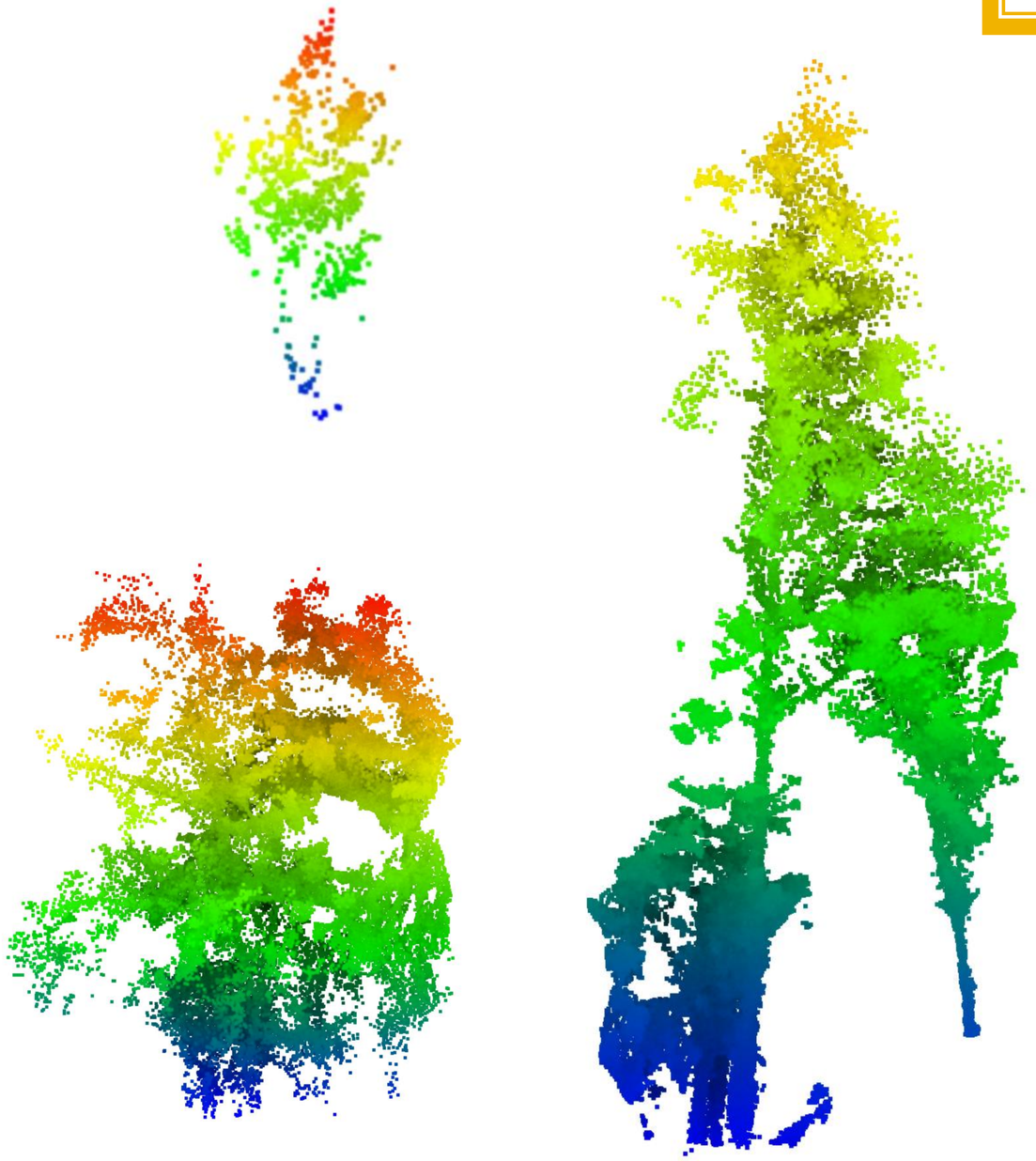
- False color represents individual object ID
- Irregular tile boundaries mean edge trees are less frequently split between tiles
- Metrics such as location, height, crown area, and total point count can now be computed



