University of Idaho
College of Natural Resources

Matching Many Lidar Tools With Many Forest Monitoring Objectives

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CONSIDERATIONS

Questions that we are going to talk about

- Your objectives matter! Define them
- The LiDAR data you need are driven by your objectives
- What inventory design will you use?
- When do you need the new inventory?
- What tools do you plan to use?
- Resources, do you have the technical skills AND the time?
- Don’t know / Can’t decide? Maybe you should buy your trees…

DEFINING YOUR OBJECTIVES

Some things to consider

- Do you simply want to replace traditional cruises?
- Is net volume your only measure of success?
- Are you willing to change what you are asking out of your inventory?
- Pick an inventory design
  - Individual Trees (We will use this for discussion)
  - Area Based Imputation
  - Mixed Model

WHAT LIDAR DATA DO YOU NEED

It’s more than just LAS files

- How big is your AOI
- When do you need the data
- Platform
- Pulse Density
- Return Density
- Segmentation / Imputation
- Training
- Validation

WHEN DO YOU NEED THE INVENTORY

Size & Timing considerations

When	Likely Outcome
• Yesterday?	Sorry you are out of luck
• 1 Week	< 500 ac, no validation, no custom training
• 1 Month	< 5,000 ac, little validation, little training
• 1 Year +	Many options

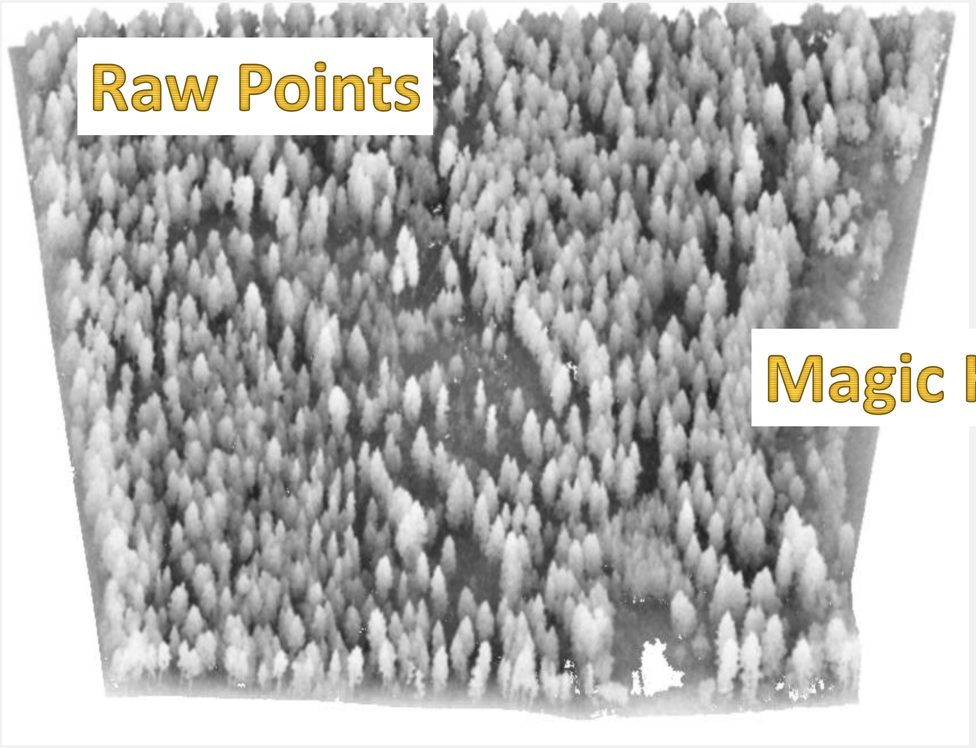
EXAMPLE INVENTORY WORKFLOW

Select AOI – Pinestia (UIEF)

