FORSITE
Forest Management Specialists

FPBC Webinar – January 21, 2026

Innovation in Forest Management

Cam Brown MF, RPF
VP – Forest Analytics

Innovation…

- Bringing new approaches or solutions to problems in a way that creates positive impact and value. **New ideas become tangible outcomes**.

Incremental	Radical	Disruptive
• Small ongoing improvements to existing approaches. • Softcopy photo interp replaces stereo viewing on paper photos	• Significant shift in tech or markets • Lidar + Sat Imagery combined with plots used to create data driven forest inventories	• Entirely new tech or transformation of a market • Autonomous drone swarms fly above/within forests to actually measure most attributes.
Most Common	Less Common	Least Common

Importance of Innovation

- Demands / Complexity of Modern Forestry
  - Higher public expectations
  - Increasing demands on our forests
  - Increase complexity of management
  - Increasing pressures
  - Increased uncertainty (climate change, markets, natural disturbances, etc)

- Innovation needed to help respond to the challenges:
  - Improved data to support better decision making / reduce costs
  - Improved management framework to support balancing econ/env/social objectives

Topics for Today

- Better Data and Visualizations (LiDAR, Sat Imagery, Phone Apps, Drones)
  - Example Products and Uses
- From Data to Decisions
  - Operational Planning Tools
  - Wildfire Management
  - Linking Strategic and Operational Planning
- Automation
  - Remote Equipment Operation (yarders, drones, truck platooning)
  - Seeding / Planting

Satellite Data

- Ranges from free lower resolution data, to higher cost, high resolution tasking services.

Example	Spatial Resolution	Revisit Rate	Cost
Sentinel-2	10-20m	<5 days	Free
PlanetScope	3m	Daily	$10-25/km2 Annual Subscription
SPOT 6/7	1.5-5m	Daily	$3-7/km2 or can get annual subscription
Maxar / Pleiades Neo	30cm	Multiple times per day	~$20–$45 per km2 (min. areas apply)
Radar NISAR / Sentinel 1	10-15m	<5 days	Free

Satellite Data – Use Cases

More than just pictures/images:

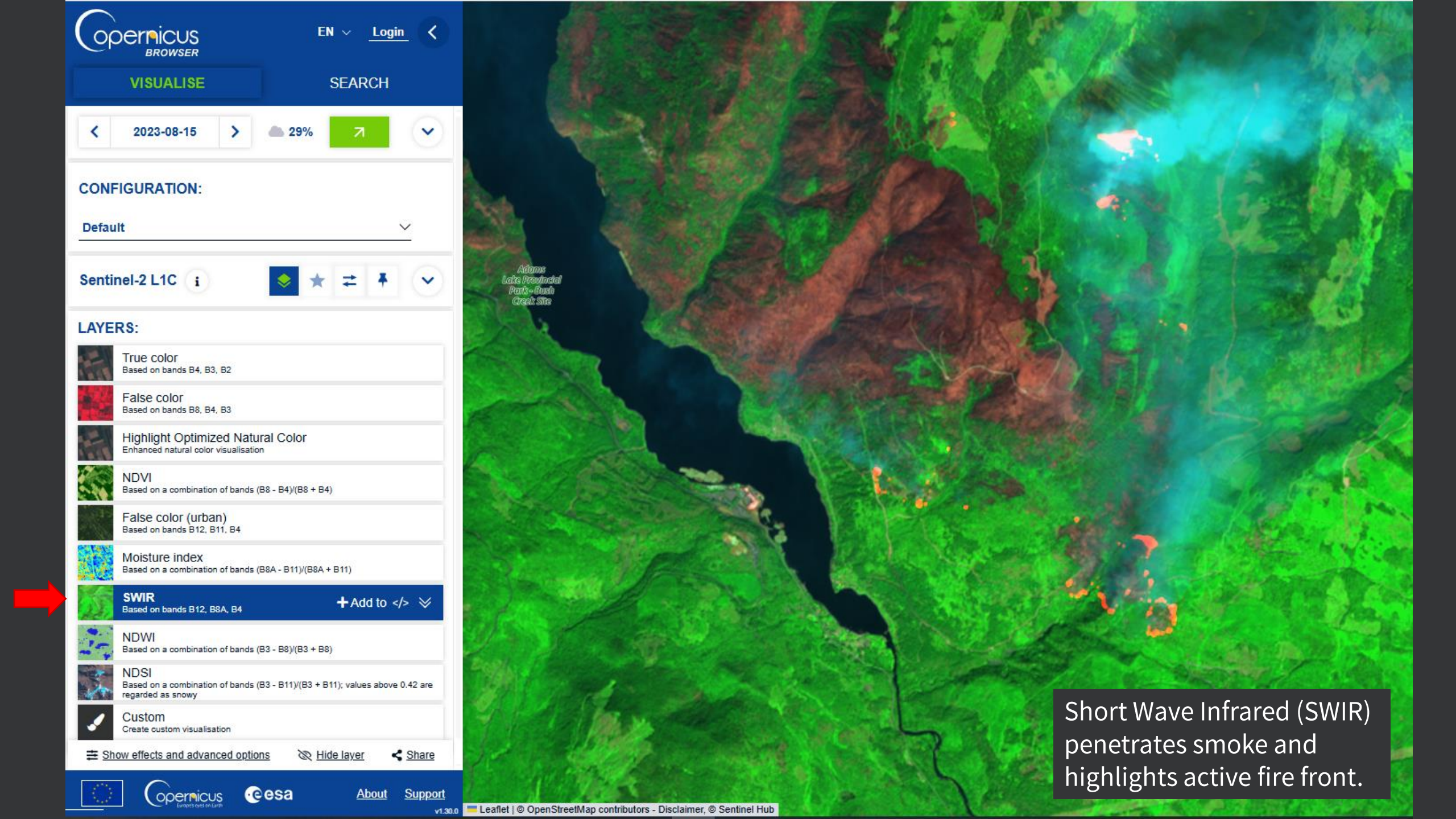
- Automated monitoring of activity (change detection - harvest, roads, etc).
- Forest health monitoring (change detection – mortality, stress)
  - Detection of chlorophyll changes (early detection of stress from drought, beetle)
  - NDVI or Red Edge (early plant stress, nitrogen content)
- Wildfire extent / severity mapping (SWIR, pre/post images)
- Tree species predictions, Fuel type predictions
- Biomass estimation, Carbon storage/change

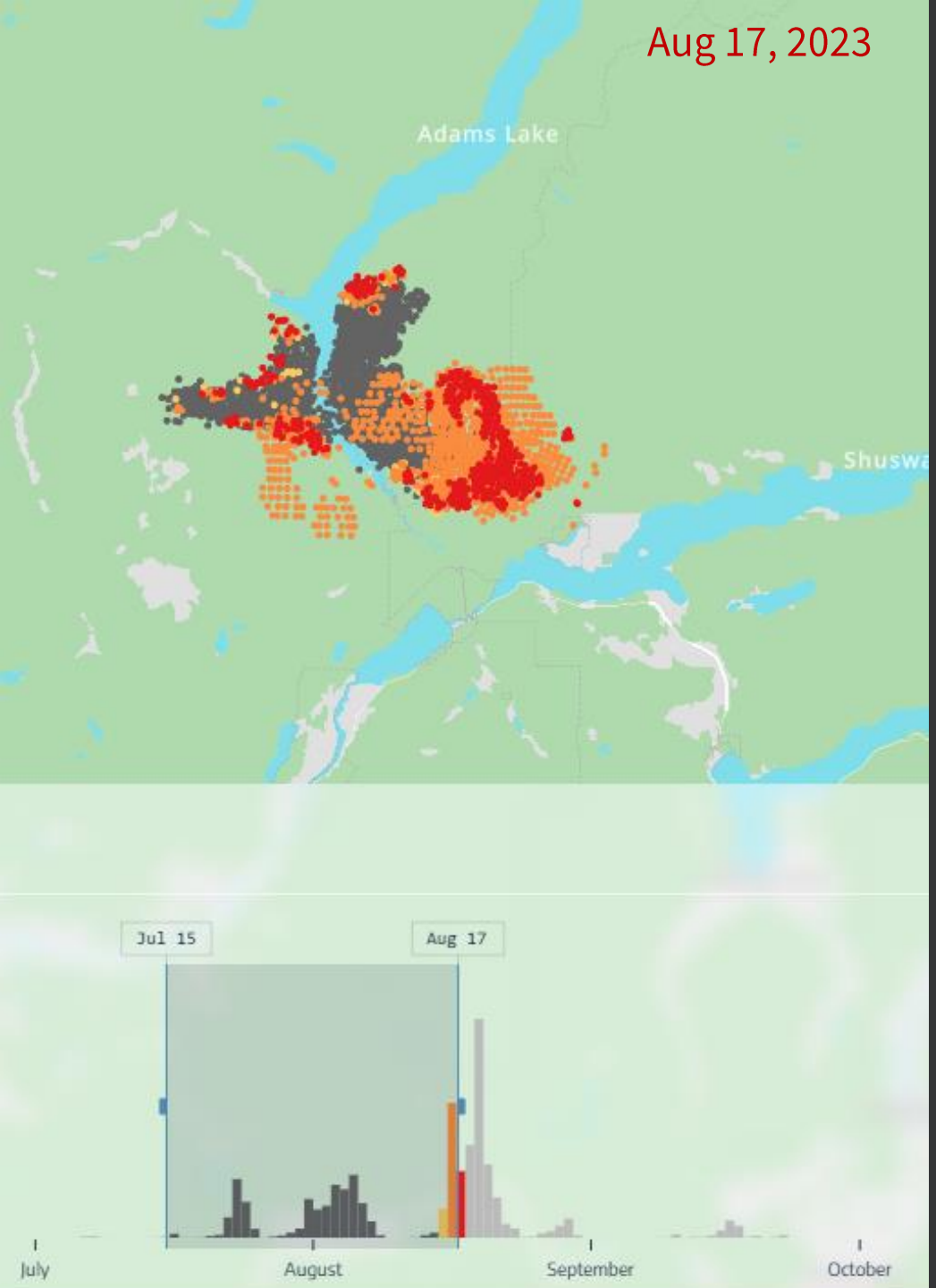
Aug 15, 2023

Freely Available, easy to access, timely satellite data (10m)

Zoom to location, Set acceptable cloud %, click through dates

https://browser.dataspace.copernicus.eu/


Copernicus BROWSER
EN
Login
VISUALISE
SEARCH
2023-08-15
29%
CONFIGURATION:
Default
Sentinel-2 L1C
LAYERS:
True color
Based on bands B4, B3, B2
False color
Based on bands B8, B4, B3
Highlight Optimized Natural Color
Enhanced natural color visualisation
NDVI
Based on a combination of bands (B8 - B4)/(B8 + B4)
False color (urban)
Based on bands B12, B11, B4
Moisture index
Based on a combination of bands (B8A - B11)/(B8A + B11)
SWIR
Based on bands B12, B8A, B4
+ Add to
NDWI
Based on a combination of bands (B3 - B8)/(B3 + B8)
NDSI
Based on a combination of bands (B3 - B11)/(B3 + B11); values above 0.42 are regarded as snowy
Custom
Create custom visualisation
Show effects and advanced options
Hide layer
Share
About
Support
v1.30.0
Adams Lake Provincial Park - Bush Creek Site
Leaflet | © OpenStreetMap contributors - Disclaimer, © Sentinel Hub
Short Wave Infrared (SWIR) penetrates smoke and highlights active fire front.



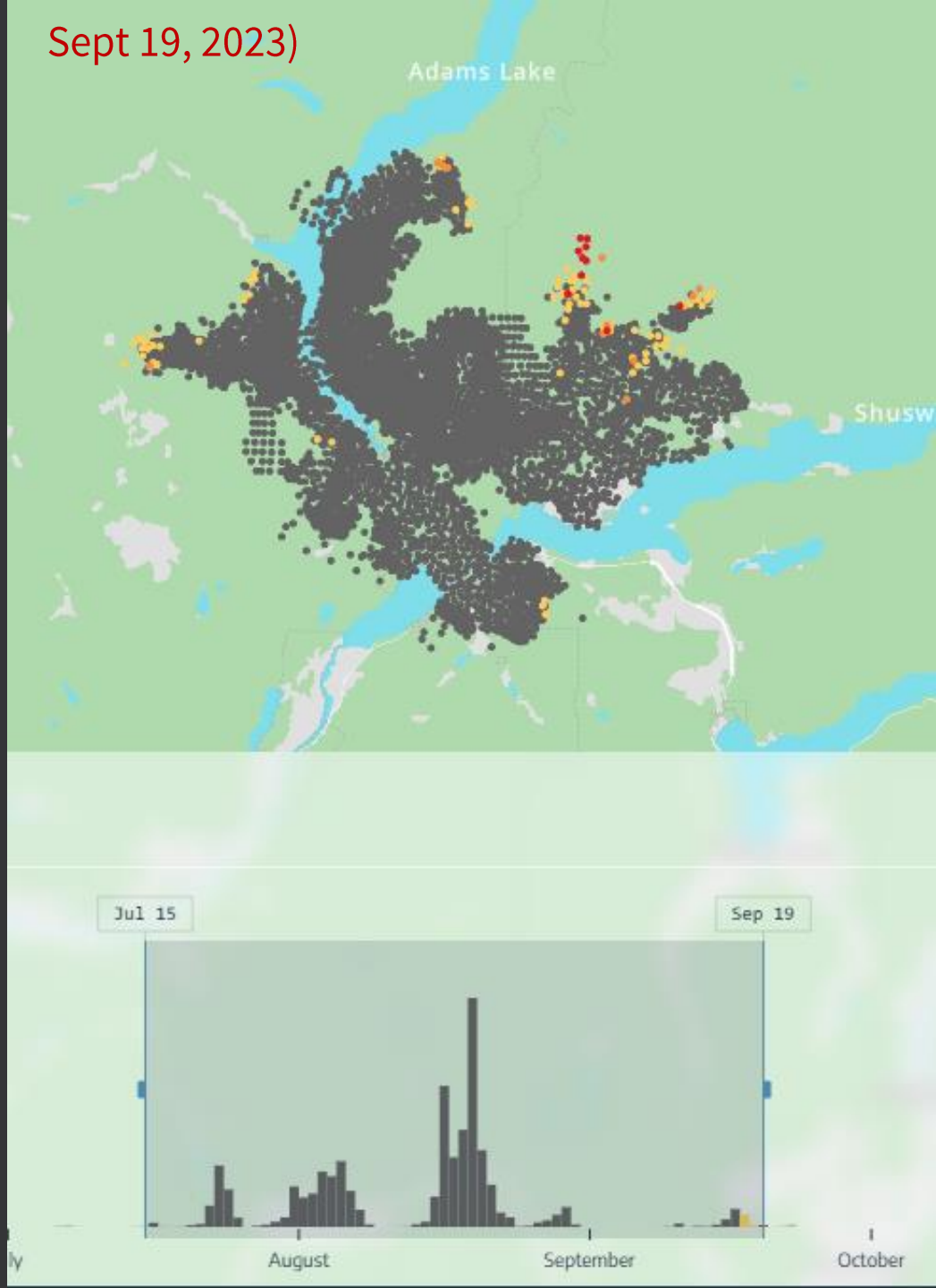
HOTSPOT MAPPING

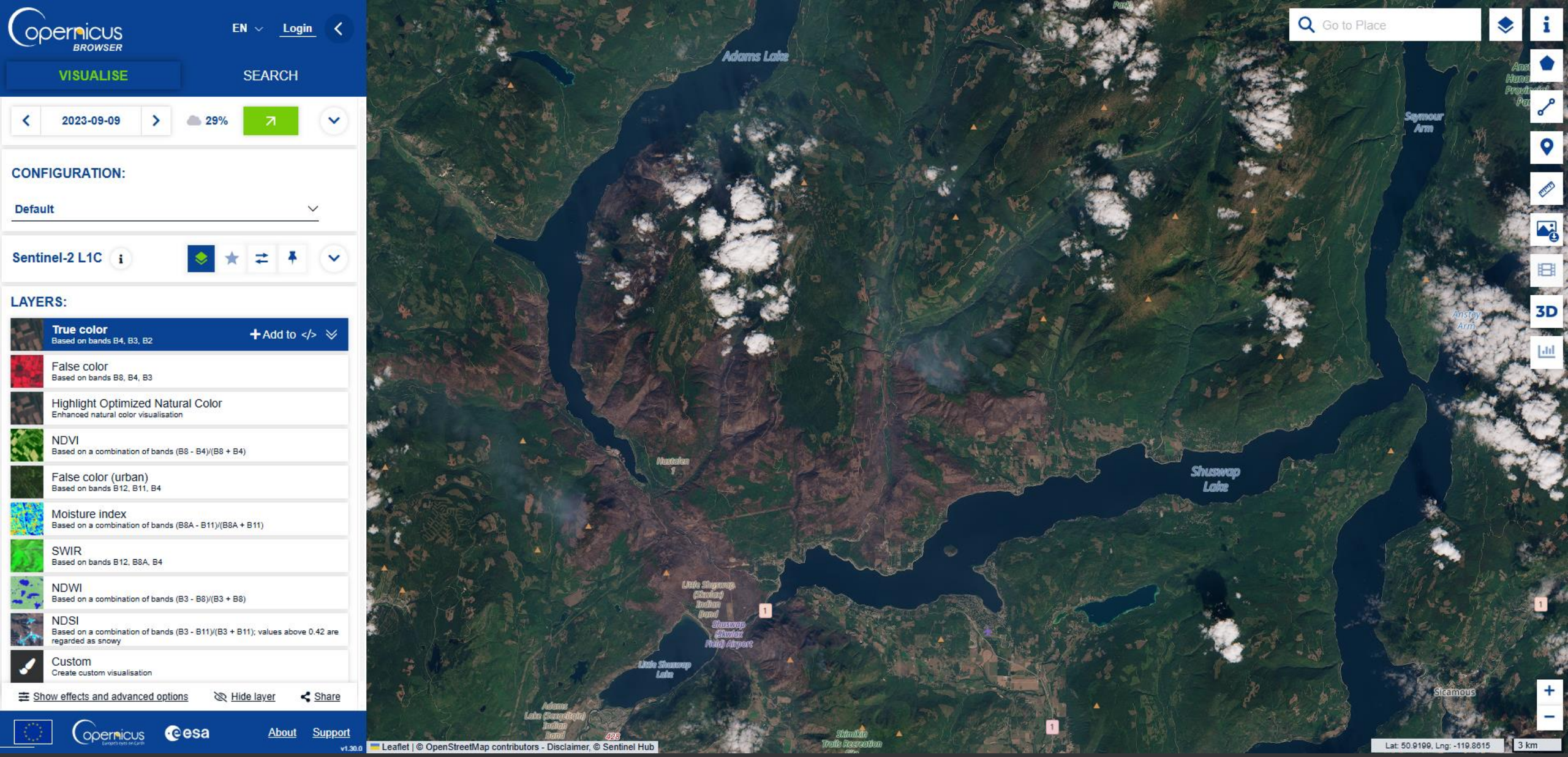
MODIS hotspots (NASA Satellites Terra + Aqua)

Daily Tracking, point in 1 km pixels

Being Replaced by VIIRS (active now) 375m pixels, 2x per day

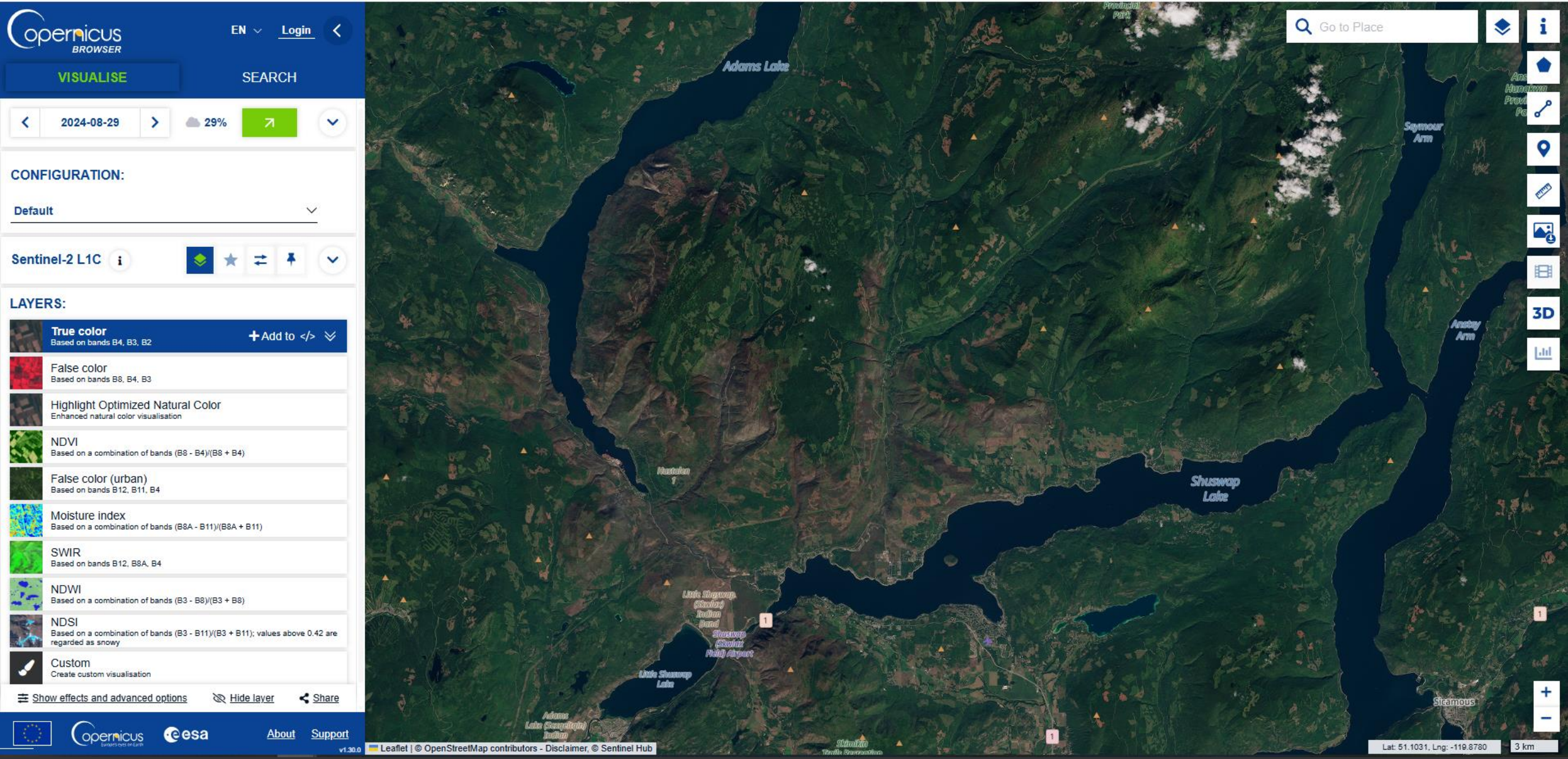
Easy to Access as GIS Datasets





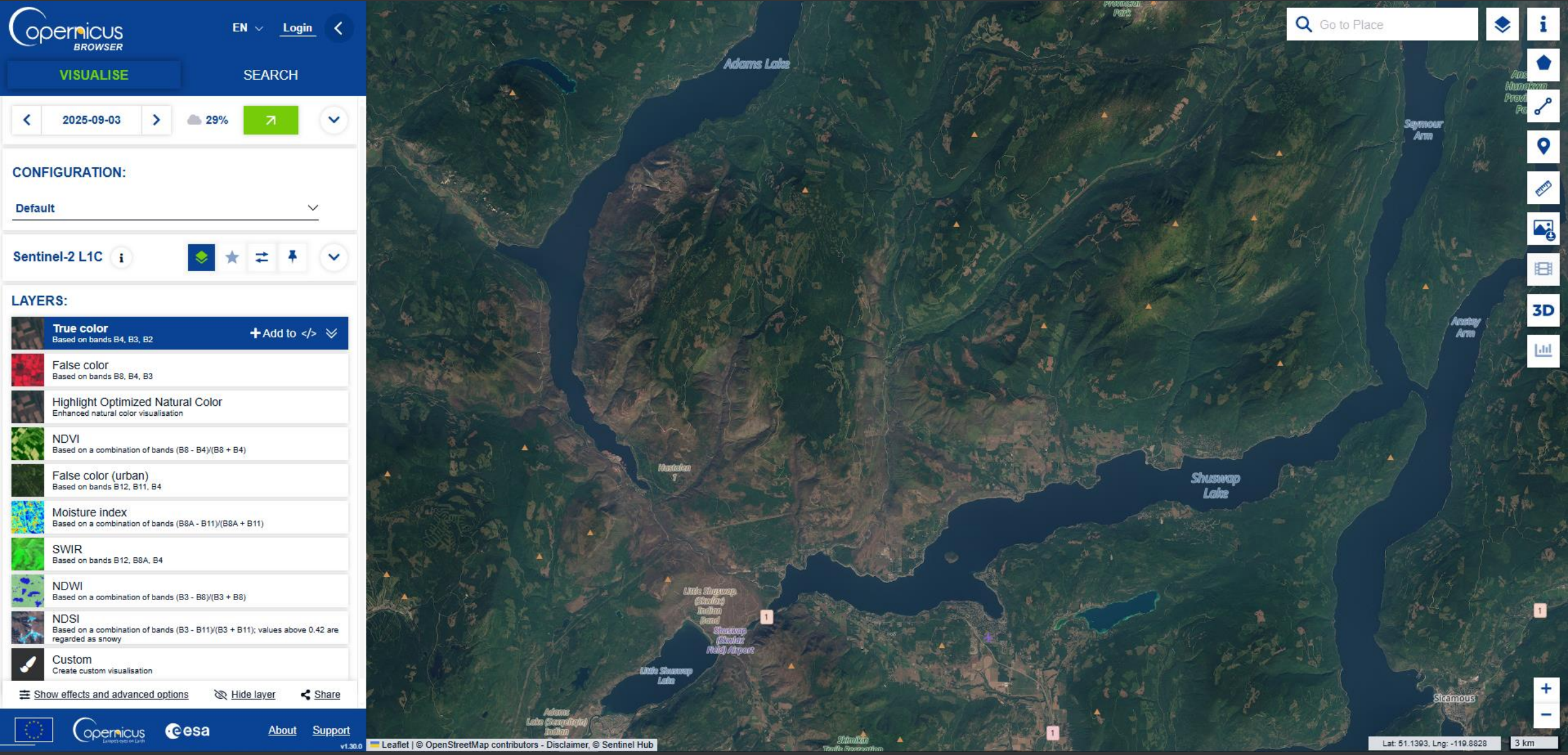
Sept 9, 2023

https://browser.dataspace.copernicus.eu/



Aug 29, 2024

https://browser.dataspace.copernicus.eu/



Sept 3, 2025

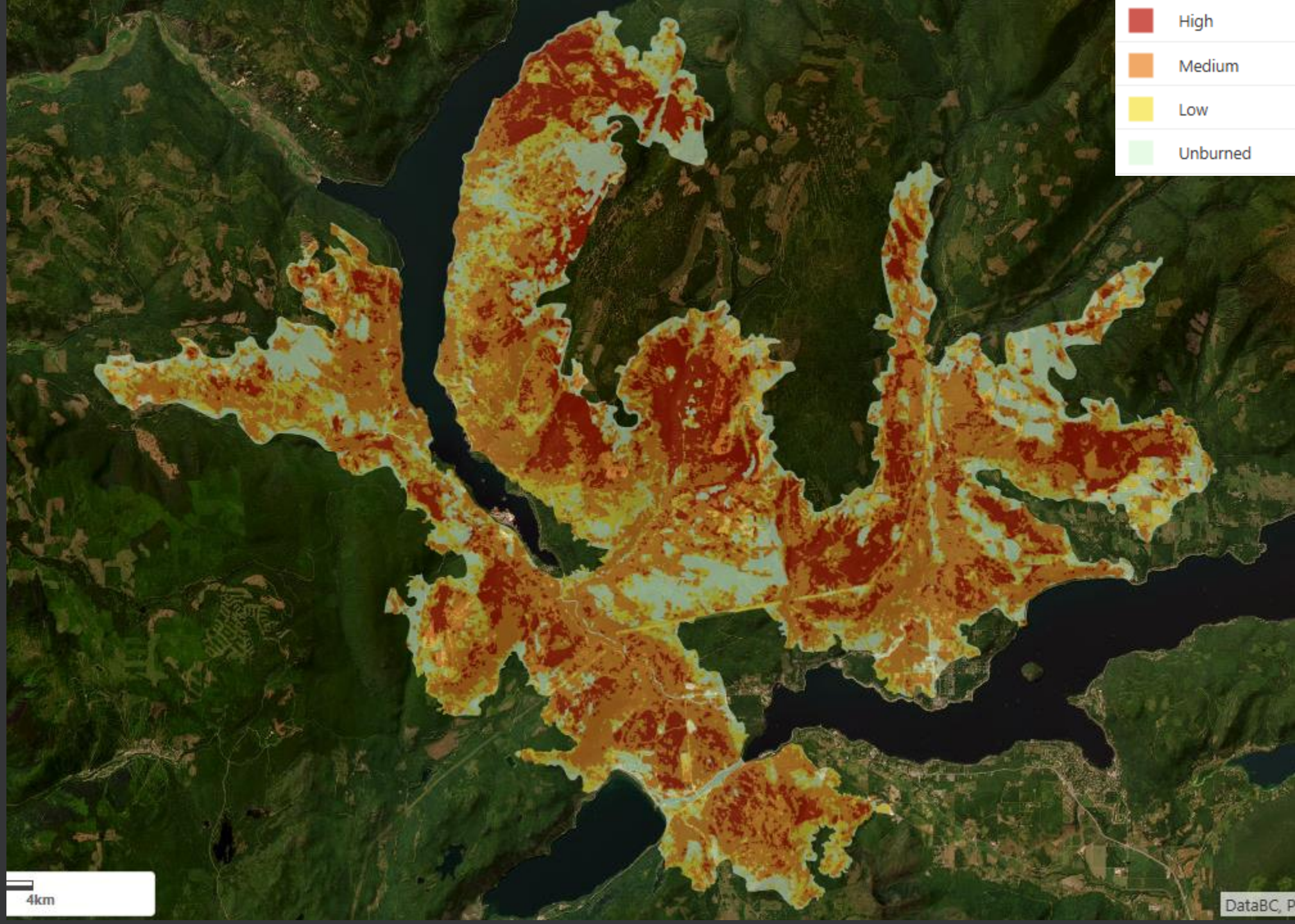
https://browser.dataspace.copernicus.eu/

Burn Severity Rating

Derived by FAIB for all fires over 100ha in size.

