



Characterizing Boreal Forest Fuels with Operational Airborne LiDAR Data

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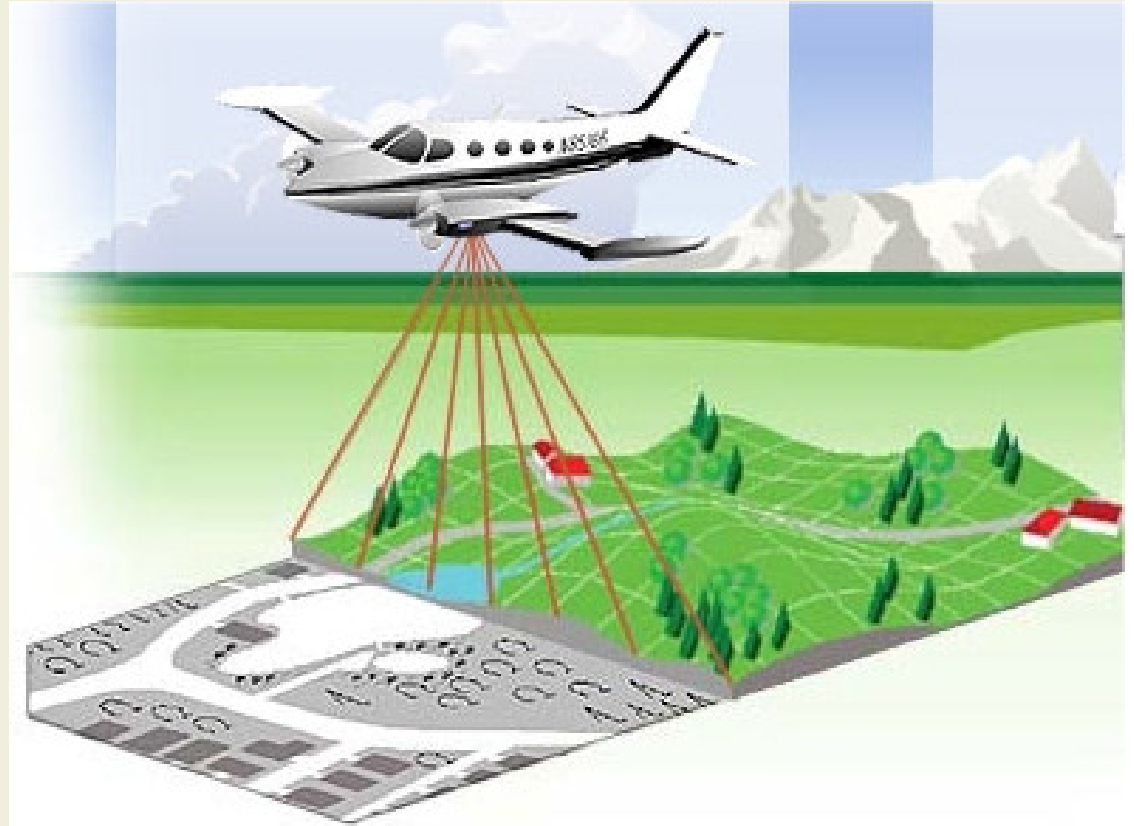
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LiDAR Overview

