AWARE

FIRST ANNUAL GENERAL MEETING

PROGRAM

Forest Centre, Grenfell Campus, Corner Brook, NL

May 24-26th, 2016.

The first annual general meeting for AWARE will be held at the Forestry Centre, Grenfell Campus, Memorial University in Corner Brook, NL from May 24th-26th, 2016. University researchers will be housed at the Forestry field station in Pasadena. Due to space limitations at the field station, a block of rooms has been reserved for other participants at the Glynmill Inn in Corner Brook.

ACCOMMODATIONS

A block of rooms has been reserved at the Glynmill Inn in Corner Brook. The Inn is located approximately 3 km from the Forest Centre at Grenfell Campus and 32 km from the field station. Rooms are available for $119.00+tax and can be booked prior to April 23, 2016 quoting the code AWARE.

GlynMill Inn
1B Cobb Lane
Corner Brook, NL
1-800-563-4400

GETTING TO THE AGM

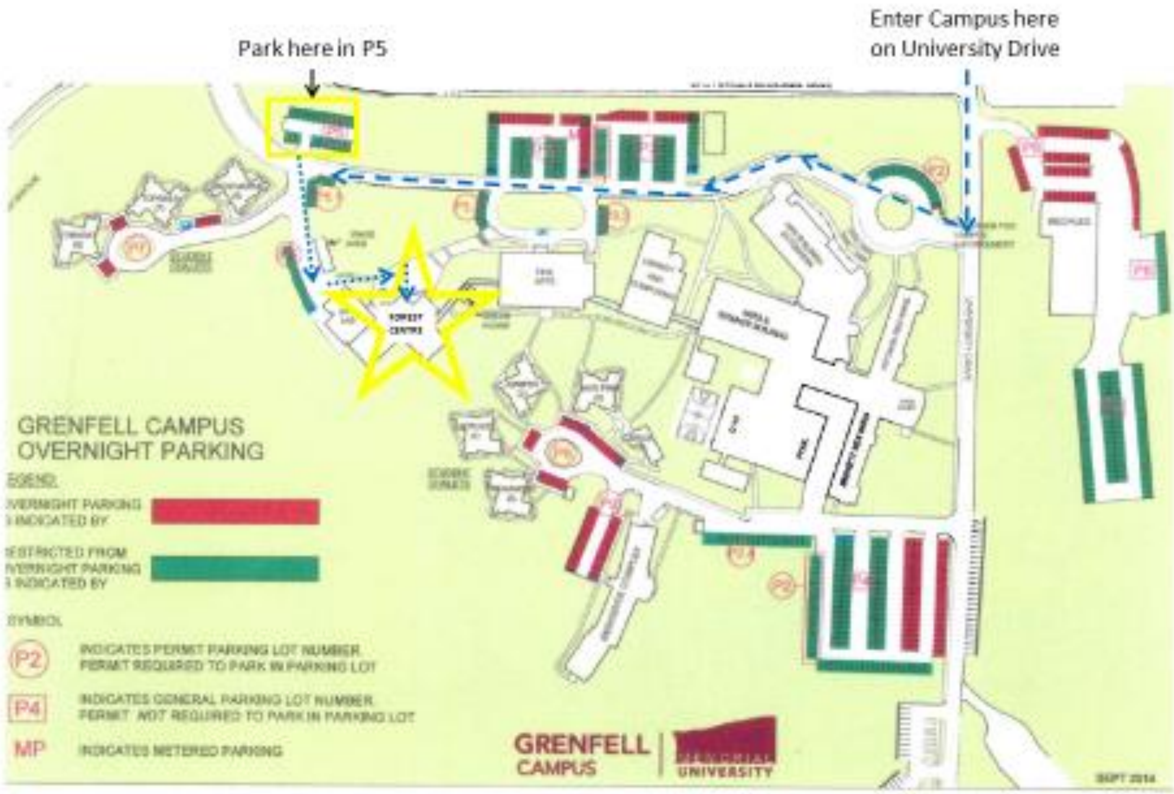
Location: FC2014, Forest Centre, Grenfell Campus, Memorial University, Corner Brook

Driving – Grenfell Campus is located in the South part of Corner Brook. If you are staying at the Glynmill Inn, head east along West Valley Road and turn right on O`Connell Drive. Proceed for approximately one km. Turn left on University Drive and drive SE along this road until you pass Corporal Pinksen Memorial Drive. Take the next right and continue past the roundabout for about 300 m until you arrive at a small parking lot, P5.