Sentinel 2 Imagery – Pre/Post Fire

(Normalized Burn Ratio - dNBR)



Fire Salvage – Monitoring Change (Sentinel 2 – time series)

March 17, 2024

April 1, 2024

May 11, 2024

https://browser.dataspace.copernicus.eu/

Other Products:

- **Sentinel-2/LandSat-8 / HLS**
- Global 30m Landsat Tree Canopy Cover
- Not as accurate as traditional forest inventory but crosses borders and is wall to wall.

https://www.earthdata.nasa.gov/data/catalog/lpcloud-gfcc30tc-003

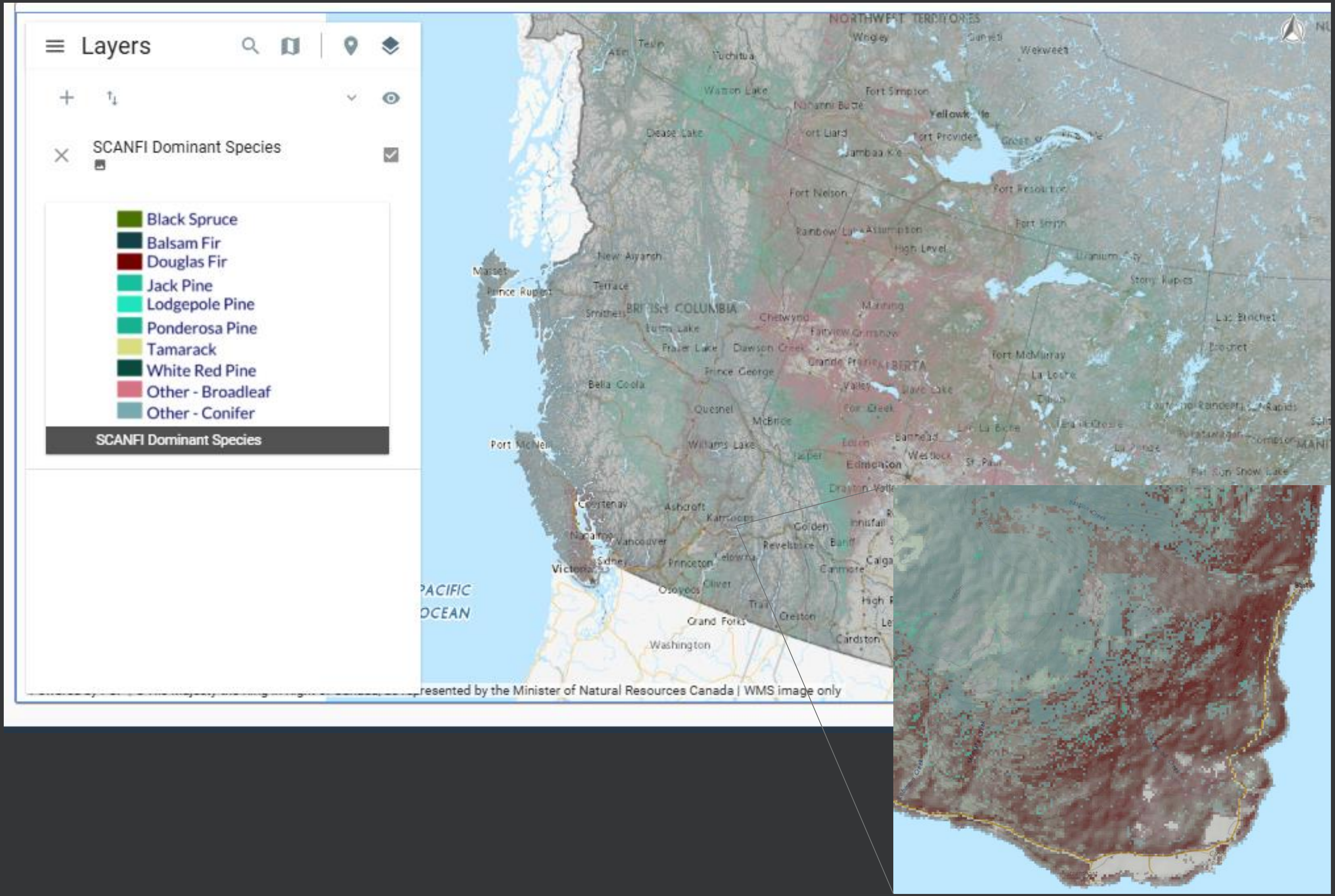
Other Products:

- **LandSat – 30m Data**

- National Forest Inventory

- SCANFI: the Spatialized Canadian National Forest Inventory data product:

- Not as accurate as traditional forest inventory but crosses borders and is wall to wall.



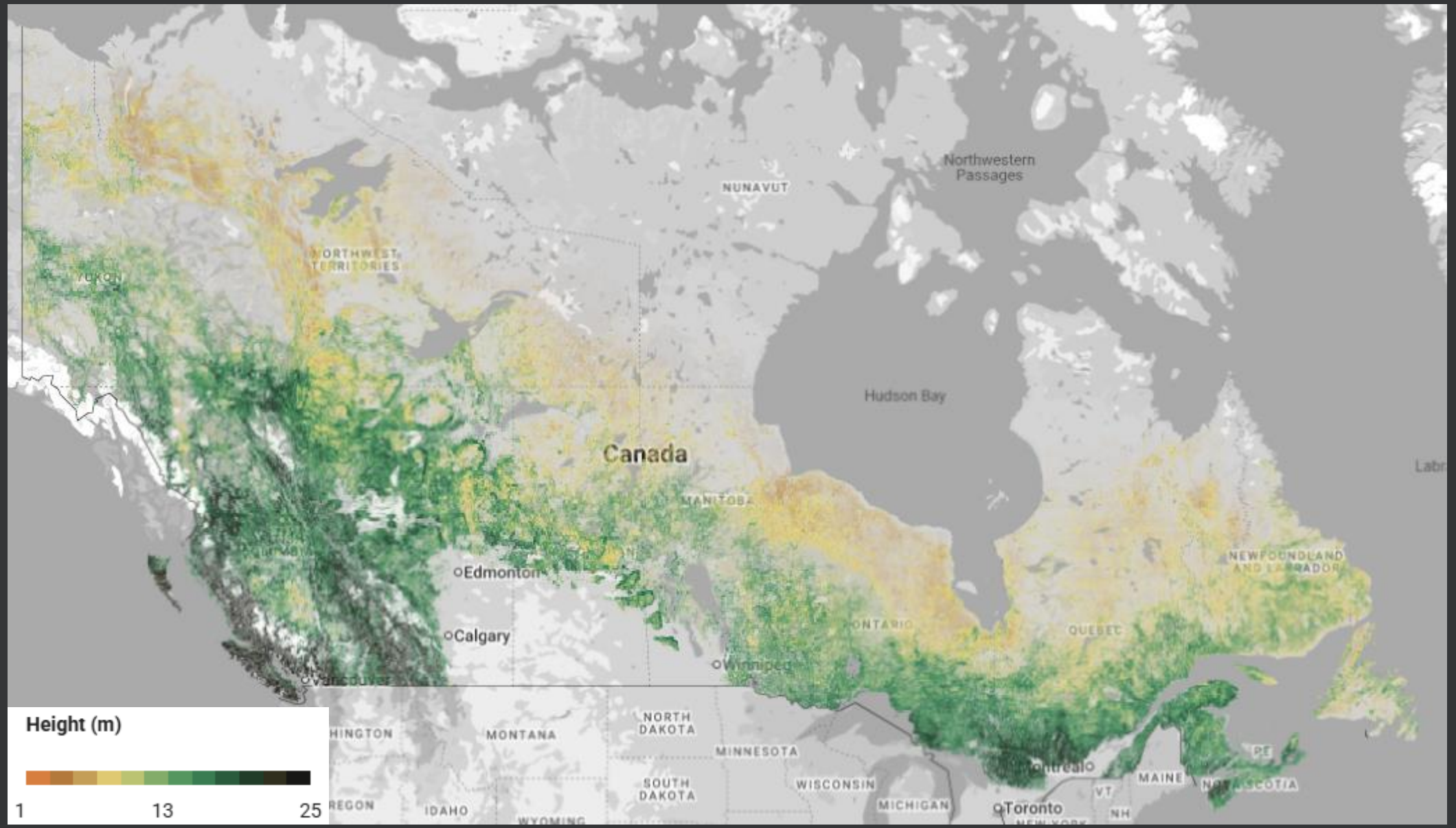
https://search.open.canada.ca/openmap/18e6a919-53fd-41ce-b4e2-

Tree Canopy Height (from 250m GEDI)

- **GEDI**: Spaceborne LiDAR datasets (University of Maryland / NASA)

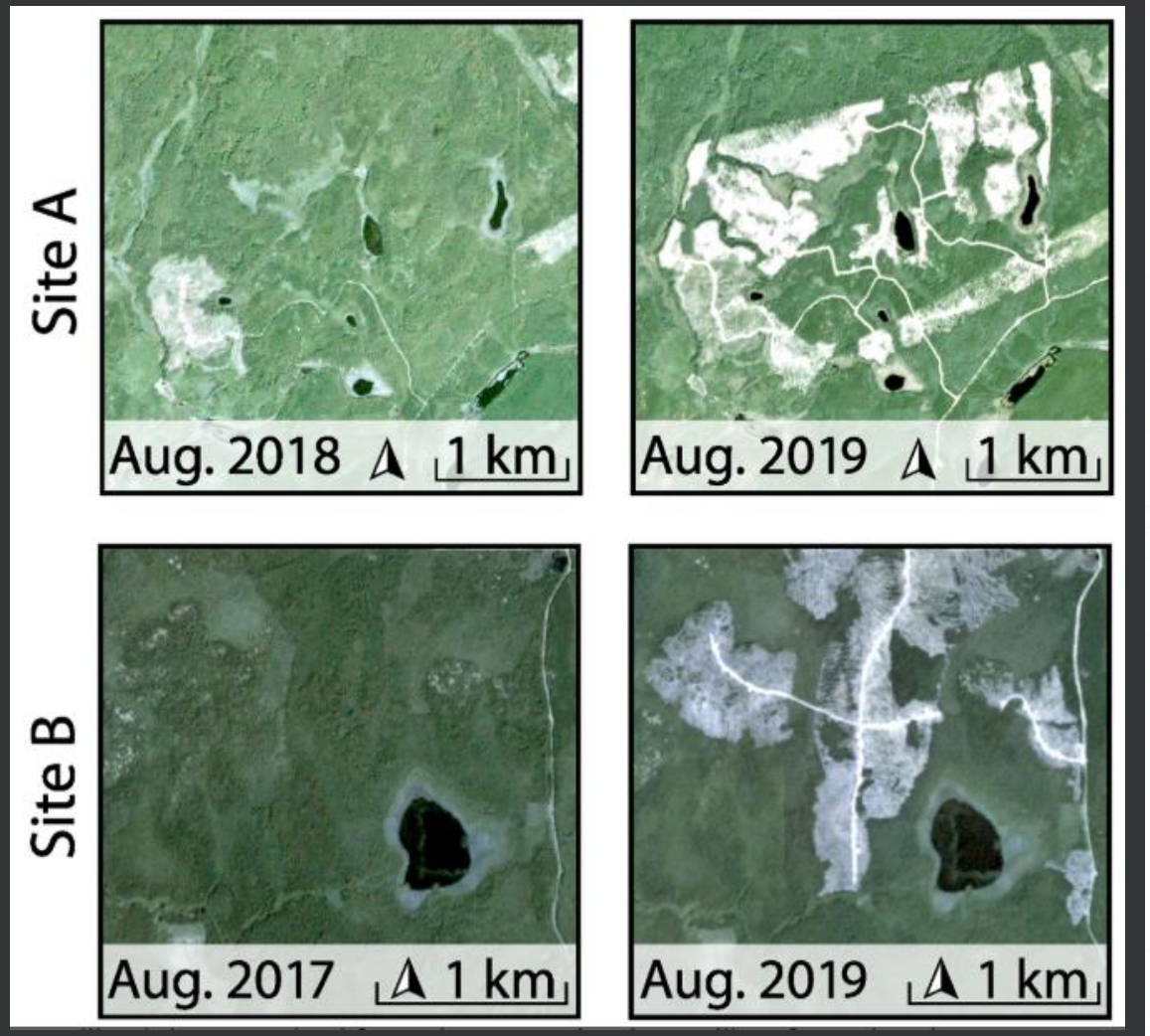
Much better data possible on small areas with good training data.

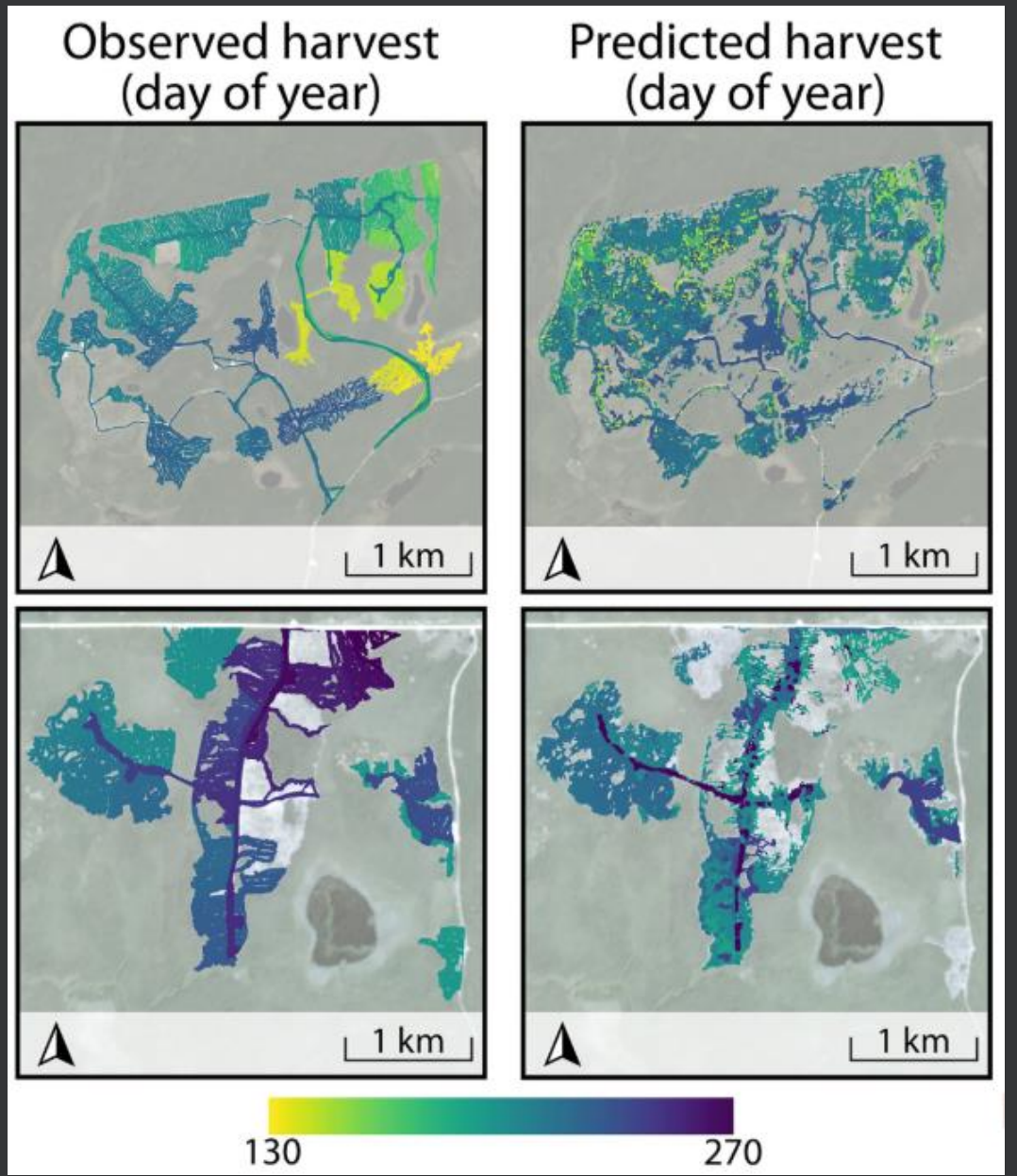
Still not as good as LiDAR (error is 3-5m and misses the tall areas)



Automated Change Detection

- **SPOT or Planet Scope (1.5- 3m resolution)**





Next Generation Satellites for Forestry

- **Planet OWL**:

  https://www.planet.com/constellations/owl/

  - 1m spatial resolution;
  - onboard real-time processing;
  - 1-hour delivery for real-time monitoring

- **OroraTech Forest-3 (launched in Jan 2025):**

  https://www.eoportal.org/satellite-missions/forest#spacecraft

  - Networks of Satellites targeting 1 hour revisit rates, 3 channels of long-wave infrared bands
  - Near-real-time wildfire alerts (ID heat anomalies)

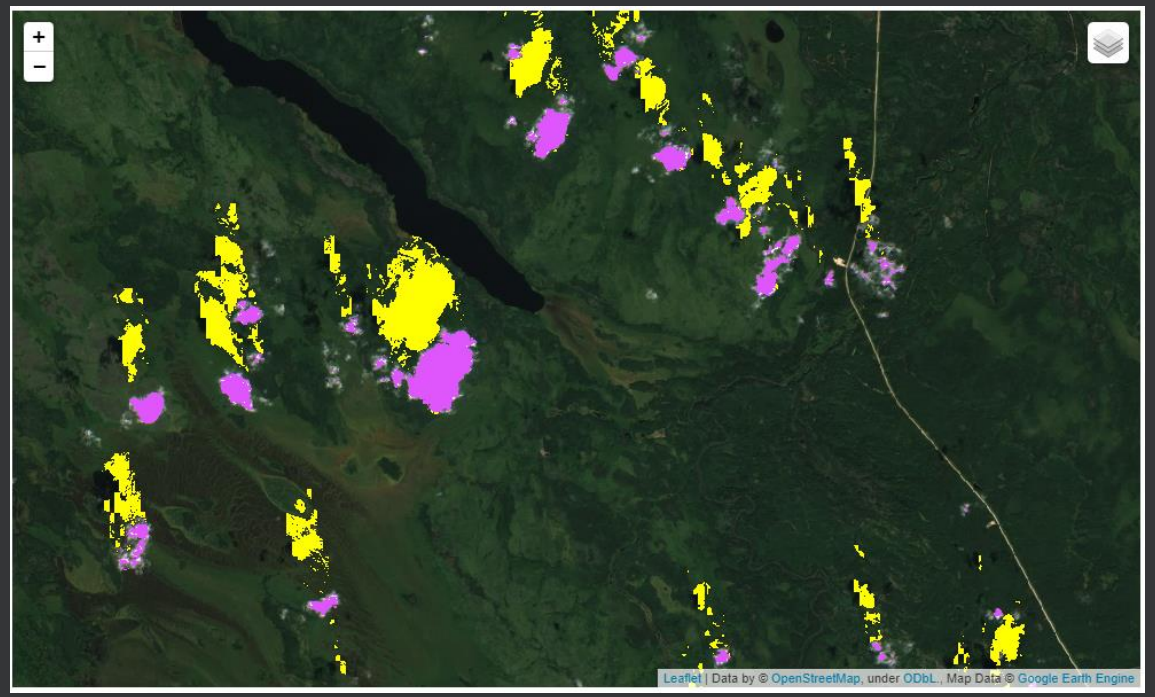
- **Landsat Next (2030/31 – maybe… budget cut by US Govt for 2026):**

  https://doi.org/10.1016/j.rse.2025.115087

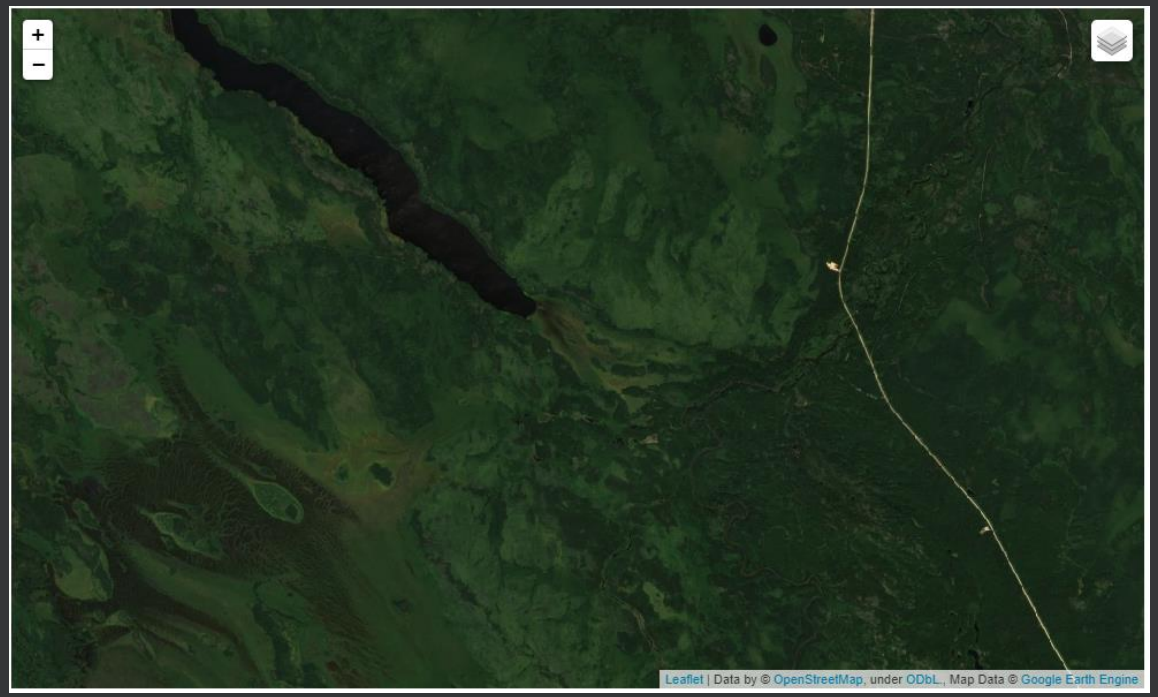
  - 3 Satellites, 26+ bands
  - Improved spatial resolution (10~20m), Improved revisit times, More Spectral Bands

Tools - Google Earth Engine (GEE)

- Using GEE (google earth engine):
  - collect the cloudless satellite data;
  - Data visualization;
  - cloud-based processing and modeling ($)



Sentinel-2 L2A with clouds(pink) detection



Sentinel-2 L2A cloud-free result

Satellite Products from Deep learning

- Tree crown delineation from imagery: complementary to lidar-based individual tree segmentation

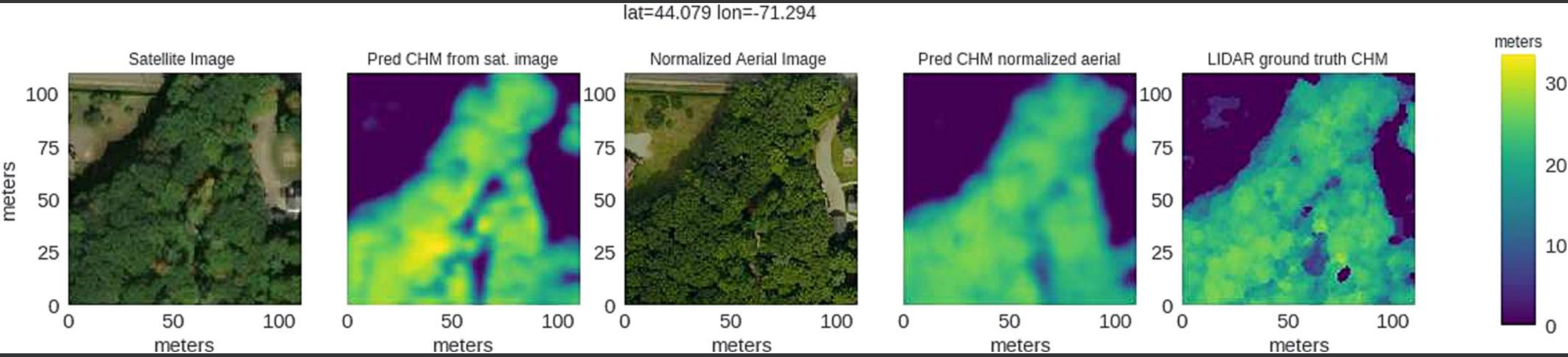
Image clip from True Ortho

Image-based delineation

Satellite Products from Deep learning

- Canopty height prediction from Satellite/Aerial Images: Compensating datasets in areas without LiDAR coverage

  ©Jamie Tolan, Hung-I Yang, etc. 2023



Drones in Forestry

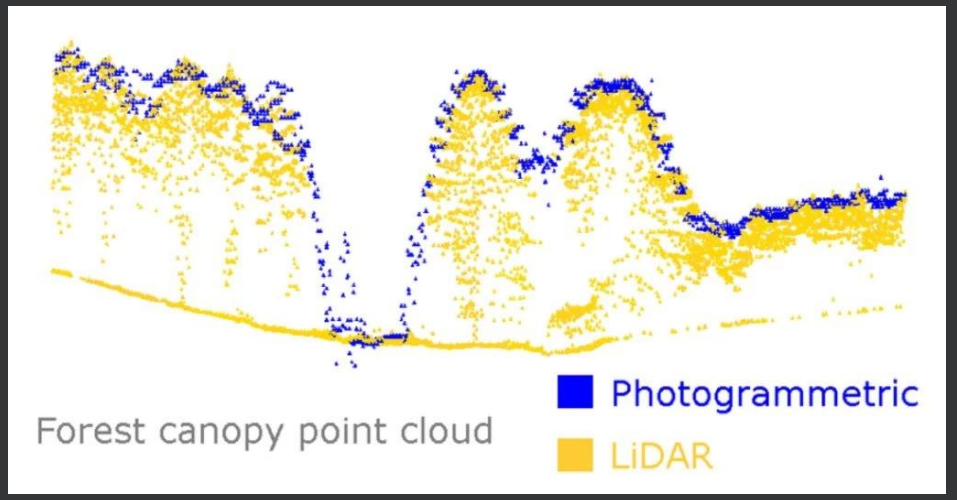
- Most relevant at stand scale (1-400 ha)
- Has been:
  - Eyes in the sky (recce/inspections)
  - Documentation (imagery)
    - Post harvest conditions, As-Built
    - Regeneration / brush / mortality

- Now - flying sensor platforms
  - Data Collection (Imagery, Phodar, LiDAR)
  - Autonomous Activities
    - Seeding
    - Wildfire hot spot mapping
    - Wildfire suppression
    - Large Area Monitoring

DeepForestry® quadrotor

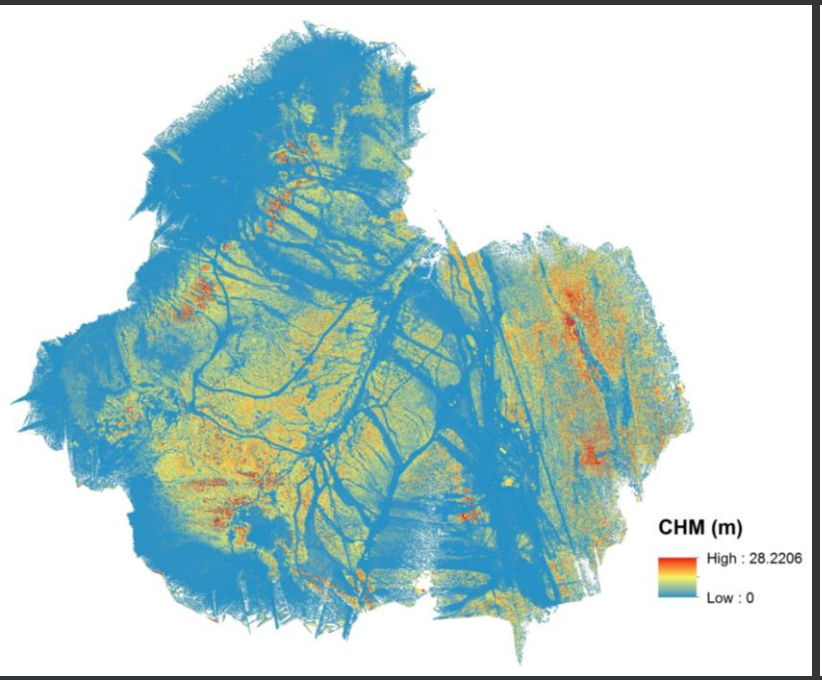
Drones in Forestry - Structure from Motion (SfM)

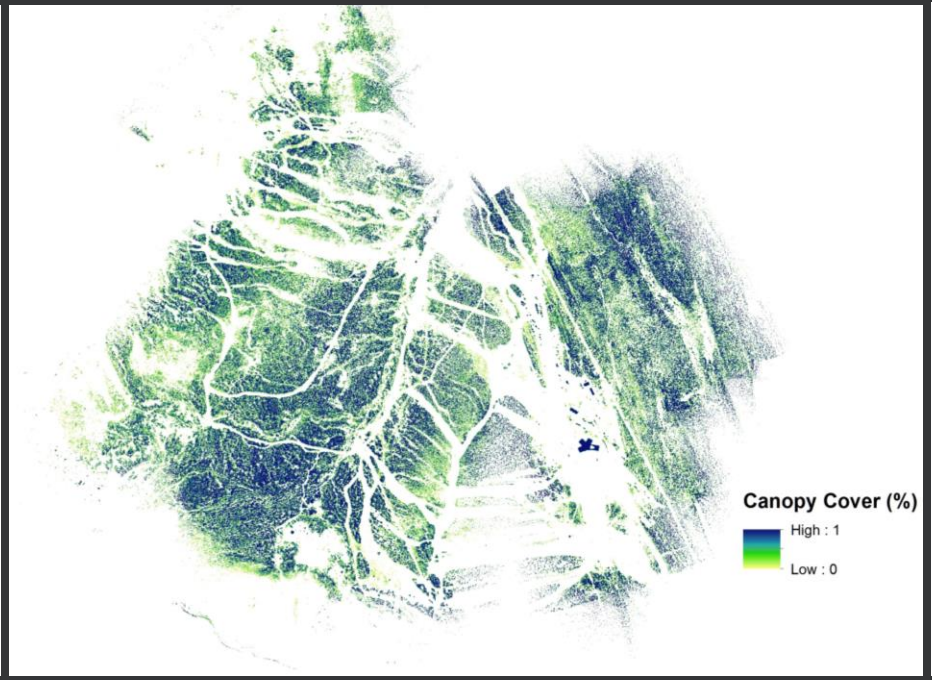
- Overlapping photos allows SfM processes to create a 3D point cloud from imagery pixels.
- Measure chip pile volumes
- Post harvest:
  - Retention Area Mapping
  - Waste Pile Mapping
- Regeneration
  - Height/Density Mapping
  - Seedling counts with Computer Vison