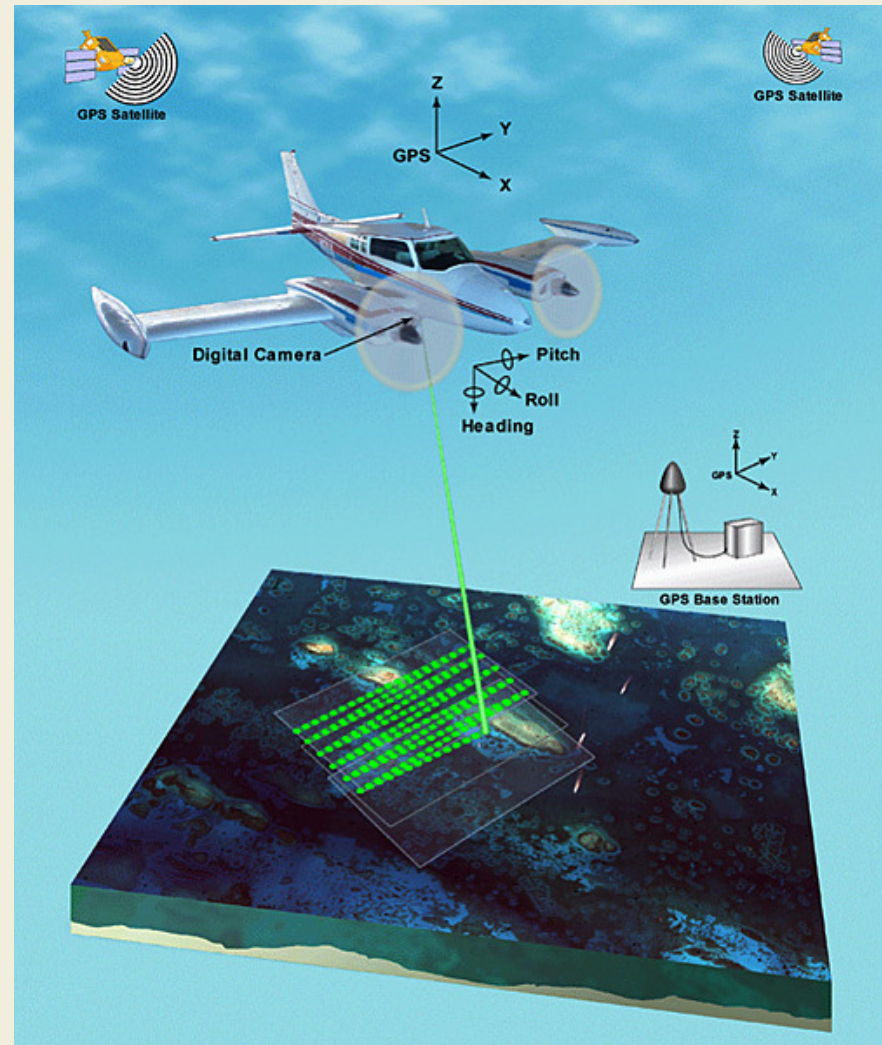
- Light Detection And Ranging
- Airborne (satellite and terrestrial also in use)
- Operational
 - Cost is comparative to traditional photo inventory at estate level





LiDAR Overview

- ~100,000 pulses of laser light per second
- Time and angle of each return
- Range and intensity for each return