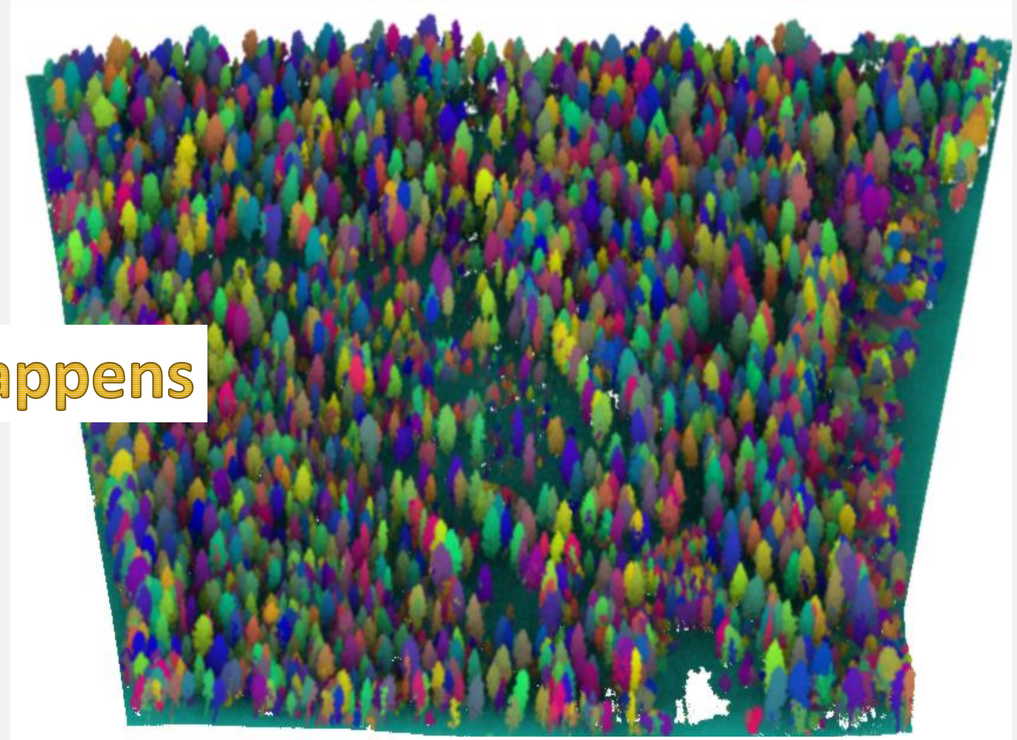
- 1 mile N of Princeton, ID
- 46 acres
- 175 stems/ac