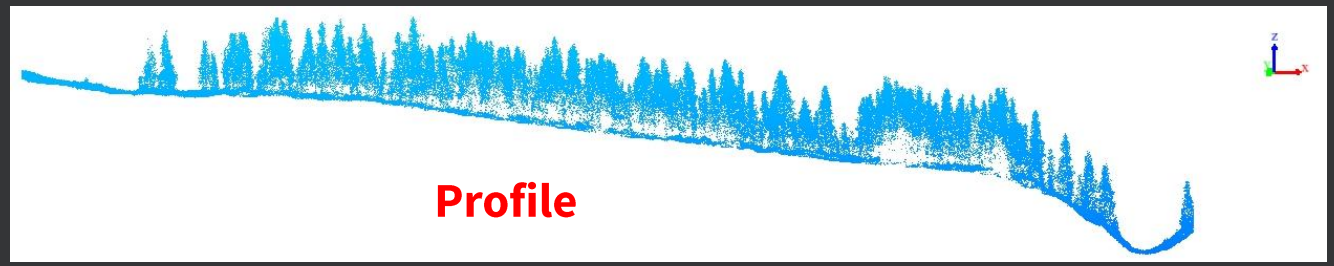


Drones in Forestry LiDAR collection + Products

3D Terrain and Forest Canopy Properties

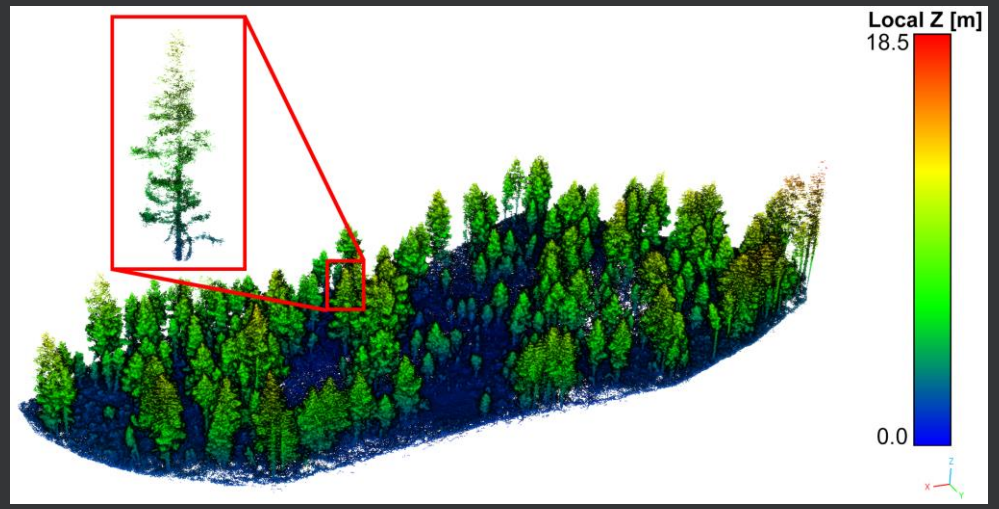






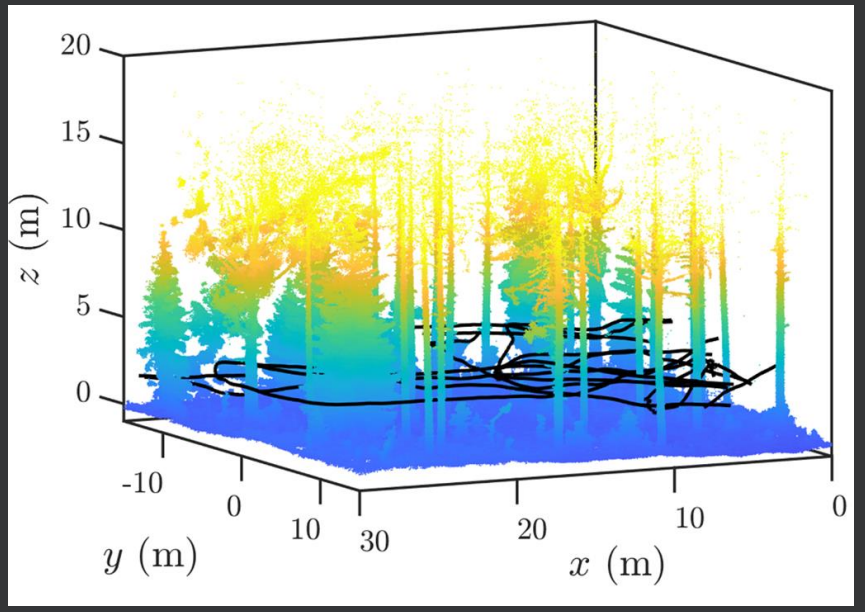
Drones in Forestry

Under canopy Autonomous Flights - LiDAR-based SLAM

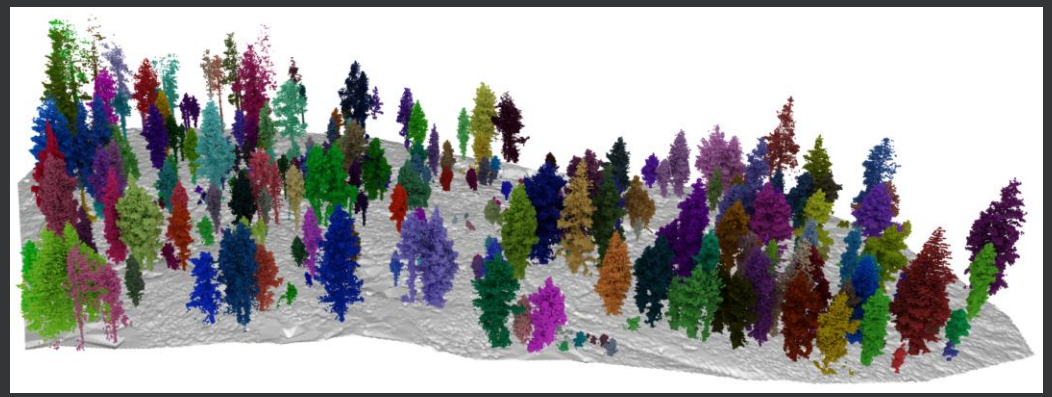


The raw, co-registered point cloud produced by LiDAR

DeepForestry® quadrotor

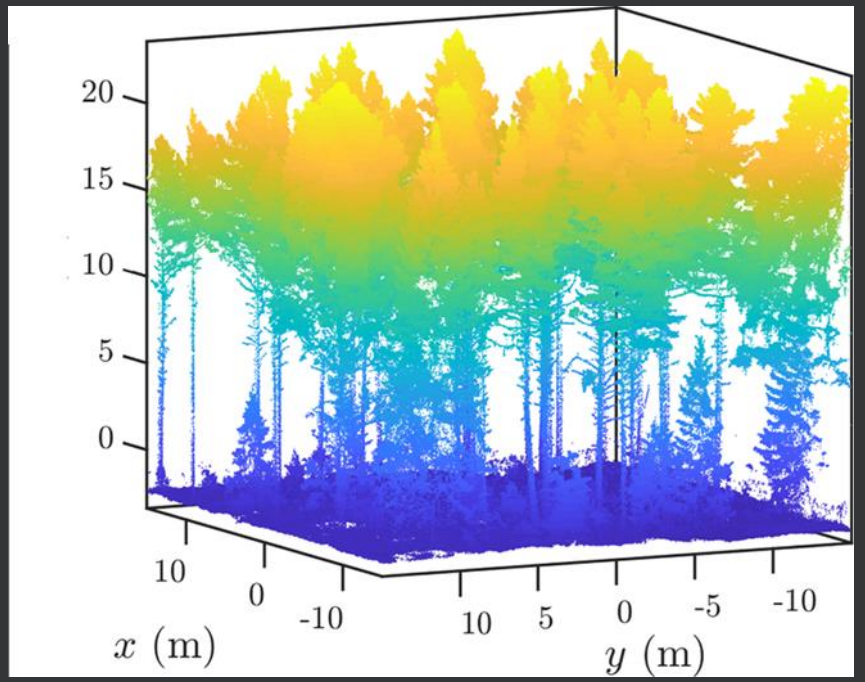


Under-canopy flying UAV



Results of tree instance segmentation on LiDAR point cloud

Diameter measurements + sweep/crook, etc



Above-canopy flying UAV

Drones in Forestry

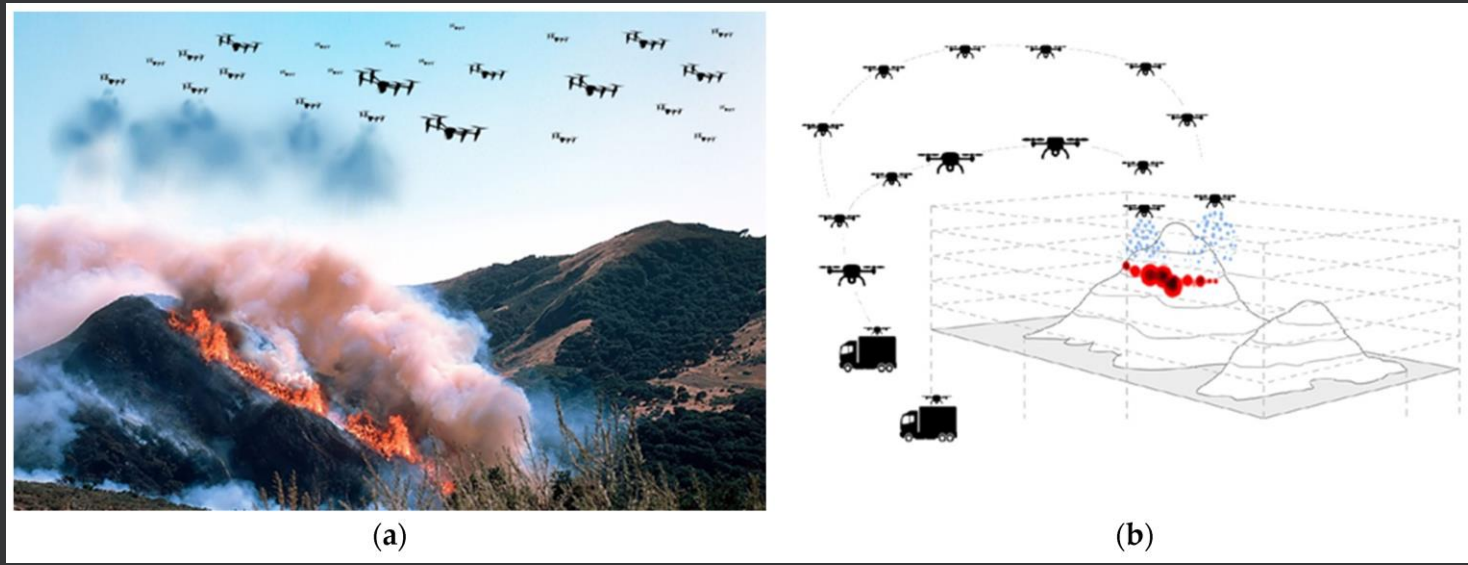
Future is longer flight times and improved data quality

- Monitoring wildlife
- Mapping forests (silviculture, post harvest waste, stand attributes)
- Need to overcome Line-of-Sight rules

Drones and Wildfire

Existing – thermal sensors used to map hotspots

Possible Future – initial attack via heavy lift drone swarms (autonomous)



Representations of the proposed firefighting system based on the use of a swarm of collaborative UAVs (https://www.mdpi.com/2504-446X/5/1/17)

Drones and Seeding

Autonomous drone flights dropping seed pods onto difficult or unsafe terrain / sites. Can be deployed quickly without ordering seedlings.

Traditional planter 1500-3000 trees/day, Drone 40-50k seedpods/day.

Phone Apps – New Tools

Not just data notebooks anymore. Leverage imagery and LiDAR along with AI (computer vision, machine learning, etc) to take measurements.

1. Tree locations and diameters
2. Tree heights and volumes
3. Log pile diameter distributions and volumes
4. Plot attributes (BA, SPH)
5. Trucking Coordination (digital load slips, load tasking)
6. Form Completion with Location Data (tailgate meetings, inspections, etc)

TIMBETER

TRESTIMA
SEE THE WOOD FOR THE TREES

AR arboreal

KATAM

ArcGIS

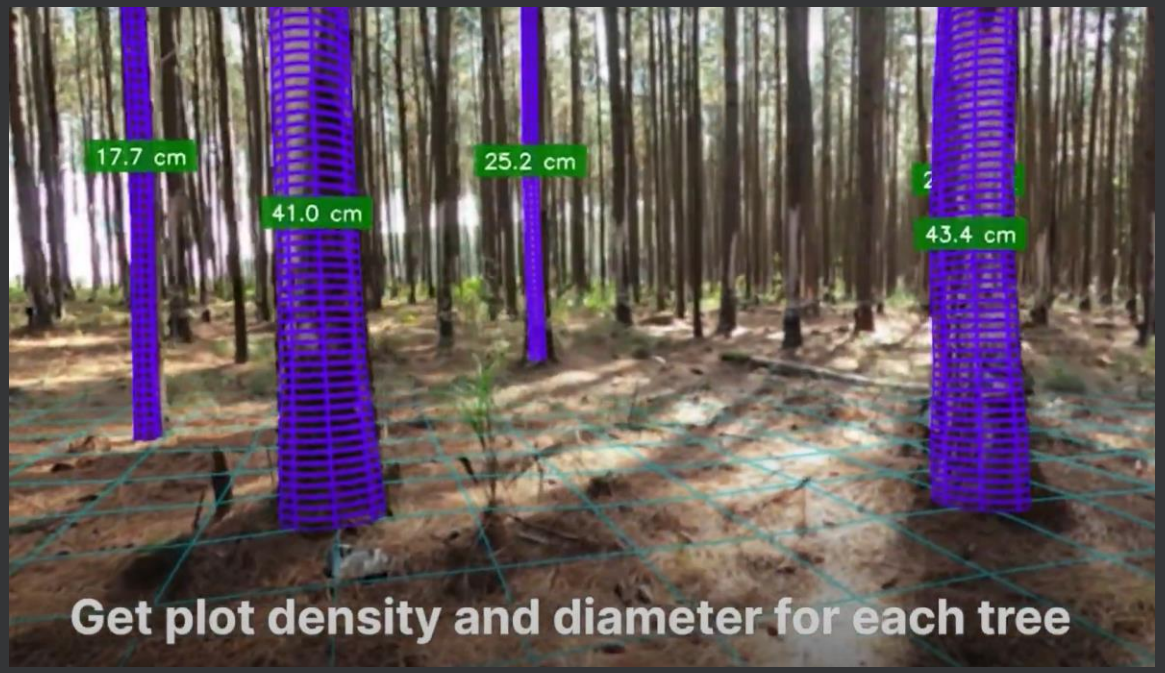
AVENZA

Phone Apps - Katam

Locate / Measure Trees by recording video (phone/GoPro). Uses AR technology.

Trees have location and diameter (in sampled locations with appropriate conditions).

Not widely used operationally due to limited conditions where it works and accuracy requirements.



Phone Apps - Arboreal

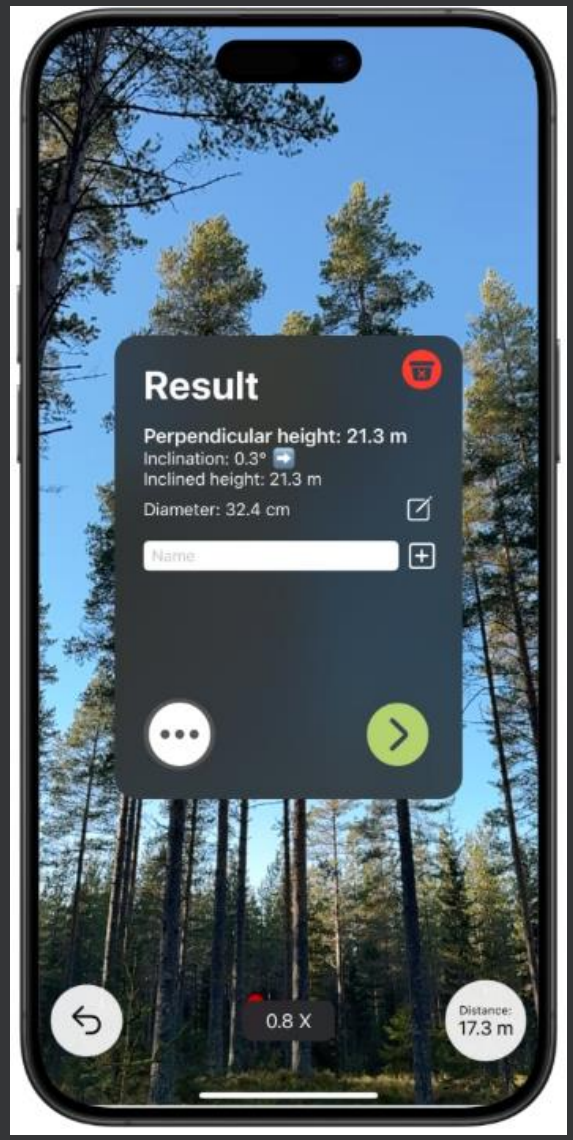
Can measure individual trees with phone camera and LiDAR.

Can also collect Fixed Area plots

- Screen/camera image shows plot radius
- “in” tree are then measured. Diameter at 1.3m and 30 cm away. Height from 10-15m away.
- Gives SPH, BAPH, vol/ha, each trees metrics

Not widely used operationally due to limited conditions where it works and accuracy requirements. Regularly spaced forests with limited underbrush are ideal.

Arboreal App: Measure Trees...

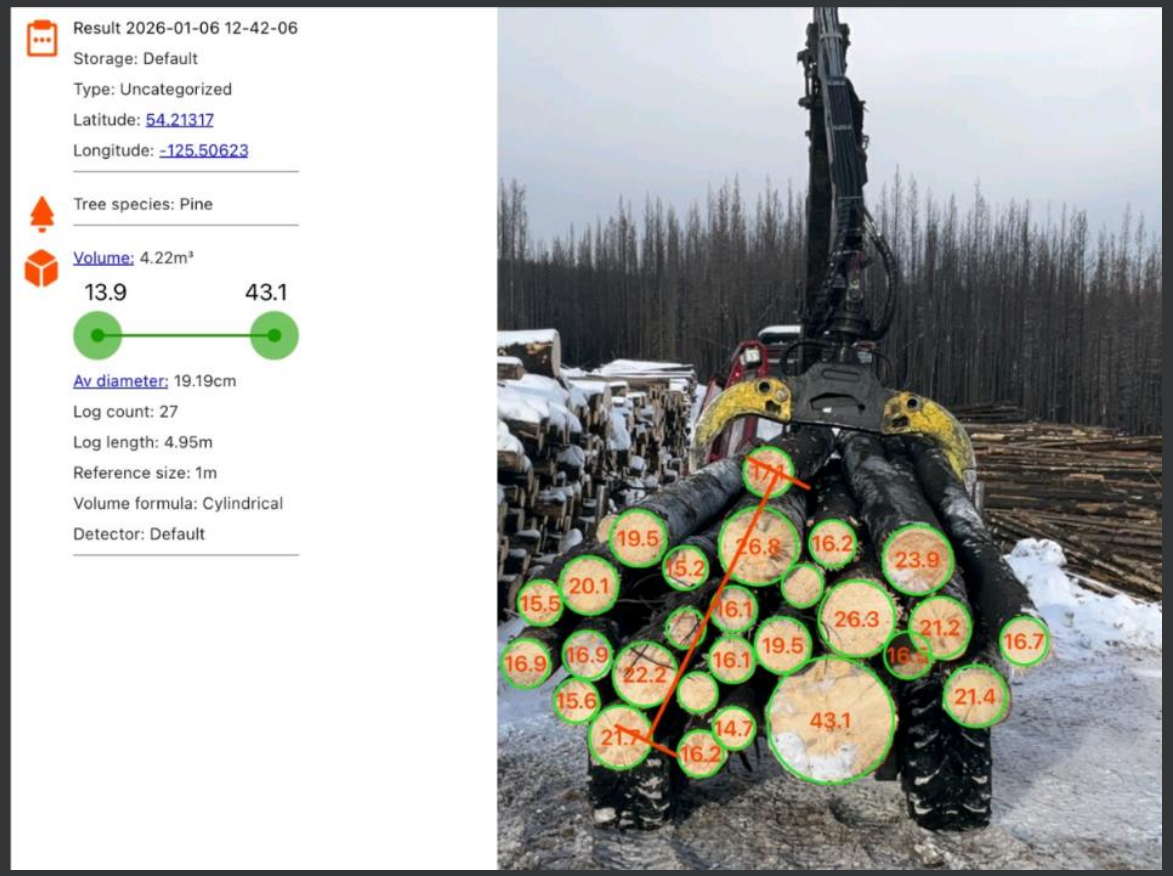


or Logs

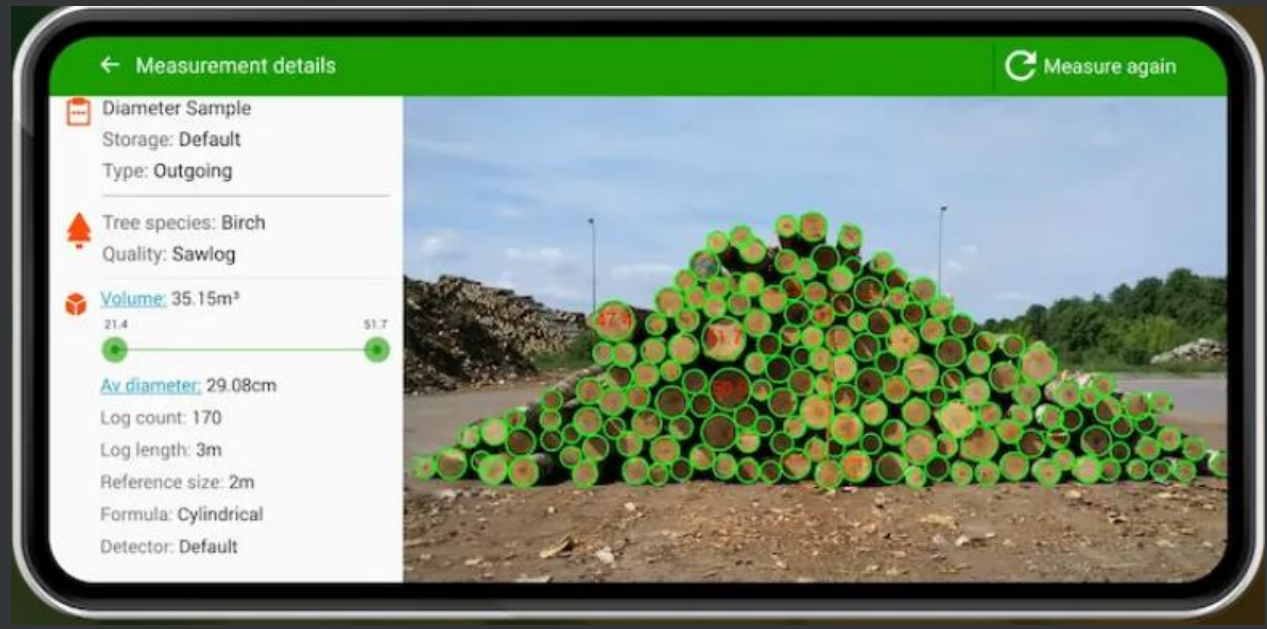
Detailed lidar scans of logs

https://www.mdpi.com/1999-4907/14/8/1553 (2023 Evaluation)

Phone Apps - Timbeter



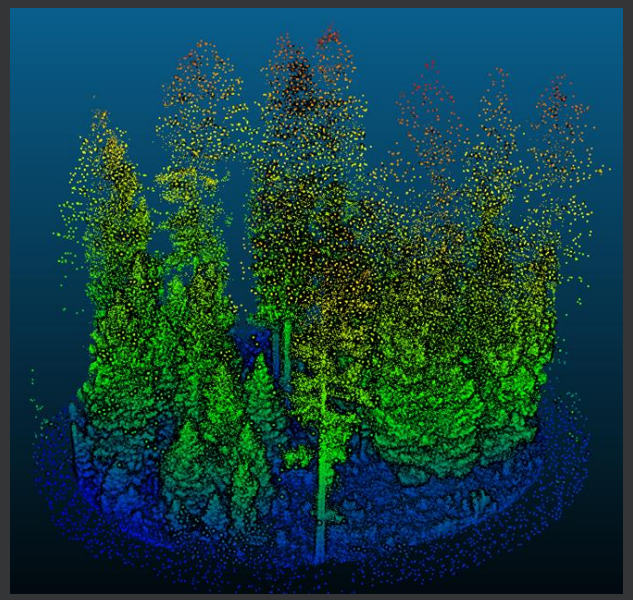
Take log deck diameter measurements with a smartphone. Data stored in the cloud for later use.

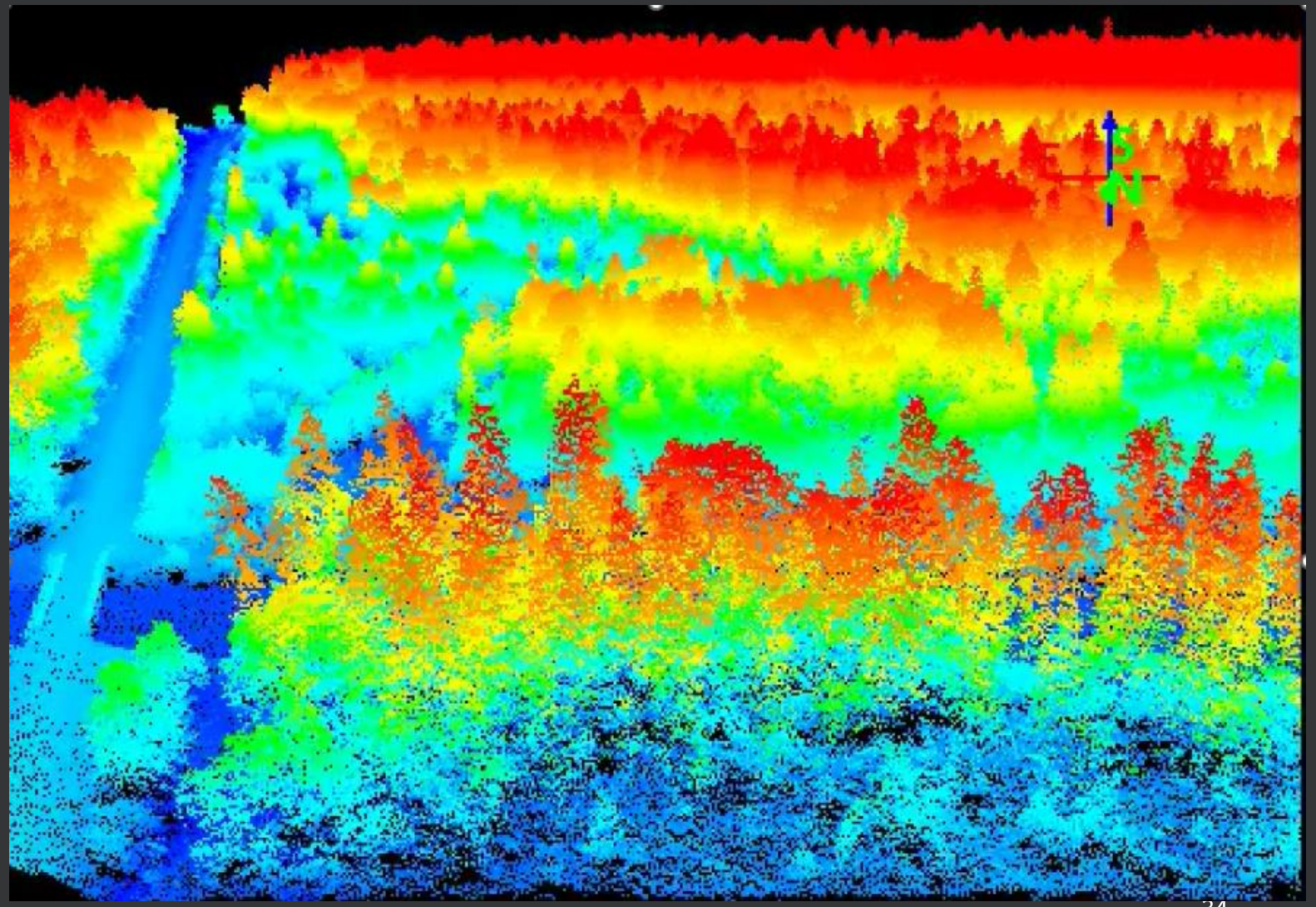


LiDAR Products

POINT CLOUDS AND MORE (LARGELY FROM PLANES)

- Point cloud allows products to be created to describe terrain and vegetation
- More detailed point clouds from ground/drone scans.

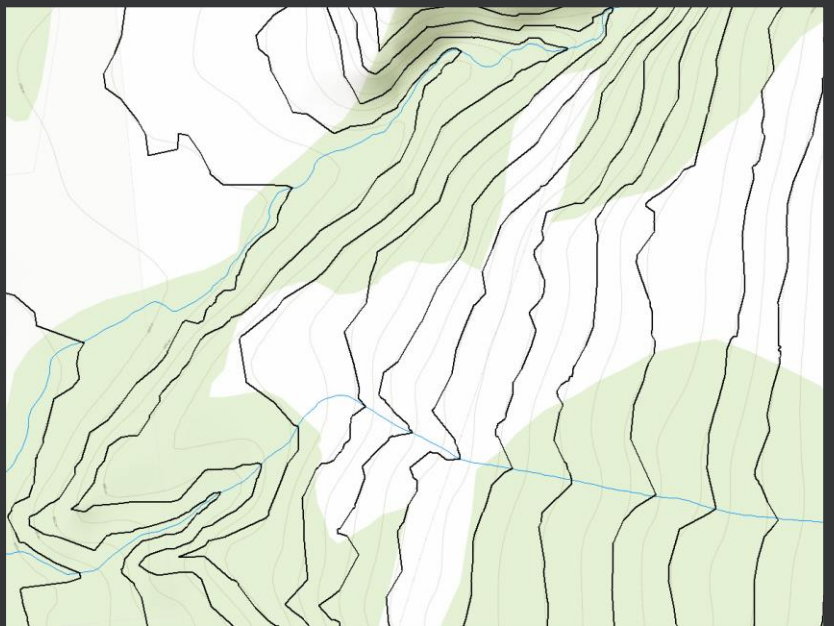




Full Feature Hillshade (DSM):

Detailed image of surface showing transmission lines, vegetation, etc.