For those coming from the field station, take the Trans-Canada highway for 30 km and take the Massey Drive exit. Turn right on Confederation Dr and the left on West Valley road. Head west for 1.5 km and turn left on O`Connell Drive. Proceed for approximately one km. Turn left on University Drive and drive SE along this road until you pass Corporal Pinksen Memorial Drive. Take the next right and continue past the roundabout for about 300 m until you arrive at a small parking lot, P5.

Park in P5 and walk south for about 75 m. Go past the garage and up the stairs on your left. Enter the main entrance of the Forest Center on your right at the top of the stairs.

FC2014 is located to the left, just after you enter through the main entrance.



SCHEDULE

<table>
<tr><th>Time</th><th>Tuesday</th><th>Wednesday</th><th colspan="2">Thursday</th></tr>
<tr><td>8:00 AM</td><td rowspan="3"></td><td rowspan="3">breakfast</td><td colspan="2" rowspan="3">breakfast</td></tr>
<tr><td>8:20 AM</td></tr>
<tr><td>8:40 AM</td></tr>
<tr><td>9:00 AM</td><td rowspan="3"></td><td>Nicholas - AWARE intro</td><td colspan="2" rowspan="2">FPI - Denis Cormier</td></tr>
<tr><td>9:20 AM</td><td>CBPP - David Chamberlain</td></tr>
<tr><td>9:40 AM</td><td>NL FAA - Adam Blair</td><td colspan="2">Q17a - Aurelie Schmidt, Sherbrooke</td></tr>
<tr><td>10:00 AM</td><td rowspan="3"></td><td>CWFC -Doug Pitt</td><td colspan="2">Q21 - Jean-Francois Prieur, UQAM</td></tr>
<tr><td>10:20 AM</td><td>morning break</td><td colspan="2">Q22 - Rachel Perron, UQAM</td></tr>
<tr><td>10:40 AM</td><td rowspan="2">Ross Nelson - Keynote Speaker</td><td colspan="2">morning break</td></tr>
<tr><td>11:00 AM</td><td rowspan="3"></td><td colspan="2" rowspan="3">Open Discussion</td></tr>
<tr><td>11:20 AM</td><td>NL core site, Richard Fournier</td></tr>
<tr><td>11:40 AM</td><td>NB core site, Benoit St-Onge</td></tr>
<tr><td>12:00 PM</td><td rowspan="3"></td><td rowspan="3">lunch</td><td colspan="2" rowspan="3">lunch</td></tr>
<tr><td>12:20 PM</td></tr>
<tr><td>12:40 PM</td></tr>
<tr><td>1:00 PM</td><td rowspan="12">Field trip to Corner Brook Core Site</td><td>ON core site - Paul Treitz</td><td rowspan="4">Student Workshop</td><td rowspan="4">Steering Committee</td></tr>
<tr><td>1:20 PM</td><td>AB core site - Nicholas Coops</td></tr>
<tr><td>1:40 PM</td><td>Q02 - Kaysandra Waldron, Laval</td></tr>
<tr><td>2:00 PM</td><td>Q03 - Melodie Bujold, Sherbrooke</td></tr>
<tr><td>2:20 PM</td><td>Q04 - Karin van Ewijk, Queens</td><td colspan="2">afternoon break</td></tr>
<tr><td>2:40 PM</td><td>Q06 - Sean Lamb, UNB</td><td rowspan="4">TLS Workshop</td><td rowspan="4">Steering Committee</td></tr>
<tr><td>3:00 PM</td><td>afternoon break</td></tr>
<tr><td>3:20 PM</td><td>Q08 - Jean-Romain Roussel, Laval</td></tr>
<tr><td>3:40 PM</td><td>Q10 - Shane Furze, UNB</td></tr>
<tr><td>4:00 PM</td><td>Q13 - Piotr Tompalski, UBC</td><td colspan="2" rowspan="3"></td></tr>
<tr><td>4:20 PM</td><td>Q15 David MacLean, UNB</td></tr>
<tr><td>4:40 PM</td><td>Q15a - Shawn Donovan, UNB</td></tr>
<tr><td>5:00 PM</td><td rowspan="3"></td><td rowspan="3"></td><td colspan="2" rowspan="3"></td></tr>
<tr><td>5:20 PM</td></tr>
<tr><td>5:40 PM</td></tr>
<tr><td>6:00 PM</td><td rowspan="3"></td><td rowspan="6">Lobster Boil (CFS Station)</td><td colspan="2" rowspan="3"></td></tr>
<tr><td>6:20 PM</td></tr>
<tr><td>6:40 PM</td></tr>
<tr><td>7:00 PM</td><td rowspan="3"></td><td colspan="2" rowspan="3"></td></tr>
<tr><td>7:20 PM</td></tr>
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TUESDAY, MAY 24th

No technical sessions on Tuesday

Corner Brook Test Forest Field Trip

Location: Corner Brook Test Forest

1:00 PM – 5:00 PM

This field trip will visit the Corner Brook Test Forest. Led by Boyd Pittman, we will get an oral history of the site and visit several stands of different maturities.

