FORSITE
Forest Management Specialists

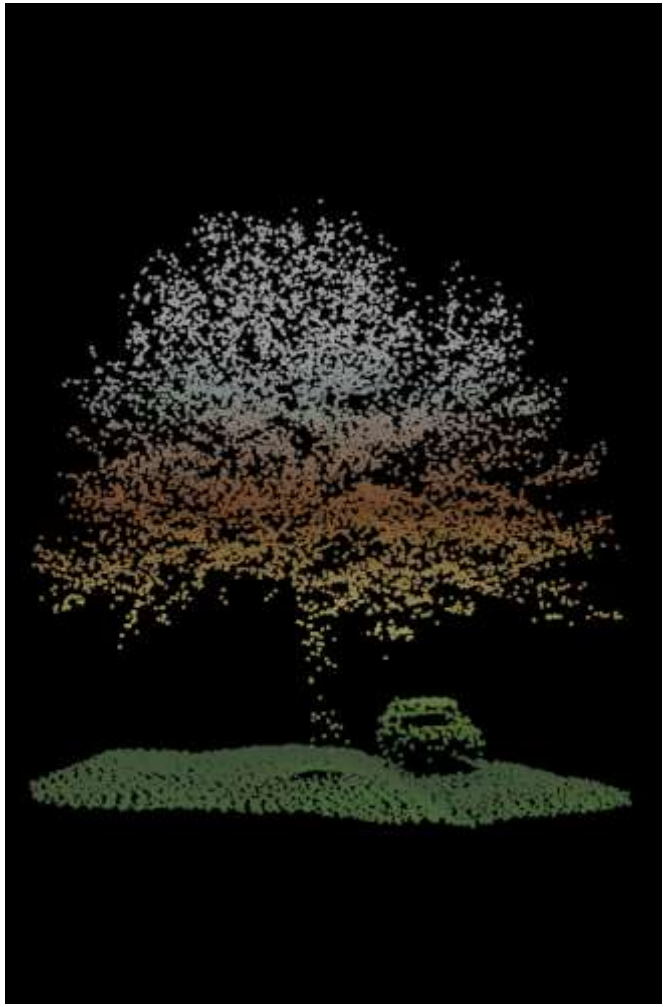
EFI to AVI

PUTTING STEREO GLASSES ON DATA SCIENTISTS

Kat Gunion RPF (BC, AB)

kgunion@forsite.ca

Overview



- Start at the end. What is AVI?
- Broad Approach
- Review Three Challenges
  - Multi Layer Stands
  - Age/Site Index
  - Polygon Delineation
- Validation
- Advantages/Disadvantages
- Next Steps

What is AVI?

What it is:

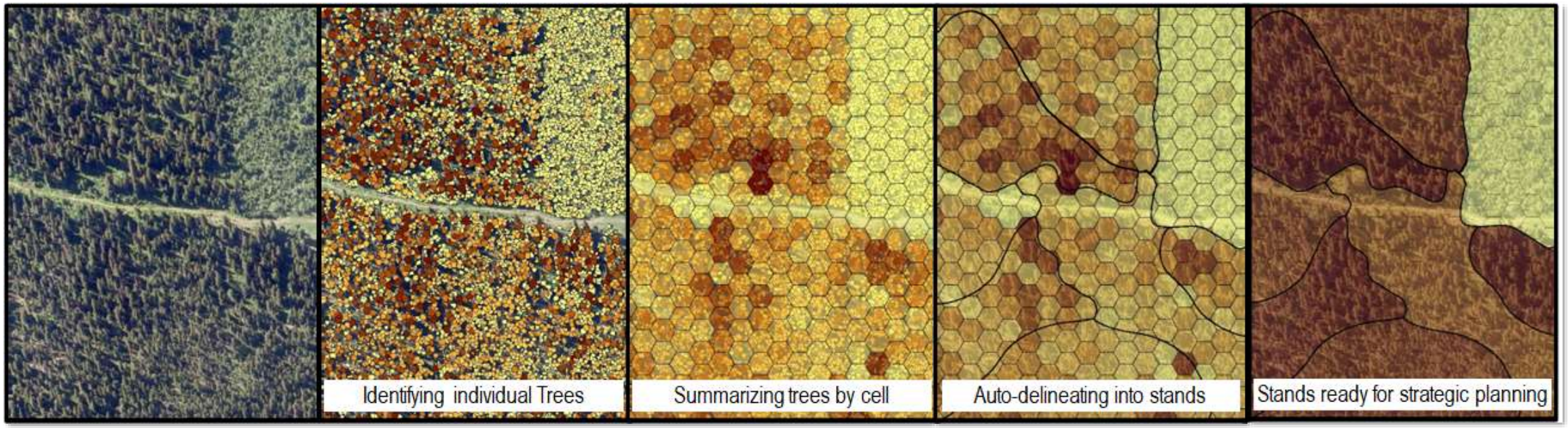
- Alberta Vegetation Inventory
- Strategic Level & Timber Supply
- Uniform Province Wide
- Height, Stand Origin, Timber Productivity, Species Label, Moisture Regime, Crown Closure

What it’s not:

- Doesn’t include basal area, diameters, stem density, or volumes.
- Yield curves are developed separately and assigned to Yield Strata from AVI.

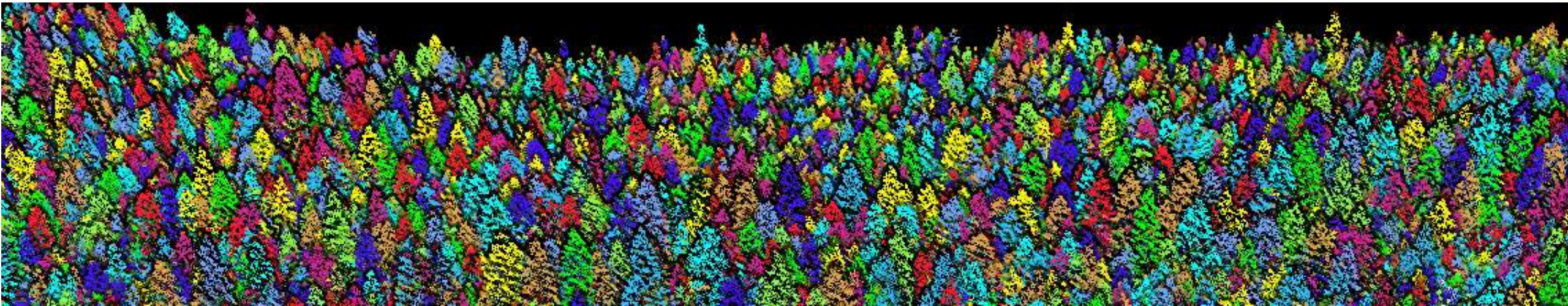
Broad Approach

- Individual Tree Inventory
- 400m^2 hexagons
- Auto-Delineated Polygons
- Assign Attributes



