Characterizing Boreal Forest Fuels with Operational Airborne LiDAR Data

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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
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
LiDAR example

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

- Jack pine – immature
- C4 fuel type
LiDAR example

- Black spruce – uneven-aged
- C2 fuel type
- 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
LiDAR 0-2m height class

Open Canopy

Closed Canopy
LiDAR average VCI

Complex Structure

Simple Structure
Sample percent vegetation returns

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

![Percent Vegetation Returns Graph]