LIDAR EXAMPLE

Raw data to Segmented Objects



Magic Happens



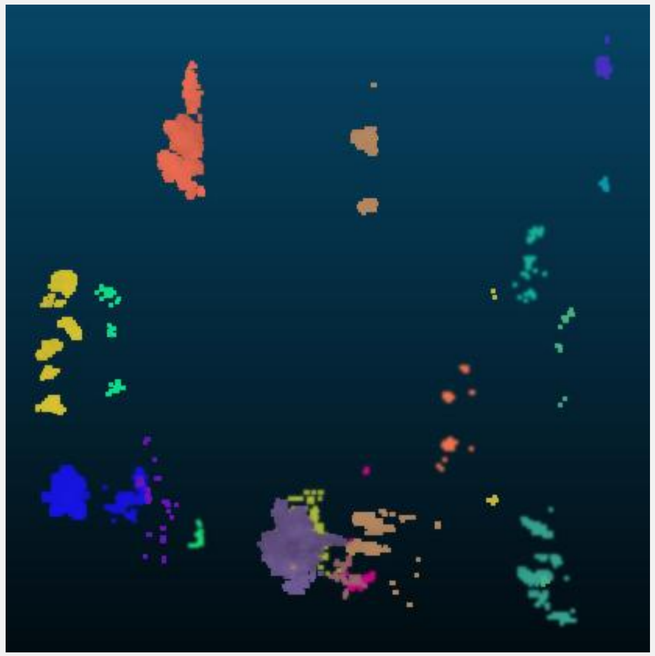
Objects, Not Trees

LIDAR EXAMPLE

Segmented objects aren’t always trees

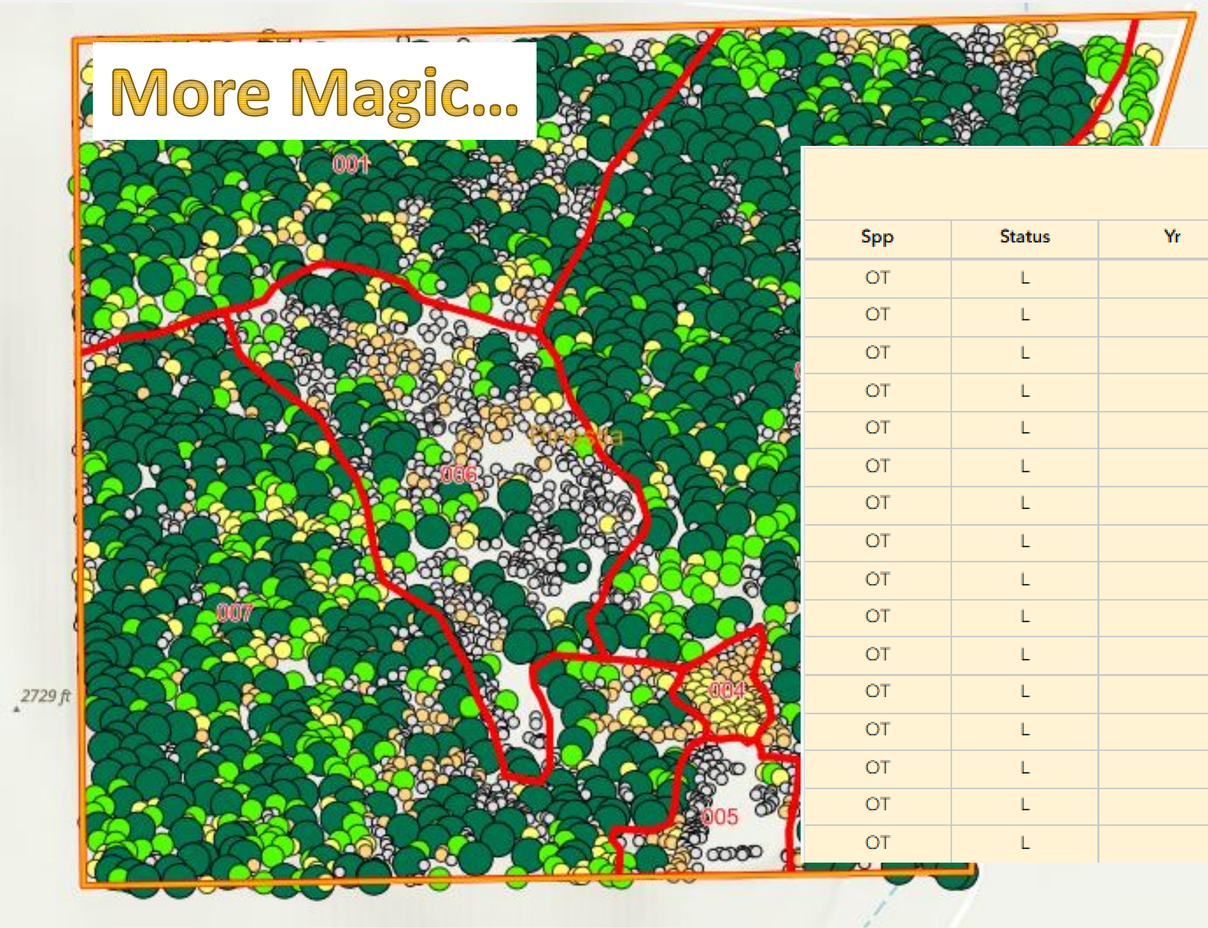
These are Trees!