Challenges - AVI Attributes using Data Science

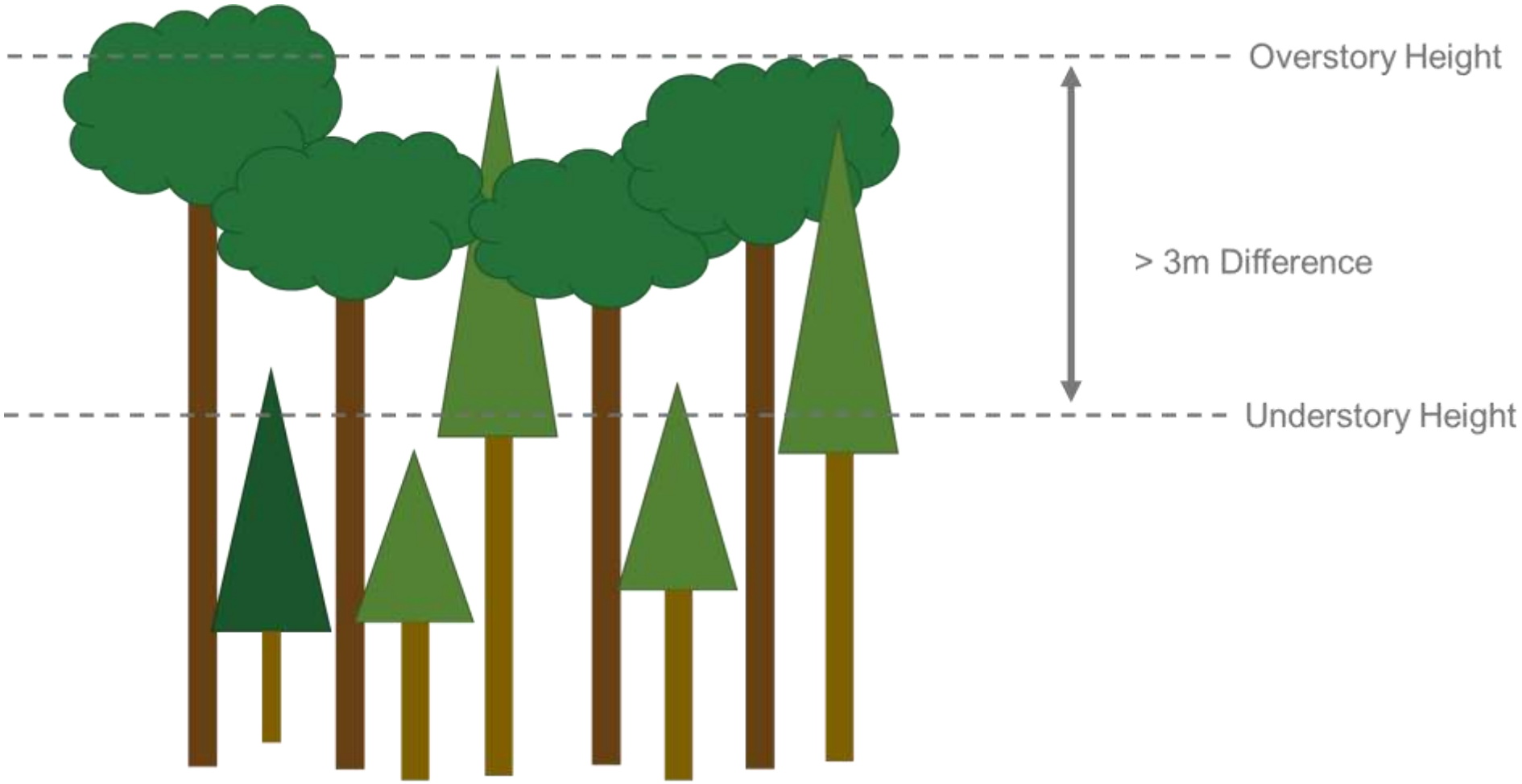
- Multi Layer stands
- Site Index –Height – Age
- Polygon Delineation
- *Categorical Attributes*
- *Human Judgement*



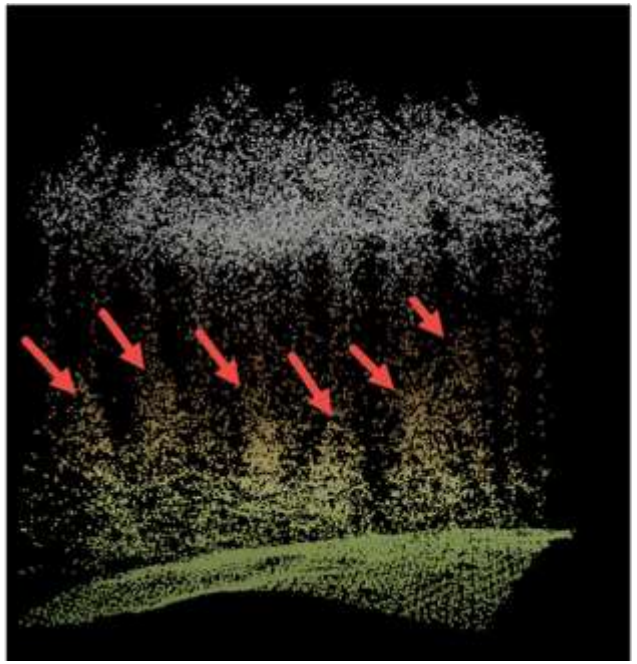
Determining Multi-Layer Stands

FORSITE
Forest Management Specialists

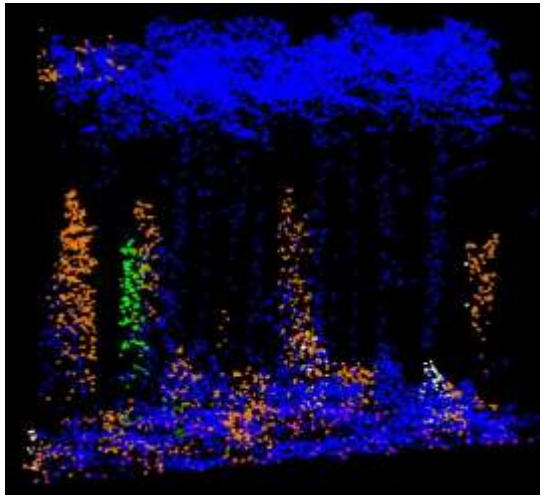
Conceptually Simple but Difficult to Achieve Systematically

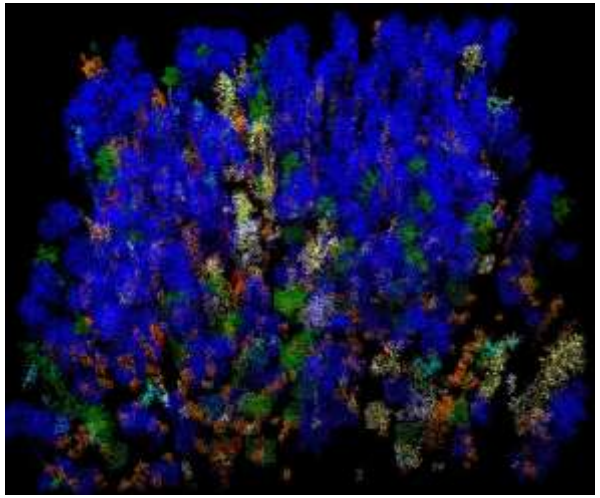


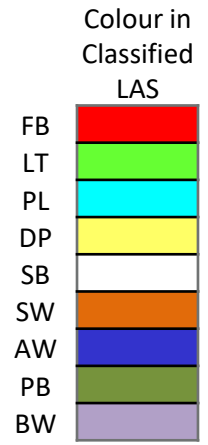
Segmentation in Understory



New segmentation algorithm detects presence of sub-canopy trees (but not all).