Characterizing fuels with LiDAR

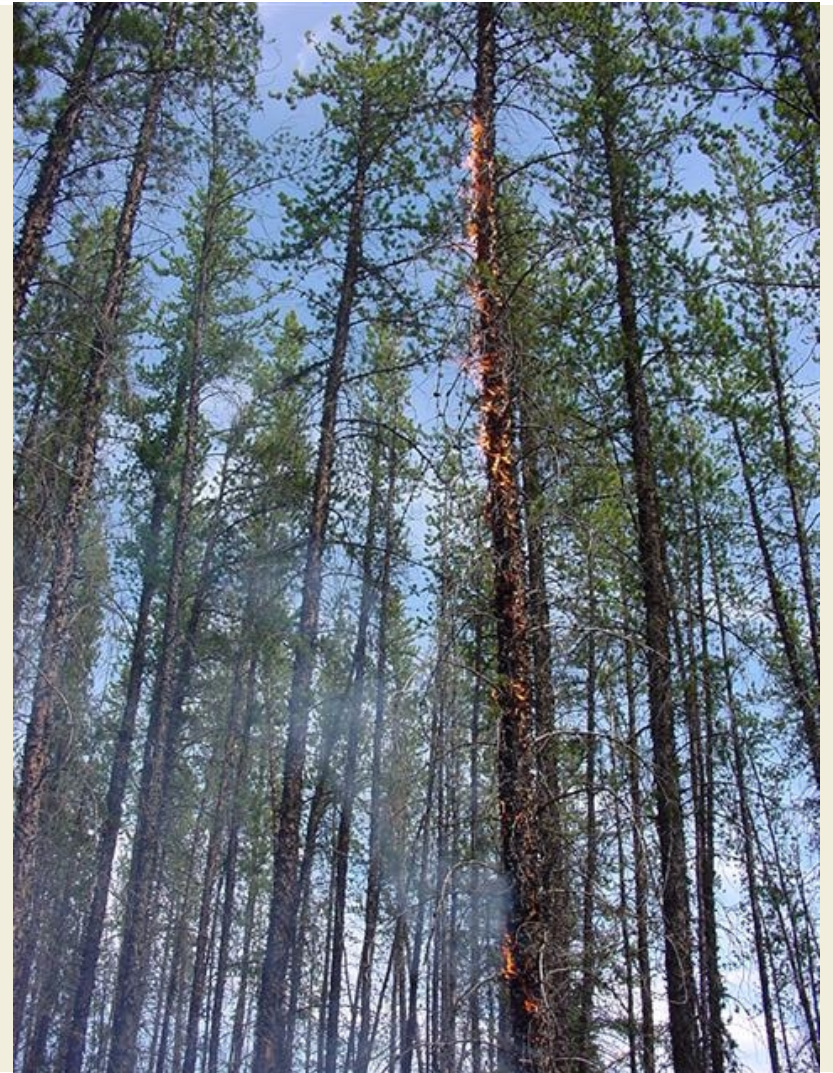
- Potentially useful information – if available
 - FBP fuel type
 - Mensuration
 - Biomass
 - Dead organic matter
 - Vertical structure
 - Gaps





FBP fuel type

- Part of FBP system
 - Rate of spread
 - Fuel consumption
 - Fire intensity
- Not an exhaustive list
- Need species to map





Mensuration

- Derive from or add to forest inventory
 - Top height
 - Density
 - Crown closure
 - Biomass/Carbon
 - Volume
 - Basal area





Biomass

- Calculate from volume
 - Boudewyn et al (2007)
- Estimate from remote sensing
- Various components
 - Foliage
 - Branch
 - Bark
 - Small trees
 - Etc...





Dead organic matter

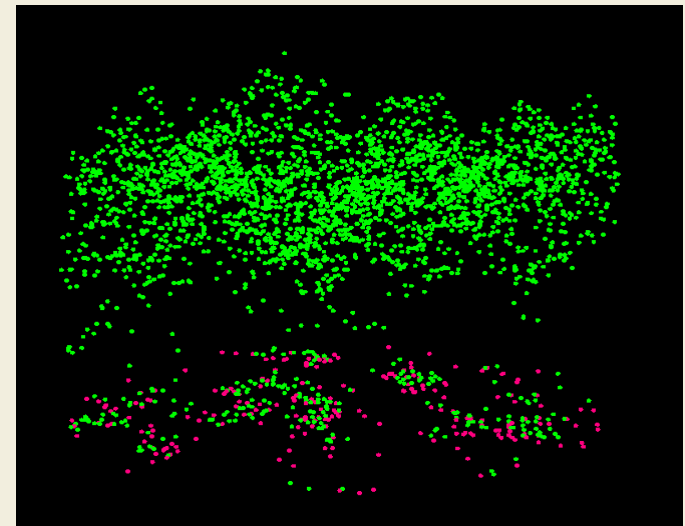
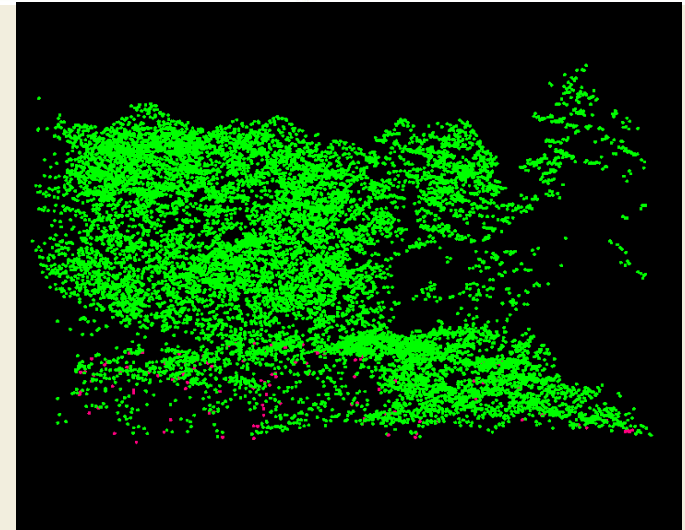
- Fuel loading
- Potentially available
 - Litter
 - Duff
 - Logs and branches
 - Snags
- Requires sampling
 - Labour intensive
 - Expensive
- Might not be possible to get from LiDAR