These are Not!



LIDAR EXAMPLE

Segmented Objects to Trees



Finally - Trees

Trees

Spp	Status	Yr	Ht	DBH	Count	Points	Width
OT	L		127		1	120,030	13
OT	L		124		1	66,251	12
OT	L		124		1	118,872	11
OT	L		124		1	174,191	11
OT	L		124		1	94,364	247
OT	L		124		1	95,264	10
OT	L		124		1	82,880	11
OT	L		121		1	148,781	16
OT	L		121		1	61,823	8
OT	L		121		1	24,792	7
OT	L		121		1	37,513	199
OT	L		121		1	24,636	7
OT	L		121		1	44,030	8
OT	L		121		1	78,704	11
OT	L		121		1	119,892	14
OT	L		121		1	47,972	8

LIDAR PLATFORMS

Ground based

Terrestrial LiDAR

(TLS)

SLAM LiDAR

(MLS)

- Shorter mission planning
- Slow collection
- Very high resolution
  30k++ returns m2
- Geolocation may need post-processing
- Below canopy, may not capture tops
- Must walk “near” all trees
- AOI size?
  1 - 1,000 Ac?

LIDAR PLATFORMS

UAV

- Shorter mission planning
- High resolution
- Highly mobile
- 100 – 300 Returns m2
- Geolocated
- Above canopy*
- Med canopy penetration
- Larger AOI’s
- AOI size?
  1 - 10,000 Ac?

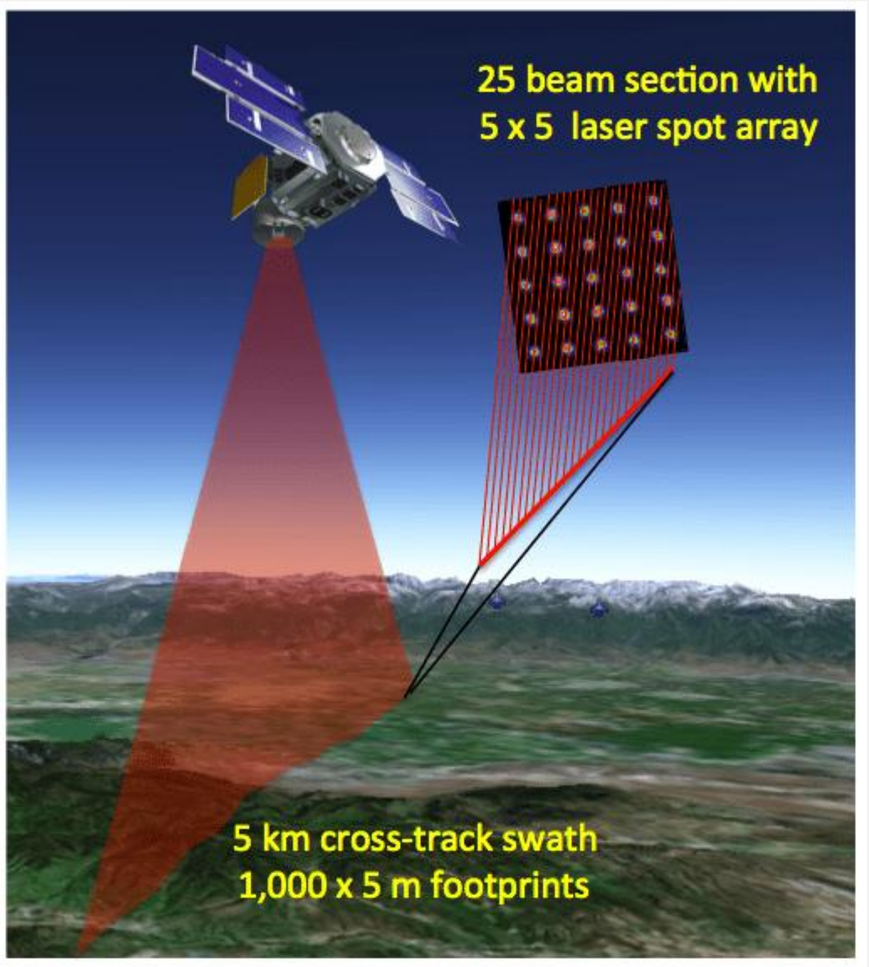
LIDAR PLATFORMS

Airborne (ALS)