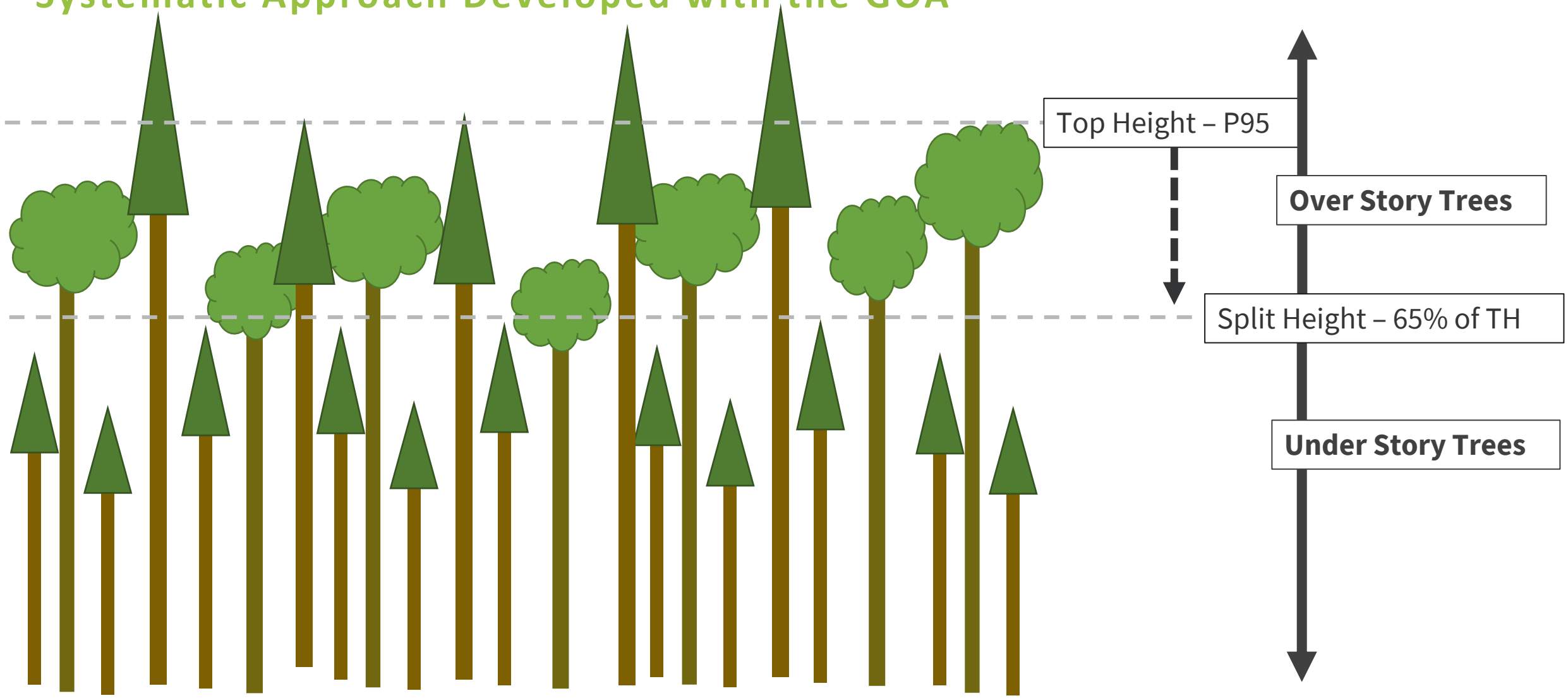




Separating the Over and Under Story Trees

FORSITE
Forest Management Specialists

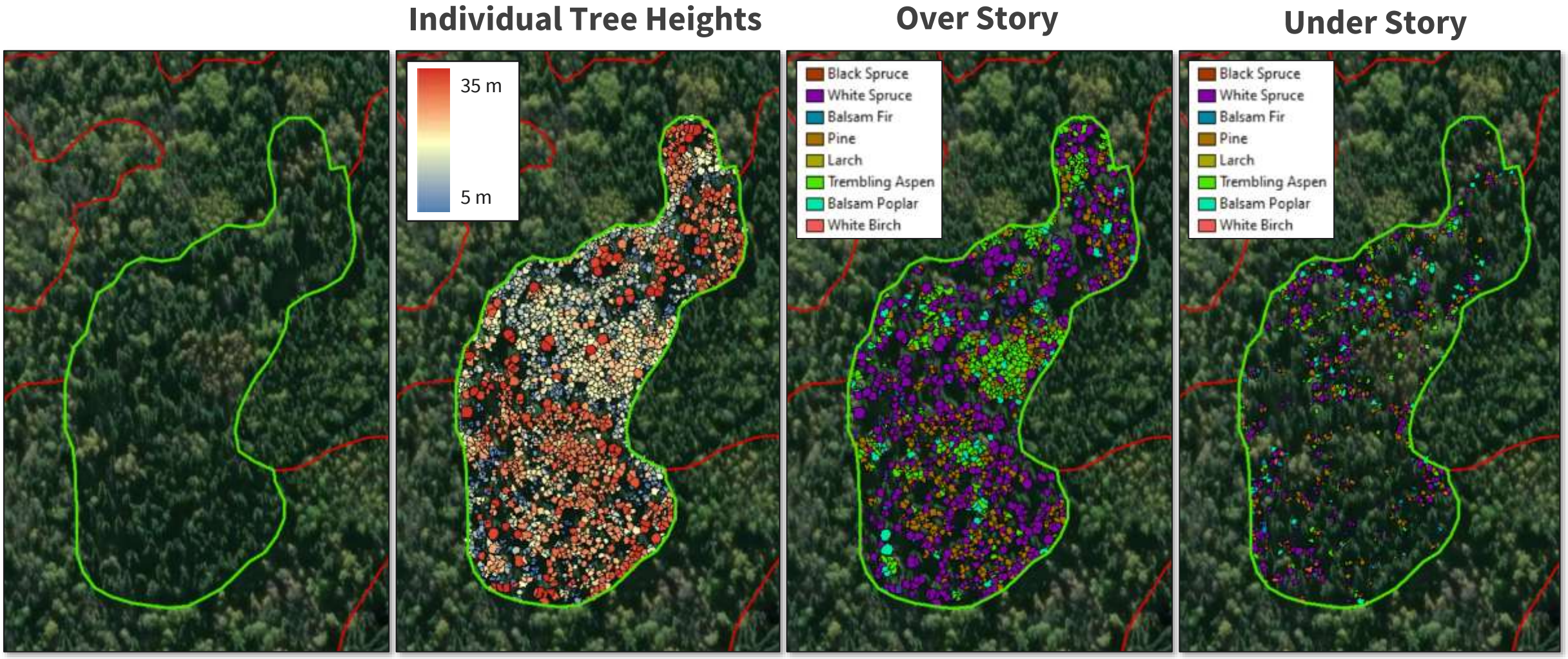
Systematic Approach Developed with the GOA