Structure

- Crown-to-base height
- Crown length
- Crown continuity or gaps
- Multiple cohorts and uneven-aged stands
 - Vertical complexity index





Available LiDAR Products

- Hearst and Romeo Mallette Forests (Tembec, OMNR, and CFS)
 - Total area ~2,000,000 ha
- Does NOT give species
- Canopy height model
 - 2m x 2m raster
 - Height class distributions (0-2m, 2-5m, 5+m)
- Vertical complexity index
- Percent vegetation returns

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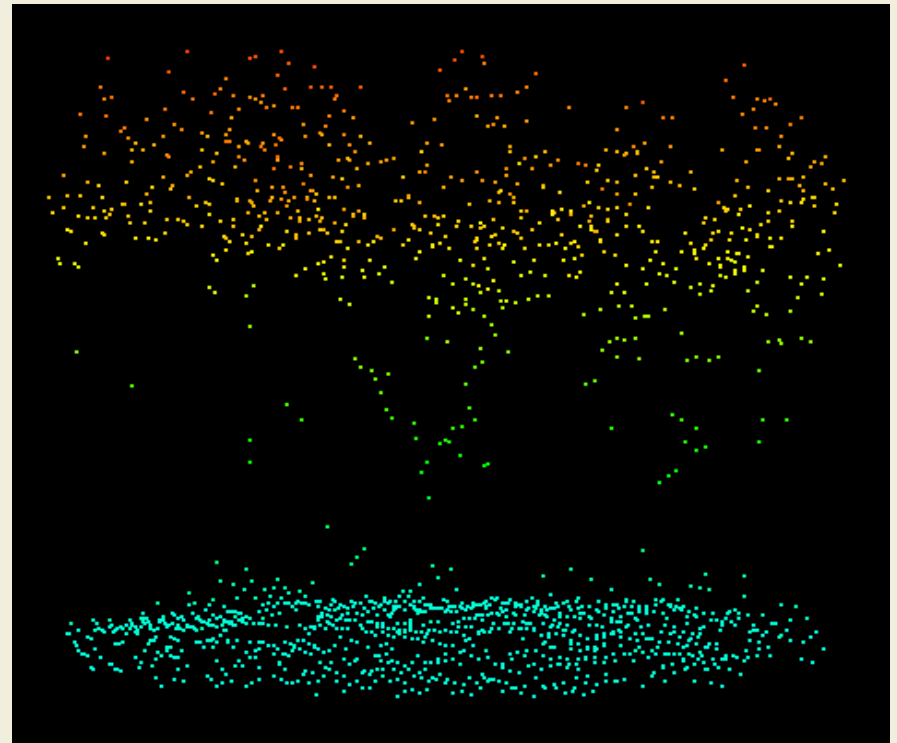
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LiDAR example