- Longer mission planning
- High mobilization cost
- Med – High resolution
- Highly mobile
- 15 – 500 returns m2
- Geolocated
- Above canopy
- Weak canopy penetration
- AOI size? 50,000+ Ac
- $50,000+/- mobilization

LIDAR PLATFORMS

Spaceborne



- No mission planning*
- No mobilization cost*
- Low resolution
- < 15 returns m2*
- Temporal limits
- Geolocated
- Above canopy
- Very-weak canopy penetration
- AOI size*

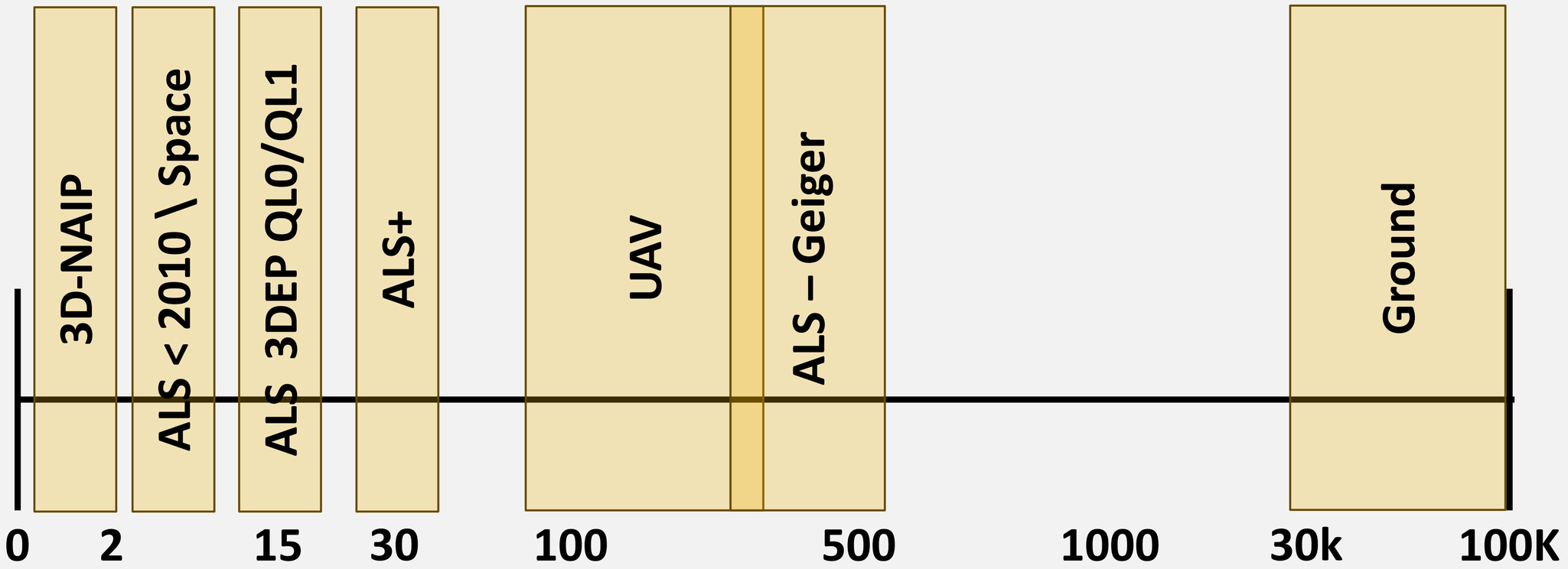
ESTABLISHING ALTERNATIVES

What are your options

1. How much are you willing to spend?
2. What are your timelines
3. What level of detail are you willing to accept

LIDAR DENSITIES