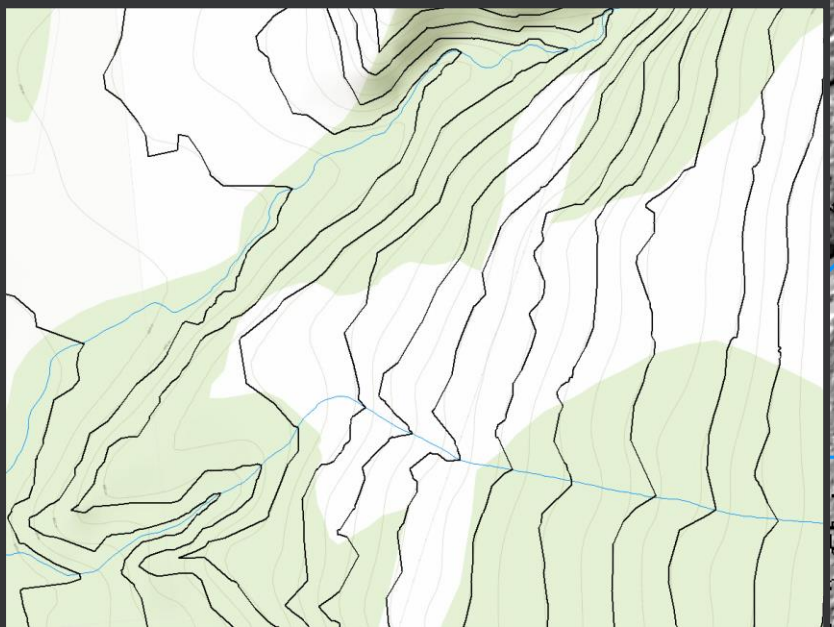
10/20m contours 1:5000



Terrain Products:

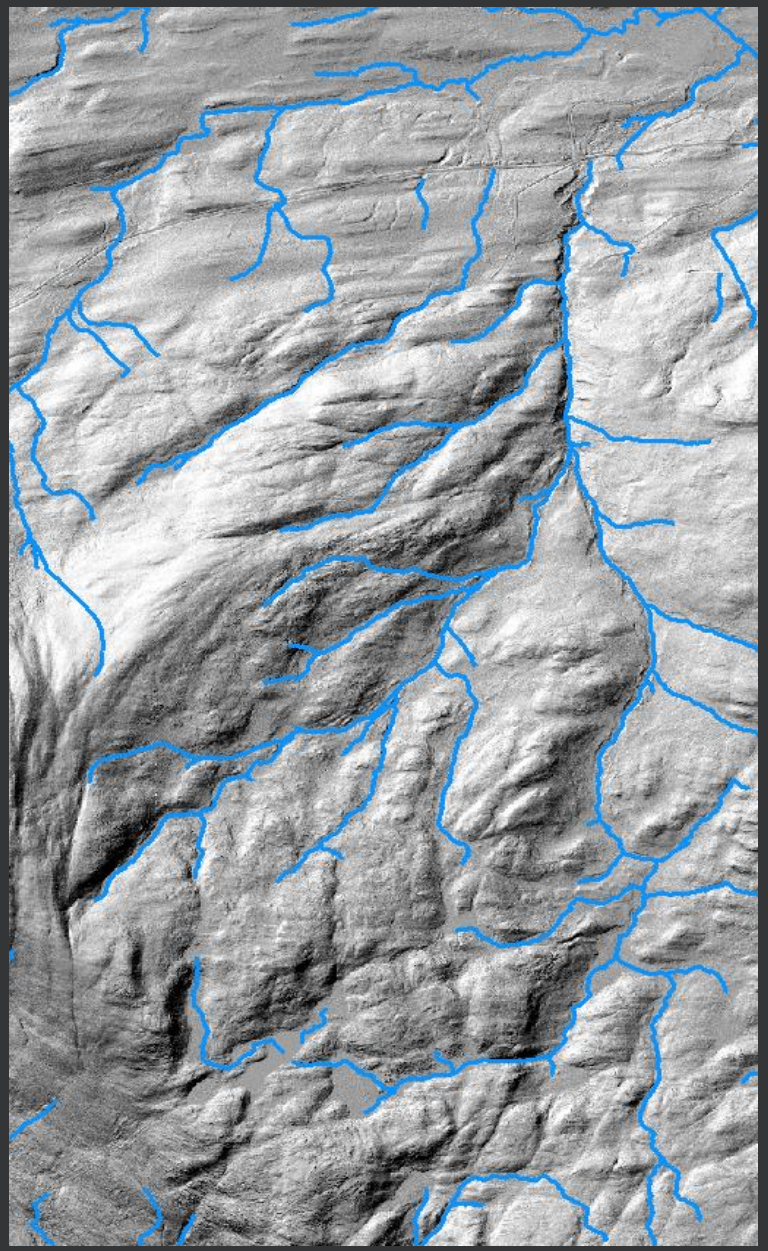
- Digital Elevation Model (DEM) (5-10 pts/m2)
- Bare Earth Hillshade
- Contours (1m, 5m)

10/20m contours (left) 1:5000

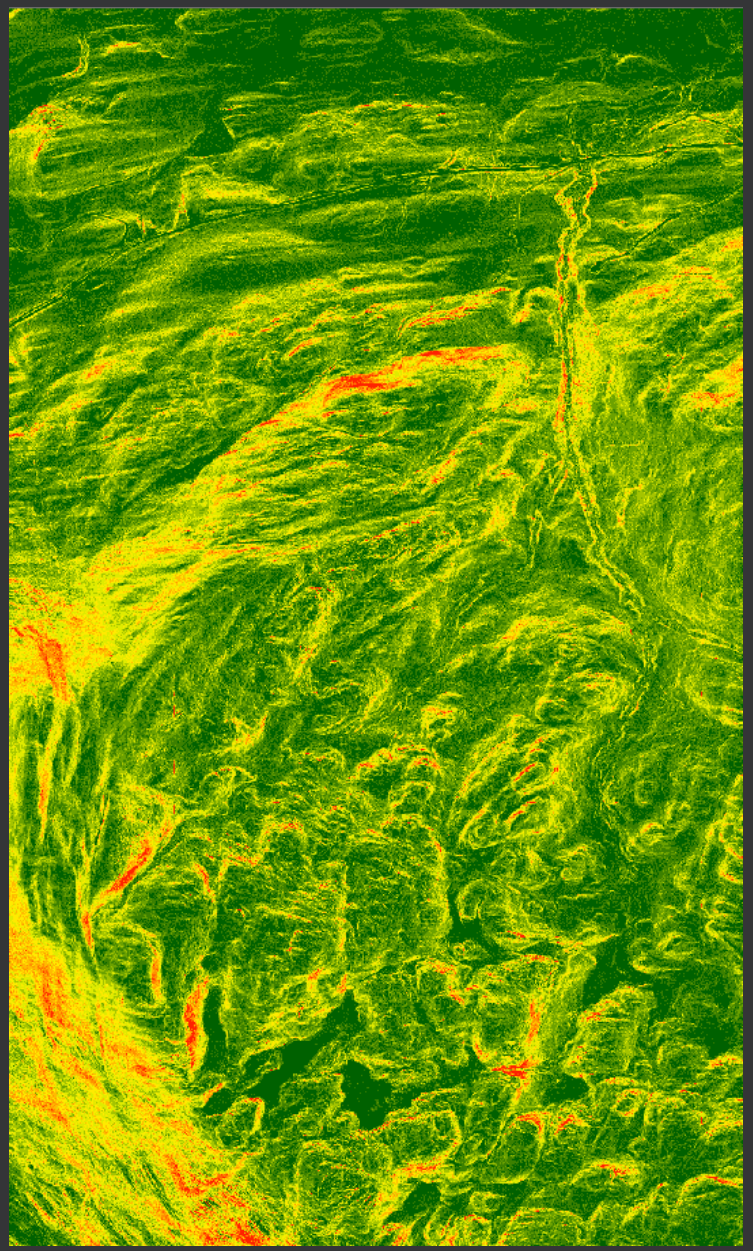


Terrain Products

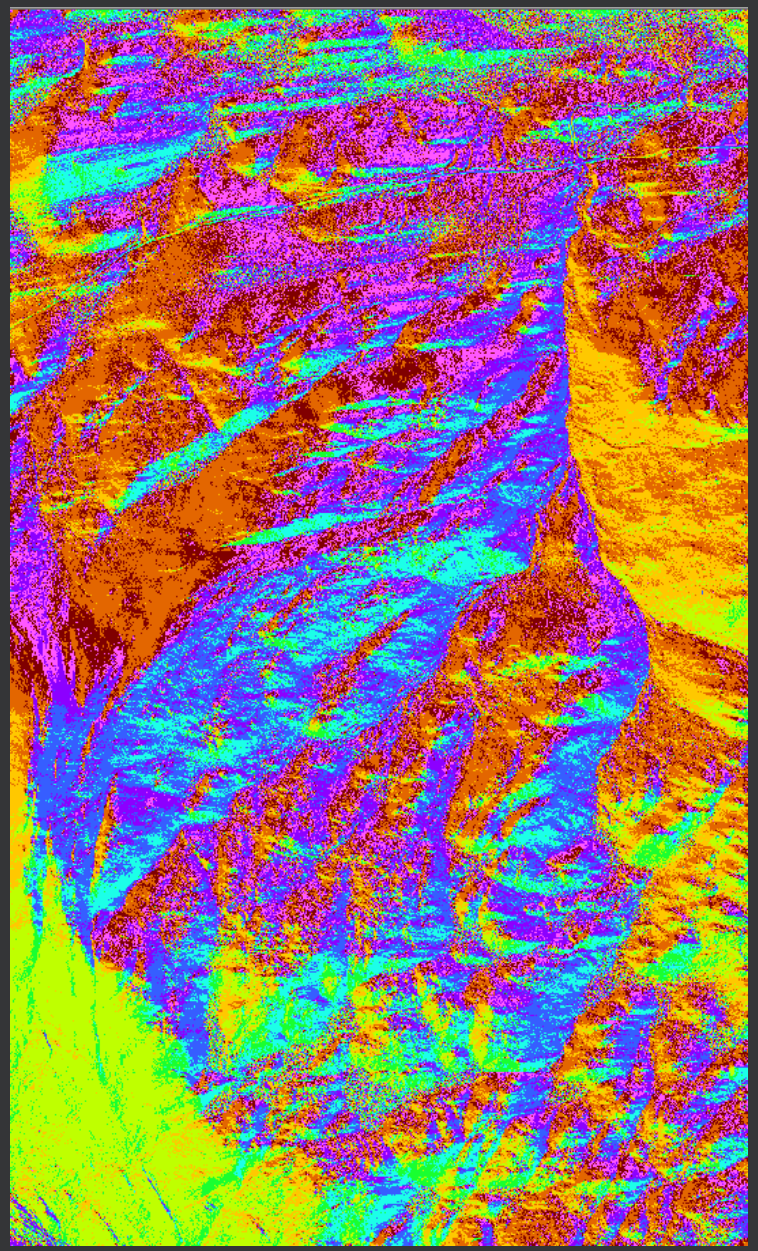
STREAMS / SLOPE THEMES / ASPECT THEMES



Streams



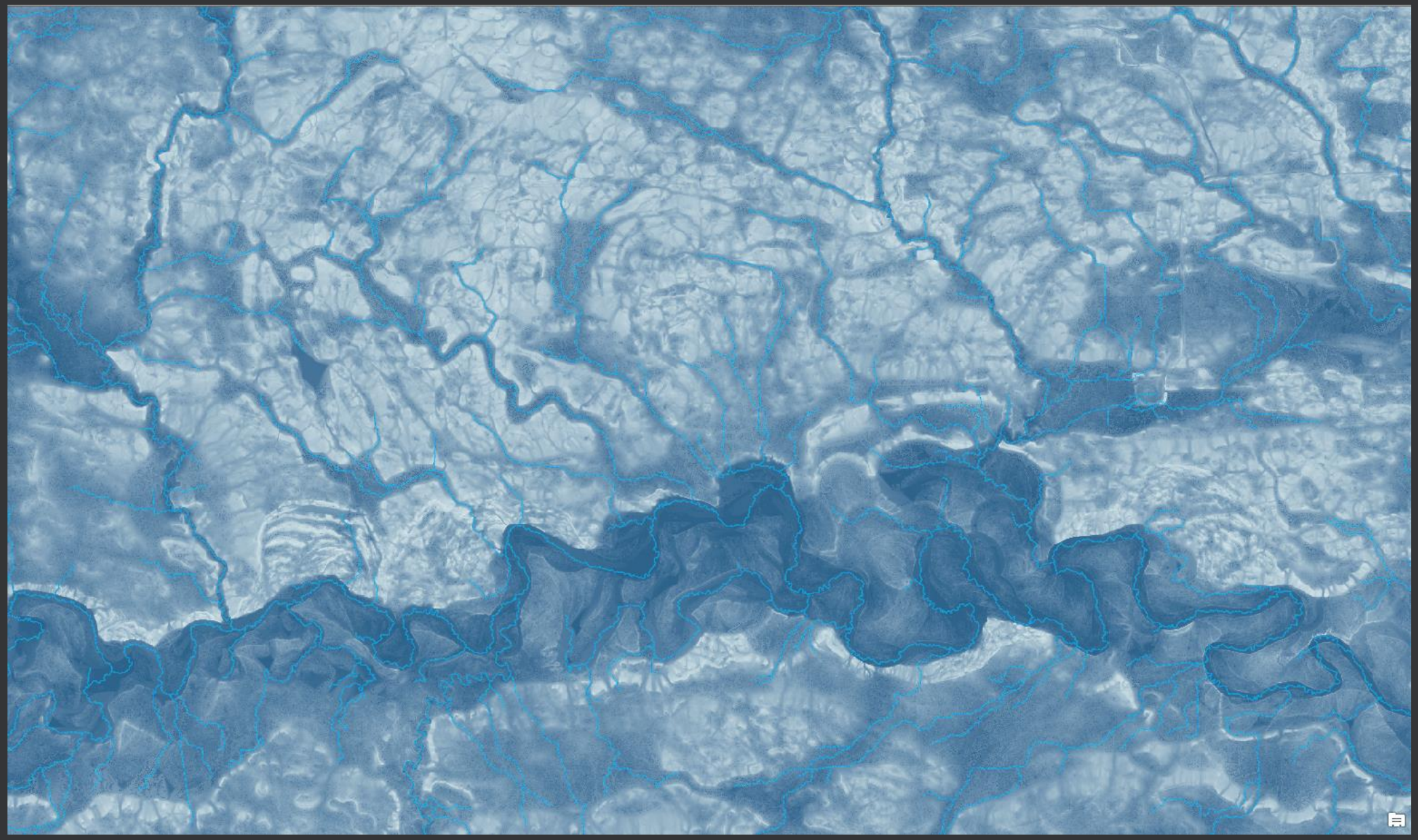
Slope (10% Classes)



Aspect (N, NE. E. SE, S, SW,W, NW

Terrain Products

WETNESS INDEX / FLOW ACCUMULATION

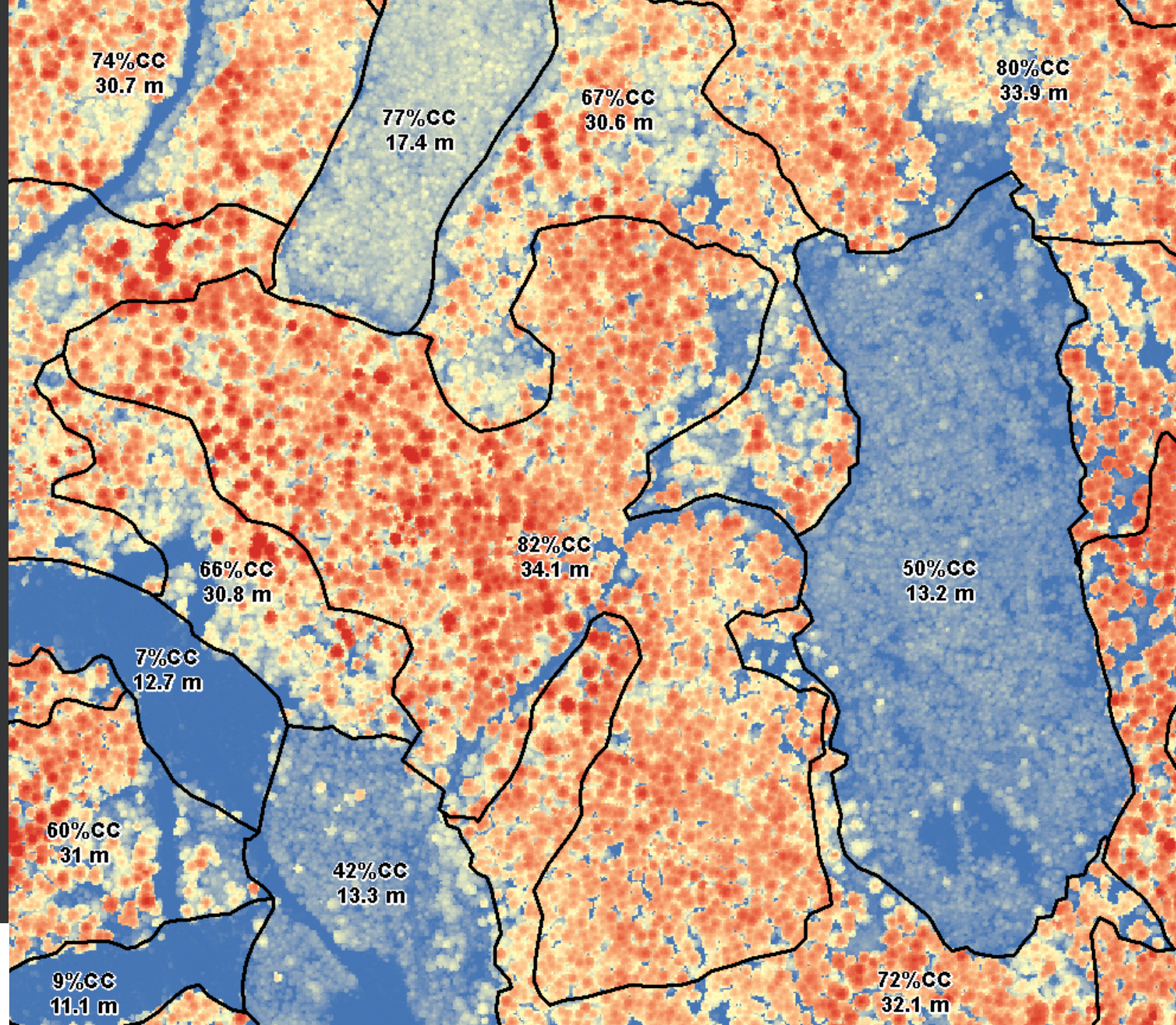


Topographic Wetness Index (2m Res)

Detailed Stream and Watershed Mapping

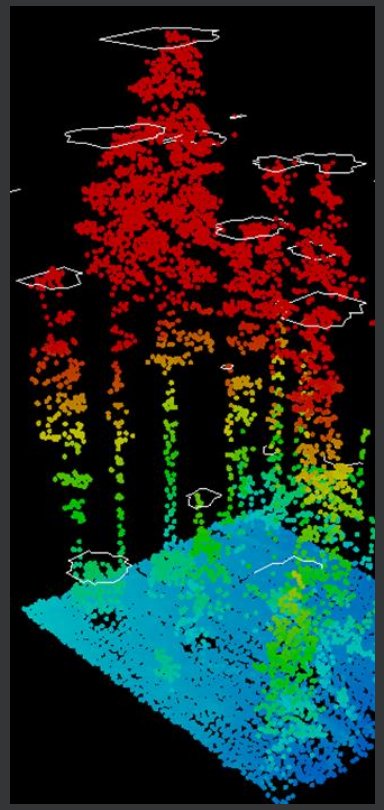
Canopy Height Models (CHM)

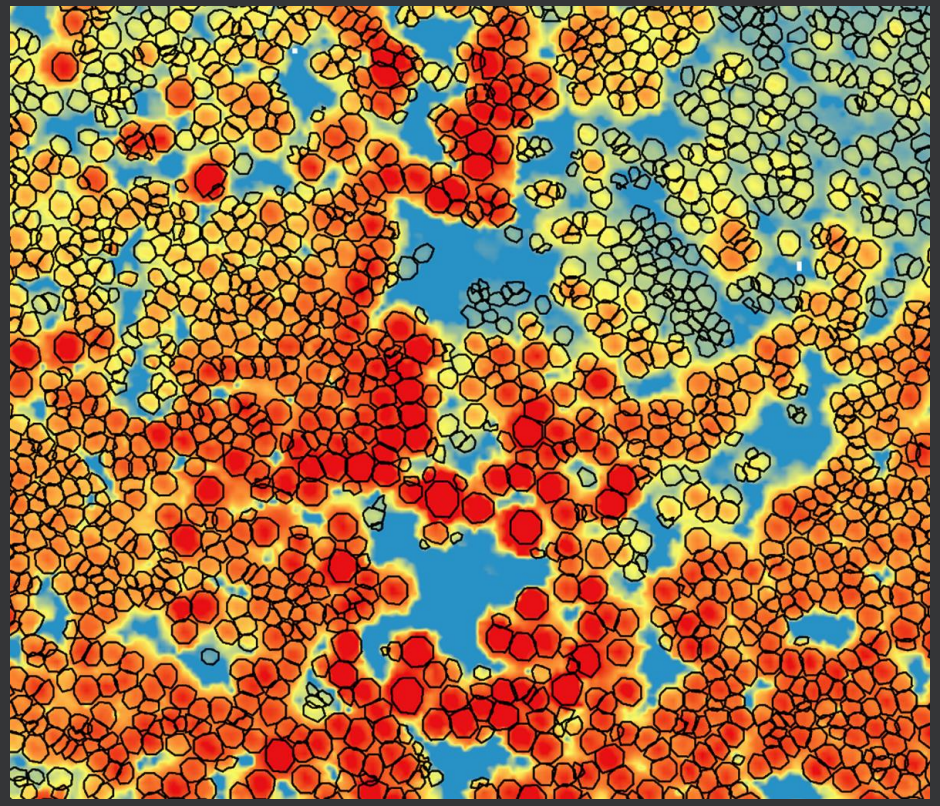
- Max Height of Vegetation in Tile (e.g. 1x 1m)
- Can Derive Stand Heights & Crown Cover %'s
- Range of circumstances require different metrics.
- Provides consistent, objective results.

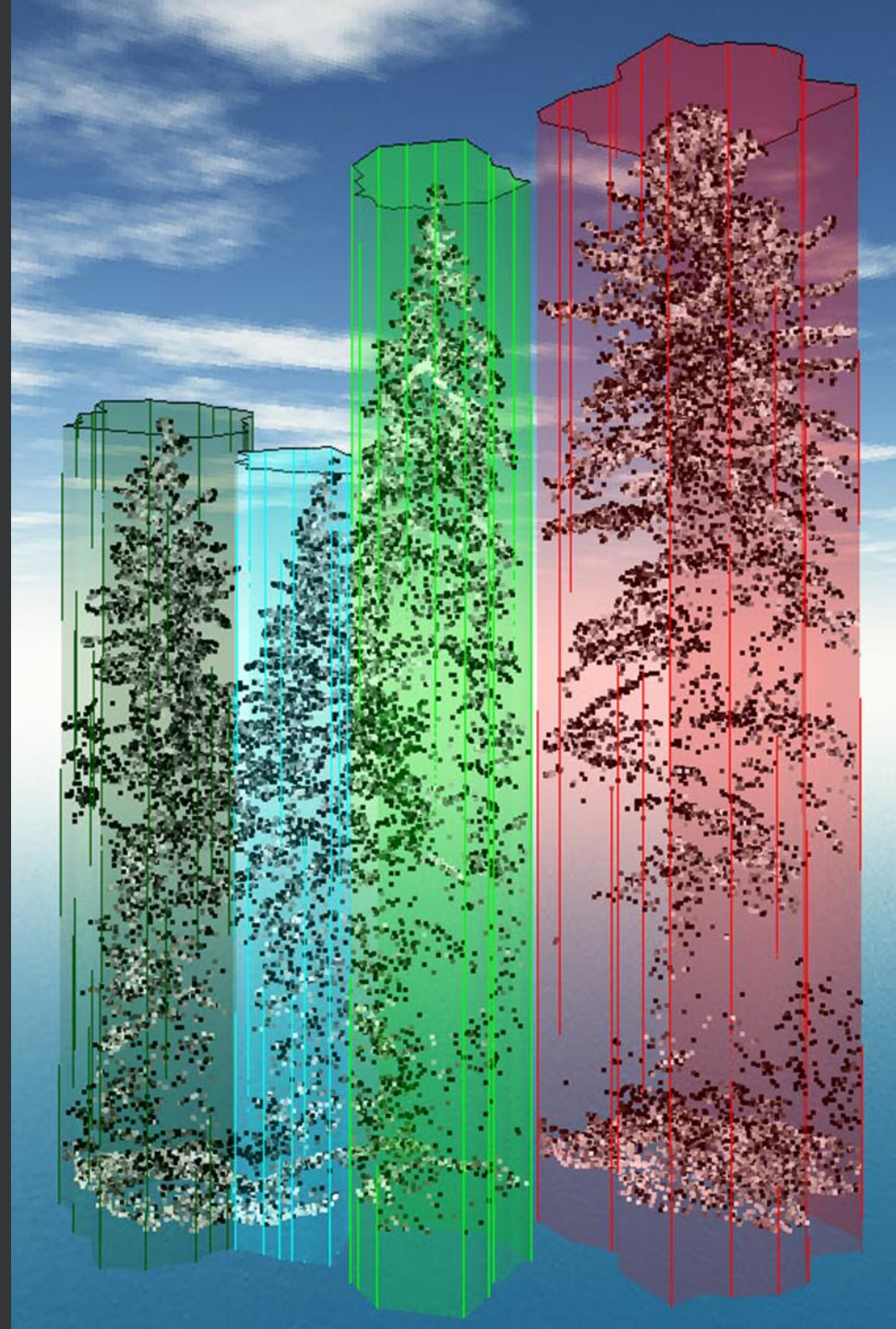


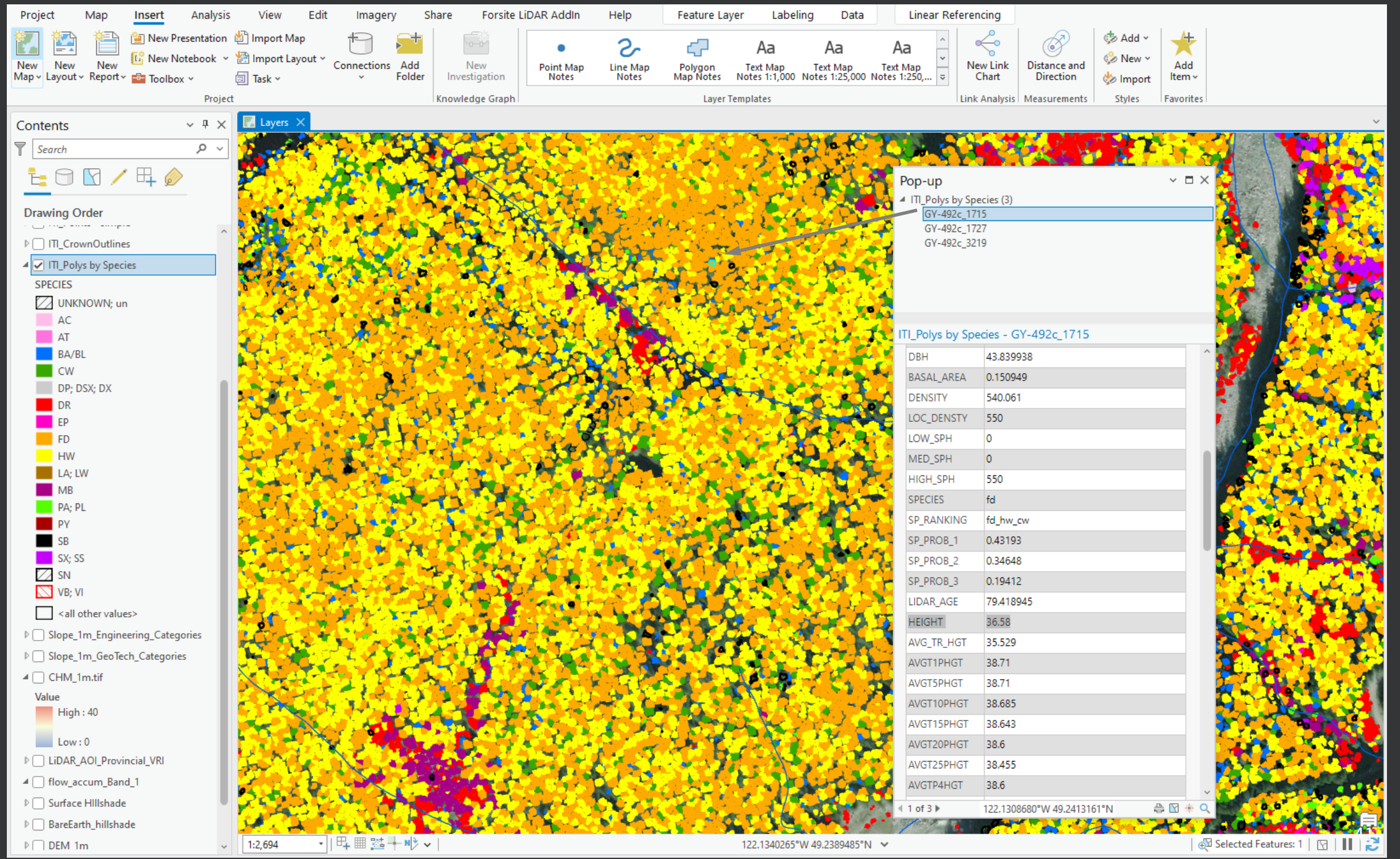
Individual Tree Inventories (ITI)

TREE LOCATIONS, HEIGHTS, SPECIES, DIAMETERS



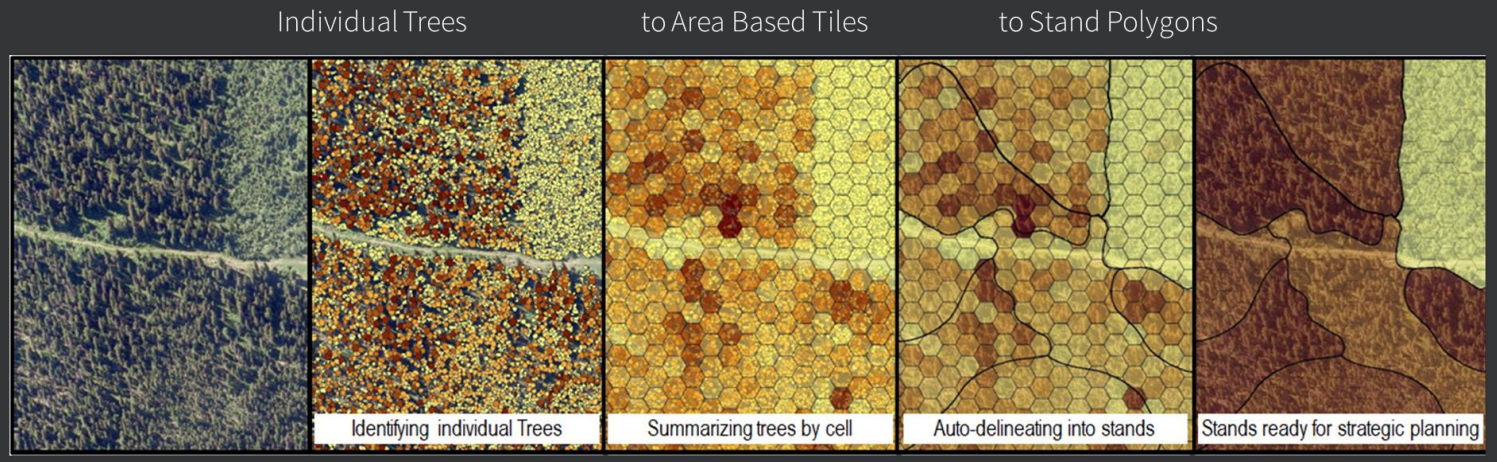


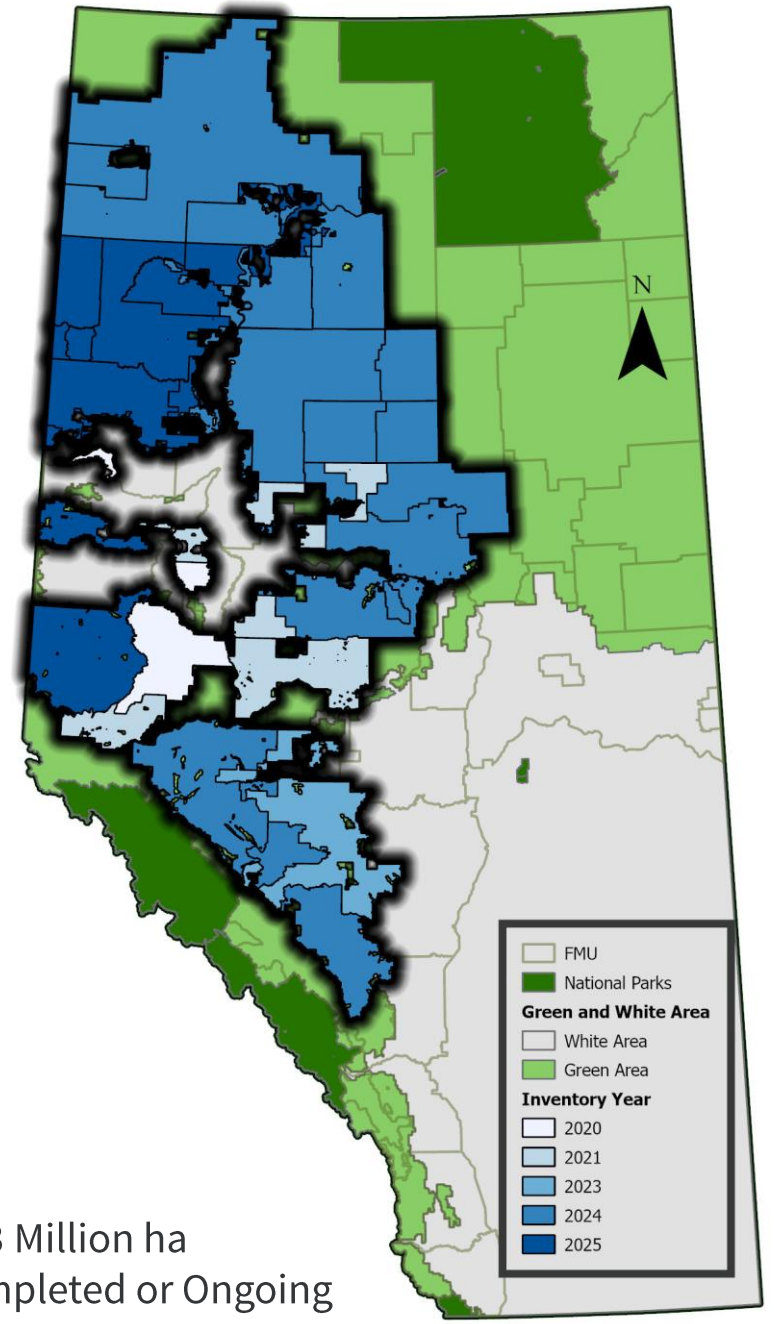



Project
Map
Insert
Analysis
View
Edit
Imagery
Share
Forsite LiDAR AddIn
Help
Feature Layer
Labeling
Data
Linear Referencing
New Map
New Layout
New Report
New Presentation
New Notebook
Toolbox
Import Map
Import Layout
Task
Connections
Add Folder
Project
New Investigation
Knowledge Graph
Point Map Notes
Line Map Notes
Polygon Map Notes
Text Map Notes 1:1,000
Text Map Notes 1:25,000
Text Map Notes 1:250,...
Layer Templates
New Link Chart
Link Analysis
Distance and Direction
Measurements
Add
New
Import
Styles
Add Item
Favorites
Contents
Search
Drawing Order
ITI_CrownOutlines
ITI_Polys by Species
SPECIES
UNKNOWN; un
AC
AT
BA/BL
CW
DP; DSX; DX
DR
EP
FD
HW
LA; LW
MB
PA; PL
PY
SB
SX; SS
SN
VB; VI
<all other values>
Slope_1m_Engineering_Categories
Slope_1m_GeoTech_Categories
CHM_1m.tif
Value
High : 40
Low : 0
LiDAR_AOI_Provincial_VRI
flow_accum_Band_1
Surface HIllshade
BareEarth_hillshade
DEM_1m
Layers
Pop-up
ITI_Polys by Species (3)
GY-492c_1715
GY-492c_1727
GY-492c_3219
ITI_Polys by Species - GY-492c_1715
DBH 43.839938
BASAL_AREA 0.150949
DENSITY 540.061
LOC_DENSTY 550
LOW_SPH 0
MED_SPH 0
HIGH_SPH 550
SPECIES fd
SP_RANKING fd_hw_cw
SP_PROB_1 0.43193
SP_PROB_2 0.34648
SP_PROB_3 0.19412
LIDAR_AGE 79.418945
HEIGHT 36.58
AVG_TR_HGT 35.529
AVGT1PHGT 38.71
AVGT5PHGT 38.71
AVGT10PHGT 38.685
AVGT15PHGT 38.643
AVGT20PHGT 38.6
AVGT25PHGT 38.455
AVGTP4HGT 38.6
1 of 3
122.1308680°W 49.2413161°N
1:2,694
122.1340265°W 49.2389485°N
Selected Features: 1