- Jack pine – mature, single cohort
- C3 fuel type



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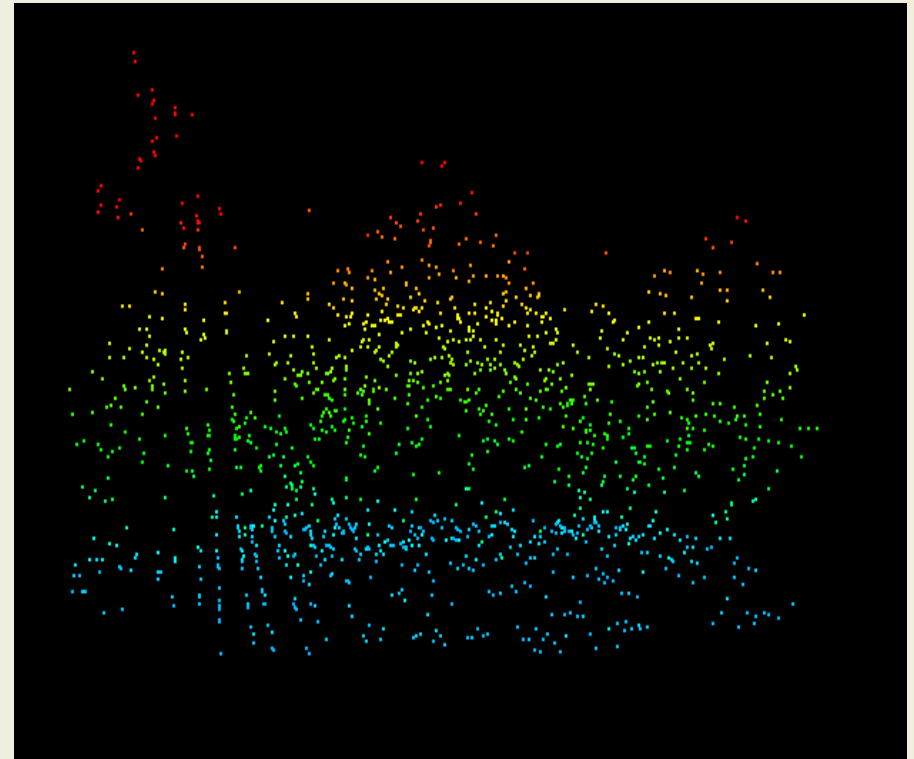
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LiDAR example

- Jack pine – immature
- C4 fuel type



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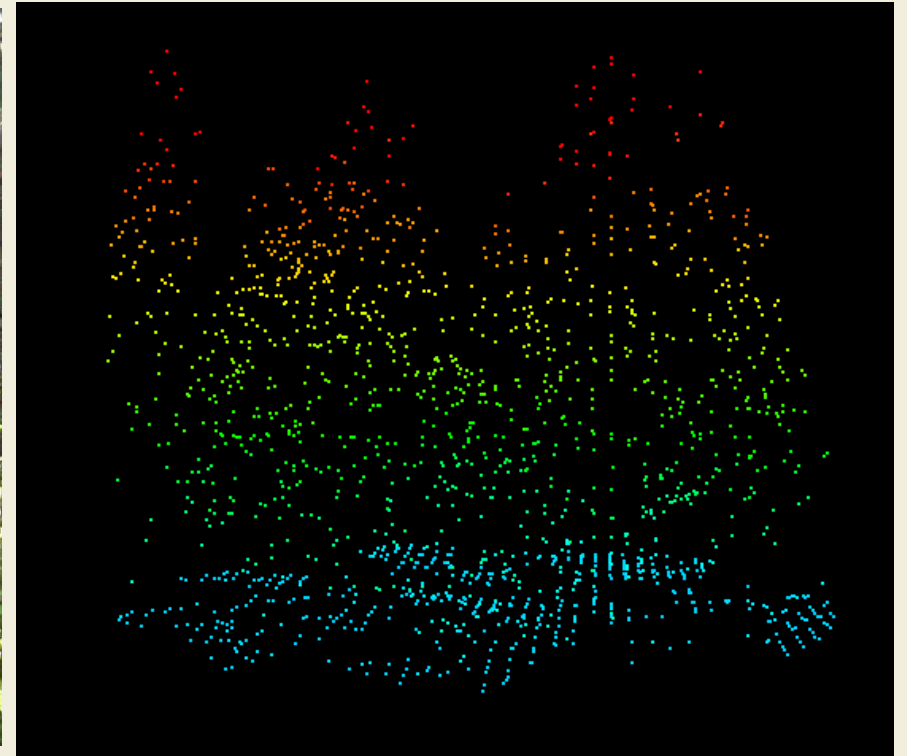
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LiDAR example