The trip will start and finish in Corner Brook, followed by a dinner social in Corner Brook. The meeting point in Corner Brook will be determined shortly and communicated to all field trip participants.

WEDNESDAY, MAY 25th

Technical sessions begin today and run for the entire day. The proceedings end with a lobster boil social at the CFS field station in Pasadena, a 20 minute drive from the conference.

9:00 AM Nicholas Coops, UBC

9:20 AM David Chamberlain, CBPPL. ”Welcome and Opening Remarks – Industry Overview”

9:40 AM Steve Balsom, NL FAA

10:00 AM Doug Pitt, CFS

10:20 AM ADM, Federal Government

11:00 AM Ross Nelson, NASA (retired). ”LiDAR – Then, Now and the Near Future”

Technical Presentations

1:00 PM Core Site Updates

Nicholas Coops, UBC. Alberta

Paul Treitz, Queens. Ontario

Benoit St-Onge, UQAM. New Brunswick

Richard Fournier, Sherbrooke. Newfoundland

2:00 PM Kaysandra Waldron, Laval. “Relationship between wood properties, stand structural characteristics and time since fire in the boreal forest.”

2:20 PM Melodie Bujold, Sherbrooke. “A comparison of strategies to map forest attributes over a large area using ALS transects: Test case for the boreal forest of Newfoundland, Canada.”

3:00 PM Karin van Ewijk, Queens. “Identifying a core set of stable/robust ALS metrics related to forest stand structure over different forest types in Ontario for the prediction of diameter and basal area distributions.”

3:20 PM Sean Lamb, UNB. “Forecasting development of planted stands in New Brunswick using LiDAR.”

3:40 PM Jean-Romain Roussel, Laval. “Reducing the error attributable to measurement parameters in predictive models of forest metrics using aerial LiDAR.”

4:00 PM Shane Furze, UNB. “Relating LiDAR-derived productivity metrics for Black Brook Watershed to atmospheric, hydrological and topographic attributes as they vary from ridge tops to valleys.”

4:20 PM Piotr Tompalski, UBC. “ LiDAR and Forest Growth Projections`.”

4:40 PM David MacLean. “Research Activities on the Spruce Budworm Outbreak in QC and NB.”

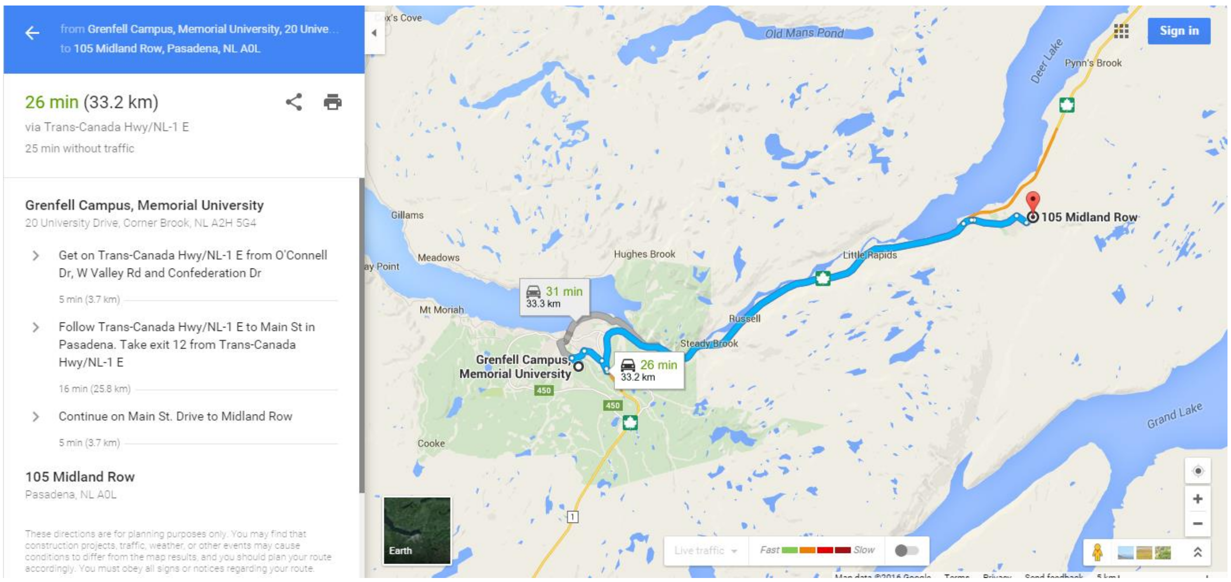
5:00 PM Shawn Donovan, UNB. “Quantification of spruce budworm defoliation using hemispherical imagery and Hyperion hyperspectral satellite data.”