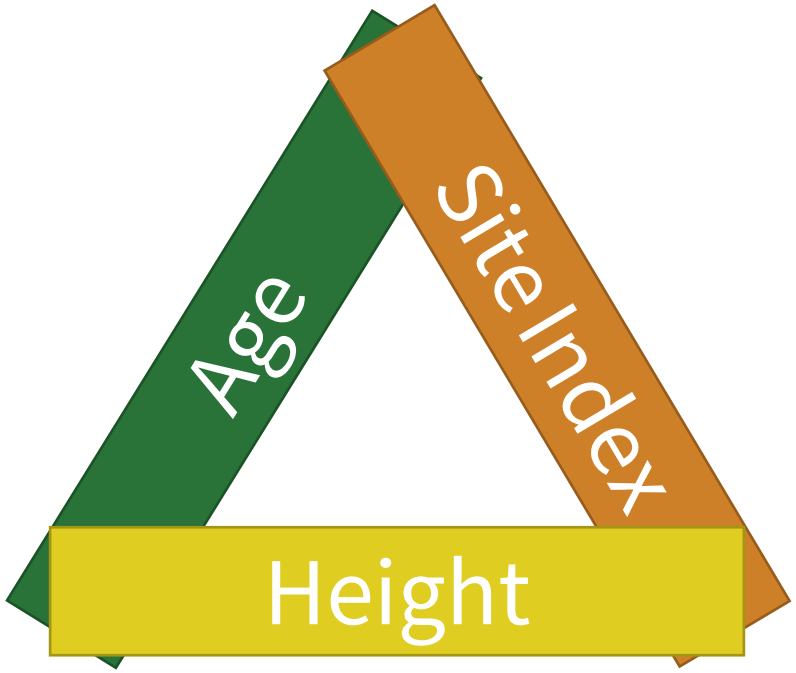
Attributing Polygons

FORSITE
Forest Management Specialists

Based on Over/Under Story Trees

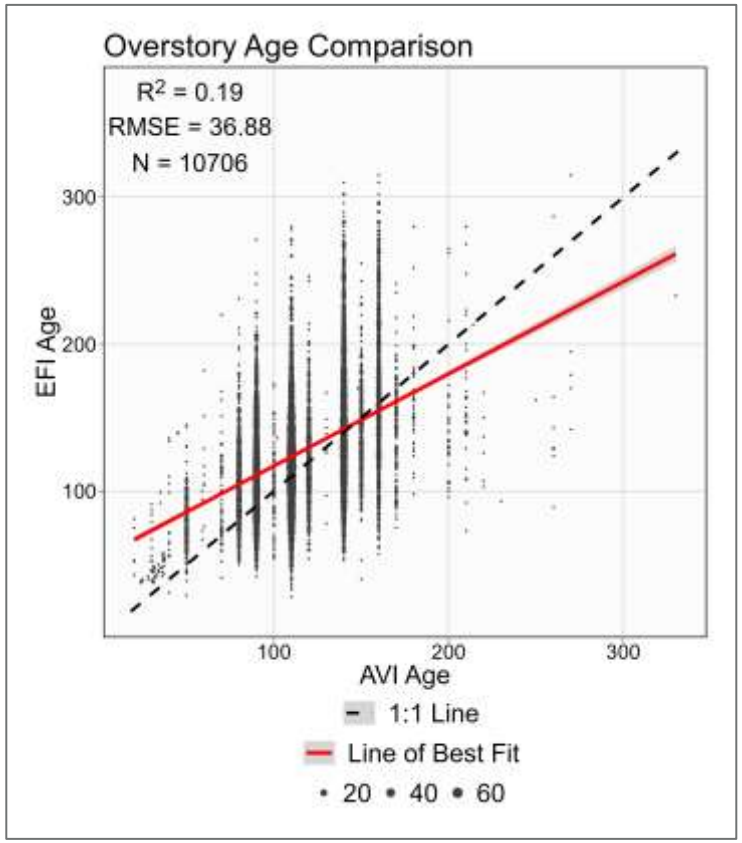


Age-Site Index-Height

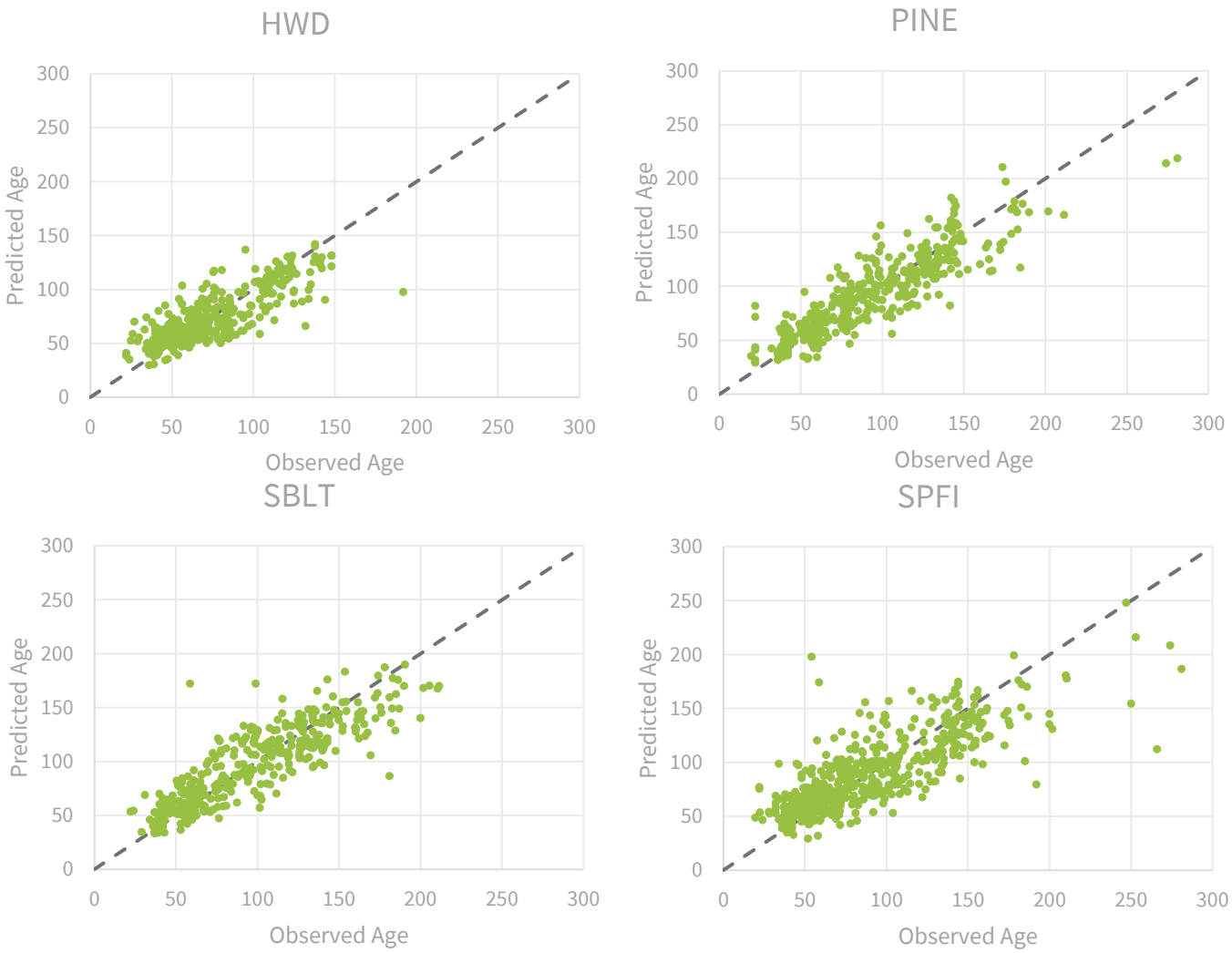


Attempt 1: Predict Site Index

Timber Productivity Rating Category		Prediction (Through Site Index)			Total (Row)	% Correct (Row)
		G	M	F		
Reference (Interp)	G	**5**	720	441	1,166	0%
	M	132	**10,554**	10,242	20,928	50%
	F	117	16,688	**18,900**	35,705	53%
Total (Column)		**254**	**27,962**	**29,583**	**57,799**	
% Correct (Column)		2%	38%	64%	**Overall Match = 51%**	
% Average Correct		**1%**	**44%**	**58%**		



Attempt 2: Predict Age



- In progress…seems promising
- Use Lidar metrics and an Elastic Net regression method