- Black spruce – uneven-aged
- C2 fuel type



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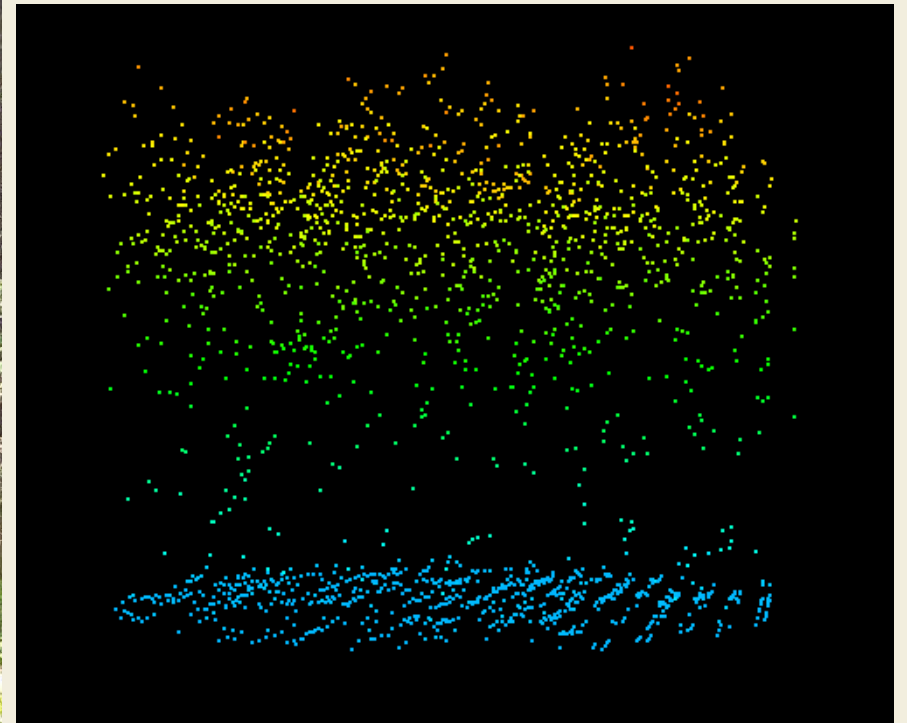
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LiDAR example

- Black spruce – even-aged
- Fuel type?





Analysis

- MODIS landcover
- Multiple sources of remotely sensed data
 - FRI
 - Biomass
 - LiDAR
 - Proportion of non-crown forest
 - Vertical complexity index (VCI)
 - Percent vegetation returns