Lobster Boil

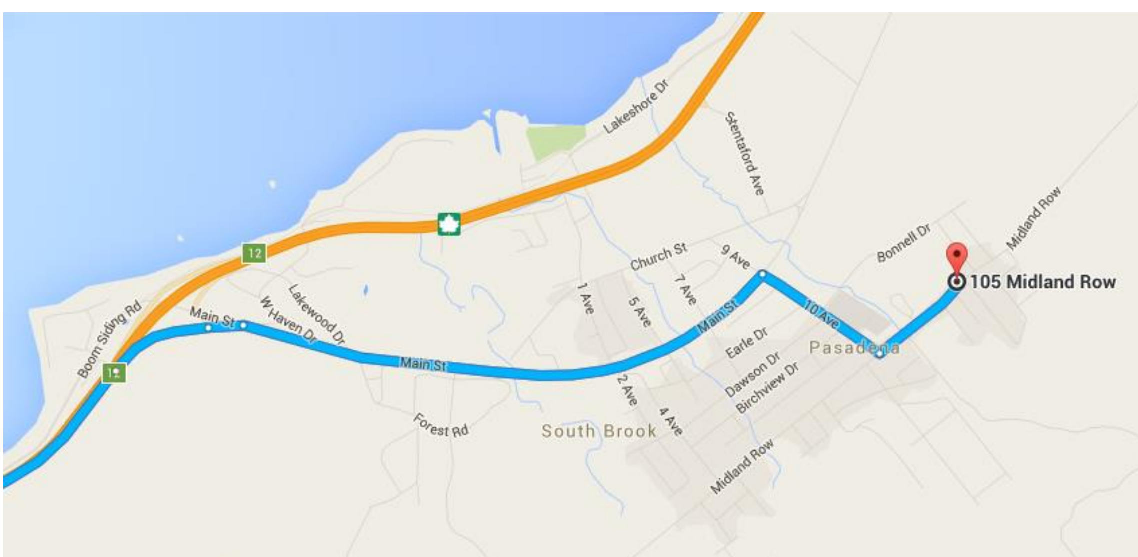
The Lobster Boil will be starting at 6 PM at the CFS Field Station in Pasadena, NL. Lobster and fixings will be provided but you’ll need to bring your own refreshments.

Address: 105 Midland Row, Pasadena, NL

Directions to Pasadena



Directions to the Research Station once in Pasadena



THURSDAY, MAY 26th

Technical sessions continue until noon. The afternoon session consists of the steering committee meeting and two workshops.

Presentations

9:00 AM Denis Cormier, FP Innovations. "FP Innovations roadmap to remote sensing applications for forest operations"

Technical Presentations and Proceedings

10:00 AM Aurelie Schmidt, Sherbrooke. "Mapping the impacts of forest management practices on water related ecosystem services"

10:20 AM Jean-Francois Prieur, UQAM. "Will the fusion of ALS and other sources of remote sensing data (multispectral aerial imagery, multispectral lidar, full waveform lidar, etc.) allow us to predict tree species at the individual tree level?"

10:40 AM Rachel Perron, UQAM. "Using LiDAR-derived metrics and contextual information to improve species classification on the individual tree level"

11:00 AM Open Discussion

Afternoon Sessions

Steering Committee Meeting (by invitation only)

Location: FC2001 CFS Boardroom

1:00 PM – 4:00 PM

Student Computational Tools Workshop

Location: FSC2014

1:00 PM – 2:30 PM

Moderated by Piotr Tompalski, this session brings together AWARE student researchers in an informal environment. They will present tools they have developed during their research for data processing or computational solutions.

TLS Workshop

Location: FSC2014

3:00 PM – 4:30 PM

This workshop is run by Richard Fournier, Jean-Francois Cote, and Olivier van Lier. Over the 90 minute workshop, Richard will give a 30 minute introduction to TLS. The remaining 60 minutes will include a live demonstration of data acquisition, followed by pre-processing and application of algorithms to the demonstration data.