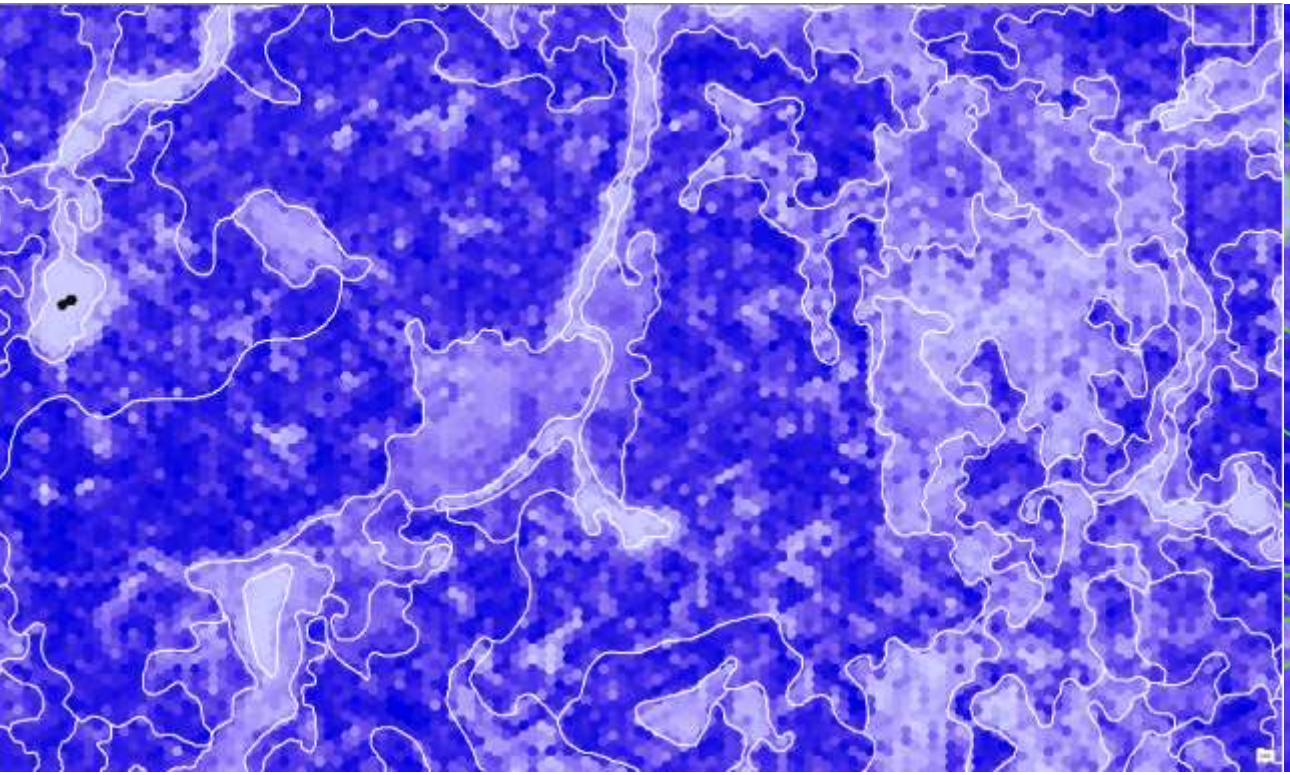
Auto Delineation

Photo Interpreter

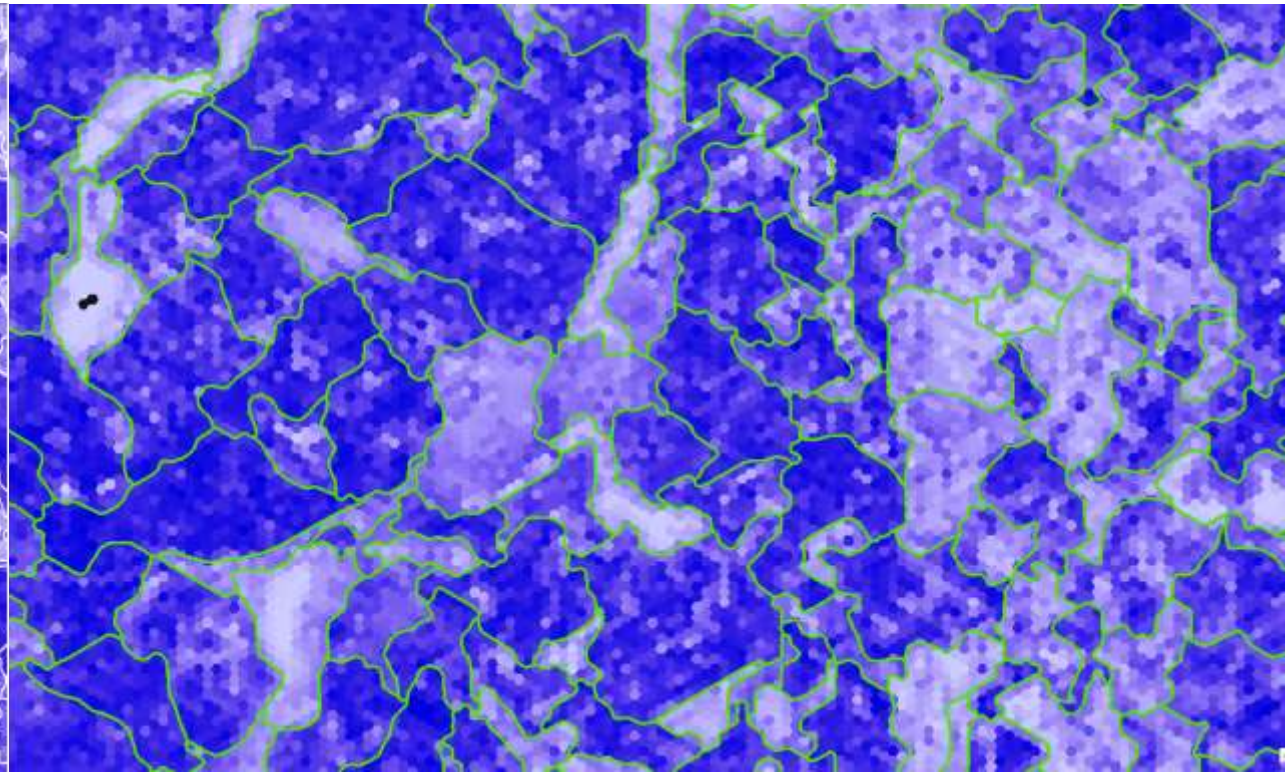
Computer Generated

Auto Delineation

Photo Interpreter

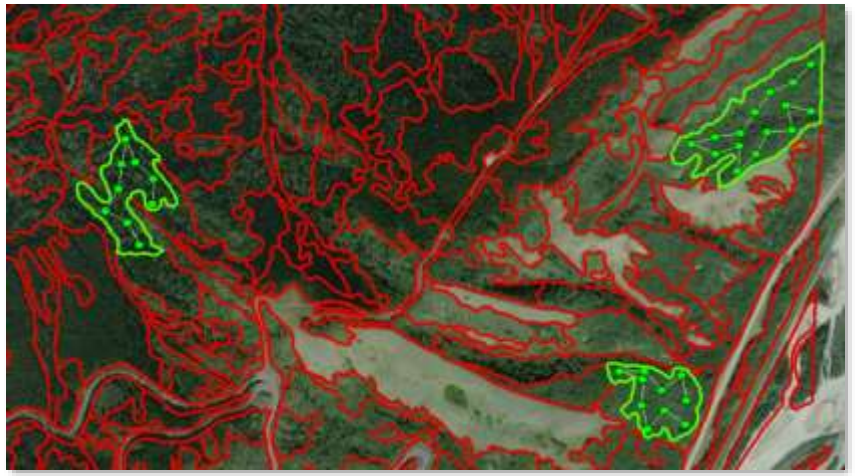


Computer Generated



Validation

- Macro-Level: Compare results on a stand-by-stand level across one of the sample areas
- Micro-Level: Stand-based validation
  - Selected 32 stands from the latest AVI layer (2019)
    - Completed a field check with pre-determined survey points to capture an average of the stand