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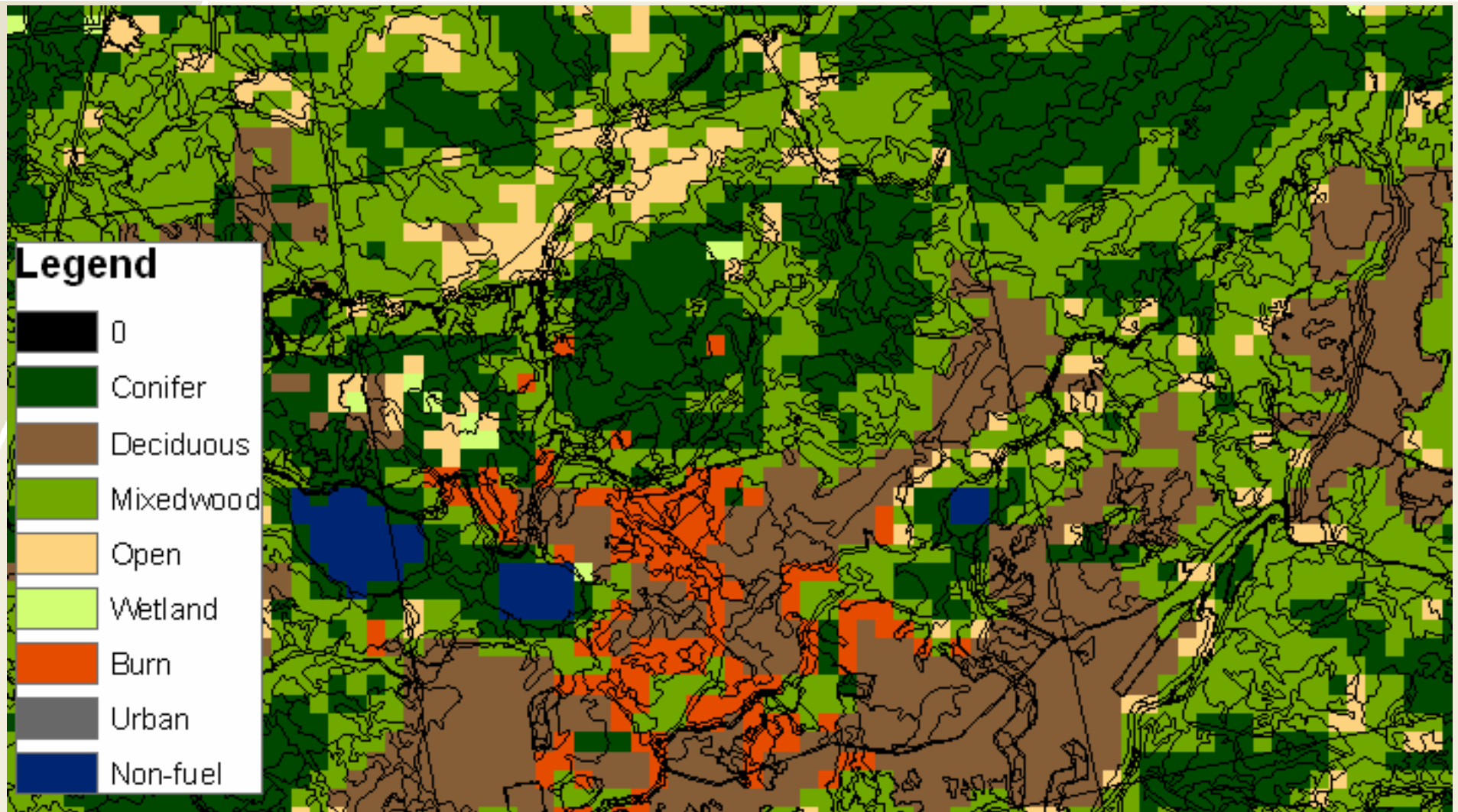
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MODIS Landcover



