Negotiation-support toolkit for learning landscapes

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14 | Simple light interception model (SLIM)

Degi Harja and Gregoire Vincent

The purpose of the Simple Light Interception Model (SLIM) is to compute canopy closure (an index of long-term light levels) at any height above the ground within a forest canopy. The forest canopy in SLIM is a 3D geometrical object modelled from measured tree properties. SLIM can be used for stand profile visualization.

Introduction

Measurement of canopy closure and its projection on the ground is not a straightforward process. While direct field measurement may require more time and effort, using a profile model allows exploration of canopy closure on any position in a stand of trees.

The amount of light received at any point in space is calculated by exploring a range of directions (combination of azimuth and zenith angles). Each time a beam originating from that point intercepts a crown envelop of a given porosity it reduces its contribution correspondingly. Total canopy openness at that point is obtained by summing up results for elementary beams. The weight of each beam is determined by the relative surface of the associated sky vault fraction.

From this information and the elevation grid, the software then computes the canopy openness either at regular grid points or at irregular spacing defined by the user or else for each tree of the stand.

Objectives

SLIM aims to produce three-dimensional visualizations of tree stands and to compute canopy closure (canopy porosity) at individual tree or plot level.

Steps

The steps to use the tool are:

1. Profile measurement of a stand (tree diameter, height and crown shape)
2. Crown porosity estimation of each individual tree or species' group
3. Data tabulation and model calibration

Example of application

SLIM can be used to visualize canopy stand at plot level. When compared to hemispherical photographs, SLIM was able to produce similar configuratiosn (Figure 14.1).

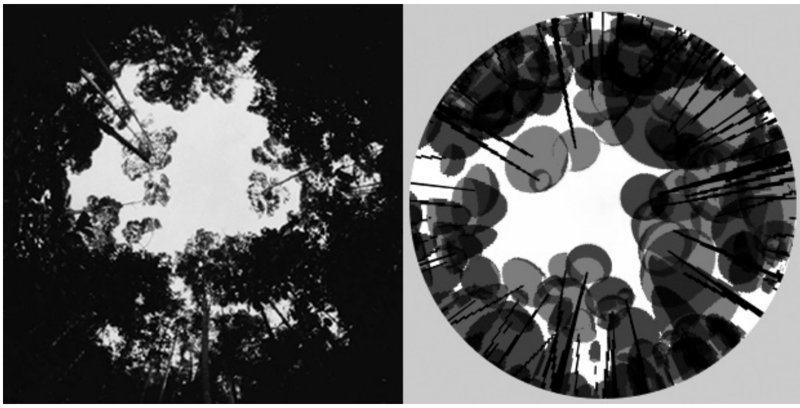


Figure 14.1. A set of hemispherical photographs was used to test SLIM predictions. Left picture was taken by camera and right picture was generated by SLIM for the same point in a real forest (left) and forest data input to SLIM (right)

Detailed stand measurement can also be visualized to better understand the configuration of the stand from various positions (figures 14.2, 14.3, 14.4, 14.5).