Data Driven Forest Inventories

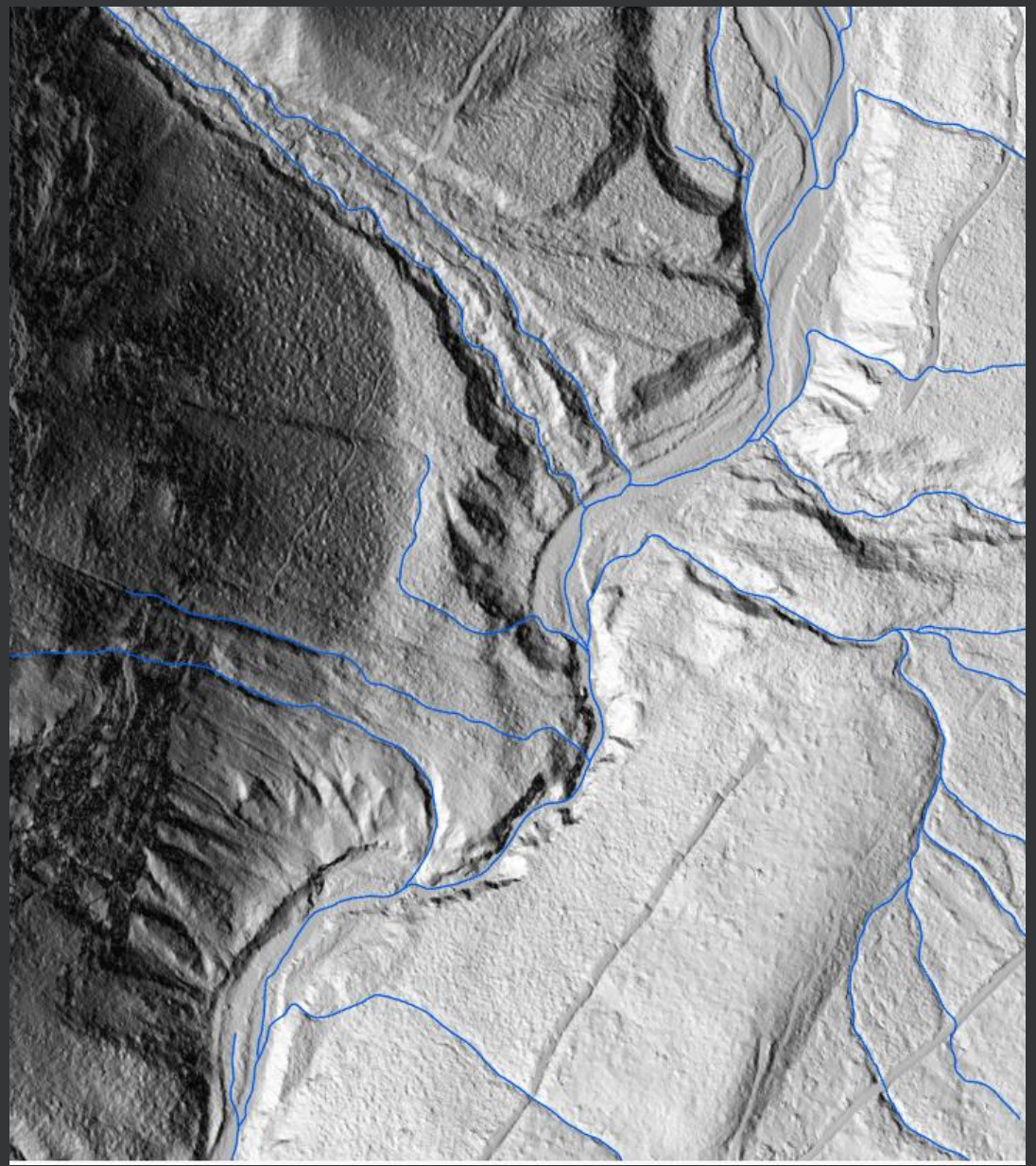
- Individual Tree Inventory + Area Based EFI
- Tree lists
- Strong links between strategic and operational planning

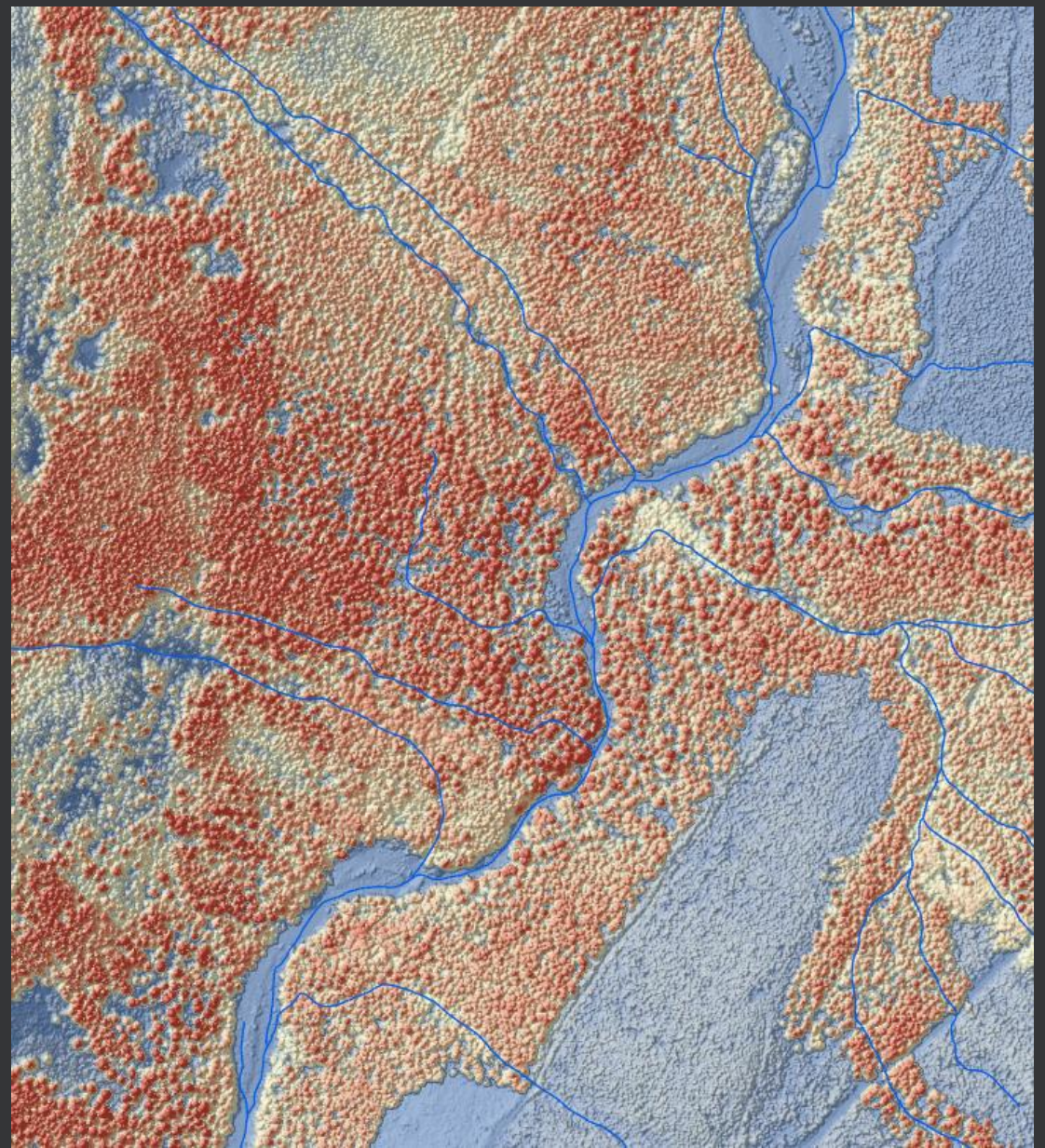




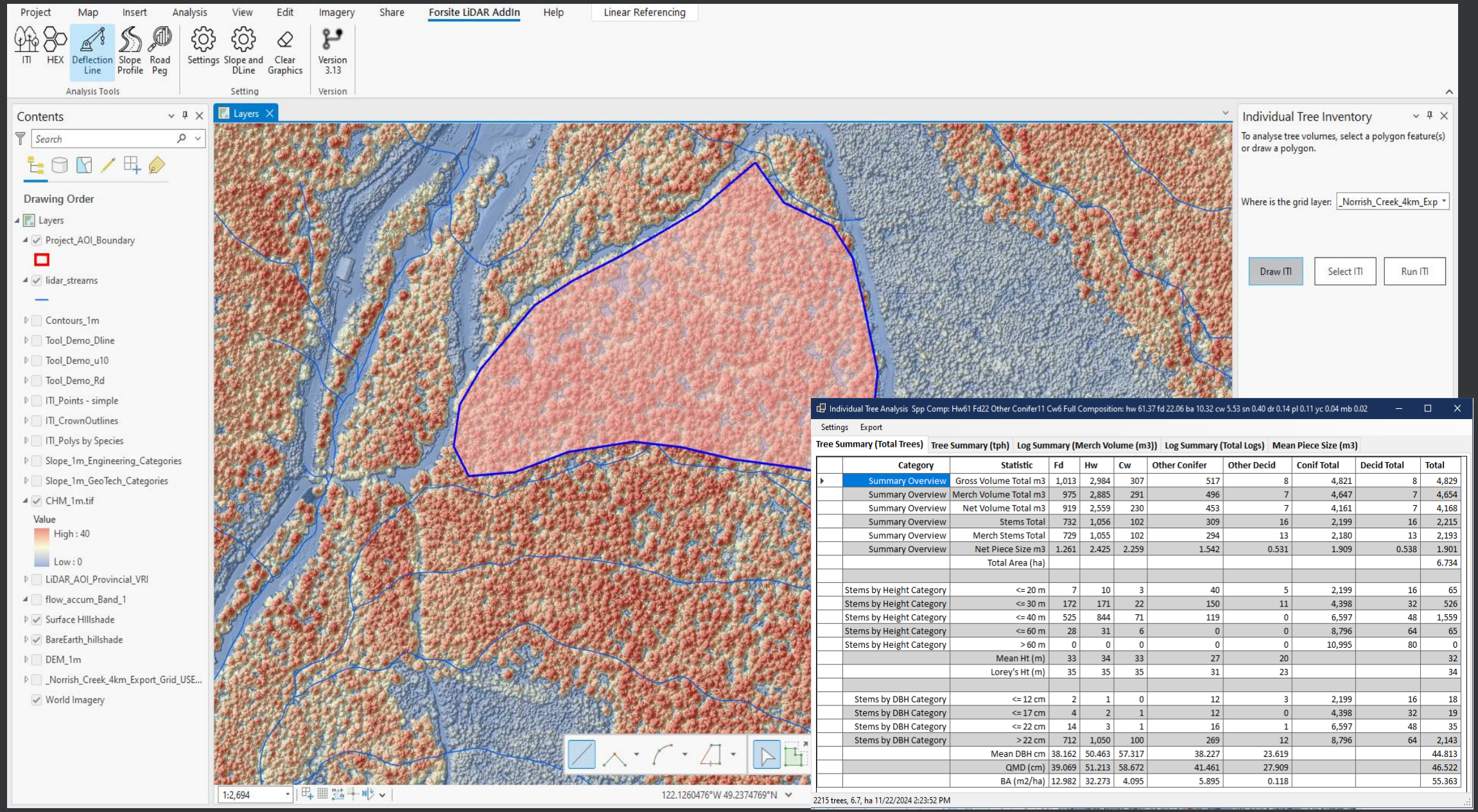
18.3 Million ha
Completed or Ongoing
Dec 2025

Operational Planning with LiDAR (Terrain + CHM)





ArcPro Tool – Virtual Cruising with ITI (Gross Merch/Tree + Net Factors)



Individual Tree Analysis Spp Comp: Hw61 Fd22 Other Conifer11 Cw6 Full Composition: hw 61.37 fd 22.06 ba 10.32 cw 5.53 sn 0.40 dr 0.14 pl 0.11 yc 0.04 mb 0.02

Settings Export

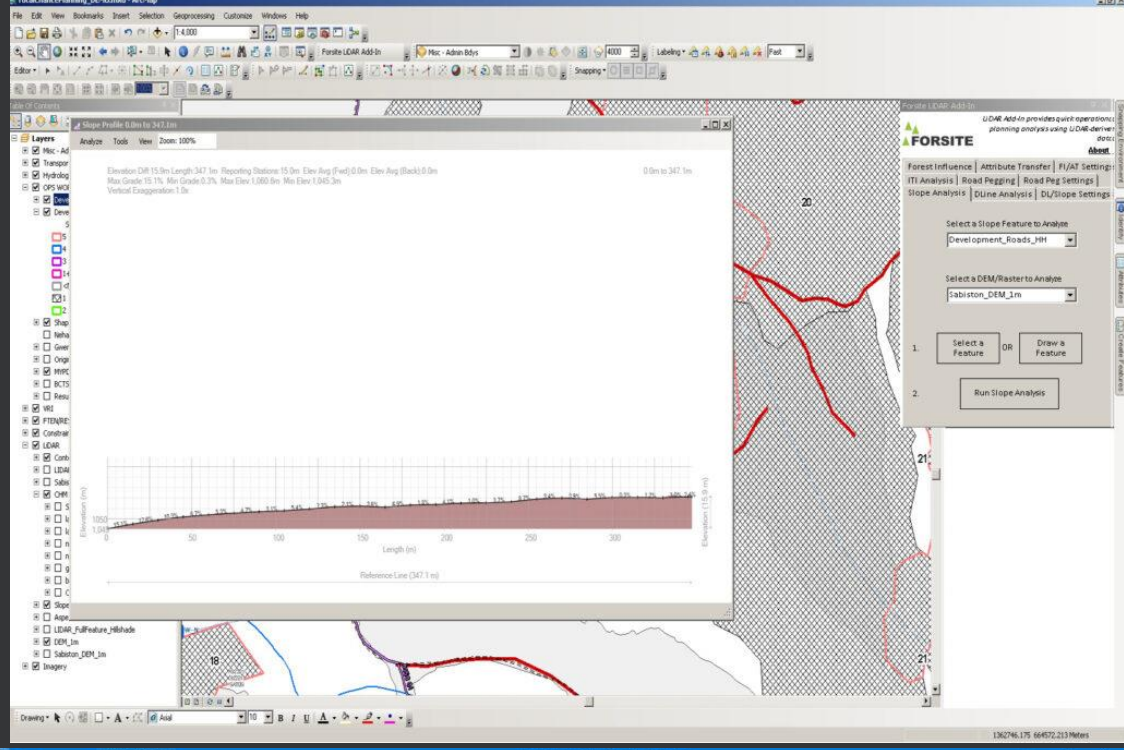
Tree Summary (Total Trees) | Tree Summary (tph) | Log Summary (Merch Volume (m3)) | Log Summary (Total Logs) | Mean Piece Size (m3)

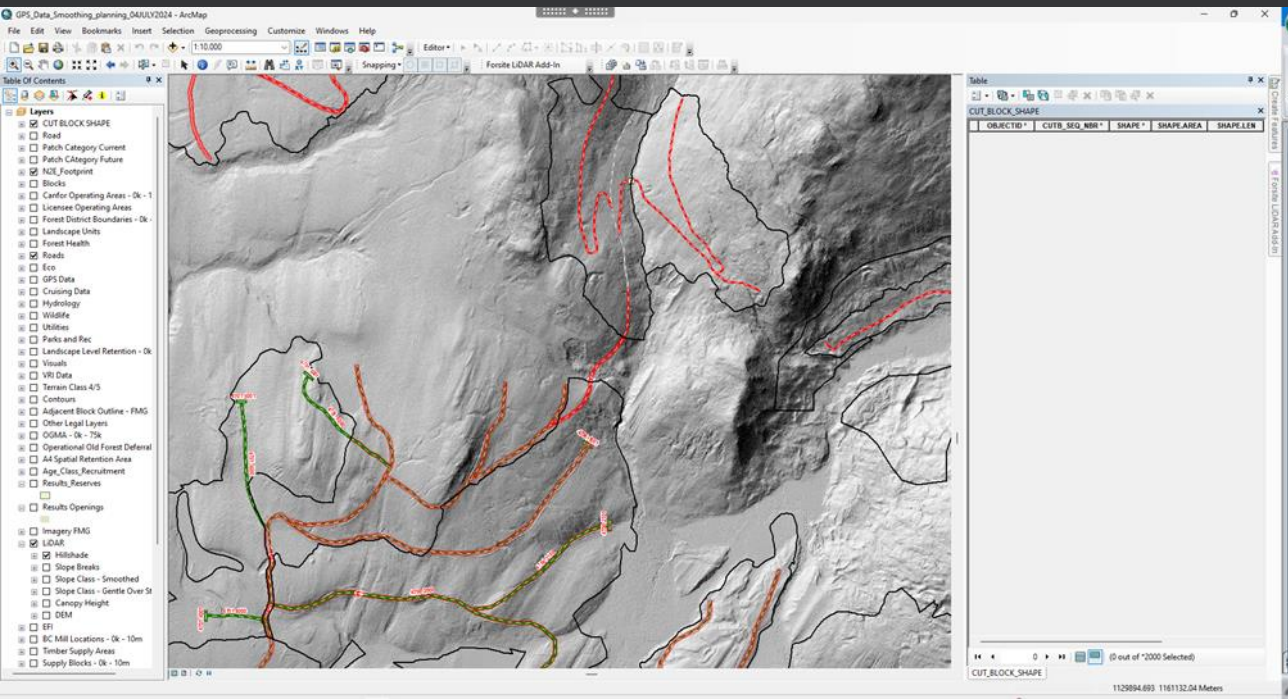
Category	Statistic	Fd	Hw	Cw	Other Conifer	Other Decid	Conif Total	Decid Total	Total
Summary Overview	Gross Volume Total m3	1,013	2,984	307	517	8	4,821	8	4,829
Summary Overview	Merch Volume Total m3	975	2,885	291	496	7	4,647	7	4,654
Summary Overview	Net Volume Total m3	919	2,559	230	453	7	4,161	7	4,168
Summary Overview	Stems Total	732	1,056	102	309	16	2,199	16	2,215
Summary Overview	Merch Stems Total	729	1,055	102	294	13	2,180	13	2,193
Summary Overview	Net Piece Size m3	1.261	2.425	2.259	1.542	0.531	1.909	0.538	1.901
	Total Area (ha)								6.734
Stems by Height Category	<= 20 m	7	10	3	40	5	2,199	16	65
Stems by Height Category	<= 30 m	172	171	22	150	11	4,398	32	526
Stems by Height Category	<= 40 m	525	844	71	119	0	6,597	48	1,559
Stems by Height Category	<= 60 m	28	31	6	0	0	8,796	64	65
Stems by Height Category	> 60 m	0	0	0	0	0	10,995	80	0
	Mean Ht (m)	33	34	33	27	20			32
	Lorey's Ht (m)	35	35	35	31	23			34
Stems by DBH Category	<= 12 cm	2	1	0	12	3	2,199	16	18
Stems by DBH Category	<= 17 cm	4	2	1	12	0	4,398	32	19
Stems by DBH Category	<= 22 cm	14	3	1	16	1	6,597	48	35
Stems by DBH Category	> 22 cm	712	1,050	100	269	12	8,796	64	2,143
	Mean DBH cm	38.162	50.463	57.317	38.227	23.619			44.813
	QMD (cm)	39.069	51.213	58.672	41.461	27.909			46.522
	BA (m2/ha)	12.982	32.273	4.095	5.895	0.118			55.363

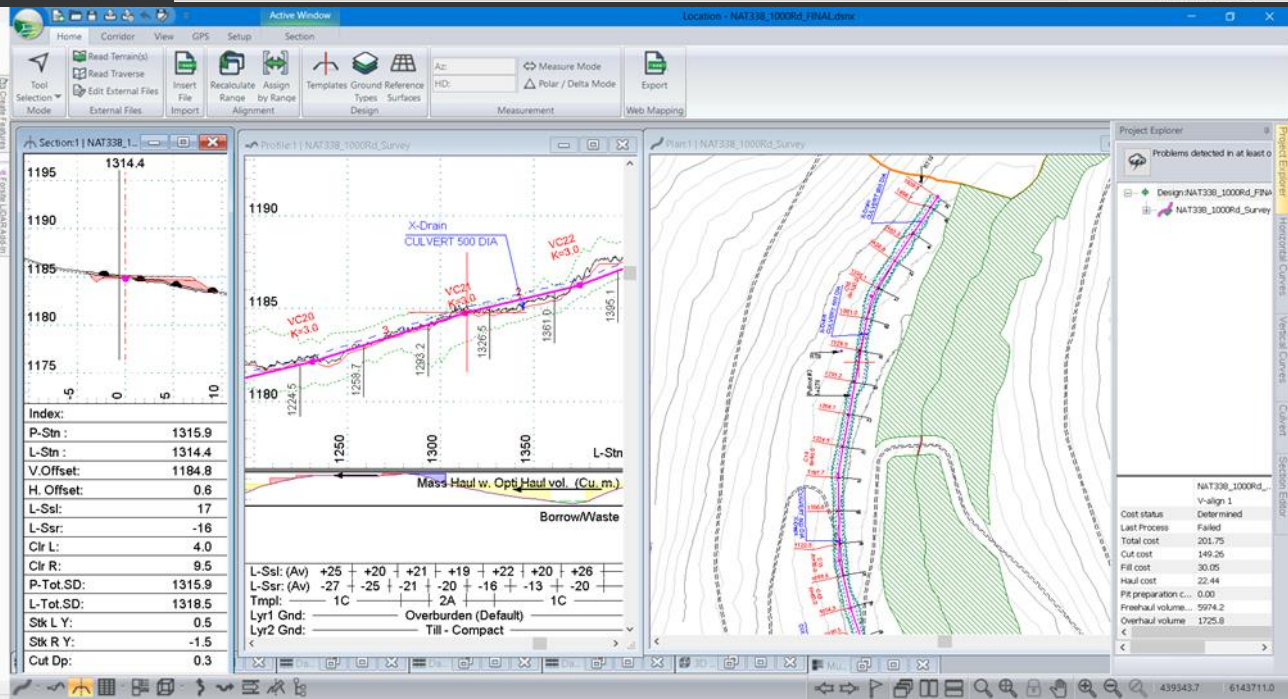
2215 trees, 6.7, ha 11/22/2024 2:23:52 PM

Planning with LiDAR (ArcPro / Roadeng)

- Road Locations / Grades / Crossing Locations
- Skid Trail Locations
- Landing Locations / Deflection Profiles
- Timber Profiles / Volumes / Piece Size
- Stream Locations and Gradients

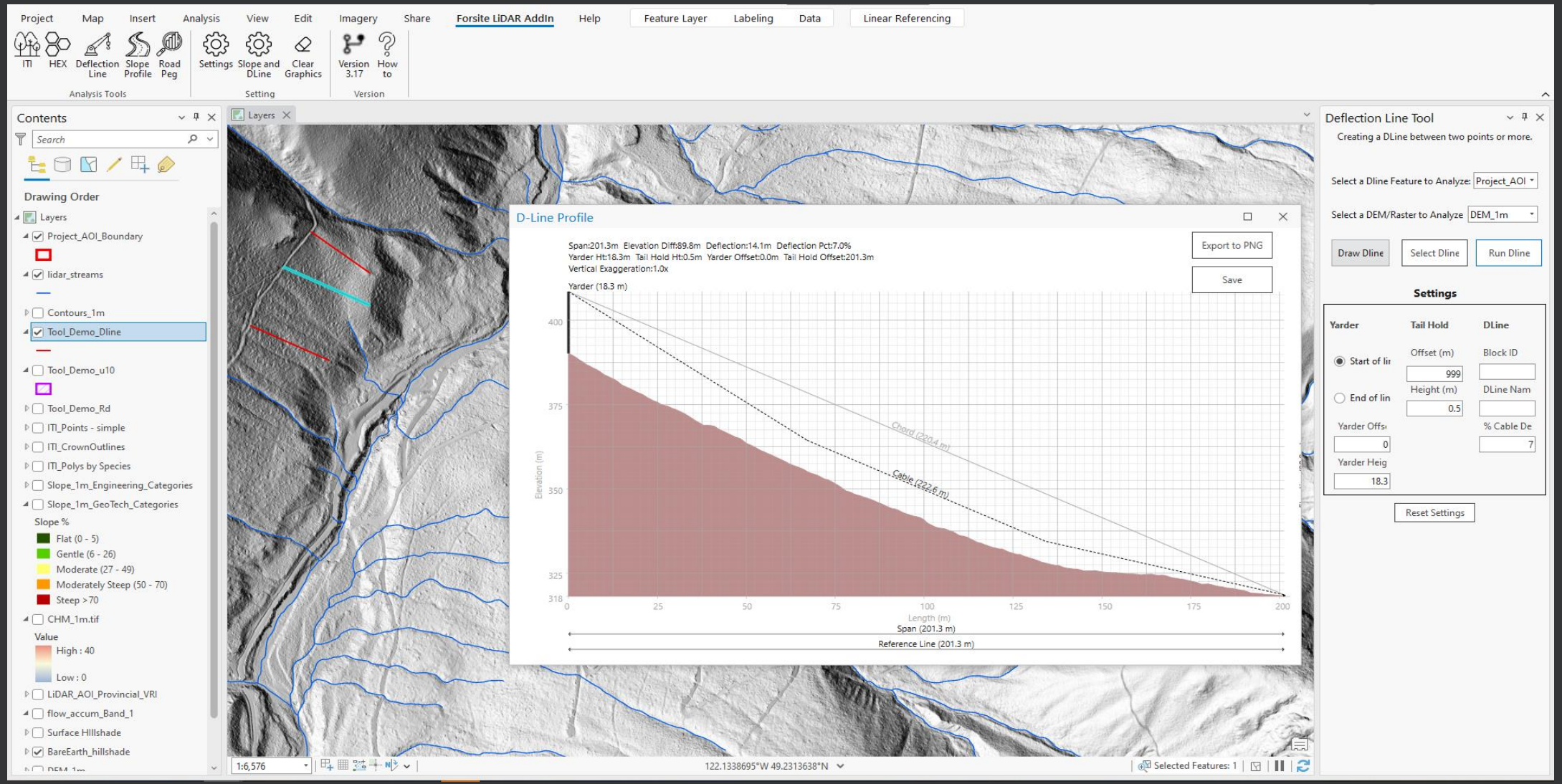






Cable Harvest Planning from the Office

- Dline's run in seconds using LiDAR terrain data in ArcPro

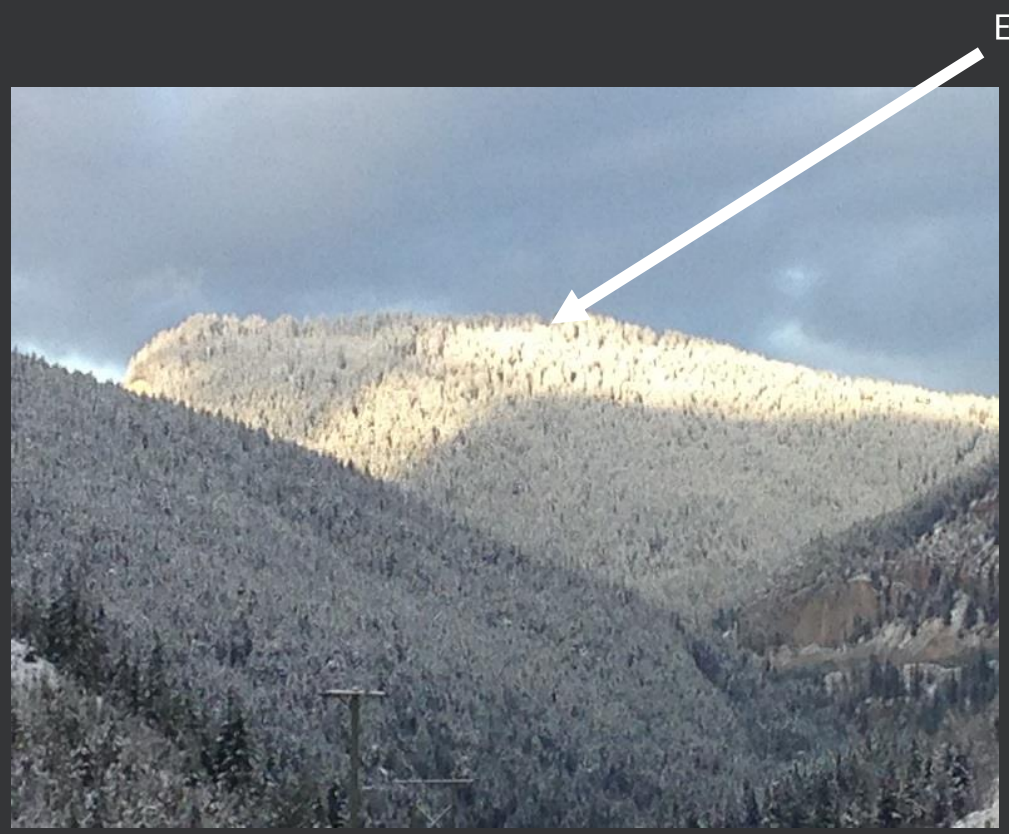


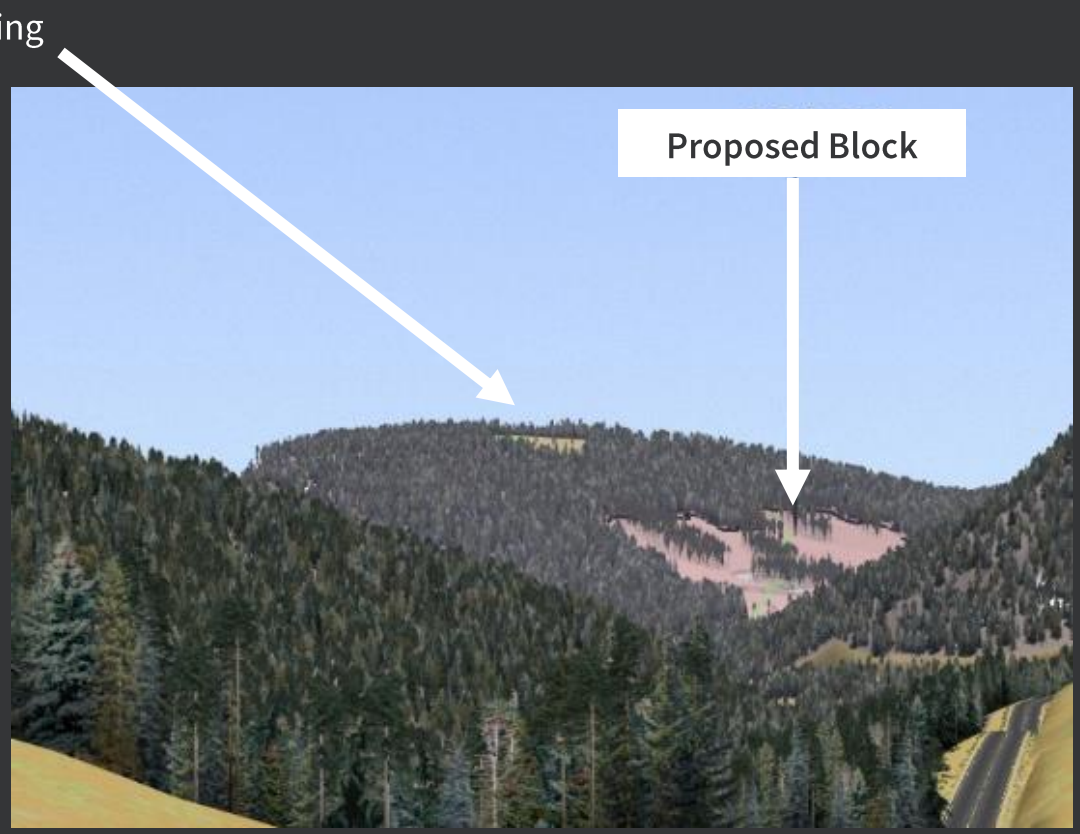
Accurate In-Cab Maps for Equipment Operators

