



Perspectives on LiDAR Assisted Inventory

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*A Division of Hancock Timber Resource Group,
A Manulife Asset Management Company*

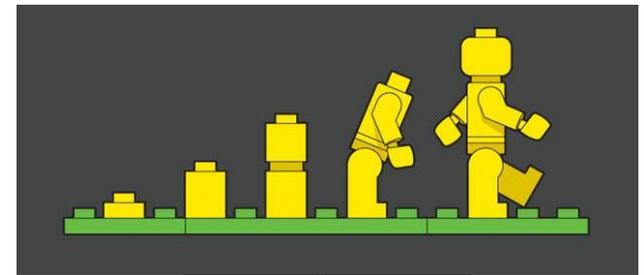
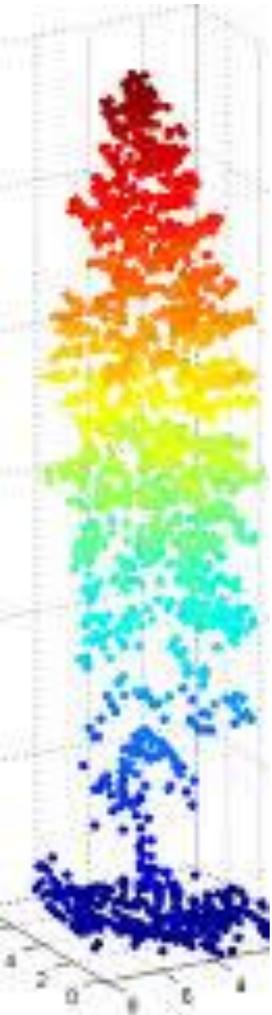
**Bruce Ripley
Strategic Innovation Manager**

17700 SE MI Plain Blvd, Suite 180
Vancouver, WA 98683
360-260-4577
bripley@hnrp.com
htrg.com

Perspectives on LiDAR Assisted Forest Inventory

What will we try to cover?

- **What's LiDAR**
- **What's a Forest Inventory**
 - Where have we been
 - Where are we now
- **Evolution?**
- OR**
- **Revolution?**



What's LiDAR?

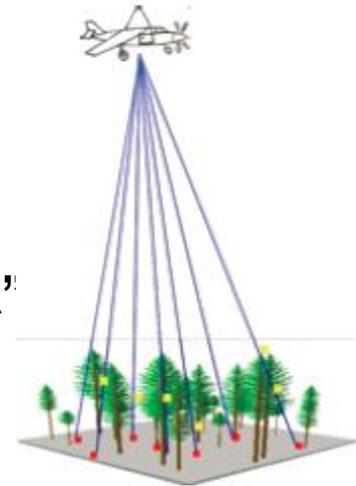
LiDAR – Light Detection And Ranging

Basics:

- Active remote sensing technology based on laser pulses
- A laser pulse is emitted and the reflection recorded
- Returns from each pulse are recorded

Types:

- Pulse based Discrete (What most call “LiDAR”)
- Phase based Full waveform (Developing)
- Photon counting



Modes or Platforms:

Space (SLS)



Plane (ALS)