AWARE Technical Presentations

Question 2: Relationship between Wood Properties, Stand Structural Characteristics and Time Since Fire in the Boreal Forest

Kaysandra Waldron[1] and Alexis Achim[2]

[1]Postdoctoral fellow; [2]Professor

Faculté de foresterie, géographie et géomatique, Université Laval,

2425 rue de la Terrasse, Quebec City, Qc, G1V 0A6

Natural disturbance regimes are known to be highly related to structural variability and species composition in forest ecosystems. In the boreal forest of eastern Canada, time since fire is a major driver of stand characteristics such as composition, productivity, structural variability and deadwood proportion. In areas where fire return interval is long, the structural variability of stands is high, which in turn may have an effect on wood properties. Our work will focus on the evaluation of the impact of tree and stand characteristics measurable by LiDAR on wood properties, taking into consideration the time since fire.

Question 3: A Comparison of Strategies to Map Forest Attributes over a Large Area Using ALS transects: Test Case for the Boreal Forest of Newfoundland, Canada

Mélodie Bujold, Université de Sherbrooke, 2500 boul. de l'Université, Sherbrooke, Qué, J1K 2R1,Canada.

Richard Fournier, Centre d'Applications et de Recherches en Télédétection (CARTEL), Université de Sherbrooke, 2500 boul. de l'Université, Sherbrooke, Qué, J1K 2R1,Canada.

Joan Luther, Natural Resources Canada, Canadian Forest Service, 26 University Drive, Corner Brook, NL A2H 5G4, Canada.

Planning, managing and monitoring forest resources over large areas, in the context of sustainable resource management, requires accurate maps of forest attributes, namely stand composition and structure. However, the acquisition of a sufficient number of field plots for reliable prediction of forest attributes is both costly and time-consuming. These limitations are further amplified when a forest area is large and composed of inaccessible areas. This project aims to overcome these constraints by developing a multi-level modeling strategy combining forest plots, ALS transects and spatially comprehensive data layers for mapping forest attributes of a large area of boreal forest in Newfoundland, Canada. A comparison is also performed to analyse if prediction accuracies of this indirect strategy are equivalent or better than those of a direct strategy using wall-to-wall data. Since mapping accuracies depend on the modelling approach, the performance of both parametric (regression) and non-parametric (random forests) methods are analysed and compared. Forest managers often need to go beyond mapping and derive estimates of forest attributes for specific areas. The accuracies and related uncertainties of these estimates are crucial to assess the sustainability of forest management activities. Thus, a model-based framework is implemented to estimate forest attributes (e.g. total merchantable volume and mean wood density) for the two main commercial tree species in Newfoundland.

Question 4: Prediction of forest inventory attributes in different forest types in Ontario using a core set of stable ALS metrics

Van Ewijk, Karin[a], Roussel, Jean-Romain[b], Treitz, Paul[a], Caspersen, John[c], Achim, Alexis[b], Jones, Trevor[d], Murray Woods[e], Douglas Pitt[f]

[a] Department of Geography and Planning, Queen's University, Kingston, Ontario

[b] Départment des sciences du bois et de la forêt, Université de Laval, Québec

[c] Faculty of Forestry, University of Toronto, Toronto, Ontario

[d] Forest Research and Monitoring Section, Ontario Ministry of Natural Resources and Forestry, Sault Ste. Marie, Ontario

[e] Ontario Ministry of Natural Resources and Forestry, Forest Resource Inventory Unit, North Bay, Ontario
[f] Natural Resources Canada, Canadian Wood Fibre Centre, Canadian Forest Service, Sault Ste. Marie, Ontario