- Aerial Imagery / Sat
- Slopes / terrain /wet areas
- Tree canopy / gaps / heights
- Locations of felled wood
- Locations of other machines

Visual Impact Assessments

Use of LiDAR in visual models improves rendering accuracy for visual assessments





3D Graphics Engines now used to produce images of proposed forest harvesting

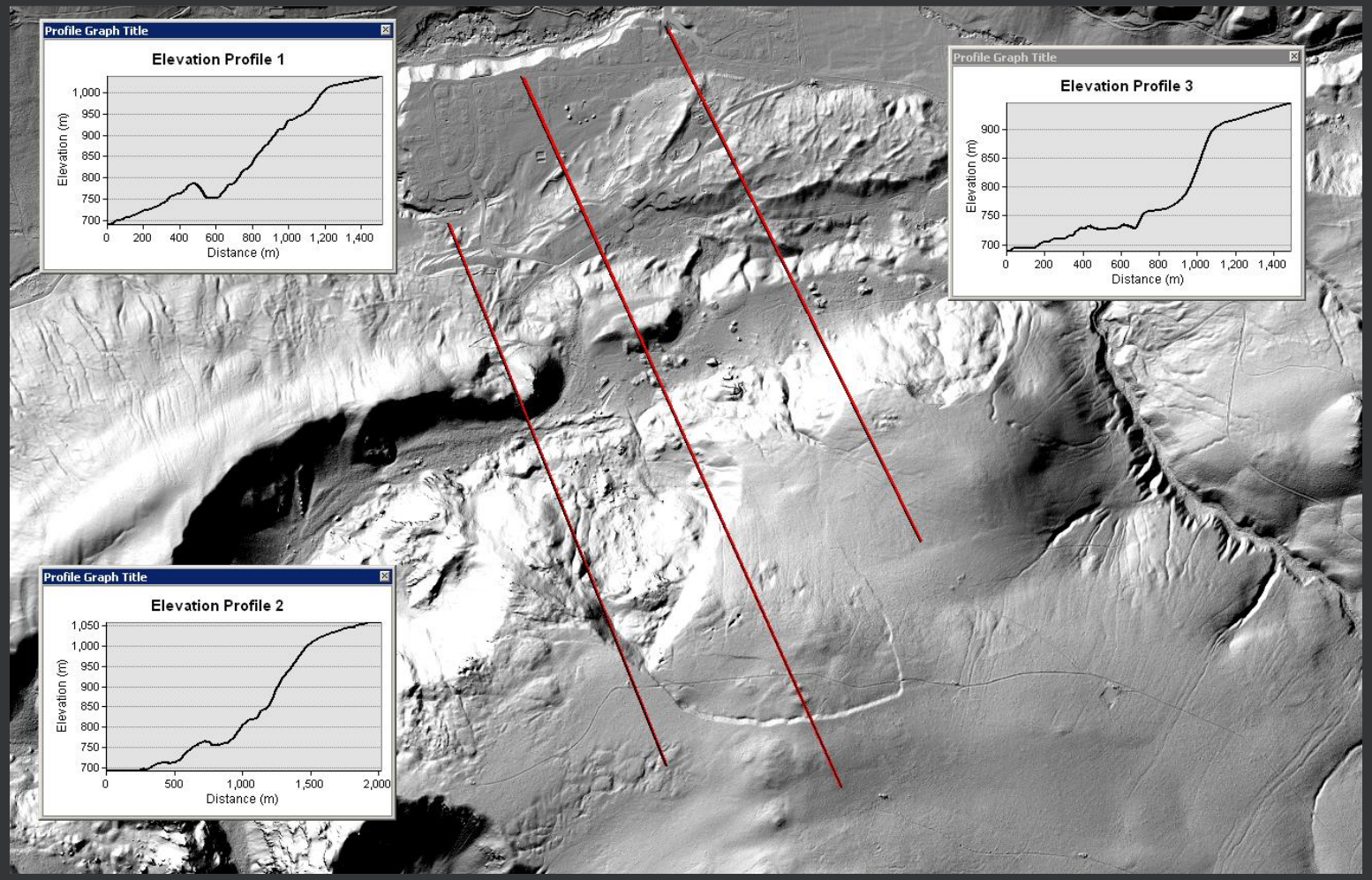
Cultural Features

PIT HOUSES

Detailed hillshade information has been used to identify historical cultural features such as pit house locations.

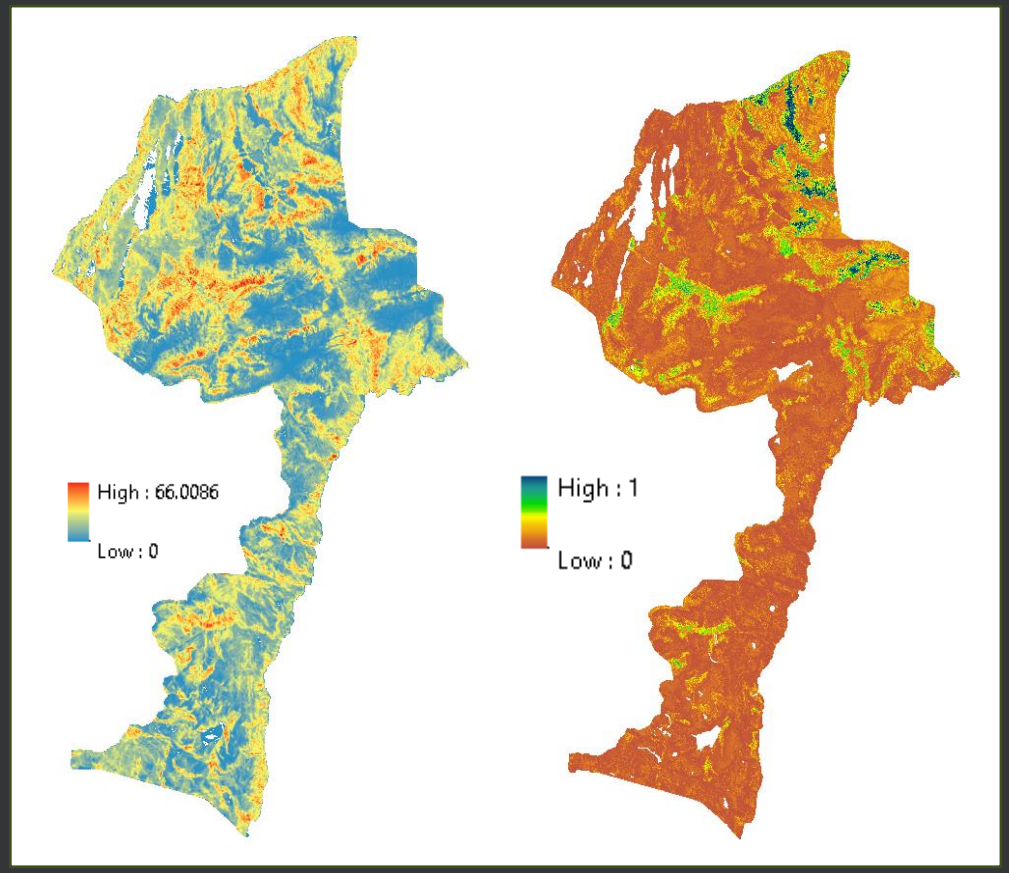
Terrain / Avalanche Assessments

- Identification of key land features is possible once the vegetation is removed (DEM/Hillshade)
- Possible to see old head scarps and failures
- Supports refined mapping of hazardous terrain

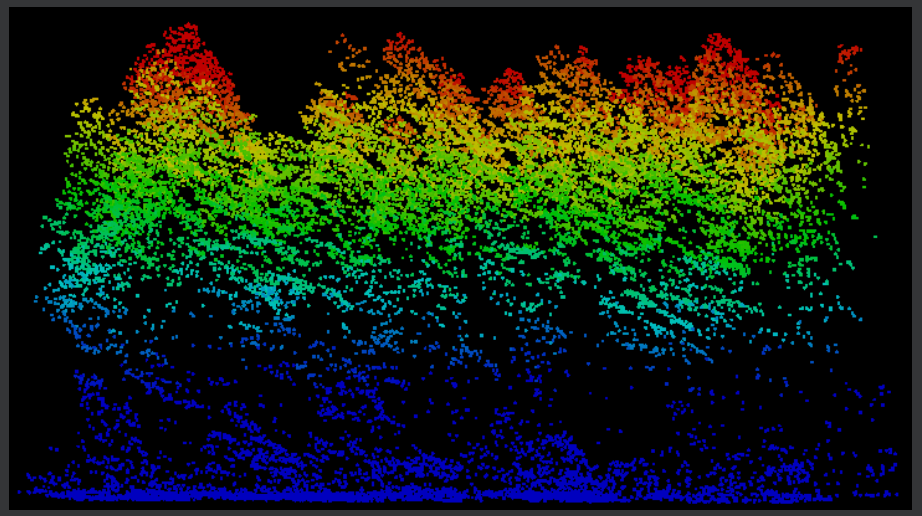


Wildlife Habitat - Goshawks

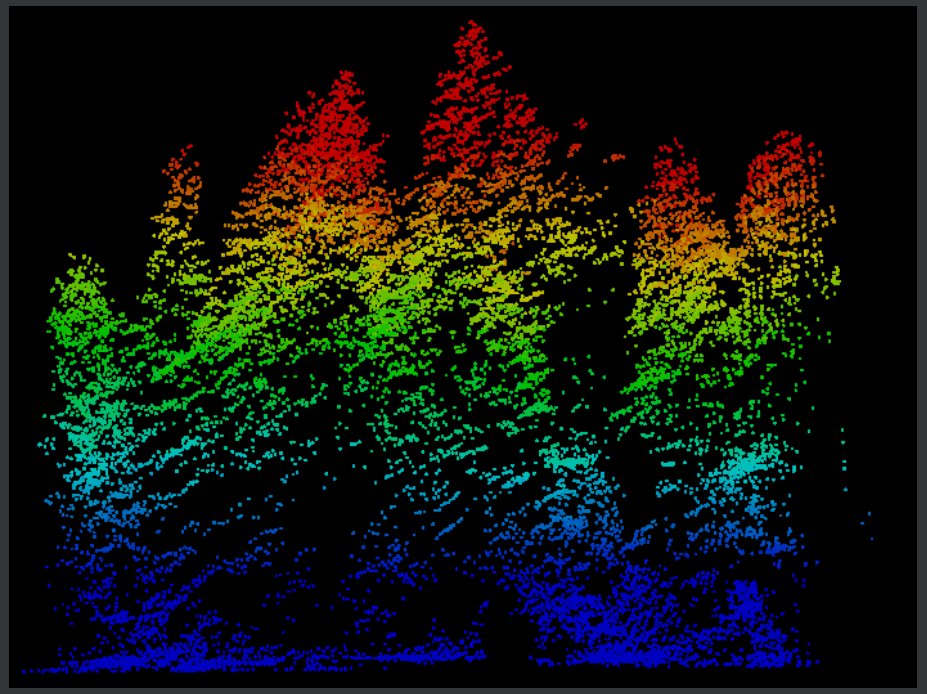
VANCOUVER ISLAND



Low Rank Habitat



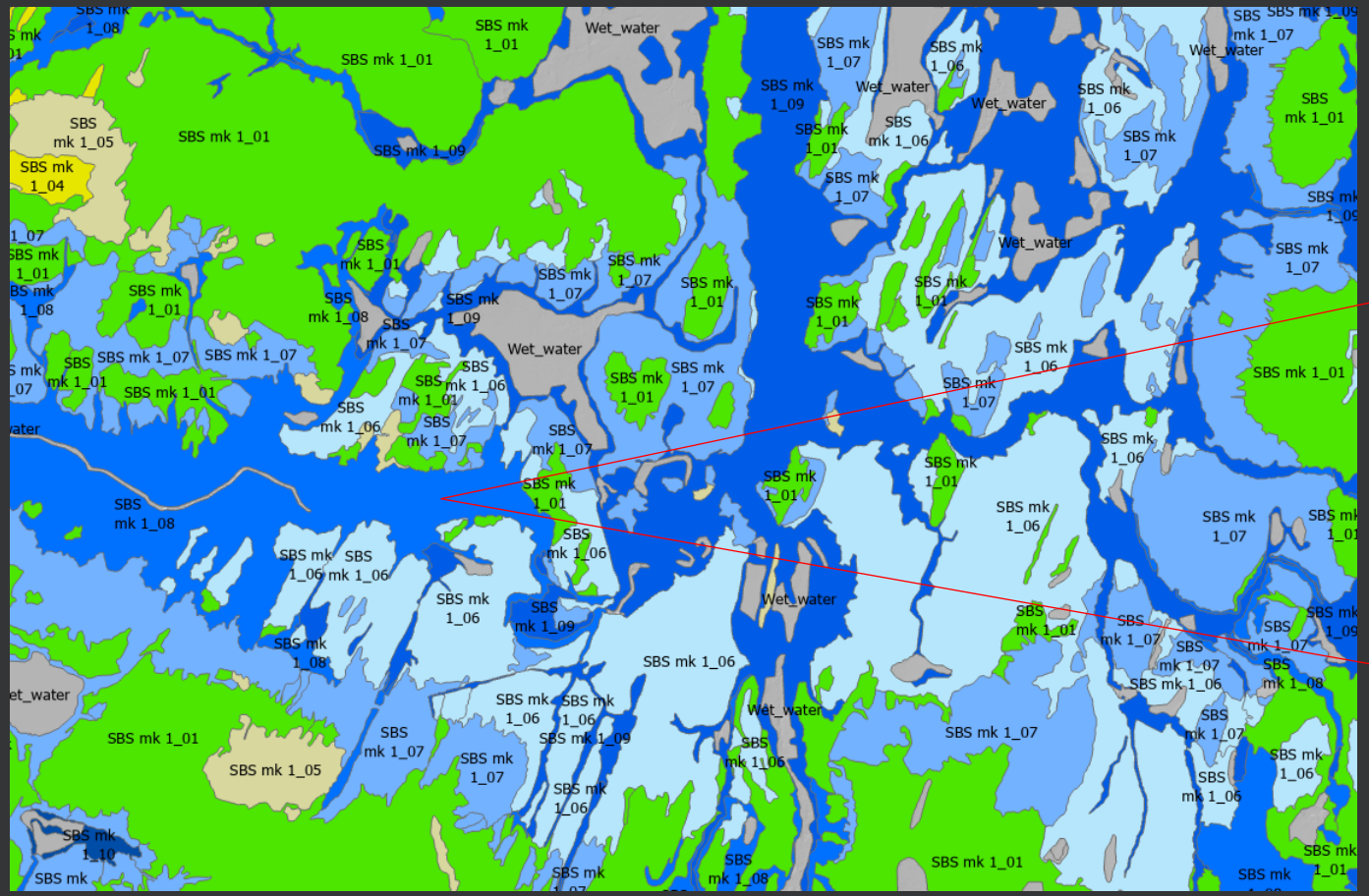
High Rank Habitat

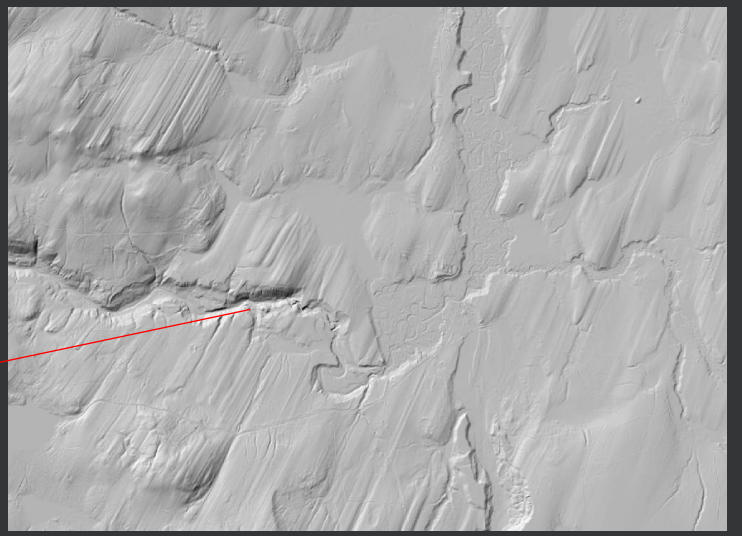


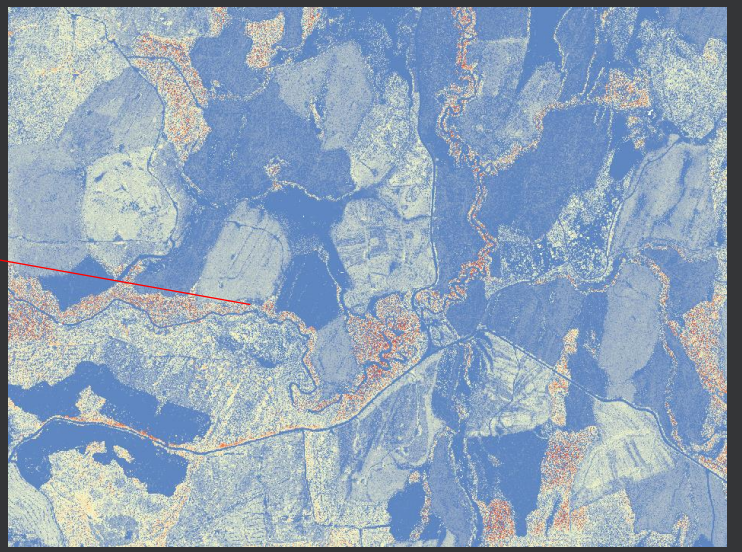
$$HSI_A = \frac{StandAge_r + Canopy\ Height_r}{2} * \frac{Canopy\ Closure_r + Flyways_r}{2} * Edge_r * ITG_r * Elev_r * Slope_r * BEC_r$$

Predictive Ecosystem Mapping (Site Level)

Fine resolution (1x1m) terrain and vegetation data means we can better predict site level ecotypes (site series)



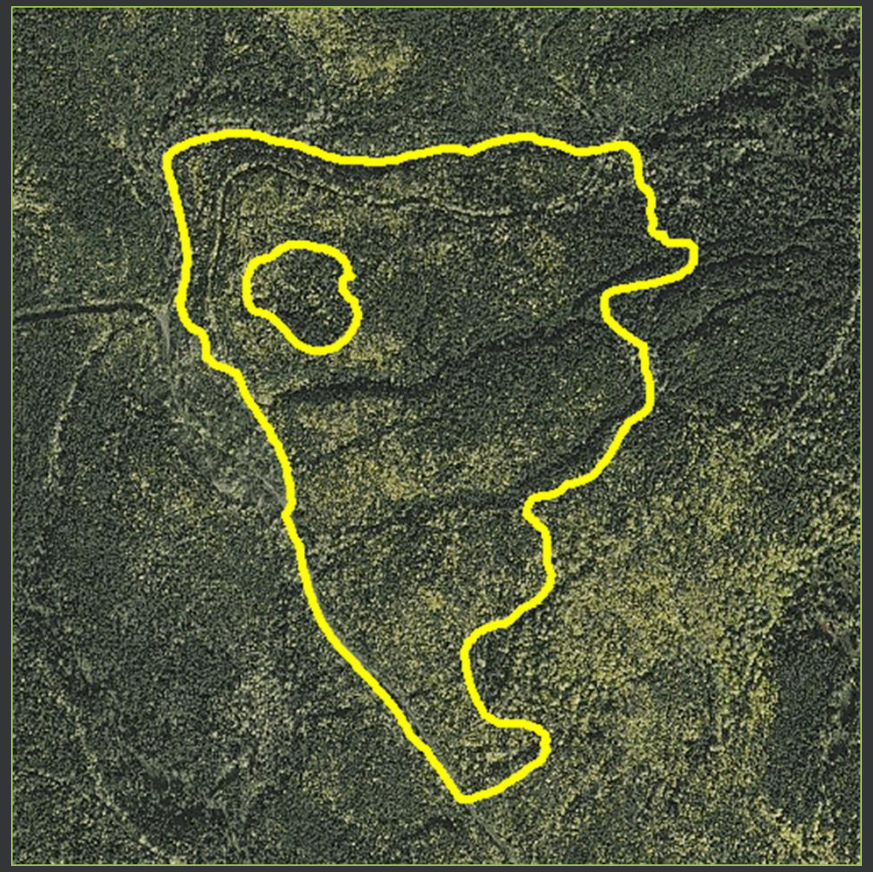




Commercial Thinning – More Efficient Planning

Detailed Initial Planning from the Office

- Target stands: 35-45 yrs old, BA > 33 m^2 BA (target to leave 20 m^2)



Individual Tree Analysis Spp Comp: Bl56 Sx25 Ep14 Hw2 Other Decid1 Other Conifer1 Sb1

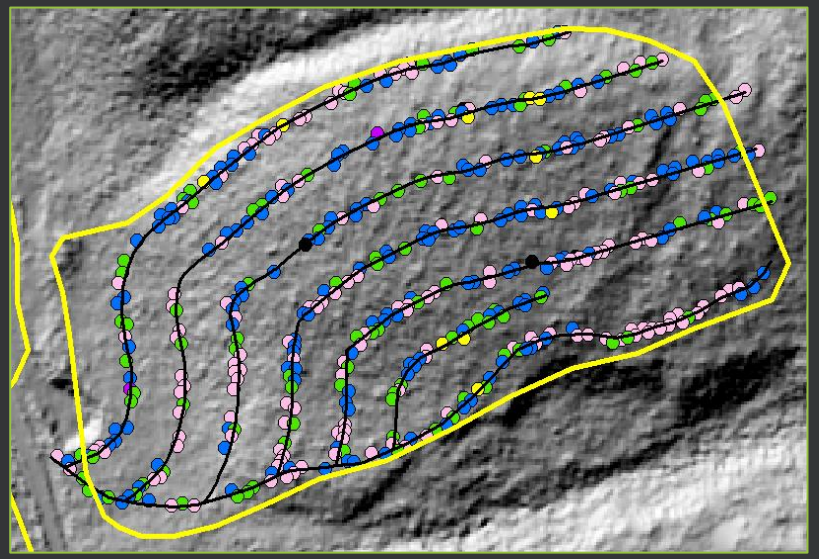
Settings Export

Tree Summary (Total Trees) | Tree Summary (tph) | Log Summary (Merch Volume (m3)) | Log Summary (Total Logs) | Mean Piece Size (m3)

Category	Statistic	Ep	Bl	Hw	Pl	Sb	Sx	Other Conifer	Other Decid	Total
Summary Overview	Gross Volume Total (m3)	3,181.4	12,068.0	483.2	65.2	173.7	5,308.9	188.9	344.5	21,814.0
Summary Overview	Merch Volume Total (m3)	2,842.8	11,174.8	330.6	58.8	141.5	4,695.0	178.3	319.0	19,740.8
Summary Overview	Net Volume Total (m3)	2,399.1	9,889.3	277.3	55.3	134.0	4,447.7	156.8	204.7	17,564.1
Summary Overview	Stems Total	10,049.0	23,072.0	1,832.0	209.0	574.0	12,773.0	252.0	691.0	49,452.0
	Total Area (ha)									87.0
Stems by Height Category	<= 10 m	509.0	276.0	1.0	24.0	80.0	465.0	30.0	17.0	1,402.0
Stems by Height Category	<= 15 m	1,437.0	1,612.0	27.0	68.0	182.0	2,442.0	46.0	119.0	5,933.0
Stems by Height Category	<= 20 m	6,896.0	10,824.0	924.0	74.0	233.0	6,750.0	66.0	355.0	26,122.0
Stems by Height Category	<= 25 m	1,029.0	8,987.0	788.0	33.0	66.0	2,417.0	44.0	159.0	13,523.0
Stems by Height Category	<= 30 m	160.0	1,296.0	88.0	6.0	8.0	639.0	37.0	37.0	2,271.0
Stems by Height Category	> 30 m	18.0	77.0	4.0	4.0	5.0	60.0	29.0	4.0	201.0
	Mean Ht (m)	17.0	19.6	20.1	15.9	15.4	17.7	19.8	18.1	18.5
Stems by DBH Category	<= 12.5 cm	0.0	161.0	12.0	19.0	73.0	427.0	20.0	4.0	716.0
Stems by DBH Category	<= 17.5 cm	1.0	443.0	675.0	43.0	102.0	1,208.0	30.0	19.0	2,521.0
Stems by DBH Category	<= 22.5 cm	3,019.0	3,306.0	804.0	75.0	182.0	3,643.0	42.0	99.0	11,170.0
Stems by DBH Category	> 22.5 cm	7,029.0	19,162.0	341.0	72.0	217.0	7,495.0	160.0	569.0	35,045.0
	Mean DBH (cm)	24.0	27.0	19.4	20.8	20.8	24.3	27.7	28.6	25.3
	BA (m2/ha)	5.3	15.8	0.6	0.1	0.3	7.3	0.2	0.5	30.2

49,452 trees, 87.0, ha 6/5/2020 1:15:27 PM

STEMS REMOVED FROM 4M TRAILS



4m Wide Trail – Stems Removed

Individual Tree Analysis Spp Comp: Bl47 Ep27 Sx23 Other Decid1 Sb1 Hw1 Other Conifer0

Settings Export

Tree Summary (Total Trees) | Tree Summary (tph) | Log Summary (Merch Volume (m3)) | Log Summary (Total Logs) | Mean Piece Size (m3)

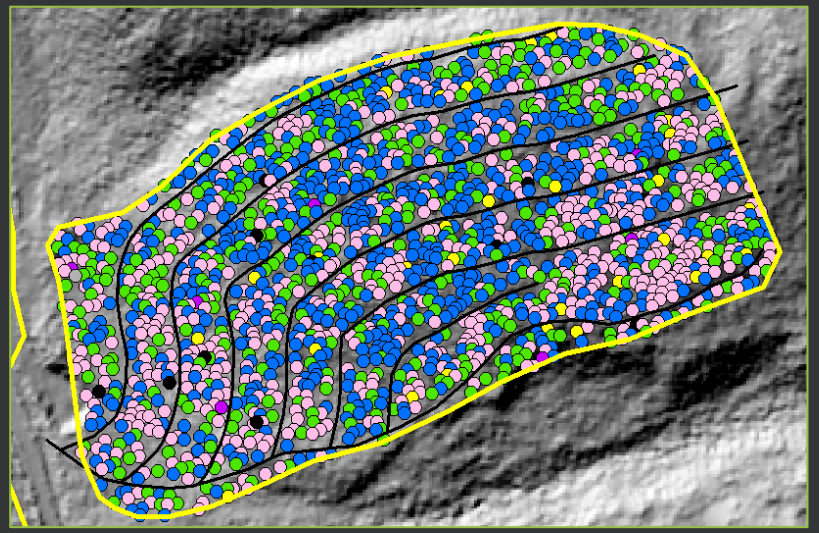
Category	Statistic	Ep	Bl	Fd	Hw	Sb	Sx	Other Conifer	Other Decid	Total
Summary Overview	Gross Volume Total (m3)	40.8	68.1	0.0	2.0	1.0	32.2	0.4	2.6	147.0
Summary Overview	Merch Volume Total (m3)	36.1	61.9	0.0	0.8	0.9	28.1	0.3	2.4	130.6
Summary Overview	Net Volume Total (m3)	32.5	55.9	0.0	0.7	0.9	27.0	0.3	1.7	119.0
Summary Overview	Stems Total	151.0	183.0	0.0	10.0	4.0	101.0	2.0	8.0	459.0
	Total Area (ha)									3.2
Stems by Height Category	<= 10 m	1.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0
Stems by Height Category	<= 15 m	19.0	9.0	0.0	0.0	1.0	13.0	1.0	0.0	43.0
Stems by Height Category	<= 20 m	128.0	134.0	0.0	5.0	3.0	77.0	1.0	7.0	355.0
Stems by Height Category	<= 25 m	3.0	38.0	0.0	5.0	0.0	11.0	0.0	1.0	58.0
Stems by Height Category	<= 30 m	0.0	1.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0
Stems by Height Category	> 30 m	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Mean Ht (m)	16.6	18.2	0.0	19.9	16.5	17.3	14.9	17.0	17.5
Stems by DBH Category	<= 12.5 cm	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Stems by DBH Category	<= 17.5 cm	0.0	3.0	0.0	6.0	0.0	6.0	1.0	0.0	16.0
Stems by DBH Category	<= 22.5 cm	76.0	55.0	0.0	4.0	3.0	43.0	1.0	0.0	182.0
Stems by DBH Category	> 22.5 cm	75.0	125.0	0.0	0.0	1.0	52.0	0.0	8.0	261.0
	Mean DBH (cm)	22.7	24.2	0.0	16.9	21.2	22.8	19.2	25.7	23.2
	BA (m2/ha)	1.9	2.7	0.0	0.1	0.0	1.3	0.0	0.1	6.2