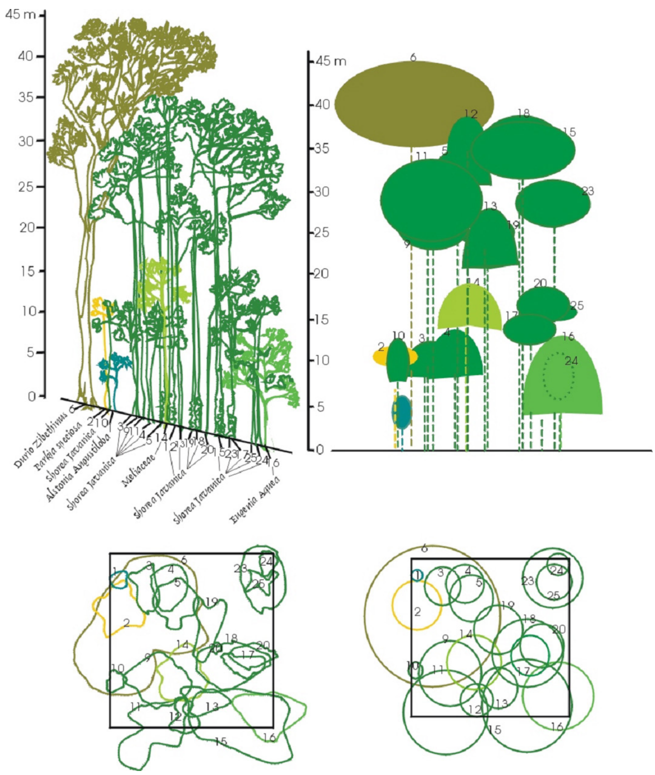


Figure 14.2. A simplified 3D description of the trees composing a stand

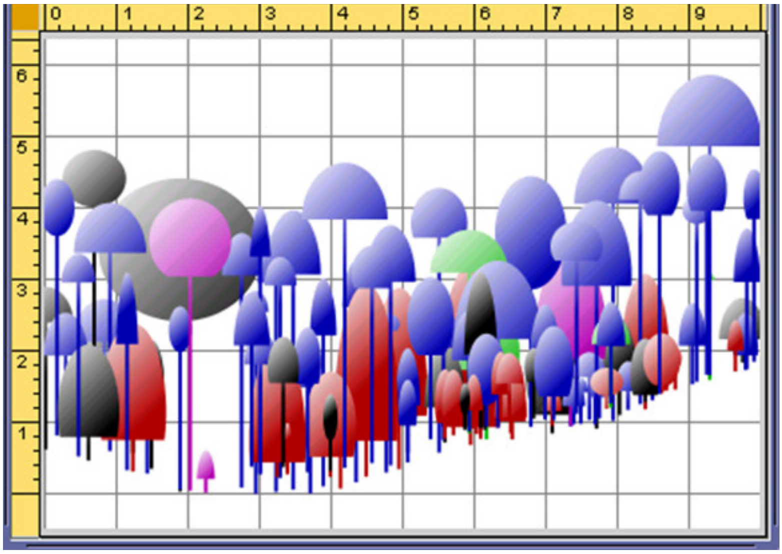
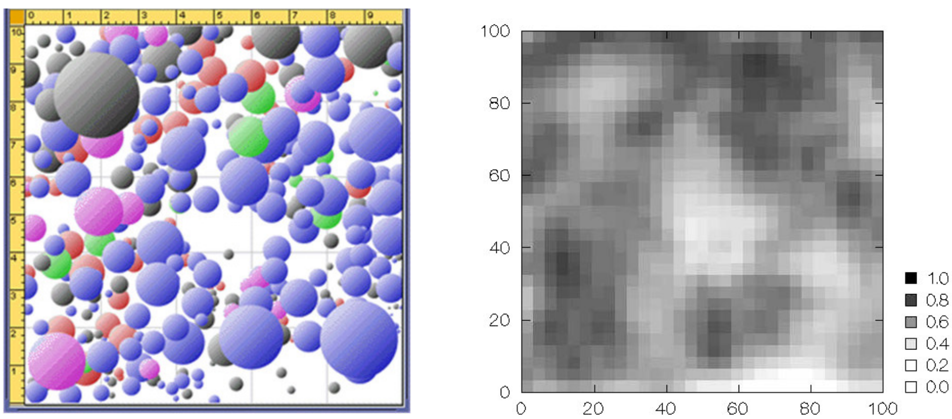


Figure 14.3. An elevation grid interpolates individual tree altitude



Aerial view of a one-hectare stand of Damar agroforest in Sumatra

Map of canopy closure of stand

Figure 14.4. Depictions of canopy openness in SLIM

A visualization of a damar (*Shorea javanica*) agroforest stand is shown in Figure 14.5. From this simplified 3D geometry of the stand, researchers can explore canopy openness in any position within a plot.

Figure 14.5. Three-dimensional view generated by SLIM of a 1 hectare stand of damar agroforest in Sumatra, Indonesia

Key references

Vincent G, Harja D. 2002. SLIM software: a simple light interception model for multi-species, multistrata forests. *Bois et Forets des Tropiques* 272(2):97–100.

Vincent G, Harja D. 2007. Exploring ecological significance of tree crown plasticity through three-dimensional modelling. *Annals of Botany* 101(8):1221–1231.

Website: http://worldagroforestry.org/regions/southeast_asia/resources/slim

The landscape scale is a meeting point for bottom–up local initiatives to secure and improve livelihoods from agriculture, agroforestry and forest management, and top–down concerns and incentives related to planetary boundaries to human resource use.

Sustainable development goals require a substantial change of direction from the past when economic growth was usually accompanied by environmental degradation, with the increase of atmospheric greenhouse gasses as a symptom, but also as an issue that needs to be managed as such.

In landscapes around the world, active learning takes place with experiments that involve changes in technology, farming systems, value chains, livelihoods' strategies and institutions. An overarching hypothesis that is being tested is:

> Investment in institutionalising rewards for the environmental services that are provided by multifunctional landscapes with trees is a cost-effective and fair way to reduce vulnerability of rural livelihoods to climate change and to avoid larger costs of specific 'adaptation' while enhancing carbon stocks in the landscape.

Such changes can't come overnight. A complex process of negotiations among stakeholders is usually needed. The divergence of knowledge and claims to knowledge is a major hurdle in the negotiation process.

The collection of tools—methods, approaches and computer models—presented here was shaped by over a decade of involvement in supporting such negotiations in landscapes where a lot is at stake. The tools are meant to support further learning and effectively sharing experience towards smarter landscape management.

World Agroforestry Centre
ASB Partnership for the Tropical Forest Margins
AARD
Federal Ministry for Economic Cooperation and Development
Norad
IFAD Enabling poor rural people to overcome poverty
CGIAR Research Program on Forests, Trees, and Agroforestry