To date many airborne laser scanning (ALS) metrics have been developed to predict a number of key Forest Resource Inventory (FRI) attributes. With this multitude of ALS metrics, however, two major issues have arisen: i) strong inter-correlations exist between metrics causing problems for feature selection and model generalization; and ii) a large subset of these metrics can be linked to only a few forest stand characteristics (Bouvier et al. 2015). Within this context, our research objective is to identify a core set of ALS metrics that has the following characteristics: (i) they relate to all aspects of stand structure; (ii) they are stable across different forest sites; and (iii) they have high predictive power for the estimation of FRI attributes such as diameter and basal area distributions within different forest sites. Petawawa Research Forest (PRF) and Haliburton Forest (HaF), both temperate mixedwood forests located within central Ontario's Great Lakes – St. Lawrence Forest Region, and Hearst Forest (HeF), a boreal mixedwood forest in northeastern Ontario represent our three study sites to test our research objectives as a number of low and high density ALS datasets exist for these sites. As a starting point we analyzed a number of "standard" ALS metrics (i.e., measures of central tendency, dispersion, percentiles, proportions and densities), assessed their correlations and reduced the data dimensionality through pairwise correlation and principal component analysis (PCA). Our preliminary results indicate that low and high pulse density ALS datasets have similar uncorrelated sets of metrics displaying comparable correlations. Our PCA demonstrates that with the same subset of ALS metrics, all three study sites show analogous relationships between ALS metrics in ordination space. For the two temperate mixedwood study sites, the ALS metrics also have matching loadings on the two major principal component axes. Correlation analyses between ALS metrics and FRI attributes in the HeF indicate high correlations with tree height and basal area attributes, however, lower correlations exist between the uncorrelated set of ALS metrics and stem density and stem diameter. Hence, there remains a need to assess other ALS metrics such as leaf area density (LAD) profile metrics (Bouvier et al., 2015), gap fraction (Morsdorf, et al., 2006), and metrics derived from canopy height models (Magnussen et al., 2012; Ozdemir and Donoghue, 2013). These metrics are currently being tested.

References

Bouvier, M., Durrieu, S., Fournier, R. A., & Renaud, J.-P. (2015). Generalizing predictive models of forest inventory attributes using an area-based approach with airborne LiDAR data. *Remote Sensing of Environment*, *156*, 322–334.

Magnussen, S., Næsset, E., Gobakken, T., & Frazer, G. (2012). A fine-scale model for area-based predictions of tree-size-related attributes derived from LiDAR canopy heights. *Scandinavian Journal of Forest Research*, *27*(1), 312–322.

Morsdorf, F., Kötz, B., Meier, E., Itten, K. I., & Allgöwer, B. (2006). Estimation of LAI and fractional cover from small footprint airborne laser scanning data based on gap fraction. *Remote Sensing of Environment*, *104*(1), 50–61.

Ozdemir, I., & Donoghue, D. N. M. (2013). Modelling tree size diversity from airborne laser scanning using canopy height models with image texture measures. *Forest Ecology and Management*, *295*, 28–37.

Question 6: Forecasting Development of Planted Stands in New Brunswick using LiDAR

Sean Lamb[1], Dr. David A. MacLean[2] and Dr. Chris Hennigar

[1] MScF student; [2] Professor; [3] Research Scientist
Faculty of Forestry and Environmental Management, University of New Brunswick, P.O. Box 4400, Fredericton, NB, E3B 5A3, Canada

The introduction of active remote sensing technology for predicting forest inventory, specifically light detection and ranging (LiDAR), has vastly improved the resolution of forest inventory. LiDAR is been used throughout New Brunswick to accurately estimate forest inventory attributes (i.e. gross merchantable volume (GMV), basal area (BA), quadratic mean diameter (QMD), etc.) at high resolution (e.g., 20X20 m). Although LiDAR can provide high resolution forest inventory, it is a one-time measurement that does not allow for the prediction of forest development over time, which is a crucial component for spatially scheduling annual harvest operations. We are developing a nearest neighbor imputation approach to impute a tree list for LiDAR cells in planted softwood stands from the J.D. Irving, Limited Black Brook District in northwestern New Brunswick for the purpose of improving annual commercial thinning schedules. This approach uses the Random Forest variant in the yaImpute statistics package to match ground plot measurements to LiDAR cells based on planted species and the most similar combination of inventory attributes (i.e. GMV, BA, QMD). Once a plot measurement has been matched to each LiDAR cell, the associated tree level inventory will be input into a tree list growth model to obtain an estimate of future inventory for each LiDAR cell. Using this approach results in highly accurate estimates of current forest inventory when compared to ground plots (r^2= 0.87-0.98).

Question 8: Reducing the Error Attributable to Measurement Parameters in Predictive Models of Forest Metrics using Aerial LiDAR

Jean-Romain Roussel[a], Martin Béland[b] , John Caspersen[c] , Alexis Achim[a]

[a] Centre de recherche sur les matériaux renouvelables, Département des sciences du bois et de la forêt, Pavillon Gene.-Kruger, 2425
rue de la Terrasse, Université Laval, Québec, QC G1V 0A6, Canada
[b] Département des sciences géomatiques, Pavillon Louis-Jacques-Casault, 1055, avenue du Séminaire, Université Laval, Québec, G1V 0A6, Canada
[c] Faculty of Forestry, University of Toronto, Toronto, Canada

Forest resource characterization using LiDAR relies mainly on statistics derived from cloud of points with an areabased approach. But derived metrics are highly dependent on LiDAR and flight configuration. Emitted pulse density, footprint size, emitted energy, scan angle, flight height, number of flightlines, emitted pulse width are some of the factors that can influence the 3D structuring of the cloud of points. Even with a constant set of parameters, the metrics may vary from one acquisition to another because of random effects.