459 trees, 3.2, ha 6/1/2020 8:08:05 AM

Removed from RoW's:

~ 6.2 m^2/ha

STEMS REMAINING



Individual Tree Analysis Spp Comp: Bl48 Ep27 Sx22 Other Decid2 Sb1 Hw0 Other Conifer0

Settings Export

Tree Summary (Total Trees) | Tree Summary (tph) | Log Summary (Merch Volume (m3)) | Log Summary (Total Logs) | Mean Piece Size (m3)

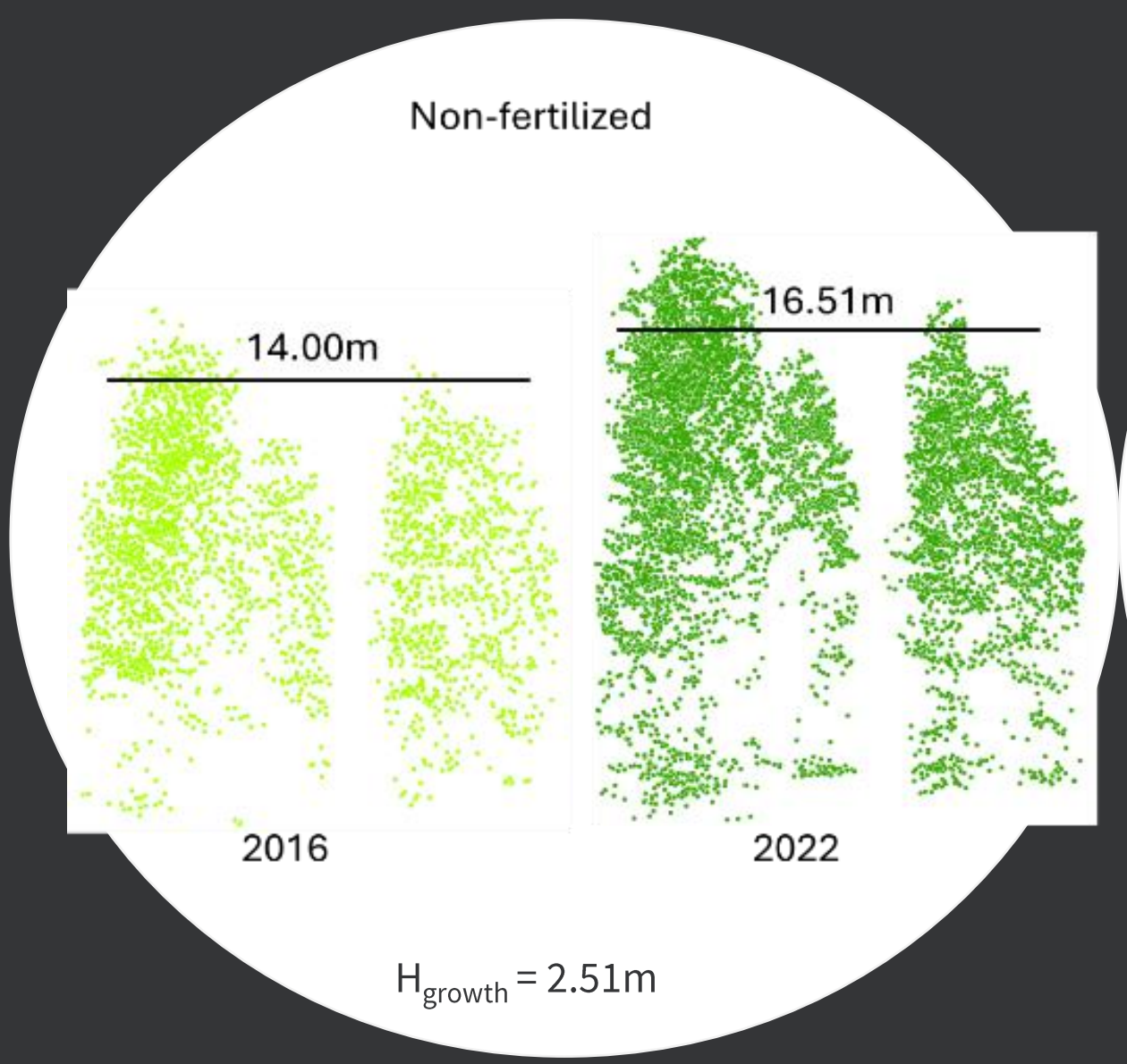
Category	Statistic	Ep	Bl	Fd	Hw	Sb	Sx	Other Conifer	Other Decid	Total
Summary Overview	Gross Volume Total (m3)	157.8	275.3	0.0	5.8	2.9	125.0	1.7	18.0	586.5
Summary Overview	Merch Volume Total (m3)	139.6	251.8	0.0	2.2	2.6	108.2	1.5	16.4	522.2
Summary Overview	Net Volume Total (m3)	125.8	227.0	0.0	1.9	2.5	103.9	1.4	11.6	474.1
Summary Overview	Stems Total	594.0	709.0	0.0	30.0	10.0	417.0	8.0	53.0	1,821.0
	Total Area (ha)									3.2
Stems by Height Category	<= 10 m	4.0	0.0	0.0	0.0	1.0	0.0	1.0	0.0	6.0
Stems by Height Category	<= 15 m	87.0	28.0	0.0	0.0	2.0	59.0	4.0	12.0	192.0
Stems by Height Category	<= 20 m	499.0	516.0	0.0	16.0	6.0	326.0	2.0	36.0	1,401.0
Stems by Height Category	<= 25 m	4.0	160.0	0.0	14.0	1.0	31.0	1.0	5.0	216.0
Stems by Height Category	<= 30 m	0.0	5.0	0.0	0.0	0.0	1.0	0.0	0.0	6.0
Stems by Height Category	> 30 m	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Mean Ht (m)	16.4	18.5	0.0	19.8	16.3	17.0	14.8	17.0	17.4
Stems by DBH Category	<= 12.5 cm	0.0	0.0	0.0	0.0	1.0	0.0	1.0	0.0	2.0
Stems by DBH Category	<= 17.5 cm	0.0	3.0	0.0	20.0	0.0	25.0	2.0	0.0	50.0
Stems by DBH Category	<= 22.5 cm	281.0	197.0	0.0	9.0	5.0	221.0	3.0	12.0	728.0
Stems by DBH Category	> 22.5 cm	313.0	509.0	0.0	1.0	4.0	171.0	2.0	41.0	1,041.0
	Mean DBH (cm)	22.7	24.5	0.0	16.6	21.3	22.4	18.4	25.7	23.3
	BA (m2/ha)	7.6	10.8	0.0	0.2	0.1	5.3	0.1	0.9	25.0

1,821 trees, 3.2, ha 5/29/2020 2:01:00 PM

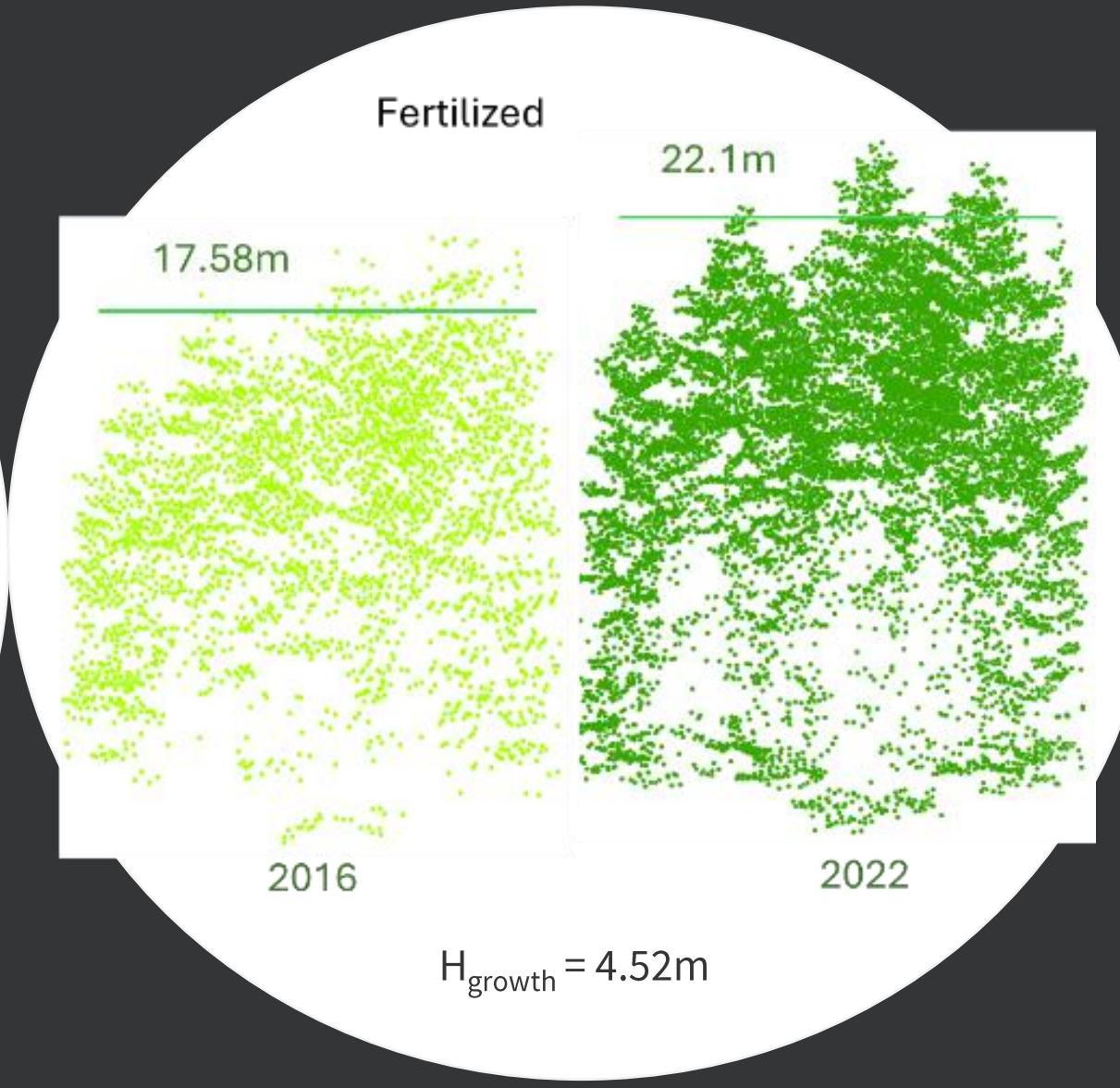
Remaining after 4m trails cut:

~ 25.0 m^2/ha

MATCHING WESTERN CEDAR TREES



H_{growth} = 2.51m



H_{growth} = 4.52m

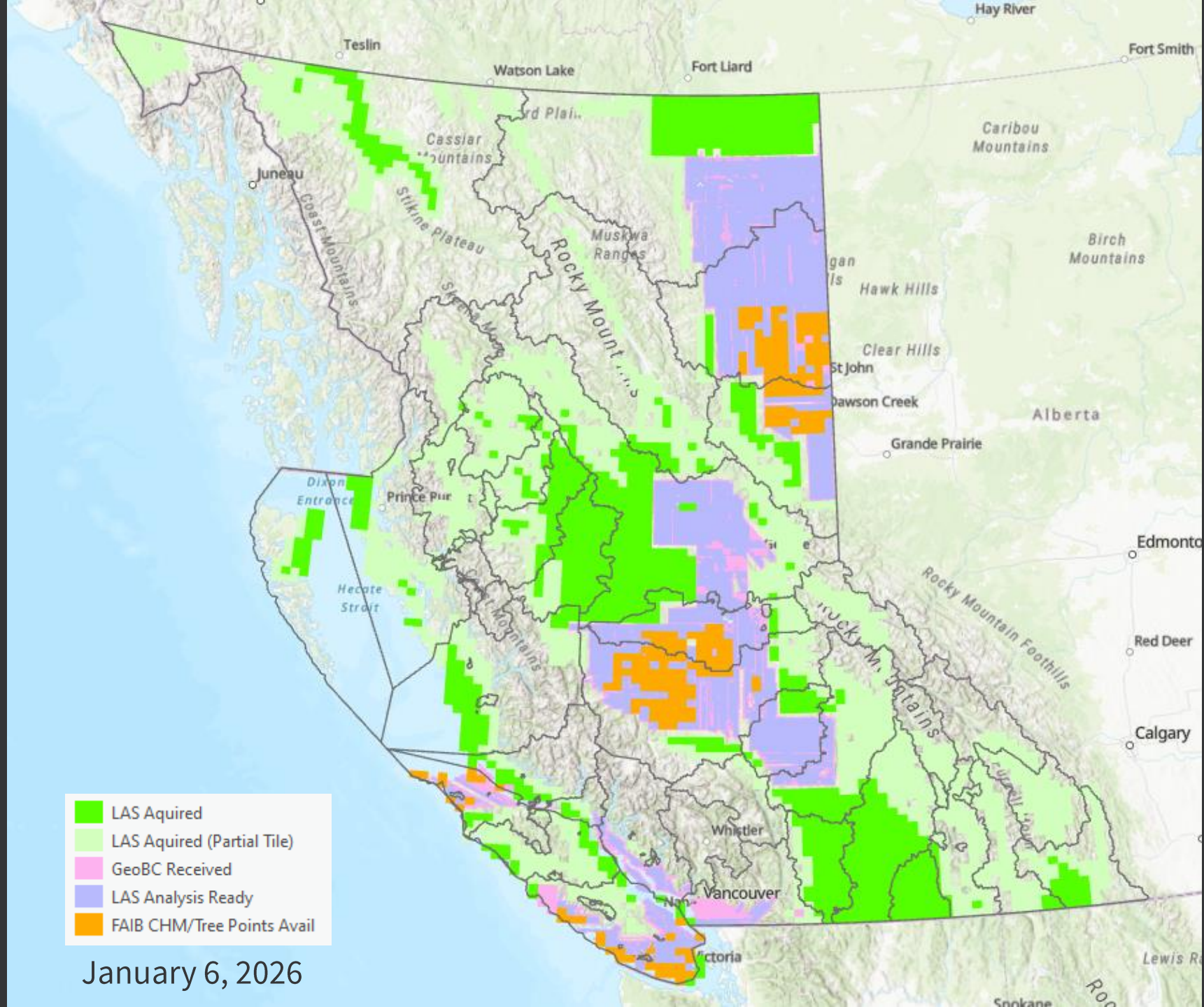
Innovation Outcomes from LiDAR

- Vastly more accurate data describing terrain and vegetation allows:
  - Detailed forest inventories (objective, data driven)
  - Improved operational scale planning
    - Faster, safer, better layout (more done from the office)
    - Better visual designs, linked to actual retention trees
  - Improved strategic planning
    - Better inventory & growing stock estimates – defensible / stats
    - Growth rates estimates
    - More accurate land base definition (THLB)

BC's Provincial LiDAR Program

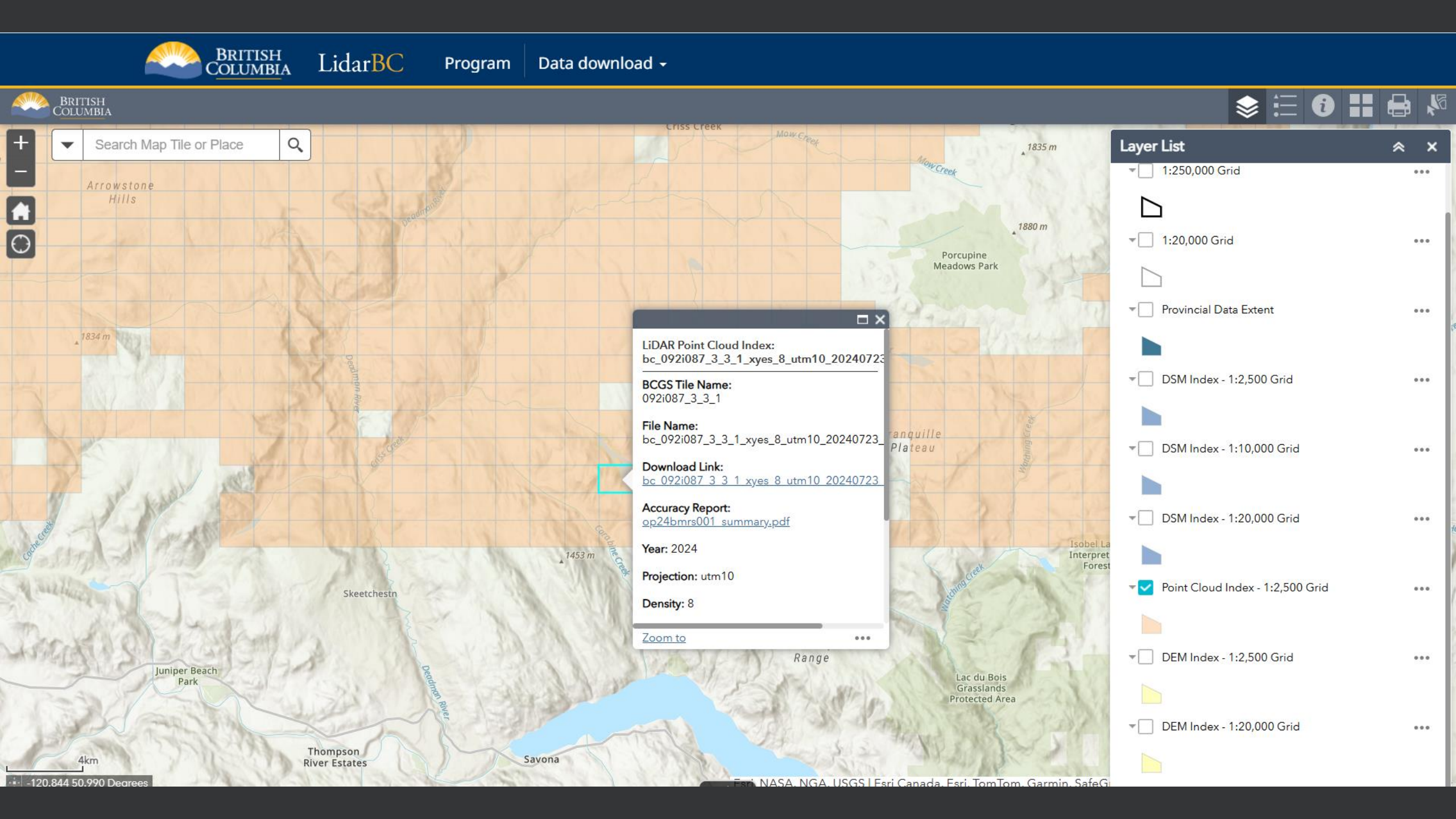
- Full province, 6 years
- Data collected in 2023, 2024, and 2025 - data release started 2025.
- Broad scale lidar availability will reduce costs and improve management outcomes.

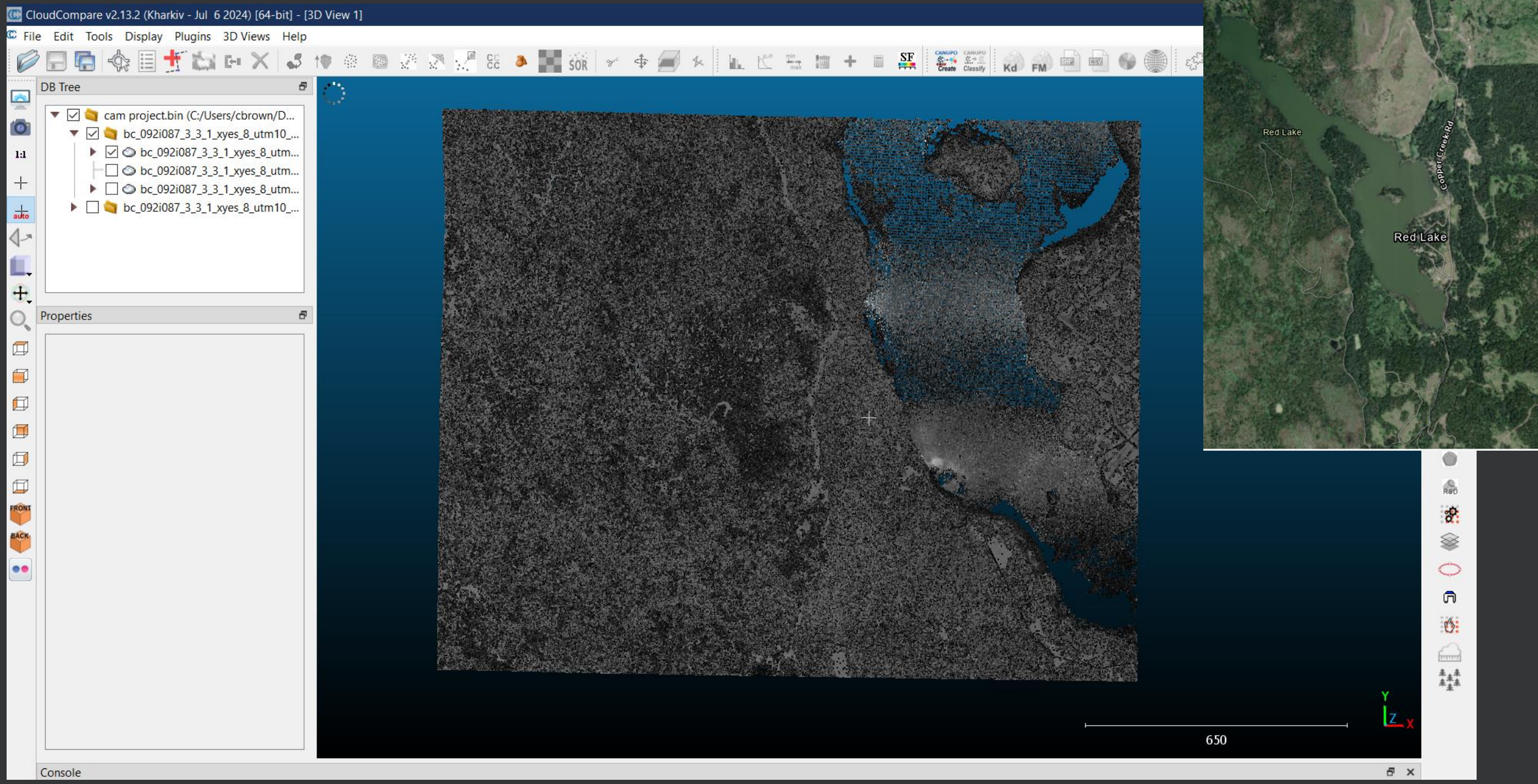
https://lidar.gov.bc.ca/pages/download-discovery




Wadley
Lake
Red Lake
Copper Creek Rd
Red Lake

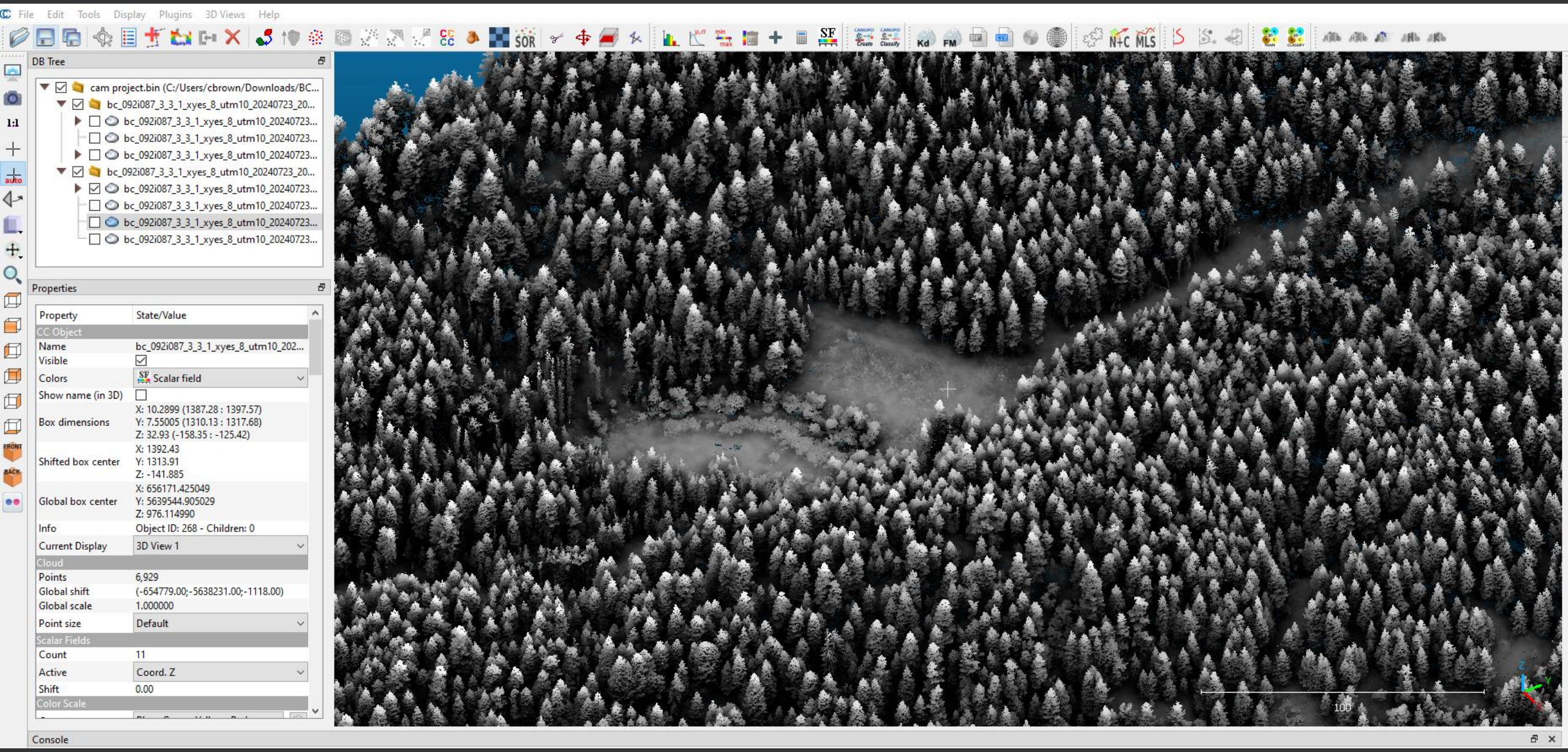

Red Lake

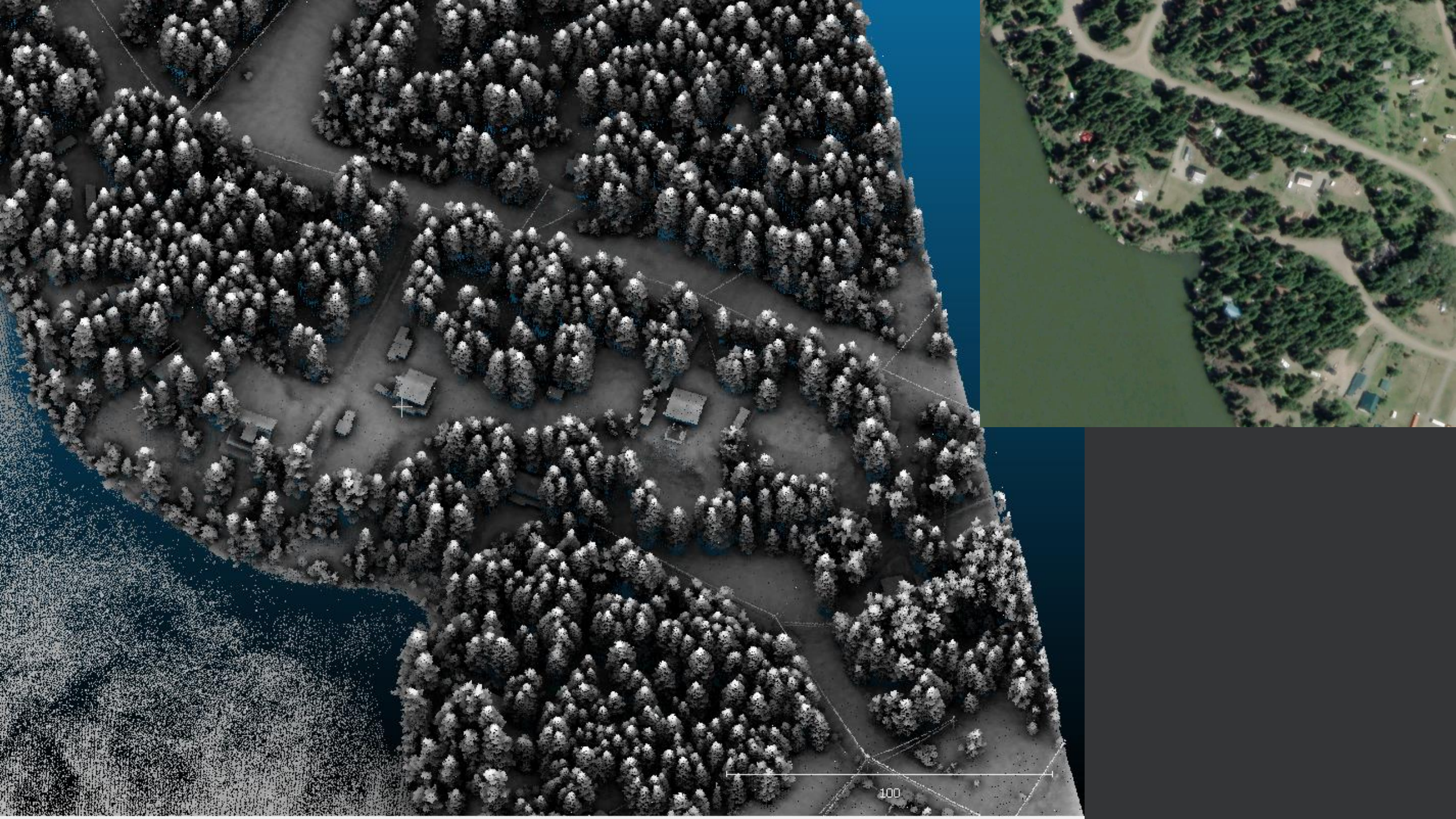

BRITISH COLUMBIA
LidarBC
Program
Data download
Search Map Tile or Place
Arrowstone Hills
Criss Creek
Mow Creek
1835 m
1880 m
Porcupine Meadows Park
1834 m
Deadman River
Tranquille Plateau
Watching Creek
Cache Creek
1453 m
Skeetchestn
Juniper Beach Park
Thompson River Estates
Savona
Range
Lac du Bois Grasslands Protected Area
4km
-120.844 50.990 Degrees
LiDAR Point Cloud Index:
bc_092i087_3_3_1_xyes_8_utm10_20240723
BCGS Tile Name:
092i087_3_3_1
File Name:
bc_092i087_3_3_1_xyes_8_utm10_20240723_
Download Link:
bc_092i087_3_3_1_xyes_8_utm10_20240723
Accuracy Report:
op24bmrs001_summary.pdf
Year: 2024
Projection: utm10
Density: 8
Zoom to
Layer List
1:250,000 Grid
1:20,000 Grid
Provincial Data Extent
DSM Index - 1:2,500 Grid
DSM Index - 1:10,000 Grid
DSM Index - 1:20,000 Grid
Point Cloud Index - 1:2,500 Grid
DEM Index - 1:2,500 Grid
DEM Index - 1:20,000 Grid