    - Thorough secondary photo-interpretation



Individual Stand Comparison

FORSITE
Forest Management Specialists

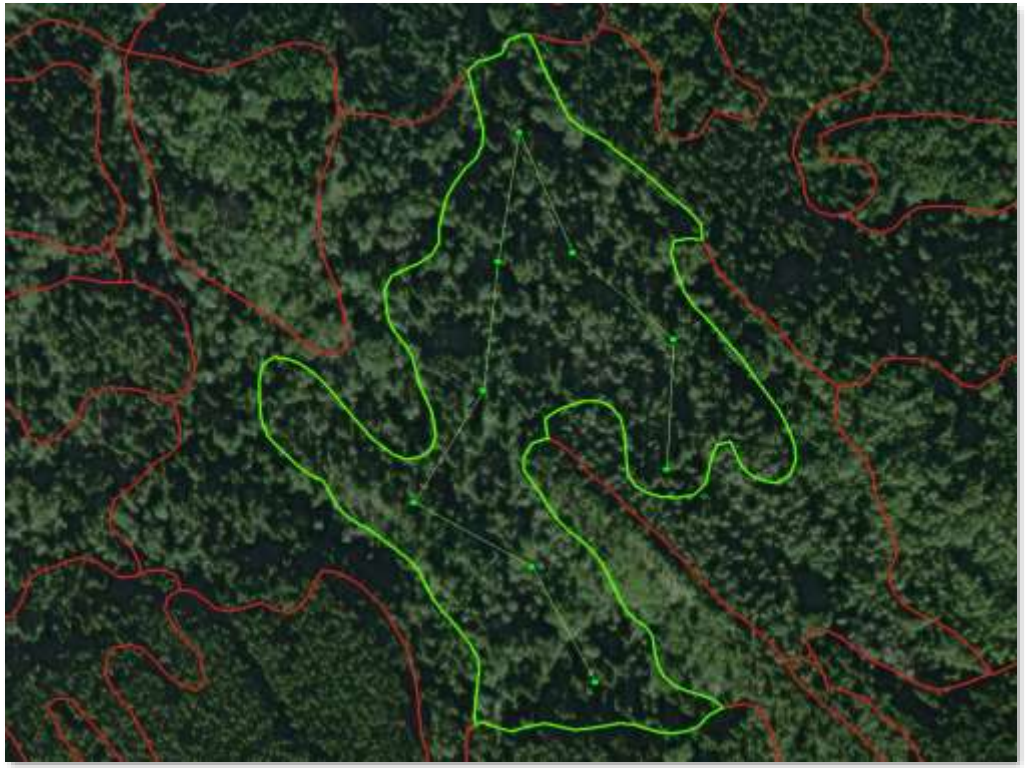
Generally Excellent Match

Sample Stand No	Source	Age	Moisture	TPR	HEIGHT	DENSITY	SP1	SP1_PER	SP2	SP2_PER	SP3	SP3_PER	SP4	SP4_PER	SP5	SP5_PER
107	Field Plot	140	w	M	26	C	Sw	10								
107	AVI	140	m	M	25	C	Sw	8	Pl	2						
107	Forsite	140	m	M	25	B	Sw	9	Pl	1						
107	Sr. Interp	140	m	M	26	B	Sw	9	Pl	1						

Individual Stand Comparison

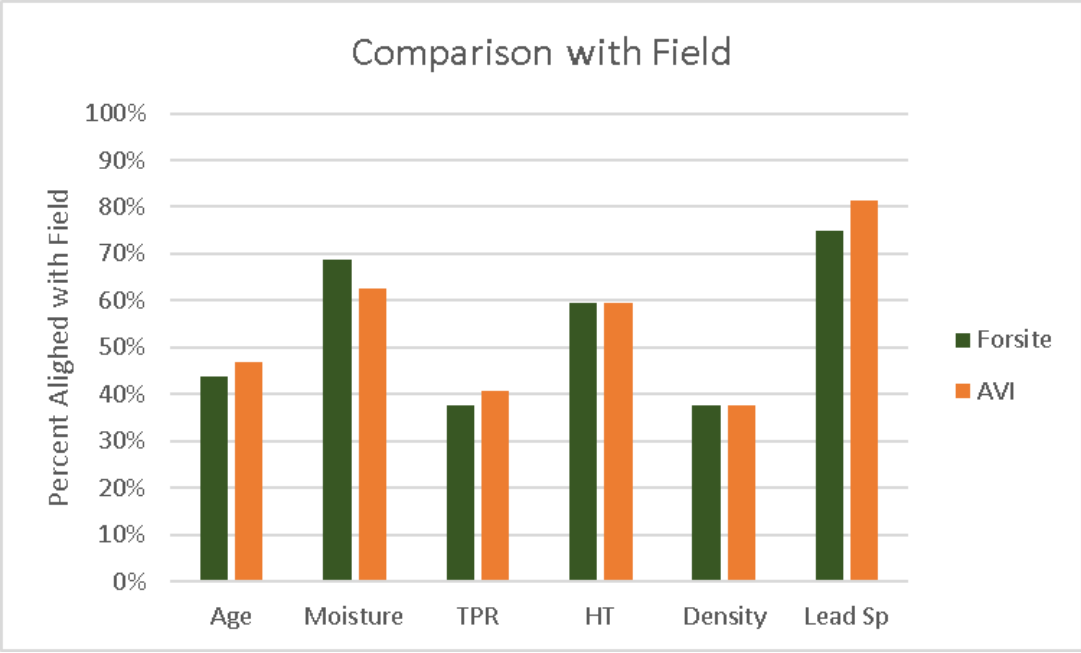
Difference in Over/Under-Story Height Split