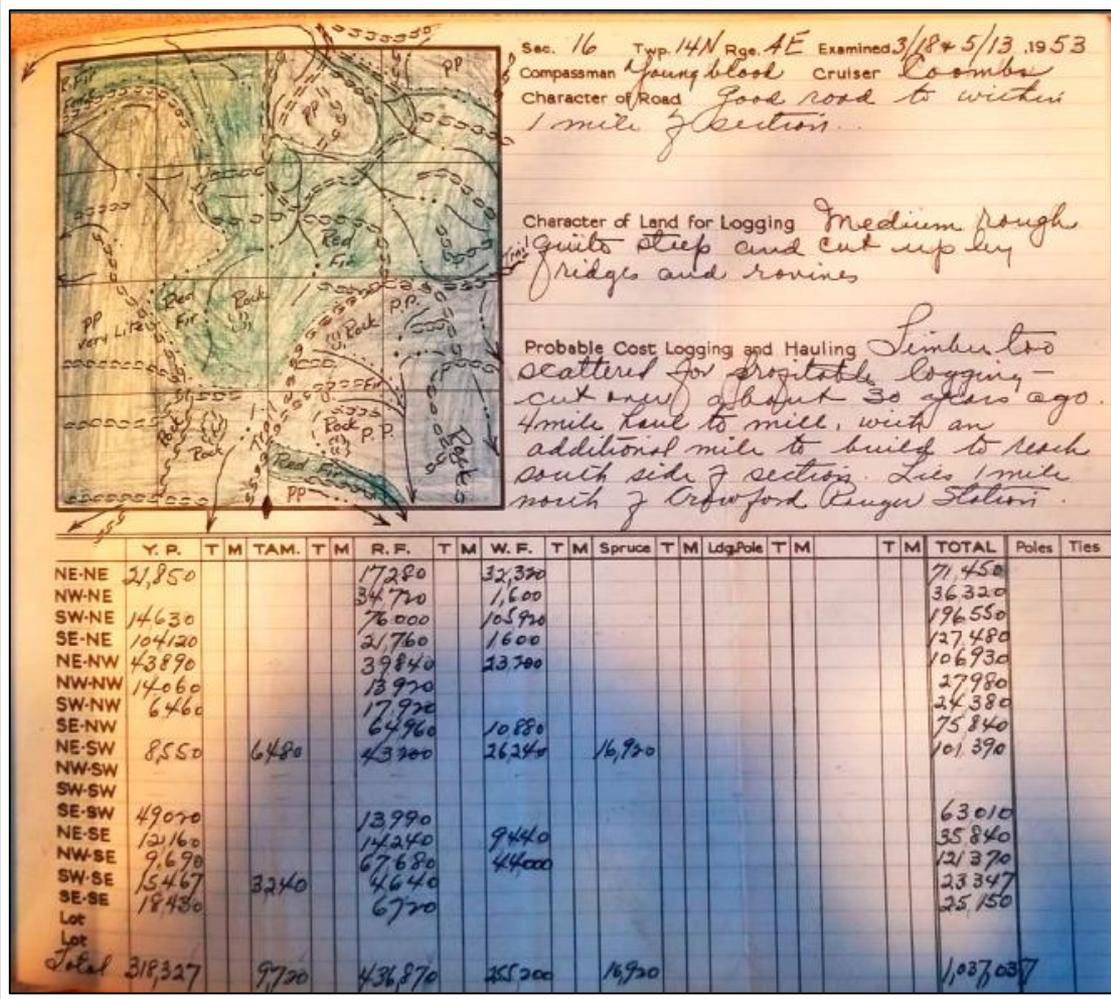
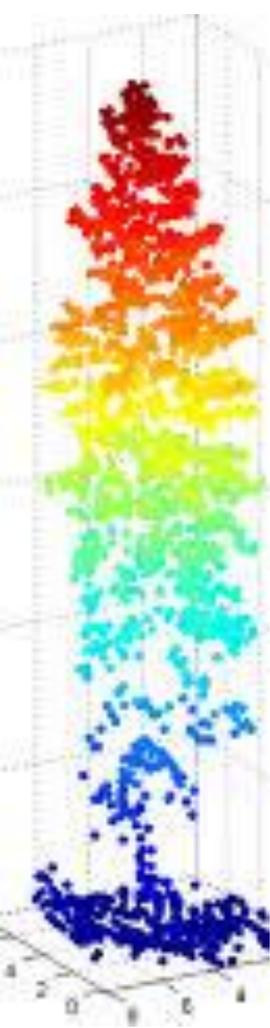
Drone (ULS)



Terrestrial (MLS)



