

# Inventory

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Government of Northwest Territories

# **Project Team**

#### Canadian Forest Service

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#### Government of NWT

- •NWT Centre for Geomatics
  - J. van der Sluijs, W. Woodley
- •Forest Management Division
  - K. Groenewegen, L. Smith

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#### University of Lethbridge

· C. Hopkinson, C. Mahoney

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# Outline

- NWT Forest Vegetation Inventory
- Inventory drivers in NWT
- Current Program methods/products
  - C.2007/2010 EOSD land cover updates
  - Field data collection
  - LiDAR modeling
  - Raster Maps
  - MVI products



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# Forest Inventory in the NWT



- Inventory comprises ~10% of forest lands
- Uses 1:20,000 1:40,000 aerial photography
- Highly detailed, expensive
- Limited coverage
- Dated, many ~20yrs old
- Require more current and cost-effective methods

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# **Inventory Drivers**

- Timber Supply Assessments
  - projecting inventory over the long term (200 years) to determine sustainable harvest levels for different products
- Biomass Strategy
  - Promoting forest industry in NWT
- Forest Health
  - Pine beetle, flooding, other mortality
- Habitat Monitoring and Modeling
  - Species at Risk
- Others: carbon, reporting, climate







# **MVI Objective**

#### Goal:

To develop a sound methodology to efficiently map the forest landscape, forest attributes, carbon fluxes, and forest change

#### Approach:

Integrate field, airborne & spaceborne LiDAR data, Landsat imagery and models to estimate and map forest attributes (forest type, stand height, crown closure, stand & total volume, aboveground biomass, stand age).





# Earth Observation for Sustainable Development (EOSD) of Forests

#### Canada-wide land-cover dataset over forested ecozones



Figure 3. EOSD land cover legend (based on the NFI level 4 classes and level 5 density descriptors).



Wulder, M.A., White, J.C., Cranny, M., Hall, R.J., Luther, J.E., Beaudoin, A., Goodenough, D.G., Dechka, J. (2008). Monitoring Canada's forests. Part 1: Completion of the EOSD land cover project. Canadian Journal of Remote Sensing 34(6): 549-562

### **EOSD Classification Process**

- 1. Acquire c.2007 (Phase 1) and c.2010 (Phase 2/3) Landsat 5 Thematic Mapper (TM) imagery
- 2. Image Preprocessing
  - Consistent radiometry across large areas
  - Partition image into smaller zones along water bodies



### **Ancillary Field Data**



## **EOSD Classification Process**

- Split each zone into homogenous spectral clusters (K-means)
- Assign an EOSD land cover class to each cluster using calibration data (GNWT FVI, Ducks Unlimited Canada aerial survey, ELC photos, NFI plots, highres imagery)
- Complete this for each zone, using neighbouring zones to aid in cluster labeling





### **Methods Flowchart**



## **Field Data Collection**

#### Plot & Tree Level Measurements **Plot** Area • 200 plots • 20 x 20 metres = $400m^2$ • Spherical densiometer (crown closure) XICCI) Presence/absence of fire, insect or logging damage Large Tree Plot Boundary Forest inventory stand call Small Tree Listing of ground vegetation Plot Boundary Pigtail CC5 Species: Sw,Sb,Pj,Aw, Bw, etc. Densiometer W 🖈 🗷 E • Height of tree (m) Measurement • DBH (cm) • Tree status: live standing or dead standing, etc. CC8 CC9 Age (5 trees/species/plot) SW SF rellowknife Deta Fort Simpson Jean Marie River Nahanni Butte ont Resolution Hay River Reserve Hay Riv út Lake Government of ort Liard Northwest Territories

## **LiDAR Sources**







### k-NN Rasters (C/D/M)

Height (m), Crown Closure (%), Stand & Total Volume (m3/ha), Aboveground Biomass (tonnes/ha), Stand Age (yrs)



### Airborne LiDAR vs Inventory (Height variability within polygon)



# Multi-Source Vegetation Inventory (Vector)



### FVI / MVI

![](_page_17_Figure_1.jpeg)

## Next Steps

#### with Canadian Forest Service & ULethbridge

#### 1. Compute volume & inventory metrics on field plots

- Ft.Prov/Ft.Simp/Ft.Liard MVI plots (remeasure 85)
- National Forest Inventory plots (remeasure 30)
- 2. Produce vector MVI coverage for Phase 2
- 3. Update geospatial Carbon Budget Model (gCBM) Estimates above ground carbon fluxes 1990-2017
- 4. Potential 2018 Titan LiDAR (multispectral) transect
- 5. Plan c.2020 remap of MVI area

New technologies may include ICESat-2, UAVs, updated LiDAR models

6. Explore Remote Sensing in forest health monitoring

![](_page_18_Picture_11.jpeg)

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![](_page_18_Picture_13.jpeg)

![](_page_19_Picture_0.jpeg)

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http://www.enr.gov.nt.ca/en/services /forest-resources/inventory-andanalysis

http://www.nrcan.gc.ca/forests/meas uring-reporting/remotesensing/13441

![](_page_19_Picture_4.jpeg)

![](_page_19_Figure_5.jpeg)