AWARE Quarterly Progress Report

Project ID: Q05
Core Site: Ontario
Title: How well do existing LiDAR metrics developed in the Eastern Mixedwood Boreal forests transfer to Western Mixedwood Boreal forest types?

Institution: Queen's University
Project Supervisor: Paul Treitz
HQP Name: Karin van Ewijk (PDF)

Committee Members

- ☐ See Progress Report Year:__________
- ☐ Names:____________________________

Report Period

Year:2019 X Q1 Apr-Jun x Q2 Jul-Sep ☐ Q3 Oct-Dec Q4 Jan-Mar

Number of Courses Left to Complete
NA

Research Progress During this Reporting Period

1. Manuscript on transferability of FRI variable models between the eastern and western boreal forests has been sent out for comments from co-authors (N. Coops, P. Tompalski, M. Woods, D. Pitt) and to Hearst and West Fraser partners prior to submission to the Canadian Journal of Remote Sensing.
2. Submitted manuscript in collaboration with Yan Wai Yeung (Hong Kong Polytechnic University) and Ahmed Shaker (Ryerson University) on intensity correction of the PRF 2016 multispectral data and the incorporation of corrected intensity metrics in the predictor set to predict ABA FRI attributes.
3. Abstract accepted for oral presentation at SilviLaser (October 8-10, 2019)

(see abstracts on page 2 and 3 for project summaries)

Presentations Done
NA
Papers Submitted:
Van Ewijk, K, Y. Wai Yeung, P., Woods, and A. Shaker. Effects of Cover Type and Spatial Resolution on Radiometric Correction for Modeling Plot Level Forest Attributes using Multispectral Airborne LiDAR Data. Submitted to Remote Sensing of Environment on August 14th, 2019.

Format:
Authors (Year).Title. Name of Journal or conference, page numbers

Annual General Meetings

AGM1	AGM2	AGM3
X Attended	X Attended	X Attended
X Reported results	X Reported results	X Reported results

Research Targets for next Reporting Period

NA

HQP Signature:
Date: September 8, 2019

Project Supervisor Signature:
Date: September 8, 2019

Effects of Cover Type and Spatial Resolution on Radiometric Correction for Modeling Plot Level Forest Attributes using Multispectral Airborne LiDAR Data

van Ewijk, Karin, Yan, Wai Yeung, Treitz, Paul, Shaker, Ahmed

Abstract

Airborne LiDAR is increasingly used for the spatially-explicit modeling of forest ecosystem attributes which include the classification of individual tree attributes, classification of land cover types, and the modeling of plot level forest resource inventory attributes. In order to use the LiDAR intensity information, in conjunction with LiDAR's height information, for forest modeling and classification purposes, radiometric correction of LiDAR intensity data is deemed to be a critical pre-processing requirement. Although successful radiometric correction methods exist, there are still some research voids. In this study, we assessed the implementation of a LiDAR scan line correction (LSLC) and an overlap-driven intensity correction (OIC) to address these research voids by removing striping that appeared within the individual flight lines as well as overlapping regions of adjacent flight lines of a multispectral LiDAR dataset, without the need of manual intervention. We tested the effectiveness of these corrections in various land/forest cover types in a temperate mixed mature forest in Ontario, Canada. Second, we predicted three plot level forest attributes (basal area (BA), quadratic mean diameter (QMD), and stem density (Nha)) using different combinations of height and intensity metrics derived from the multispectral LiDAR data to determine if LiDAR intensity data (corrected and uncorrected) improved predictions over models that utilize LiDAR height information only. The results show that LSLC can reduce the intensity banding effect by 0.19% to 23.06% in channel 1 (1550 nm) and 4.79% to 66.87% in channel 2 (1064 nm) at the close-to-nadir region. The combined effect of LSLC and OIC is notable particularly at the swath edge. After implementing both methods the intensity noise is reduced by 5.51% to 12% in channel 1, 6.37% to 42.93% in channel 2 and 6.48% to 33.77% in channel 3 (532 nm). Our results further demonstrate that BA and QMD predictions in our study area gained little from additional LiDAR intensity metrics. Intensity metrics from multiple LiDAR channels and intensity normalize difference vegetation index (NDVI) metrics did improve Nha predictions up to 7.2% in RMSE and 1.8% in Bias. However, our lowest Nha prediction errors (%RMSE) were still approximately 10% larger than for BA and QMD. We observed only minimal differences in plot level BA, QMD and Nha predictions between models using original and corrected intensity. We attribute this to: i) the variation in effectiveness of LSLC and OIC in different land cover types, and ii) the effect of spatial resolution on intensity noise.

Transferability of ALS-derived Forest Resource Inventory Attributes between Eastern and Western Canadian Boreal Forest Mixedwoods.

Karin van Ewijk, Piotr Tompalski, Paul Treitz, Nicholas C. Coops, Murray Woods(ret.), Douglas Pitt (ret.)

Abstract

Over the last decades, the use of Airborne Laser Scanning (ALS) data to predict a wide range of forest resource inventory (FRI) attributes has become common practice. The ability to expand the use of these predictive models to broader regional scales and is crucial for supporting large scale sustainable forest management and conservation efforts. The objective of this research is to examine the transferability of ALS-based FRI attributes for mixedwood forest sites between the eastern and western boreal forest regions of Canada. The boreal mixedwoods are one of the most prevalent and productive forests within the boreal forest. They are also structurally diverse due to a strong east-to-west gradient in climate, edaphic conditions and disturbance regimes. Hence, for the two study sites we first examined the similarity between: (i) five bioclimatic variables; and (ii) ALS data - FRI attribute relationships. Second, we applied two operational approaches, i.e., Ordinary Least Squares (OLS) regressions and Random Forest (RF), to predict four FRI attributes (i.e., basal area (BA), gross total volume (GTV), Lorey's height (LHT), and quadratic mean diameter (QMD) and test if the inclusion of calibration data from the target location site improves the performance of transferred FRI attribute models. As the study sites were located on opposing sides of a bioclimatic gradient, inclusion of some calibration data for each site improves transferred model performance. The areal extent that became environmentally similar when datasets were combined supports this finding. However, FRI attribute prediction accuracy varies with modelling approach, FRI attribute, site, and forest type. The best transferability models fell within a ± 5% relative RMSE of the local predictive models but increased up to 10% in relative bias. Overall, LHT produced the most accurate predictions when transferred, whereas GTV models were more difficult to transfer, in part because observed GTV varied across the two sites.