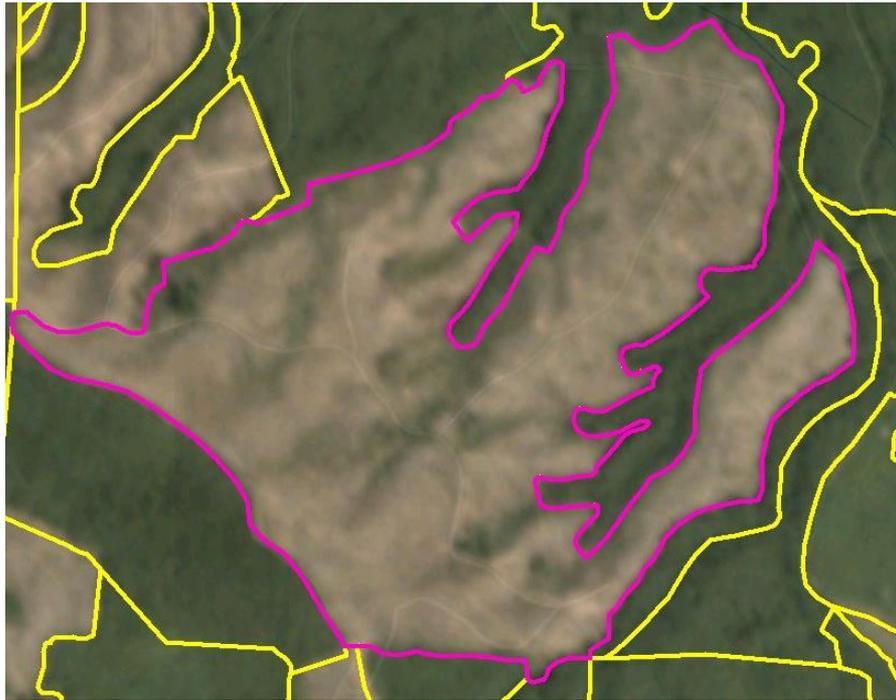
Forest Inventory: Where have we been?



1953 Field Inventory

- It's spatial
- Provides:
 - Volume
 - Species
 - Topography
 - Timber Value
 - Roads
 - Operating Constraints

Forest Inventory: Where are we now?



NetAcres	101.02
StandAge	3
CruiseYear	2017
Species	55
TPAc	115
pTPAc	115
mTPAc	<null>
mQMD	<null>
mHT	<null>
RD	0
SDI	1
BAAc	0
mBAAc	<null>
MBFAc	0
TotalMBF	0
BFpc	<null>
GrowthMBFAc	0

Modern Inventory Characteristics

- Digital GIS
- Stand based
- Inventory based on plot sampling
- Field data collected 10 – 20 years
- Some manual interpretation (boundaries)
- Some averaged information (slope, elevation, inventory)

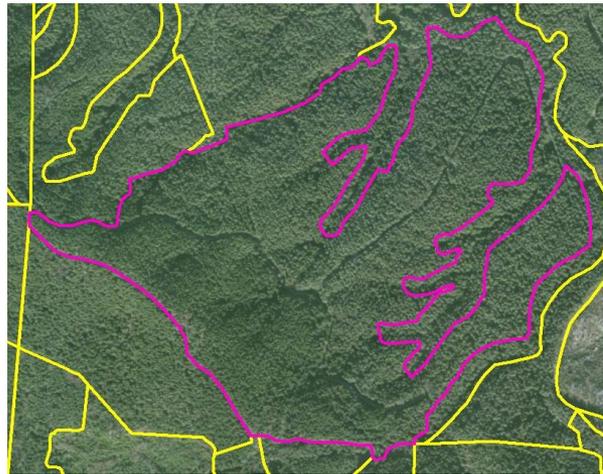
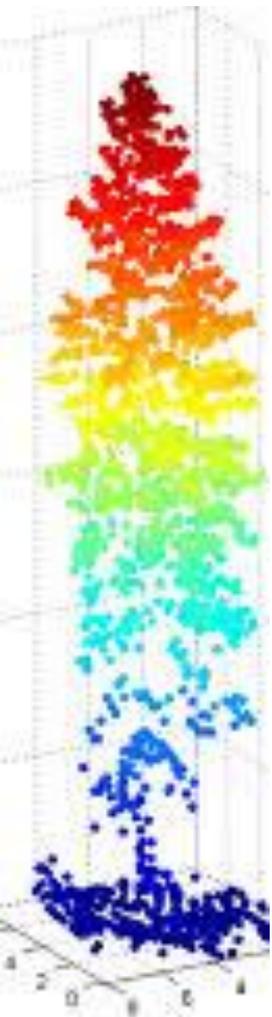
What is LiDAR providing that's new?