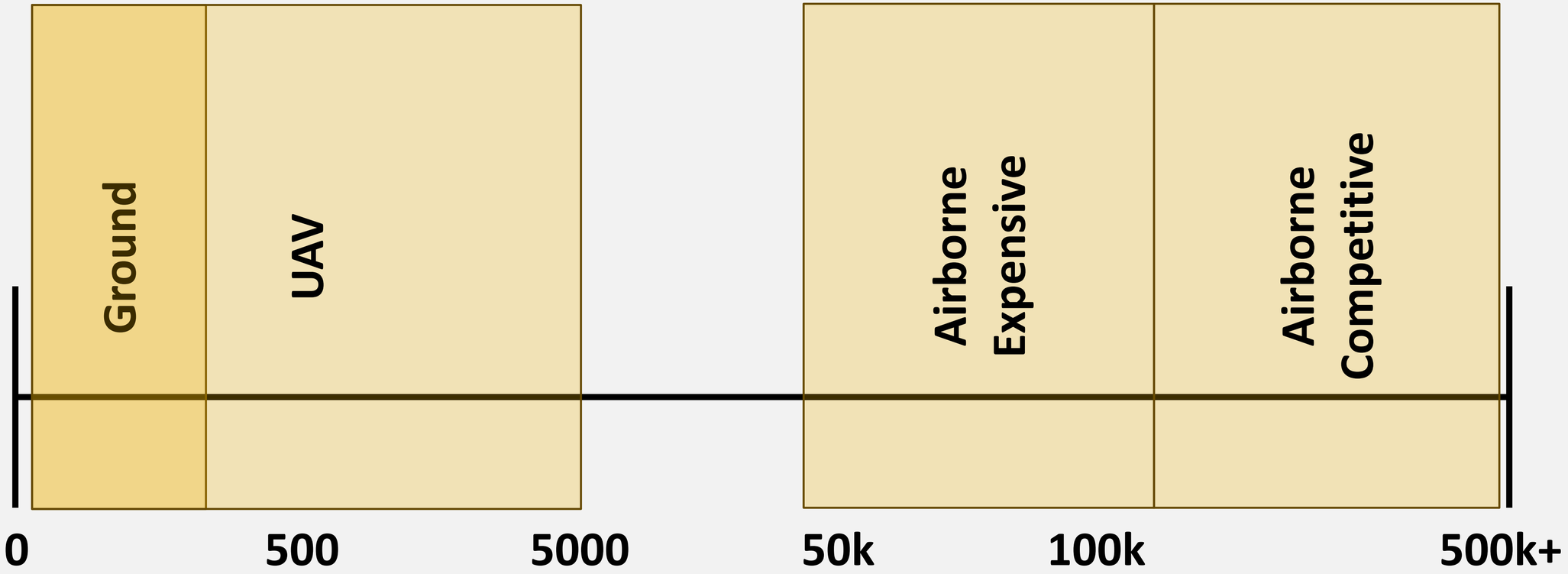
Typical data densities by platform/spec



TASKED COLLECTION REALITIES

AOI Size Really Matters

~$50k Mobilization Cost



Effect Of AOI Size (Acres) On Platform Choice

IMPACT OF SIZE ON COST

How much will you have to spend

- If you choose to do this yourself there are lots of details to work out
  - Costs: LiDAR acquisition is a high up-front cost
  - Size: AOI > 50k – Tasked collection is feasible
    5k to 50k – Tasked collection is infeasible
    You can use public data
    UAV acquisition possible but $$$
    1 to 5k – UAV very feasible and $-$$
    1 to 100 – Ground collection is feasible but $$$

