LiDAR and Inventory in Coastal Forests - Challenges and Opportunities

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Outline

• Review ITLP’s experiences since we let LiDAR into our lives
• Review the challenges faced during the various phases
• Review some of the current and future opportunities
• ~ 255,000 ha of Private land
• Operating under authority of the...
  o Private Managed Forest Land Act
  o Water Act
  o Wildlife Act
  o Drinking Water Protection Act
  o Fisheries Act (Federal)
  o Species at Risk Act (Federal)
  o Professional statutes
  o Plus a bunch more
THE EVOLUTION OF LiDAR AT ITLP

Phase 1… the early years

• 2009 – CEO said… “go research this thing called LiDAR” so a few of us were asked to investigate the pros and cons, costs and benefits

• Flew a 6,000 ha pilot project in the China Creek drainage

• Produced and used “basic” LiDAR-derived products

• Used these products to confirm alternate road options, block boundaries, and verify skyline deflection
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Phase 2... we really liked it, let’s do more

- July 2010 to Sept 2011 - Terra Remote acquired and processed LiDAR on approx. 220,000 ha
- Flown with a rotary-wing Bell Jet Ranger, using a proprietary Mk III sensor, data was acquired at 150khz, targeting a nominal point density of 8/m²
- Concurrent with the delivery of DEM and DSM, ITLP produced contours, hillshades, slope and “height” class layers. These were published in ArcMap and actively used by staff and consultants
Phase 3... beyond simple contours, let’s get some LiDAR derived forest attributes

- Olaf Neimann and Diana Parton at Uvic CARMS (Centre for Applied Remote Sensing, Modelling and Simulation) completed classification cleanup, height normalization, gridding and metric extraction

- Using the Buckley Bay area as a pilot, Gord Frazer developed a sample design that would facilitate production of robust prediction models for a wide range of forest inventory attributes
Sampling Design

Source: Gord Frazer, 2011
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Phase 3... LiDAR derived forest attributes continued

- Jeff Sandford established 11.28m radius plots and Contour cruised the 120 full measure plots

- Gord Frazer and Nick Smith took the cruise data and developed correlations between the LiDAR metrics and the field measurements
\[ \ln VOLUME = -0.1 + 2.0 \ln Lh_{0.70} + 0.5 \ln CC_0 \]

Source: Gord Frazer, 2011
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Phase 3... LiDAR derived forest attributes continued

- Results were promising so ITLP decided to expand the field collection to the entire LiDAR acquired area

- Build statistical models to predict forest inventory attributes everywhere LiDAR was acquired
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Phase 3... LiDAR derived forest attributes continued

Other desirable inventory attributes

- Stand height (Lorey’s, arithmetic mean, top)
- Quadratic mean diameter
- Basal area
- Stem density
- Volume (net merchantable, total, gross biological)
- Log product mix (sawlog, gang, chip & saw, pulp)
- Total aboveground biomass/Carbon

- Continue to test and refine these models to increase the confidence of the output values
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Phase 4... what’s up next??? To the bleeding edge and back

• Species identification. ITLP has partnered with Object Raku to explore all combinations and permutations of observed and collected data

• Investigating point cloud segmentation, crown shape, crown depth, elevation, geometry and intensity etc to develop a set of species unique signatures

• Reconcile roads, creeks, block boundaries

• Explore other processes ie Object Raku’s Feature Type Interpreter for road, NP identification
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Phase 4... what’s up next??? To the bleeding edge and back

- Complete terrestrial LiDAR pilot application
  ie product optimization

- Continue to explore field inventory sampling efficiencies

- Explore the use of UAVs
CHALLENGES: WITH ACQUISITION

- Mountainous and gullied terrain
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• Mountainous and gullied terrain
• West coast weather issues... fog, rain, snow levels, solar flares...
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• Mountainous and gullied terrain
• West coast weather issues... fog, rain, snow levels...
• Large size and varied conditions across the project area
• Impatience
Processing and Data Management:

• Huge project
• 1.4 TB of data
• 42 billion xyz points
• Divided the project area into 12,665 manageable 500x 500m .LAS files
• Acquired and processed in batches that eventually had to be mosaicked together
CHALLENGES: POST ACQUISITION

• Calibration and cleaning of the data complicated by collection spanned over many days / weeks / months

• Removing atmospheric / false echo returns

• Data delivery and organization

• Data storage and management at Island Timberlands end

• Impatience
CHALLENGES: FOREST ATTRIBUTES

- The Coastal Region is complex and diverse in vegetation (species and size range), terrain (elevation 0 - 1400m)

- Cannot determine sorts and therefore values

- Data storage and management at Island Timberlands end

- Raster formats
CHALLENGES: FOREST ATTRIBUTES

• Species identification (12+ commercial species)

• Merchantable trees are 40 to 600 years old, very different

• Within a species, size and quality can depend on the site

• Variable forest conditions depending on age class, can be homogeneous or multi-layered canopy
Name that Tree

- Tree #2

Douglas Fir
Name that Tree

- Tree #3

Western Red Cedar
OPPORTUNITIES

• Have unprecedented detailed information across most of ITLP’s land ie heights, volumes
• Improve various datasets across our landbase
• Ability to complete total chance plans
• Continue to capture cost savings, engineering, roads
• Highly reliable pre-mission planning, smart office time
• LiDAR is becoming more common, incorporated into more commonly used software ESRI, Softree, etc
• Doing VIAs in-house, catchment area determinations, hillslope position/aspect/curvature to enhance TEM/PEM, habitat review etc

• World travel
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That’s it…

Questions???

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