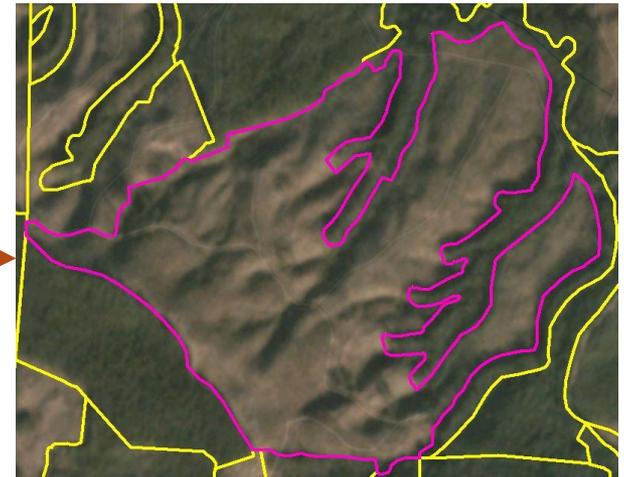
<http://arcg.is/1S9jDD>

- **Extremely high spatial sample density / resolution**
- **Individual tree level data**
- **Vertical structure (forest) detail**
- **Details on other forest level characteristics**

Starting point: What's your time frame?



Harvest

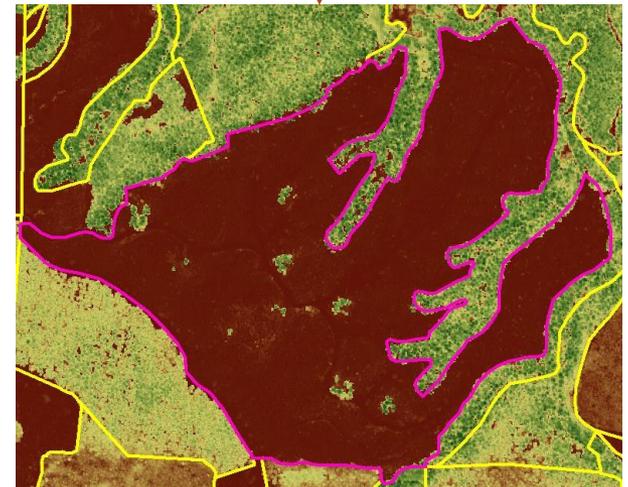


Harvested

Stand

Mature Stand Condition

- LiDAR is collected at a single point in time.
- That point in time will represent a single size/structure only
- Repeated collections will represent a different point in time for any point in space
- Sub-stand information may be practical using LiDAR data



5 Year Old Stand

Revolution: Sub-Stand Features

- Stand polygons have been the basis of inventory and forest inventory systems for decades (or longer)
- Most systems rely on the average metrics provided by current sampling systems.

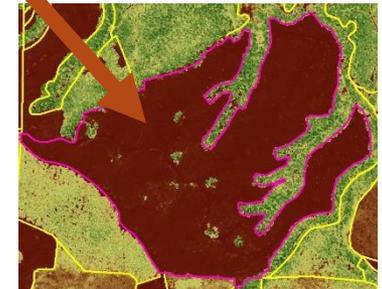


Polygon Based

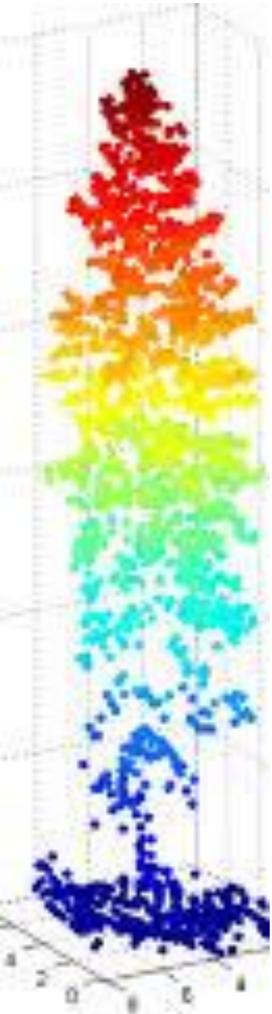
Sub-Stand Level Details

Preserving Spatial Details

- No minimum mapping unit
- Data managed at the raster / sub-raster level
- Data averaged to ANY polygon as desired
- Important characteristics are no longer ignored