These intrinsic and extrinsic variations imply that a derived statistic cannot be assessed with certitude, and thus that there will always be an inherent error in predictive models of forest metrics. This error will not only be associated with random and uncontrolled biologic phenomena, but also with the fact that models inputs are not stable. This project aims to understand and quantify the derived statistics behavior and variability in an attempt to allow a better control of models accuracy. The control of accuracy could be achieved by reducing the term of error that is inherent to the measure.

Question 10: Modeling Site Productivity through LiDAR-derived Terrain Indices and High Resolution Soil Attribute Mapping

Shane Furze[1*] and Paul A. Arp[2]

Forest Watershed Research Centre, Faculty of Forestry and Environmental Management
University of New Brunswick, P.O. Box 44555, Fredericton, NB E3B 6C2.
Furze.shane@gmail.com

This project focuses on improving forest plantation growth predictions based on digital terrain and soil modelling. In this, soil properties are considered to change continuously as affected by increasing ridge-to-valley soil moisture content and by landform type and position. Currently, soil information is spatially represented by tessellated boundaries, omitting the spatial variations of the growth-affecting soil attributes, such as soil moisture, texture, bulk density, coarse fragment content, rooting space, cation exchange capacity, organic matter content, pH etc. It is hypothesized that some of this variation can be captured through application of high-resolution LiDAR-derived digital elevation models which applies already-developed topographic and hydrological algorithms, including the cartographic depth-to-water index. These protocols must be adjusted to differentiate the influences that specific landforms pose on soil attributes and drainage classes. The goal of this research is predictive models for plantation height growth over age by topographic, landform position, and hydrological regimes with plantation species referring to White, Black, Red, and Norway Spruce.

Question 15a: Quantification of Spruce Budworm Defoliation using Hemispherical Imagery and Hyperion Hyperspectral Satellite Data

Shawn Donovan[1] and Dr. David A. MacLean[2]
[1] MScF student; [2] Professor;
Faculty of Forestry and Environmental Management, University of New Brunswick,
P.O. Box 4400, Fredericton, NB, E3B 5A3, Canada

The biggest forest health issue in eastern Canada is the damage caused by periodic eastern spruce budworm (*Choristoneura fumiferana* Clem.) (SBW) outbreaks, which covered 52 million hectares at the peak of the last outbreak in 1975. SBW larvae reach extreme population levels and repeatedly consume the current-year foliage of spruce and balsam fir trees, resulting in tree growth reduction and mortality averaging 85% in mature fir stands. The current SBW outbreak reached 6.3 million hectares of defoliation in Quebec in 2015, and populations are still low but increasing in neighbouring New Brunswick. A large $18 million project to develop and test early intervention strategies against SBW is underway and is testing several remote sensing platforms to assess SBW defoliation, including airborne hyperspectral (CASI and SASI) sensors, EO-1 Hyperion satellite, and Digital Globe WorldView3 satellite. This project will complement those efforts.

Most studies of SBW effects quantify defoliation as percentage of current-year foliage removed. However, resulting effects on tree growth or survival are actually a function of the foliage remaining on a tree, not foliage that is removed. Therefore, the first objective of this project is to use hemispherical canopy images within plots with detailed repeated defoliation measurements to estimate changes in Leaf Area Index (LAI) caused by SBW defoliation. The EO-1 Hyperion satellite has shown promising results in predicting SBW defoliation using coarse-scale aerial survey defoliation data (Huang, 2015, MScE thesis at UNB). The second objective of this project, therefore, will test the use of Hyperion hyperspectral data to estimate SBW defoliation, using the Huang (2015) methods but a much more accurate data set of defoliation measured on over 8000 trees, >1500 branches, and 75 plots in 2014 and 2015.

Question # 17A : How Can Effects of Forest Management Practices on Water Related Ecosystem Services be Quantified using Available Geospatial Data?