POST PROCESSING

OBJECTS VS TREES

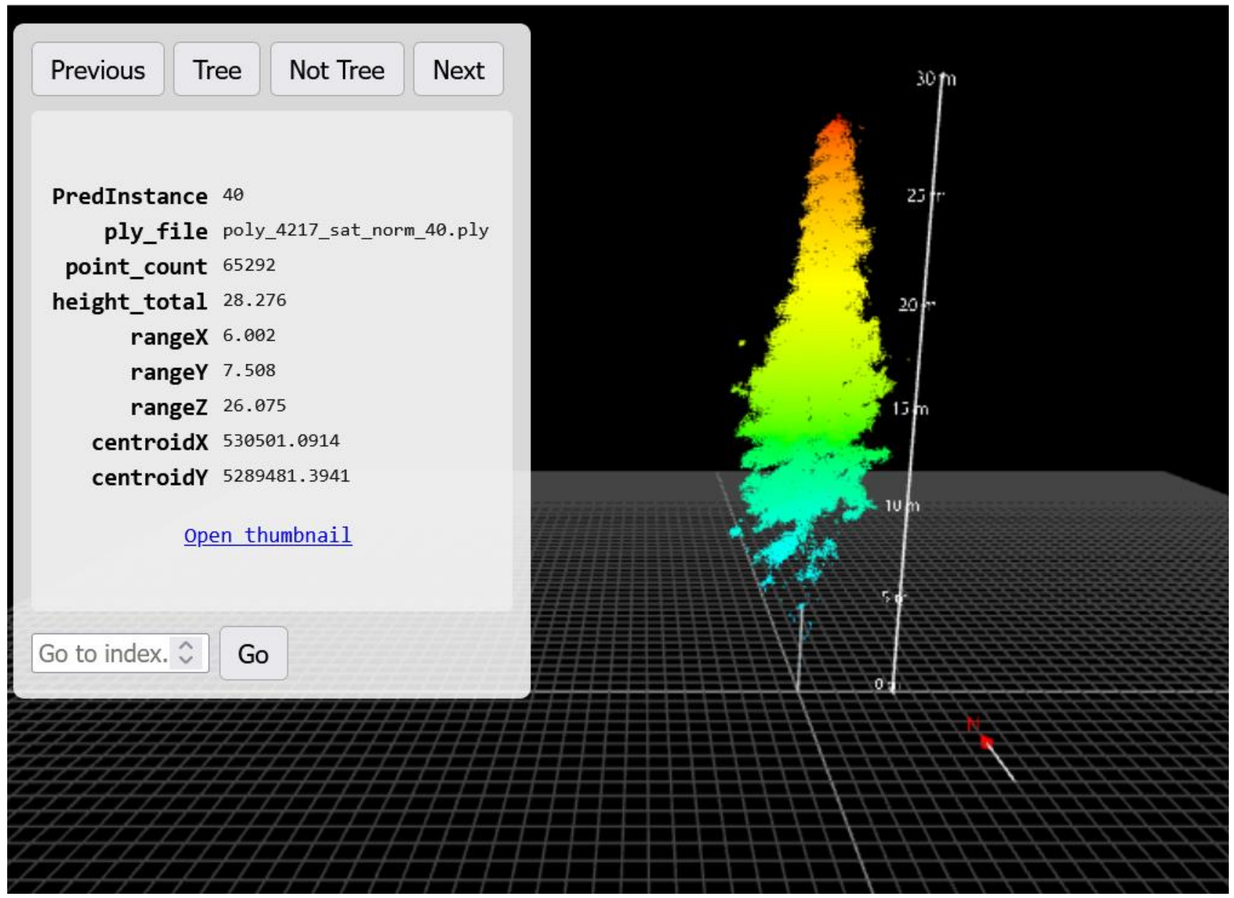
- Segmentation is not perfect
- Artifacts include
  - Combined trees
  - High objects (canopy fragments)
  - Low objects (confusion with ground veg)
- Post-segmentation classification can be done using statistical methods