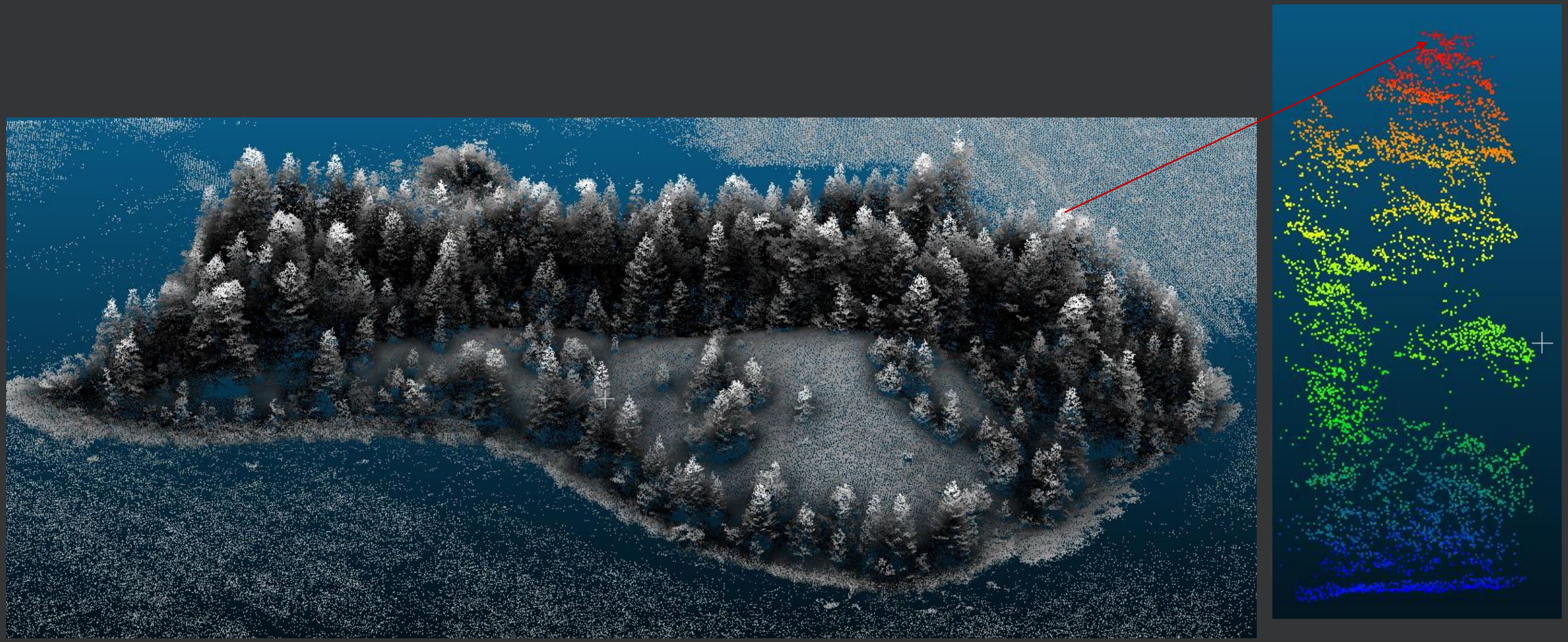


https://www.cloudcompare.org/ (Free)

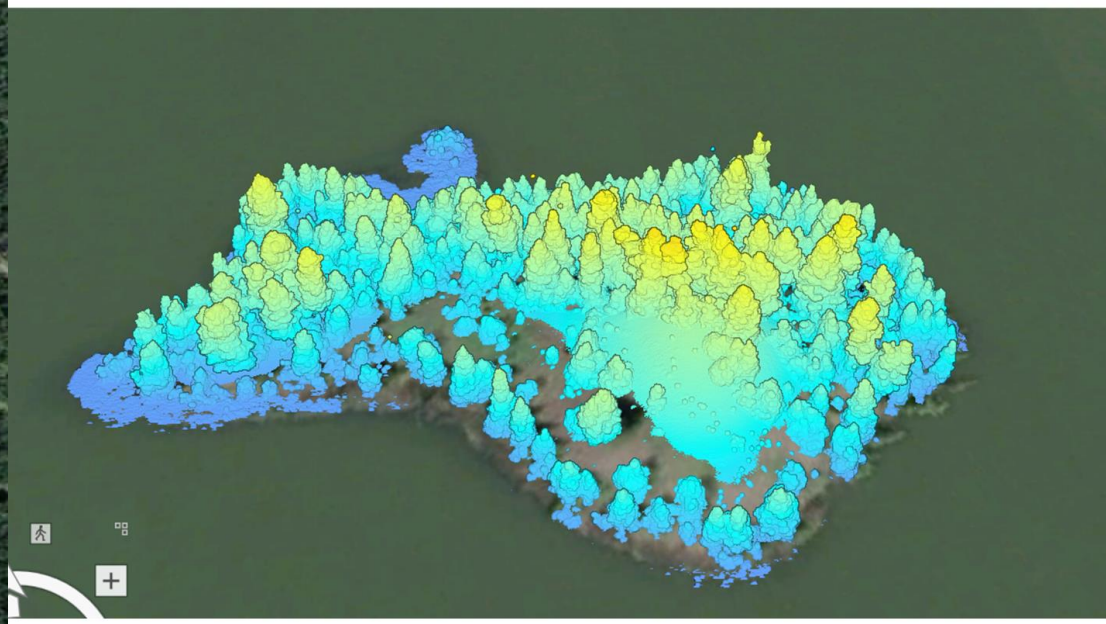

200


File
Edit
Tools
Display
Plugins
3D Views
Help
DB Tree
cam project.bin (C:/Users/cbrown/Downloads/BC...
bc_092i087_3_3_1_xyes_8_utm10_20240723_20...
bc_092i087_3_3_1_xyes_8_utm10_20240723...
bc_092i087_3_3_1_xyes_8_utm10_20240723...
bc_092i087_3_3_1_xyes_8_utm10_20240723...
bc_092i087_3_3_1_xyes_8_utm10_20240723_20...
bc_092i087_3_3_1_xyes_8_utm10_20240723...
bc_092i087_3_3_1_xyes_8_utm10_20240723...
bc_092i087_3_3_1_xyes_8_utm10_20240723...
bc_092i087_3_3_1_xyes_8_utm10_20240723...
Properties
Property
State/Value
CC Object
Name
bc_092i087_3_3_1_xyes_8_utm10_202...
Visible
Colors
Scalar field
Show name (in 3D)
Box dimensions
X: 10.2899 (1387.28 : 1397.57)
Y: 7.55005 (1310.13 : 1317.68)
Z: 32.93 (-158.35 : -125.42)
Shifted box center
X: 1392.43
Y: 1313.91
Z: -141.885
Global box center
X: 656171.425049
Y: 5639544.905029
Z: 976.114990
Info
Object ID: 268 - Children: 0
Current Display
3D View 1
Cloud
Points
6,929
Global shift
(-654779.00;-5638231.00;-1118.00)
Global scale
1.000000
Point size
Default
Scalar Fields
Count
11
Active
Coord. Z
Shift
0.00
Color Scale
100
Console


100



GEO BC: DEM and Point Clouds (classified as ground/non ground)
Forest Analysis and Inventory Branch: Canopy Height Model + Tree Points (location and height)



Need to save out as a LAS to bring it into ArcPro (Scene)

QGIS has good support for point clouds.

Tree Points and CHM (FAIB Products)

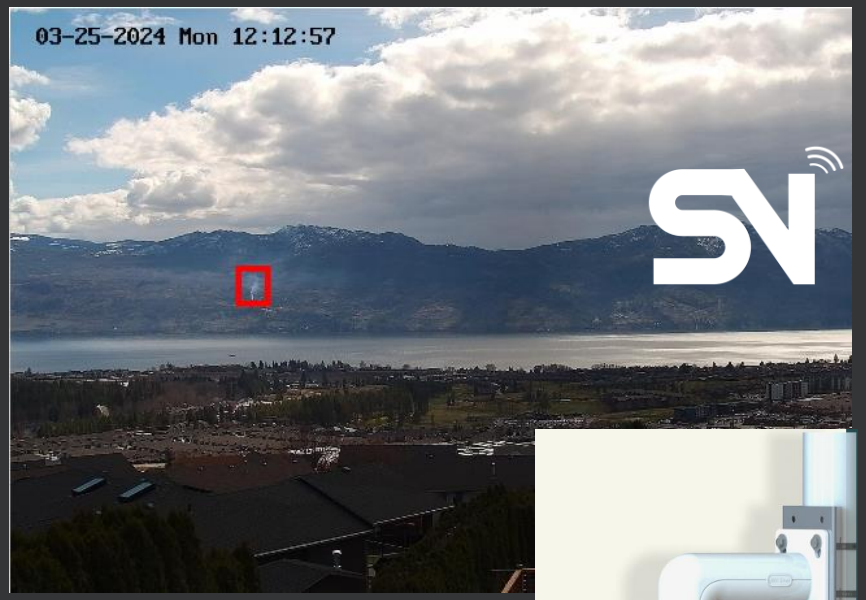
1m CHM used to generate tree points with heights (missing trees, very coarse, captures non trees)

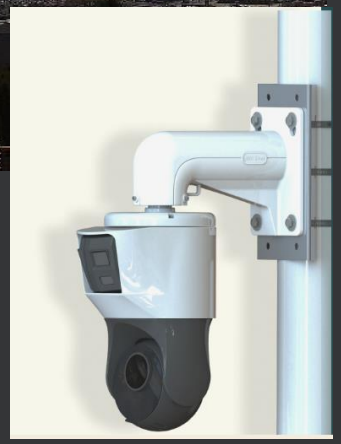
Tree Points (Basic waterfall segmentation on 1m CHM)

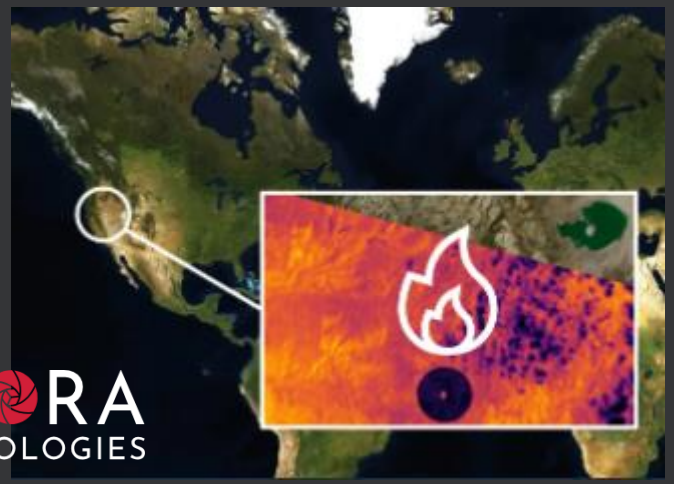

Fire

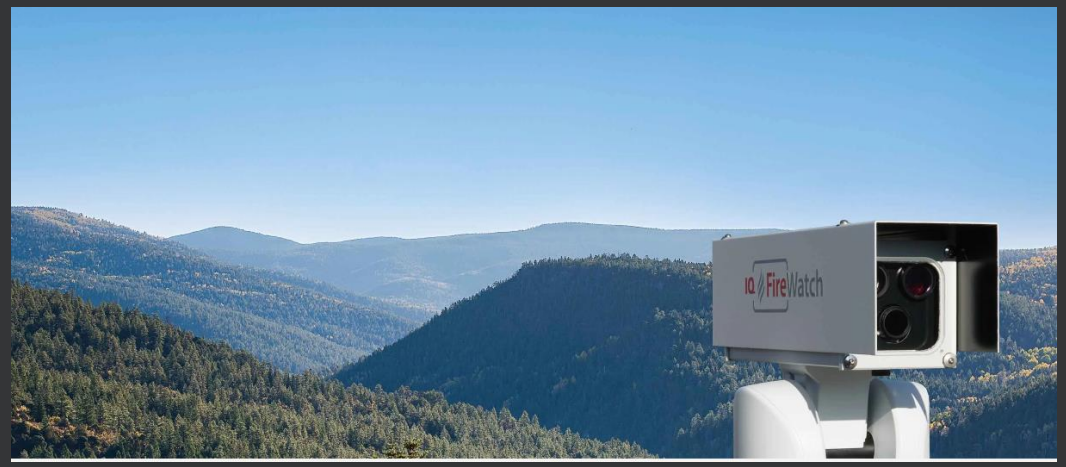
Fire Detection and AI

- **Detect Fires**
  - Localized Gas/Thermal Sensors
  - Smoke Detection Cameras with AI
  - Satellite based thermal sensors

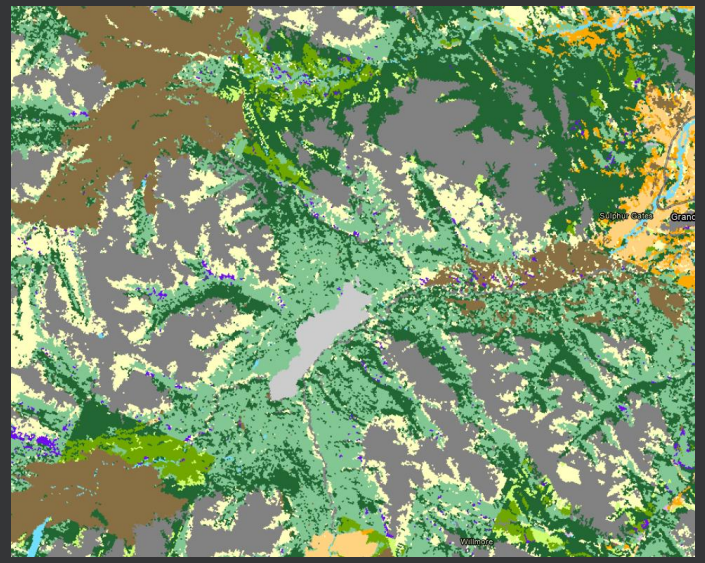


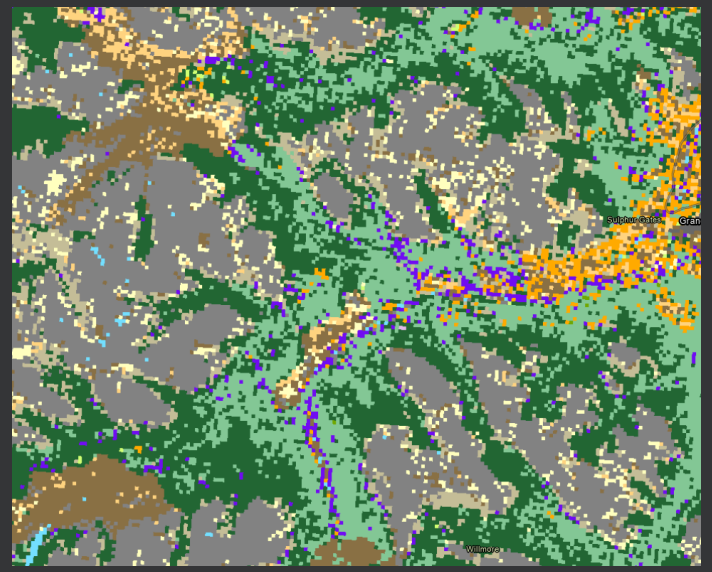


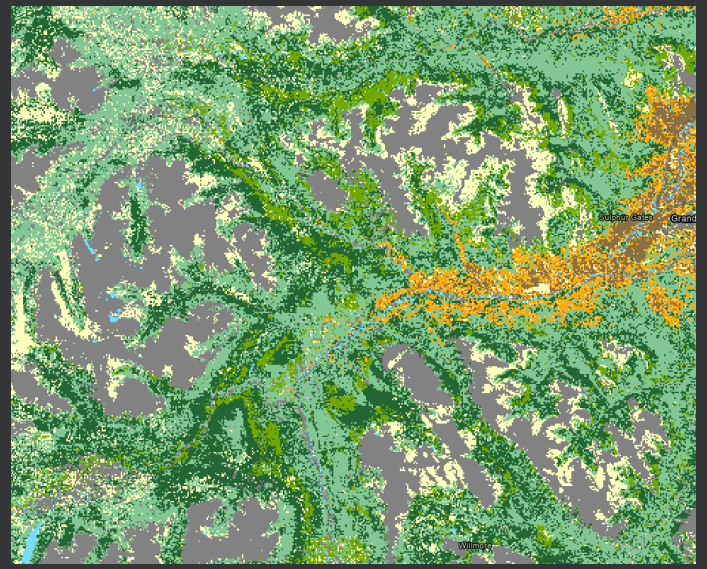


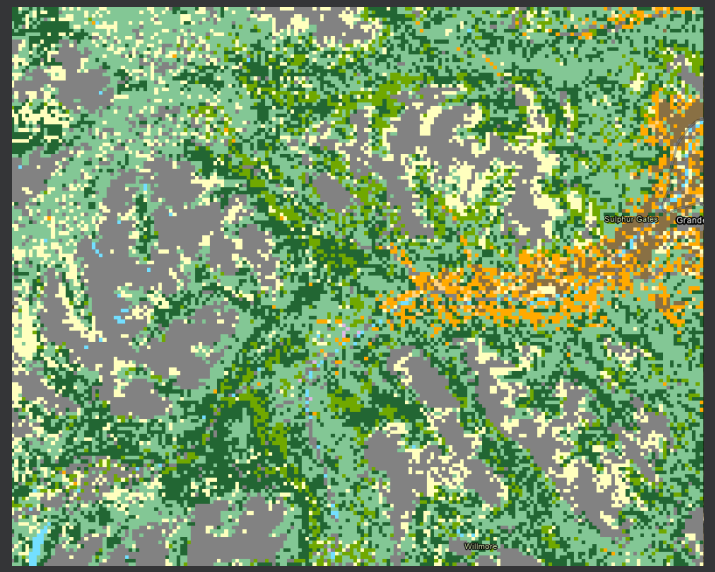


Wildfire Fuels Mapping – Lidar and/or Sat Imagery







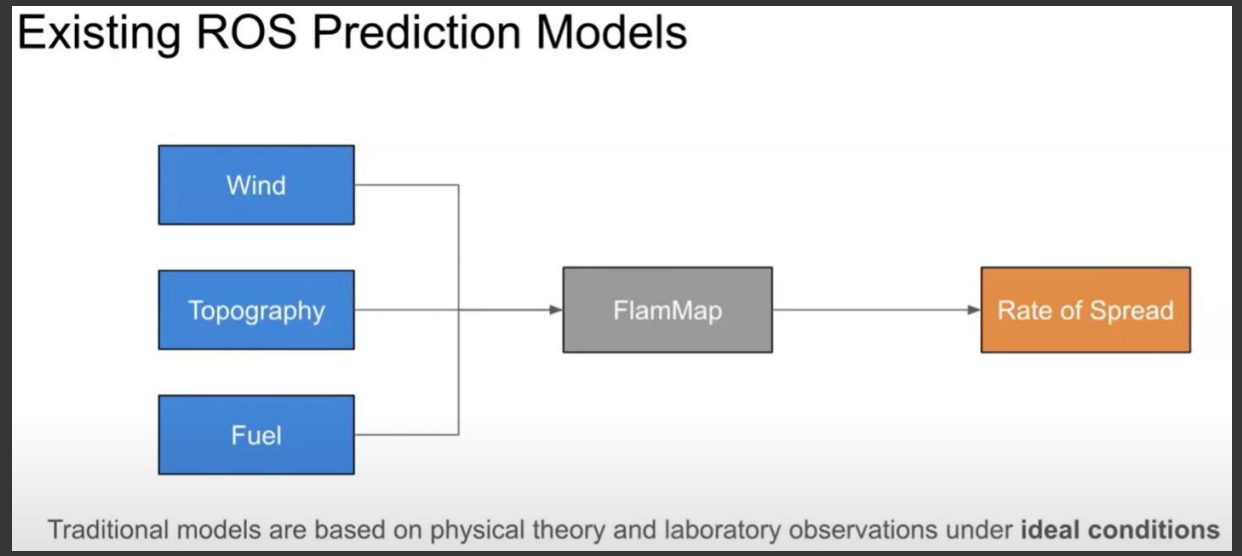


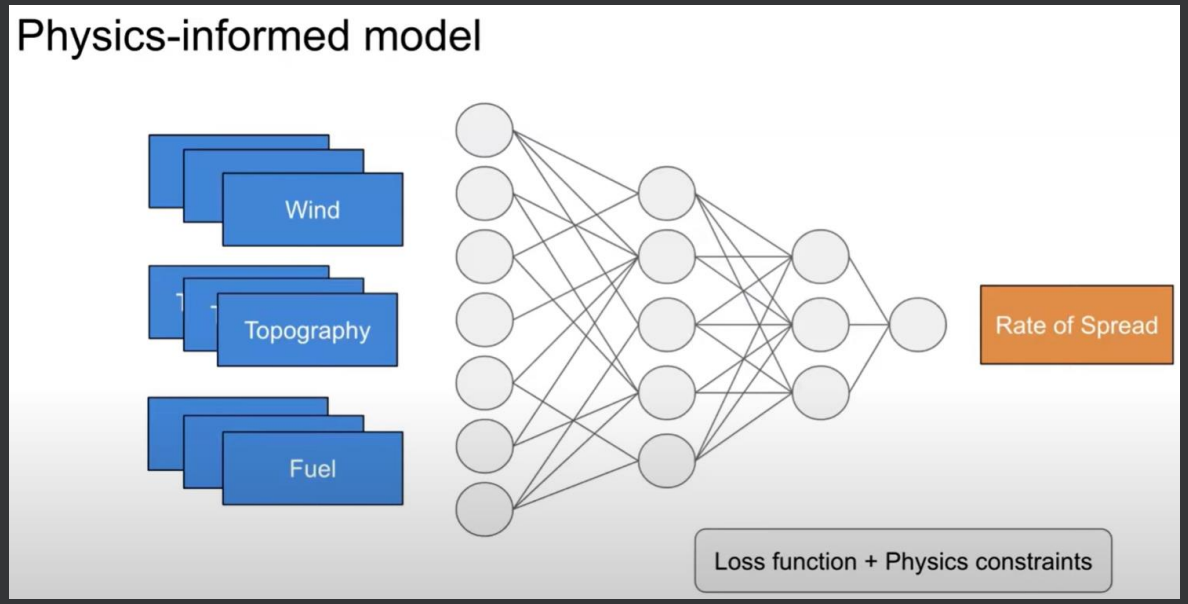
- C-1
- C-2
- C-3
- C-4
- C-5
- C-7
- D-1
- D-1/D-2
- O-1
- Non-Fuel
- Water
- Vegetated Non-Fuel
- M-1/M-2 C < 50%
- M-1/M-2 C > 50%

Predicting Fire Behavior with AI

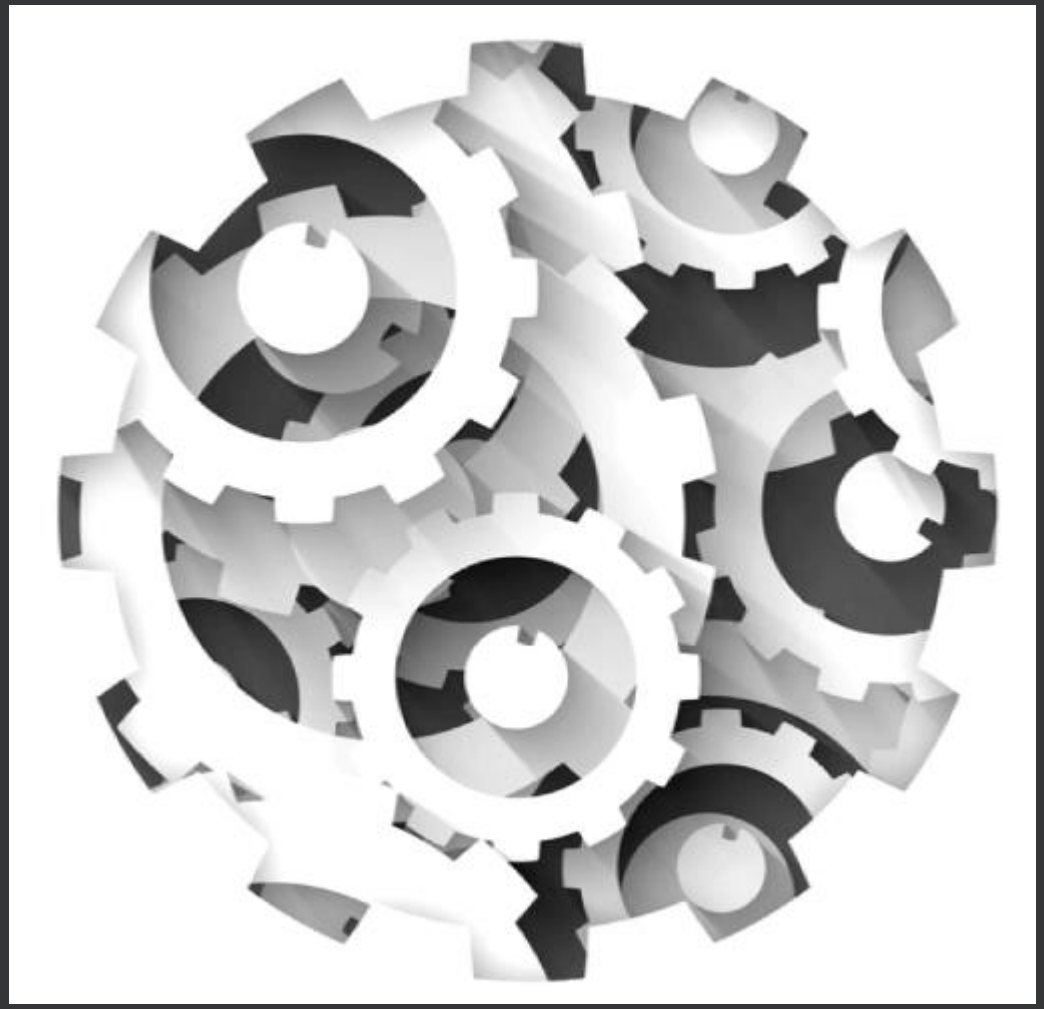
Current – Physical state models used to predict fire behavior (constant conditions)

Future – Data Science (AI) used to predict fire behavior (informed with 3D fuel models)





Automation



Remote Operation of Equipment

Retrofits of cable yarders, bunchers, and skidders with cameras and LiDAR. Operators can control these machines from a remote trailer or office.

Automated / Mechanized Planting

Mechanical Planters (crewed) – high production but limited applicability. Robot planters…?

AI + GPS + Mechanical Planters = Autonomous planting

Forest Management Planning Innovations

Historic / Current

- Silo'd gov't staff define management practices (FRPA, GAR Orders)
- TSR Defines AAC using Current Practice every 10 years (Not forward looking)
- Operations decide where/what to log with very limited connection between Strategic and Operational Plans

Current / Future

- Local Forest Landscape Planning tables will define desired future forest conditions.
- Management approach is defined in parallel with an associated AAC.
- Operations implement harvesting consistent with the management approach and operations take detailed guidance from the strategic plan.
- Outcomes are monitored against the plan.
- Better inventory/models/planning = better management

Forest Management Planning Innovations

FLP's

- Involve FNs and benefit from local knowledge
- Align with Adaptive Management Principles (to manage uncertainty)
- Connects the AAC, practices, values, and operational implementation into a single framework.

Public, stakeholder and Indigenous engagement help establish forest management objectives for diverse values that support a long-term forest management strategy. Objectives vary throughout Canada to meet local values.

Experts from various fields of expertise provide important input to:

- forest management
- fish and wildlife
- forest ecology and biology
- forest modeling and analysis
- land use
- parks and natural heritage
- forest pest management
- wildfire
- enforcement

SFM practices and policies are continuously improved as new science and data become available or as societal values change.

Science-based decision support tools, or computer models, help forecast the impacts of forestry on forests and the values they provide through potential scenarios. They also help to understand the cumulative effects that natural and human disturbances can have on forests.

There are three forest management certification systems in Canada. They complement our laws and regulations and ensure that a forest company is operating legally, sustainably and in compliance with world-recognized standards.

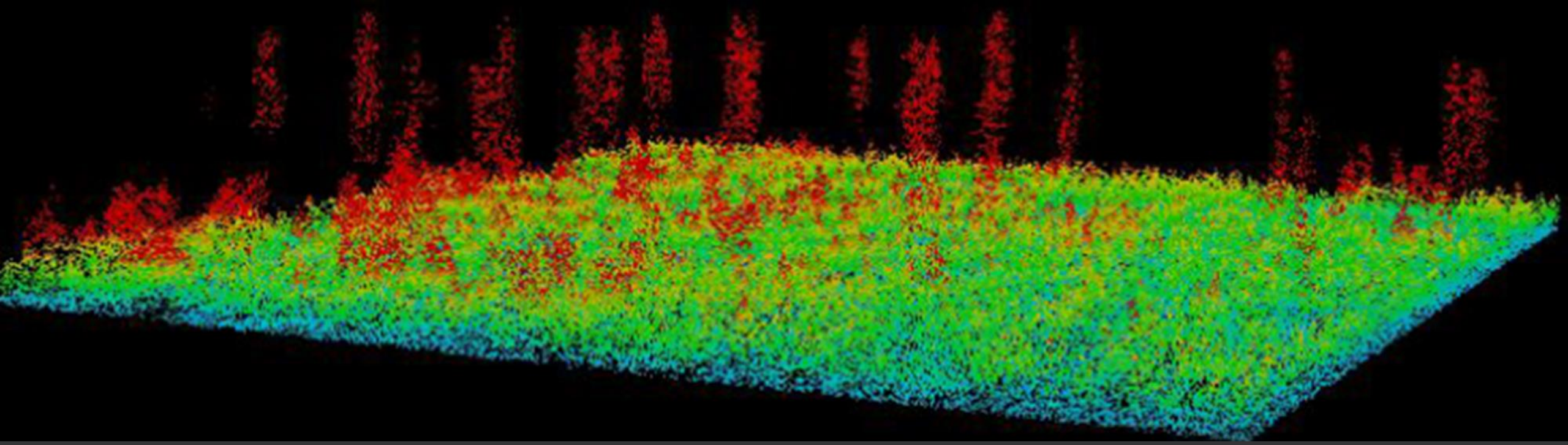
- Canadian Standards Association (CSA)
- Forest Stewardship Council (FSC)
- Sustainable Forestry Initiative (SFI)

Monitoring, knowledge improvement and advances in technology will continue to increase efficiencies and capabilities in forest management planning, as lands are managed for diverse forest values.

Harvesting strategies Approaches vary according to composition, structure and function of Canada's many forest types.

Summary - Innovation & Forest Management

- LiDAR is becoming widely available and provides a information step change
- Phone Apps - cheap easy ways to collect data but limited applicability
- Drones – new uses being found all the time but LOS limits options
- Satellites – greatly expanding options with new launches
- Automated / Autonomous equipment – in development
- Linking Strategic and Operational Planning – bring reality to a forest near you



Thank you

Cam Brown MF, RPF

VP – Forest Analytics
Salmon Arm, BC

cell 250-833-6631
cbrown@forsite.ca

FORSITE
Forest Management Specialists