Aurélie Schmidt[1*], Richard A. Fournier[2] and Joan E. Luther[3]

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2. Full Professor, Département de géomatique appliquée, Université de Sherbrooke, 2500 boul. de l'Université, Sherbrooke, QC, J1K 2R1, CANADA, 819-821-8000 ext. 63209, Richard.Fournier@USherbrooke.ca
3. Research Scientist, Natural Resources Canada, Canadian Forest Service - Atlantic Forestry Centre, 26 University Drive, Corner Brook, A2H 5G5, Canada, 709-637-4917, JoanE.Luther@NRCan-RNCan.gc.ca

The awareness that forest ecosystems provide benefits to human society dates back to the early 1970s. Since publication of the Millennium Ecosystem Assessment in 2005, the number of studies directly related to the mapping of ecosystem services (ES) is steadily increasing. ES mapping is a key element in the decision-making processes for forest management and biodiversity conservation. A new challenge for ES mapping is the need to develop spatially-explicit methods that take in account the ecological processes inherent in the ES in order to improve their integration into environmental planning and management at all levels of decision making.

Water-related ES are amongst the most important to consider when making land management decisions to ensure the sustainability of quality of life. Therefore, assessing how forest management practices impact ES related to water is very important. The western part of Newfoundland is dominated by forested areas, therefore forest and water management need to be integrated to maintain environmental quality within the impetus of industrial prosperity in a sustainable context. My research project aims to develop a method using spatial indicators to quantify and map the impacts of forest management practices, especially harvesting, on three critical water-related ES of western Newfoundland: (1) provision of clean water, (2) water regulation and (3) water-related recreational activities.

Key words: Ecosystem services, water, forest management practices, indicator, mapping

Question 21: Does the Fusion of Discrete Return ALS with Other Sources of Remote Sensing Data (Multispectral Aerial Imagery, Multispectral LiDAR, Full Waveform liDAR, etc.) Allow Us to Predict Tree Species at the Individual Tree Level in a Precise and Robust Manner?

Jean-François Prieur

PhD student
Département de Géomatique Appliquée, Université de Sherbrooke
2500 Boulevard de l'Université, Sherbrooke, QC, J1K 2R1 Canada

Tree species identification is an important area of research from both an operational and environmental point of view. Allometric equations are used that relate more easily obtained parameters (like height for example) to more difficult parameters to measure such as volume and ABG biomass. Without accurate tree species information, generic allometric equations are used. The use of generic equations instead of species-specific ones can cause large errors in the derived parameters (Tompalski, *et al.*, 2014).

Achieving a high accuracy for species identification at the individual tree level using only ALS discrete return data is not economically feasible for Canadian forests. Our research is investigating the fusion of other types of remote sensing data (multispectral aerial imagery, multispectral lidar, full waveform lidar, etc.) with ALS DR data in order to develop a robust set of metrics and methods that will allow us to identify tree species at the individual tree level.

Question 22: Using LiDAR-derived Metrics and Contextual Information to Improve Species Classification on the Individual Tree Level.

Rachel Perron[1] and Dr. Benoît St-Onge[2]
[1] MScF student; [2] Professor;
Département de Géographie, Université du Québec à Montréal,
C.P. 8888, succ. Centre-Ville, Montréal, QC, H3C 3P8, Canada

Species assessment is an important aspect of optimal forest inventories. In the context of commercially exploited forests, it is essential for a more effective management of wood stock –giving information on the composition of stands, growth and spatial distribution. Put in relation with local elements, it is also a way to improve our understanding of forest ecology. Different approaches have been employed in the past to identify tree species but were expensive, slow or inaccurate. LiDAR is a promising option, answering many of these issues. It has already been used successfully, with an area-based approach, for mapping structural attributes and identifying tree stands. Species recognition of individual tree using LiDAR is now starting; in this research context, we aim at improving the methods for the single-tree level classification.

For this project, the area of research is the Black Brook forest in New-Brunswick. The whole territory was mapped with aerial LiDAR in 2012 and 2013. Our general objective is to provide a way to identify the species of all the trees of this site. More specifically, a recurring problem is the presence of fir regeneration within the spruce plantations, lowering the productivity, and therefore value, of the spruces stands. One sub-objective of this study is to locate the areas where firs and other less-desirable species are abundant. As of now, individual tree crowns were delimitated based on the LiDAR points cloud. We then have developed algorithms in Python to calculate metrics from the LiDAR points associated with each tree. Using a machine-learning approach, we have started to train different classifiers with tree samples for which the species is known (individuals identified on the field and trees from pure plots). Our approach will also consist of using the known species of plantation (contextual information) to train and apply a special classifier in those zones in order to specifically distinguish between the planted species and unwanted fir regeneration. Based on the best classifying algorithms, we will map species over the entire zone.