Sample Stand No	Source	Age	Moisture	TPR	HEIGHT	DENSITY	SP1	SP1_PER	SP2	SP2_PER	SP3	SP3_PER	SP4	SP4_PER	SP5	SP5_PER
109	Field Plot	0	m	G	15	C	Sw	8	Pb	2						
109	AVI	90	m	M	21	A	Sw	7	Pb	3						
109	Forsite	80	m	M	17	D	Sw	4	Pl	3	Pb	2	Aw	1		
109	Sr. Interpreter	90	m	M	21	A	Sw	7	Pb	3						

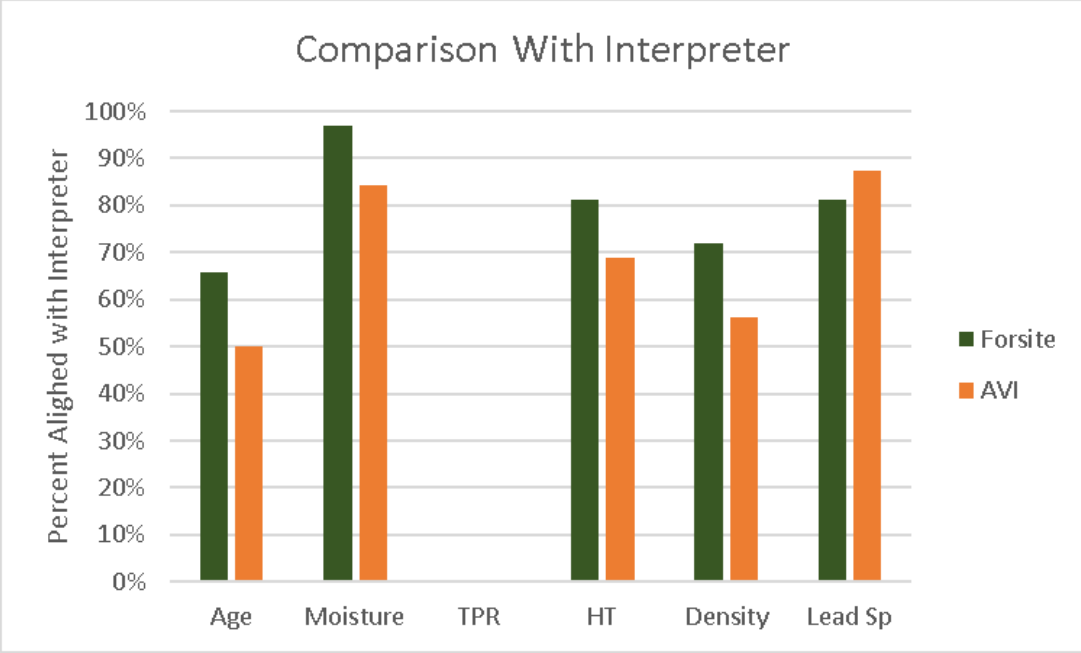


Results - Overstory

Compare to Field Plots

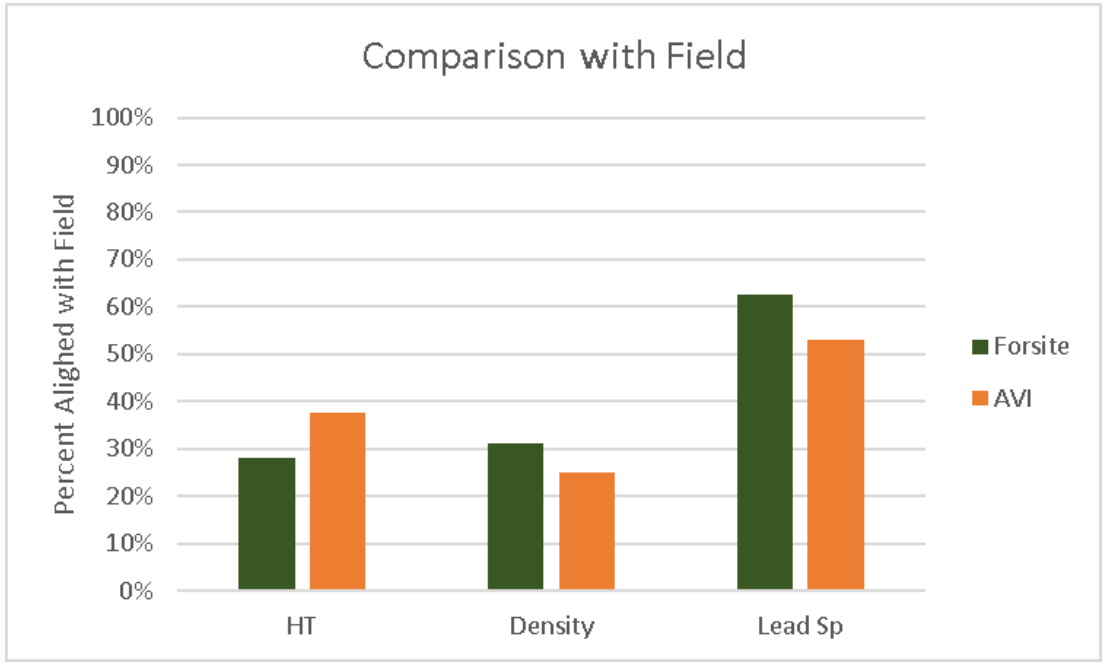


Compared to Sr. Interpreter

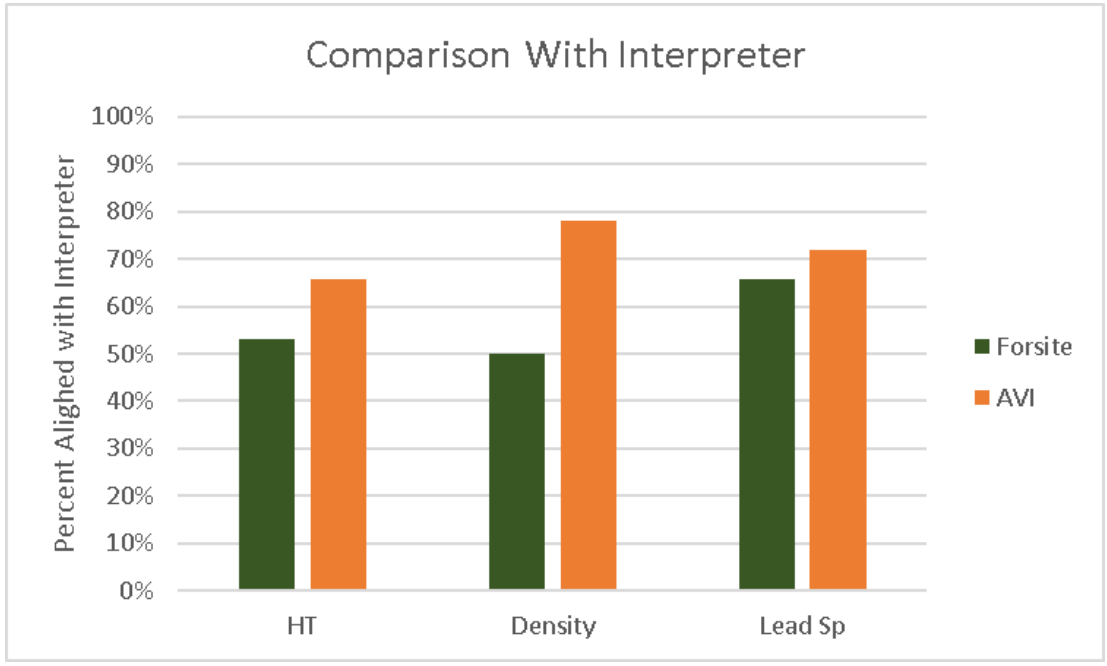


Results - Understory

Compare to Field Plots



Compared to Sr. Interpreter



FORSITE

Summarize Results and Challenges

- Matching AVI layers is difficult in a data driven environment
- Best to predict age directly, and calculate site index
- Polygons are smaller, do not look like human drawn polygons, but are more homogenous
- Core attributes align well in the overstory, and conifer presence/absence in understory is successful

Were We Successful?

- Short Answer: No
  - Wont pass current GoA AVI Standards audit
  - We could pass a standard if it were designed for a data approach
  - Really sensitive to the layer call & full details on the understory
  - We can create polygons, but they don’t look like human drawn polygons
- But There are Advantages and Disadvantages to Data Driven AVI.

Time Frames & Budget

Advantage

- Produced in a much shorter timeframe
- Most time restrictive element is the plots
- Millions of hectares can be done in 6-10 months

Disadvantage

- Less efficiencies on small landbases