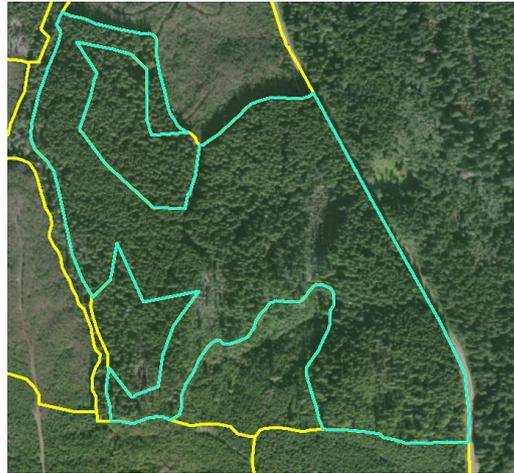


Raster Based

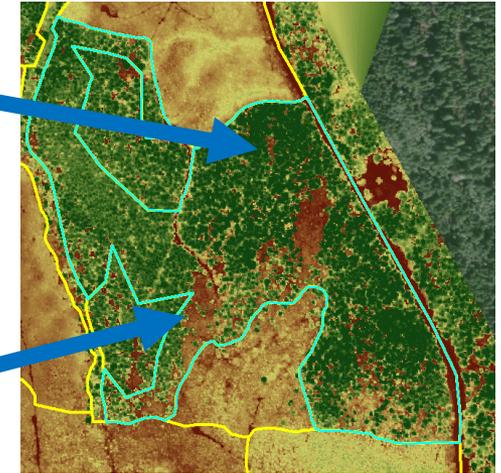


Revolution: Sample vs Census

Sample



Census



30 – 40 m

< 10 m

**Average
to the Polygon**

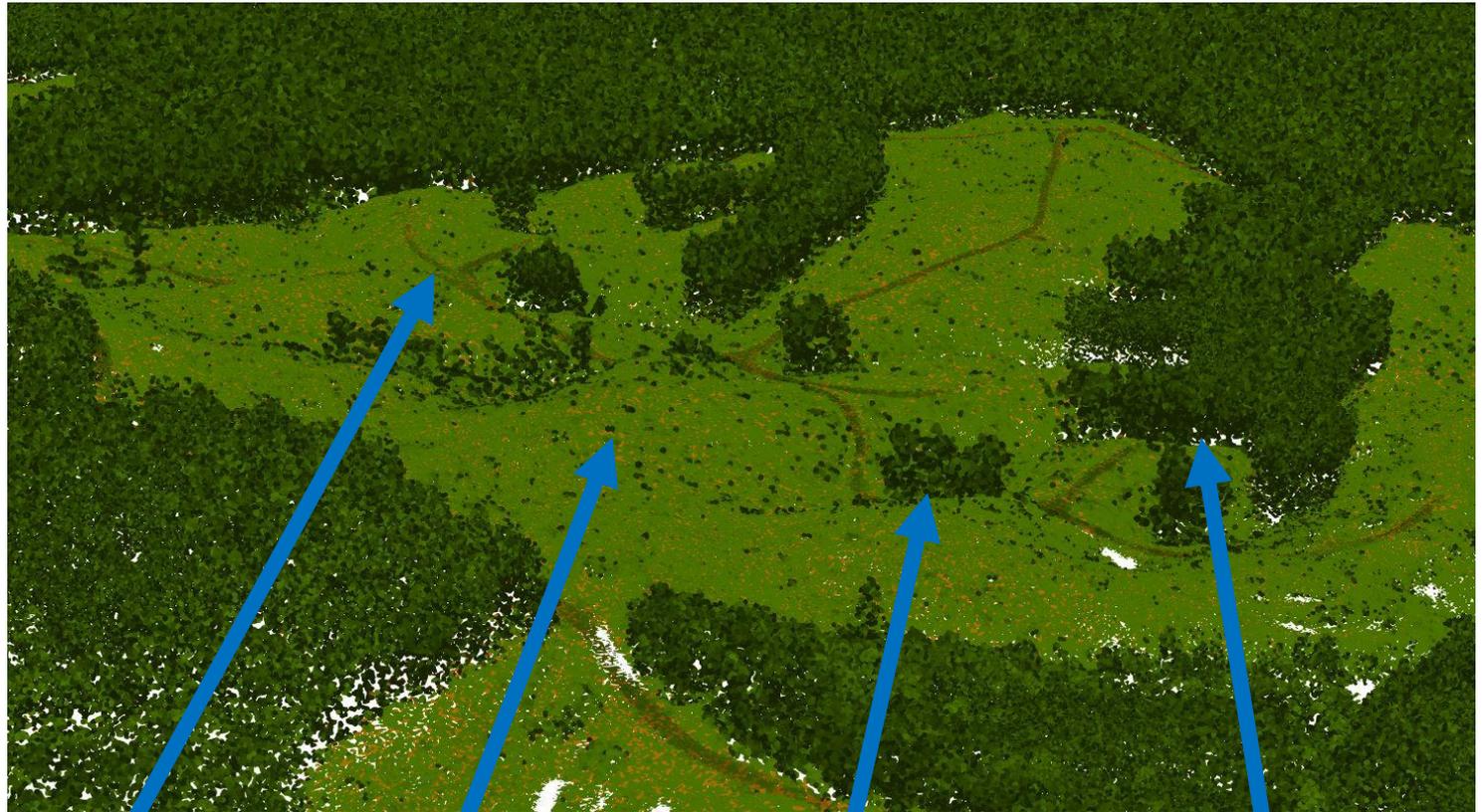
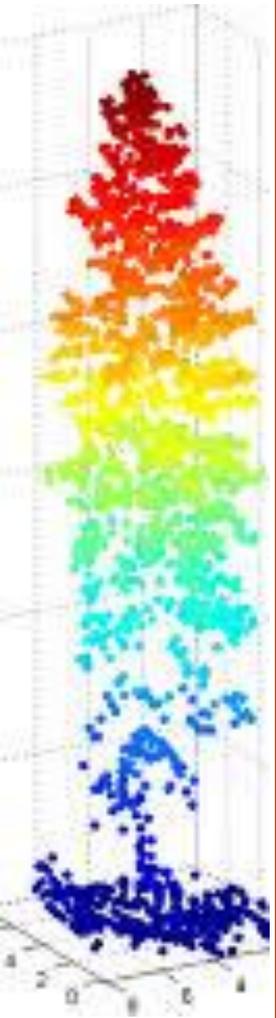
**Much more precise
estimates for totals
and averages.**

Potential For:

- Individual trees
- Tree Height
- Crown Width
- Leaf Area
- Crown Volume
- DBH

NetAcres	0
StandAge	72
CruiseYear	2016
Species	WH
TPAc	111
pTPAc	0
mTPAc	111
mQMD	21.7
mHT	117
RD	61
SDI	384
BAAc	285
mBAAc	285
MBFAc	44.1
TotalMBF	0
BFpc	133
GrowthMBFAc	0.73

Revolution: High precision feature tracking



Non-Forest
Spatial Details
(Roads)