POST PROCESSING

LABELING

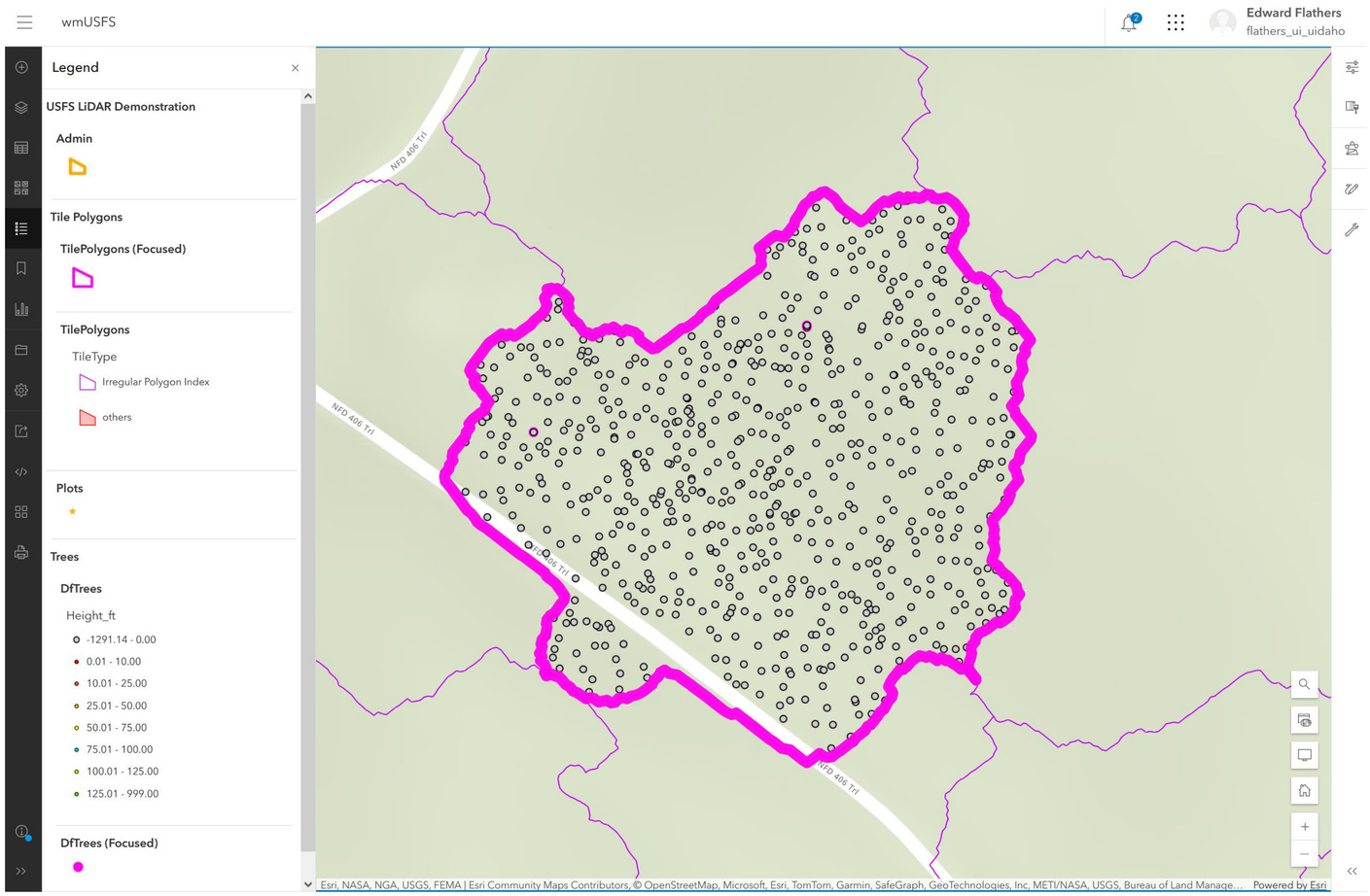
- A web app supports labeling instances
  - From simple tree/not tree to more complex labeling schemes
- Labeling can be crowdsourced to provide multi-user reinforcement
- Labeled dataset can be used to re-train AI models
- Labeled data are used to train classification algorithms that assign p(tree) to every object



VECTOR GENERATION

THE GIS PRODUCT

- A vector layer that can be used in desktop GIS
- Thumbnail and 3D viewer links incorporated into ArcGIS Pro
- ArcGIS Online services
- Data can feed dashboard apps that support forest decisionmakers



QUESTIONS

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