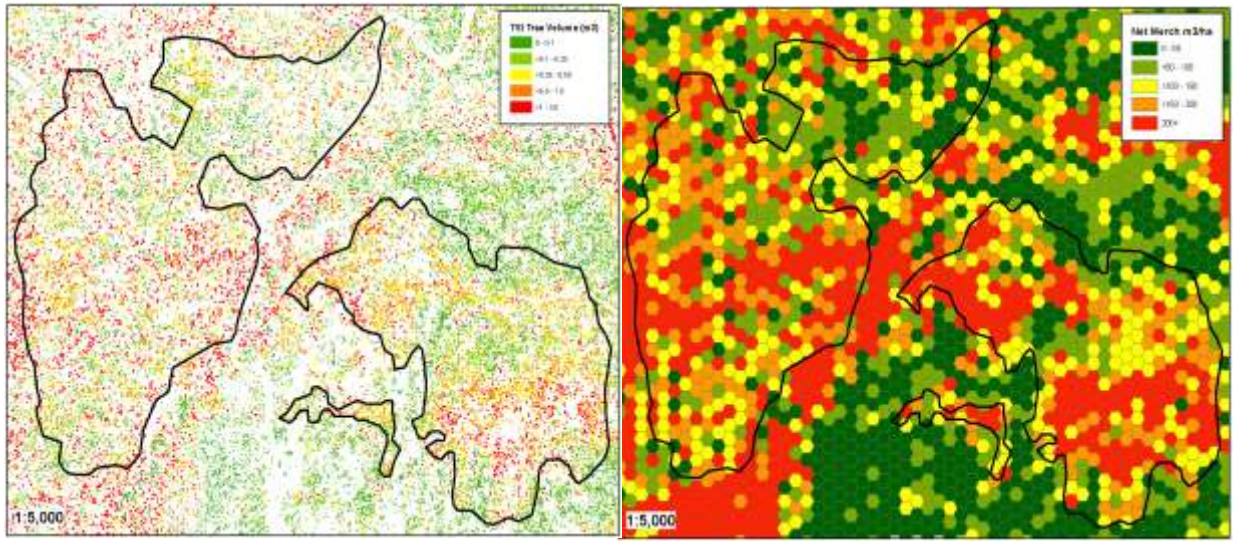
Products/Attributes

Advantage

- ITI and EFI also delivered
- Less subjective attribution
- Plot driven corrections in the hexagon EFI
- Volume/BA/Stems information created

Disadvantage

- Reduced accuracy on understory layer relative to AVI



Consistency

Advantage

- More consistent attribution
- Eliminates potential Data Entry Errors
- Will allow users to compensate for any bias over time

Disadvantage

- Less able to address unique or special conditions where human judgement is necessary

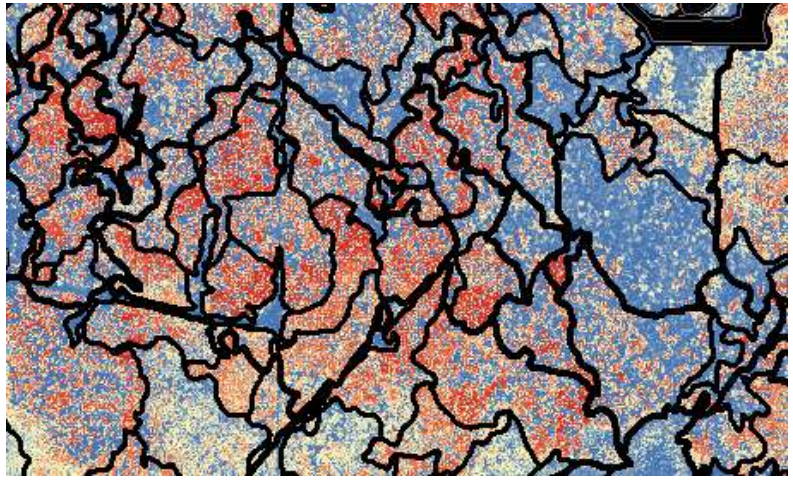
Polygon Homogeneity

Advantage

- Smaller polygons can be created for no additional cost
- These smaller polygons are more homogeneous
- Better growth and yield estimates due to less within polygon variability
- Population level growing stock check with volume estimates

Disadvantage

- Do not always capture landforms as well as human delineated polygons
- Does not look like traditional AVI polygons



Future Research

1. Improve understory identification
2. Define Stand Types across the landbase prior—single story, two story or complex. (Woods and Penner Petawawa research forest – CWFC 20023 presentation)
3. Continue adapting the age and Site Index methodology
4. Continue refining polygons

FORSITE
Forest Management Specialists

Kat Gunion RPF

Sr. Forest Analyst &
Biometrics Team Lead

kgunion@forsite.ca

Cam Brown RPF

Manager – Resource Management &
Technology Group

cbrown@forsite.ca

Julianno Sambatti

Sr. Data Scientist

jsambatti@forsite.ca