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IMPACT ON RESOURCES

Do you have the technical skills and the time

- There are MANY steps required to collect a point cloud and then clean, segment, QC, and finally produce trees.
- All these steps have many possible routes and choices
- Segmentation can be challenging
    - There are MANY segmentation models available
    - Some some have significant data quality requirements
    - Segmenting intermediate or suppressed trees requires high density LiDAR with good canopy penetration
    - You will need to find a way to screen segmented objects

TAKE HOME MESSAGES

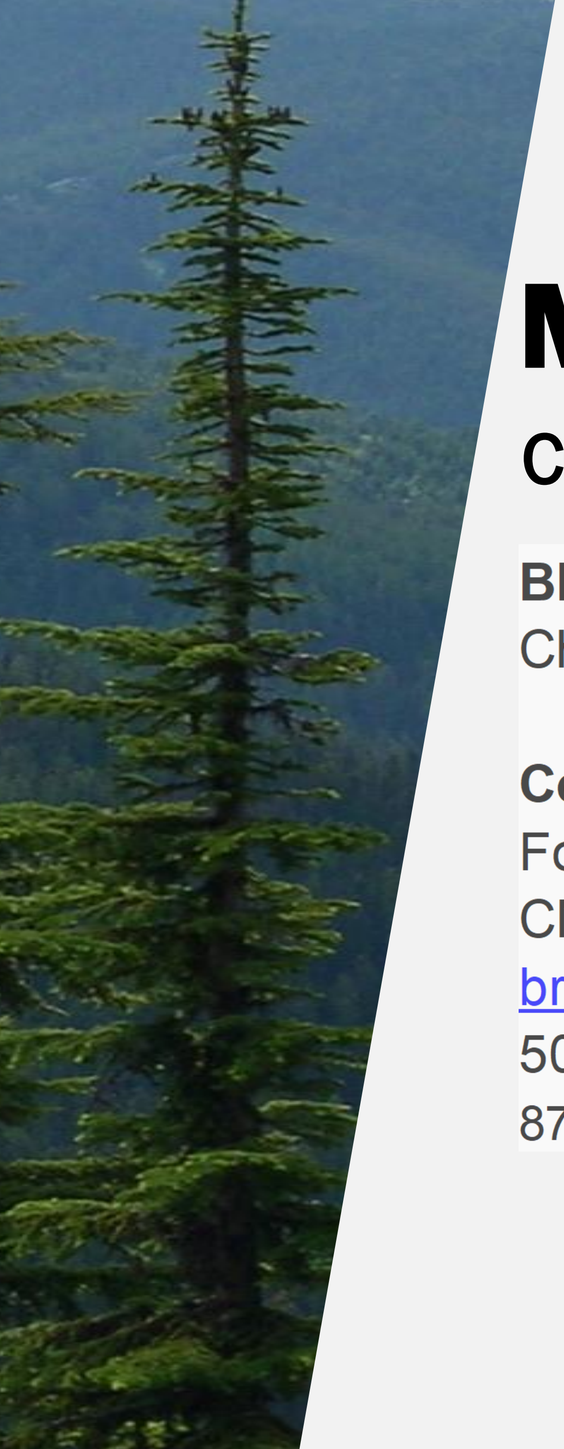
What's important

- Small AOI's have limited choices
- Identify how much you are willing to pay and your timeline for the project and they will define your available choices
- Develop a first approximation to learn how to manage and use your data
- First approximations can be developed cost effectively
- All segmentation models will produce some non-tree objects
- Don't forget you can just buy your trees

WHAT'S UI WORKING ON?

Through our Forest Innovations Affiliates

- Develop batch processing tools that should simplify processing and increase efficiency
- Develop novel approaches that will allow small landowners to access these types of data
- We are developing a series of demonstration tools
    - Data design and engineering
    - Analytical templates
    - Fully functional digital twins



MORE INFORMATION

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