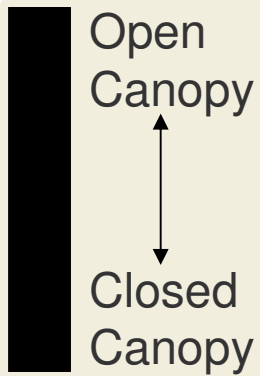
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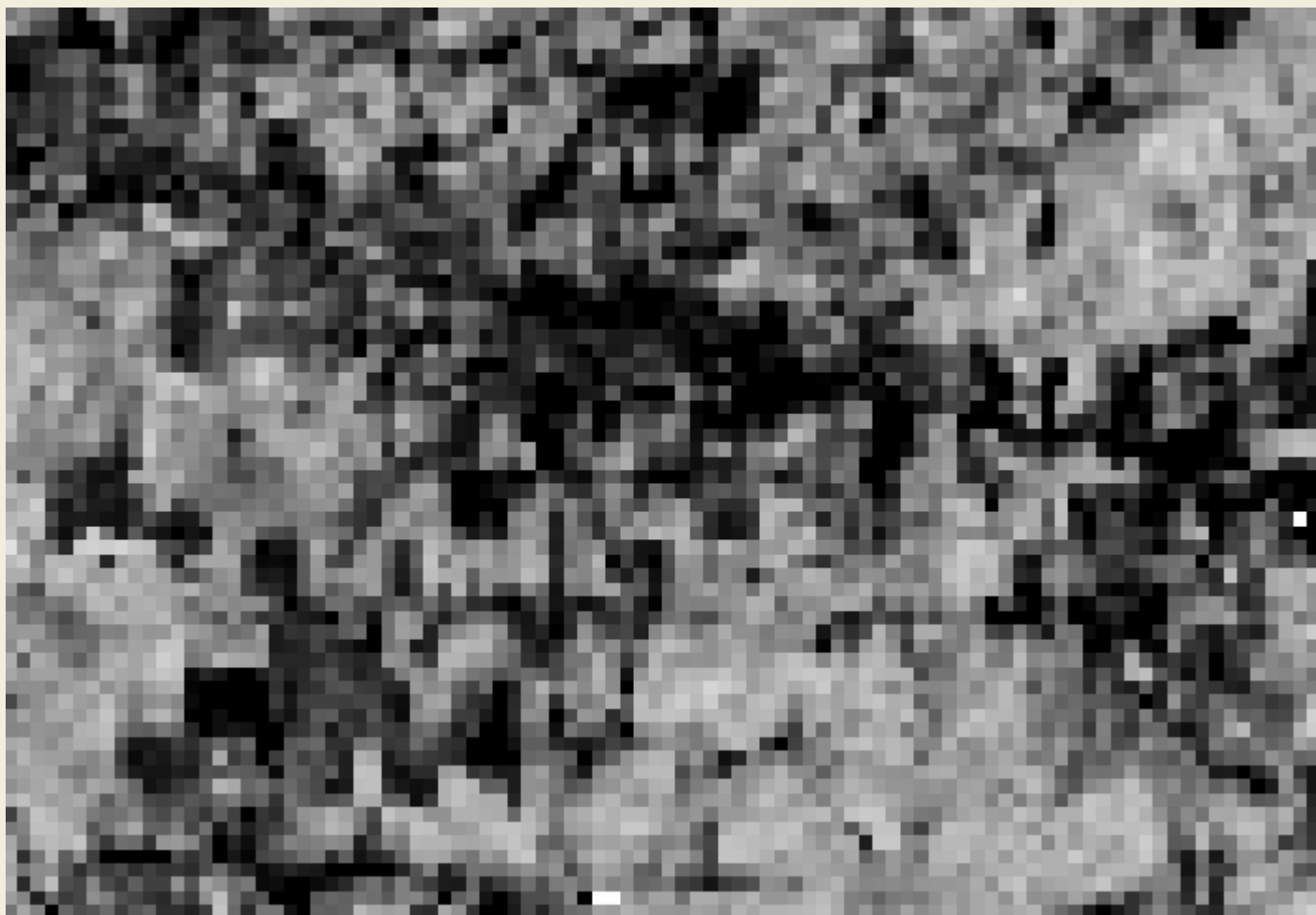
LiDAR 0-2m height class





LiDAR average VCI

Complex Structure
↑
↓
Simple Structure



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Sample percent vegetation returns

- Crown to base height
- Crown bulk density
- Ladder fuels

