Regional Training: Lidar Data processing for biomass estimation
06-10 February 2017
The Bazaar Hotel, Bangkok, Thailand

Background

The analysis of biomass through a combination of remotely sensed and field data has been gaining increasing interest, due to the GHG-reporting requirements under the UNFCCC and in particular the Reducing Emissions from Deforestation and Forest Degradation (REDD+) Framework, as well as the need to conserve and increase forest carbon stocks in Non Annex 1 countries.

Advances in climate change research and remote sensing methods have contributed to the increased interest by forestry agencies in the Mekong region to build capacity to utilize various data sources to improve their biomass estimates from the forestry sector.

Light Detection and Ranging (Lidar) data is of particular interest as it provides three-dimensional information on the vegetation structure that can be regressed against plot-level aboveground measurements of biomass to provide biomass estimates. In addition, there are number of published IPCC-compliant biomass estimates deriving from integrating airborne Lidar data and field data, that can be used for testing and modifying in different landscapes. However, when using tree height estimated with Lidar, elements such as forest type, tree age, speciation etc., need to be considered and understood in order to improve the estimates of forest biomass.

As countries in the Mekong region progress with developing the MRV for REDD+ and GHG-reporting it is particularly relevant to consider the cost-effectiveness of using Lidar data to train optical data for developing biomass estimates and generating emission factors from the forestry sector. As part of different forest research projects, countries in the Mekong region have been acquiring different Lidar data sets for limited areas. However, due to the lack of technical capacity within the forestry agencies, these data sets have not been fully understood or assessed as potential data for biomass estimation.

This one-week training aims to build the basic skills for Lidar data processing and to enable participants to better understand the opportunities and limitations of using Lidar data for estimating biomass Experience from Nepal and their ongoing work with integrating Lidar data for biomass modeling will be shared in order to initiate discussion on potential replication in the region.

Training Objectives

The overall objective of this training course is to build technical capacity of the participants to utilize Lidar data for estimating forest biomass in the context of improved emission factors and REDD+ and GHG-reporting from the forestry sector. In particular, the training aims to build participants' skills to:

- Work with FUSION lidar processing software to generate canopy structure products. FUSION is an open source software, that can be downloaded here: http://forsys.cfr.washington.edu/fusion/fusionlatest.html
- Generate forest canopy structure spatial data sets across large landscapes from lidar data
- Use canopy structure spatial data (lidar derivatives) to model (predict) other forest structure metrics (e.g., biomass, basal area, etc.) using the R statistical software
- Understand field inventory protocols appropriate for training lidar-based statistical models used to predict and map forest inventory parameters (biomass, basal area, etc)

Participants

The training is primarily organized for three countries in the Mekong region (Cambodia, Lao PDR and Thailand), with focus on technical officers from forestry agencies, directly involved in REDD+ MRV and biomass mapping, as well as researchers working with Lidar data. Participants from other countries in the region will also be invited to contribute to sharing experiences with using Lidar data for biomass mapping.

Pre-training webinar

Half-day pre training webinar will be organized to prepare the participants for the training. The webinar will give a general overview of Lidar technology and its application for forest biomass mapping and will introduce the FUSION processing software and introduce the training topics and agenda. Brief demonstration on how to work with FUSION software will be provided, followed with few short exercises to practice some of the steps. All training participants are required to join the webinar. The webinar will also be open for wider audience.

TRAINING AGENDA

Day 1 – Monday, February 6

- 8:30am – 9:00am: **Registration**
- 9:00-9:15**:** Opening Remarks**, Department of National Park, Wildlife and Plant Conservation**
- **SilvaCarbon**
- **09.15 – 09.30:** Training Introduction**, SilvaCarbon Regional Program**

Generate Lidar Derived Canopy Structure Products from Generic Dataset

- 9:30am – 10:15am: *Presentation* - **Review Large Lidar Acquisition Processing Workflow**
- 10:30am – 12:00pm: *Hands-on Exercises* - **Convert Bare Earth Grids into a FUSION DTM Format, Review Batch File Setup and Perform Quality Assessment of Data**

Lunch

- 1:00pm – 2:00pm: *Demonstration* – **Processing Setup and Run**
- 2:00pm –4:00pm: *Hands-on Exercises* - **Generate Lidar Metrics (grid metrics) for project area, Incorporate lidar grid metrics into GIS**
- 4:00pm – 5:00pm: *Discussion* - **Review Lidar Derived Forest Canopy Structure Products: Canopy Cover, Canopy Density, Canopy Height, etc.**

Day 2 – Tuesday, February 7

Generate Lidar Derived Canopy Structure Products from Local Lidar Dataset

Students will work independently and at their own pace with their own dataset. The instructors will provide troubleshooting and facilitate discussions and demonstrations as appropriate based on participant needs.

- 8:30am – 12:00pm: *Self-paced Processing* - **Convert Bare Earth Grids into a FUSION DTM Format, Review Batch File Setup and Perform Quality Assessment of Data**

Lunch

- 1:00pm – 4:00pm: *Self-paced Processing* - **Generate Lidar Metrics (grid metrics) for project area, Incorporate lidar grid metrics into GIS**
- 4:00pm –5:00pm: *Wrap-up and Discussion* - **Review Lidar Derived Forest Canopy Structure Products: Canopy Cover, Canopy Density, Canopy Height, etc.**

Day 3 – Wednesday, February 8

Introduction to Lidar-based Forest Inventory Models

- 8:30am – 9:30am: *Presentation* – **Overview of Lidar Inventory Modeling and Case Study**
- 9:30am – 10:30pm: *Hands-on Exercises* – **Sample Design, Field Data Requirements and Clipping Associated Lidar Plots**
- 11:00pm – 12:00pm: *Presentation* – **Sample Design Considerations and Field Data Protocols**

Lunch

- 1:00pm – 3:00pm: *Self-paced Processing* – **Process local field data, if available**
- 3:00pm – 4.00 pm: **Sharing regional experience with using Lidar data**
- 4:00pm – 5:00pm: *Hands-on Exercises* – **Install R and R studio, Getting Started with R**

Day 4 – Thursday, February 9

Lidar-based Forest Inventory Modeling, Key Elements and Considerations

- 8:30am – 9:00am: *Presentation and Demonstration* – **Building Regression Models with field and lidar plots and working in R**
- 9:00am – 12:00pm: *Hands-on Exercises* – **Getting Started With Data In R, Data Exploration**

Lunch

- 1:00pm – 2:00pm: *Demonstration* – **Explore variable selection methods/logic and proceed to model creation and evaluation**
- 2:00pm – 5:00pm: *Hands-on Exercises* – **Create spatial predictions of inventory parameters (Basal Area, Biomass, etc.) across the landscape**

Day 5 – Friday, February 10

Building Lidar-based Forest Inventory Models in R

- 8:30am – 9:45am: *Discussion and Demonstration* – **Model validation and interpolation on the landscape**
- 9:45am – 10:15am: *Presentation* – **Transferability of lidar models to new acquisitions/Landsat data, USFS introduction**
- 10:15am – 11:15am: *Presentation and Demonstration* – **Lidar data and biomass estimation in Nepal: Progress and next steps, Shiva Khanal, DFRS Nepal**
- 11:15am – 12:30 pm: Discussion session

Lunch

- 1:30pm – 2:30pm: wrap up discussion, next steps
- 2:30pm: photos, hand out certificates