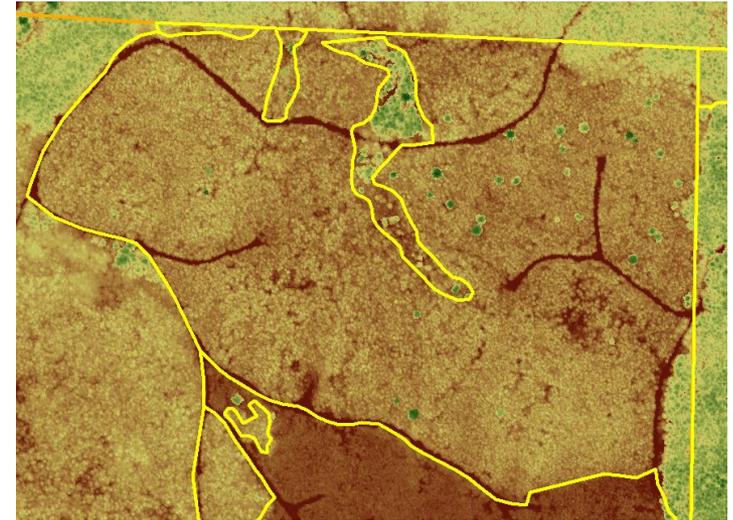
Scattered
Vegetation

Reserve Trees

Riparian zones

Features can be tracked and change measured over time

Revolution: Limits on Precision?



What are the limits on precision?

1. The practical limit on precision it will shrink over time.
2. Currently cell level estimates for forest metrics are common
 - TPA
 - QMD
 - Height
3. Individual tree imputation is coming... sooner than you think!
That means every* tree in your forest.. But what's a tree?
Every - Dominant / Co-Dominant trees will be the initial focus*

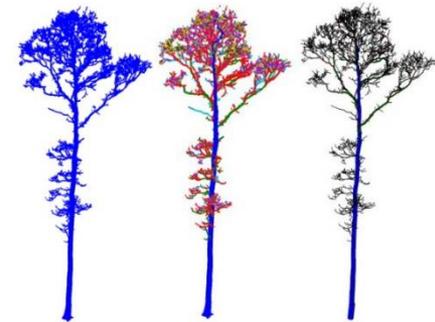
Data / Product Examples

- There are almost no limits on the available products
- LiDAR base products include:

- ✓ DEM (Digital Elevation Model)
- ✓ DSM (Digital Surface Model)
- ✓ CHM (Canopy Height Model)

- Forest Inventory products (Cell based)

- ✓ TPA
- ✓ Tree Crown Cover
- ✓ Veg Cover
- ✓ Height
- ✓ QMD
- ✓ Volume



- Site Productivity? The preverbal unicorn!

<http://arcg.is/1uC445>

Canopy Height Model

The Future? It depends on your vision

What if you don't want to change? You Won't!

Is anybody going to make you change? Probably not

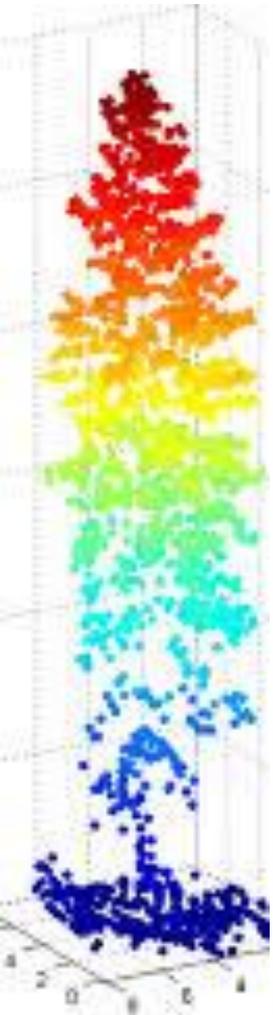
Where's the value? It depends

Isn't it expensive? Maybe

Do I have to do all this in one day? No

- Develop a vision for your information system
- Begin to understand the use of enhanced data
- Start by augmenting your existing system
- Move toward a higher precision system at your pace

Best Suggestion: Start... No one will do it for you!



What did we cover:

- **LiDAR isn't LiDAR, there are differences**
- **Before you collect have a plan for how you want to use it**
- **Assume you will use it for inventory / vegetation assessment**
- **The main difference in LiDAR platforms is sample density**
- **Every platform is not suited for every level of collection**
- **LiDAR measures distance, intensity, and even more**
- **The data is measured at the point level but interpreted at higher and higher levels, such as the tree, the stand and the forest.**

QUESTIONS?