Mapping Vegetation 3D Structure with Lidar, Radar and Ancillary Data

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1. INTRODUCTION

In recent years we produced 3D maps of mangrove forests of the Caribbean and Africa using Lidar and Shuttle Radar Topography Mission (SRTM) elevation data (Fatoyinbo et al.,2008; Simard et al., 2008; Simard et al., 2006). Canopy height and biomass were derived at the landscape scale. These 3D maps were used to describe the variability of mangrove canopy structure to regions and latitude. Using lidar, we were able to estimate height class distribution and instantaneous forest productivity. This was performed by model inversion of the lidar waveforms that included allometric equations. Although the estimation of mangrove canopy height is relatively simple due to negligible topographic features, the success of the methodology showed that combining lidar with radar interferometry and field data had an enormous potential for global mapping of forest 3D structure. Therefore, we extended this methodology to produce a global map of forest structure using ICEsat/Geoscience Laser Altimeter (GLAS) and radar data, land cover maps and environmental variables.

2. METHODS AND RESULTS

We produced maps of canopy height as defined by the 50th or 100th energy percentile of the GLAS lidar waveform. We also produced maps of canopy closure. The waveforms were corrected for topography using global slopes derived from Shuttle Radar Topography Mission (SRTM) elevation data. A simple geometric model was used to estimate the impact of slope on the waveform. We aggregated sparsely distributed GLAS data by land cover type as defined by the Global Land Cover 2000 product (GLC2000 http://www-tem.jrc.it/glc2000/) to obtain a smooth and continuous map. We only selected land cover types with trees. This segmentation allowed us to derive statistics specific to each land cover type. To improve spatial resolution within a class segment, we used a model driven by environmental variables. Vegetation 3D structure was shown to respond very well to these variables in several North American sites, however, it is unable to account for other forcings such as clear cuts, regrowth and fire. The radar backscatter was mainly used to identify wetlands and slopes. Canopy height estimation error was estimated using LVIS (airborne lidar) and field data.

3. CONCLUSIONS

We produced global maps of canopy height and closure with error of 6m rms. Statistics for height and canopy closure was derived for each forest type. We designed a model based on environmental variables to interpolate between GLAS data points belonging to a same land cover type.

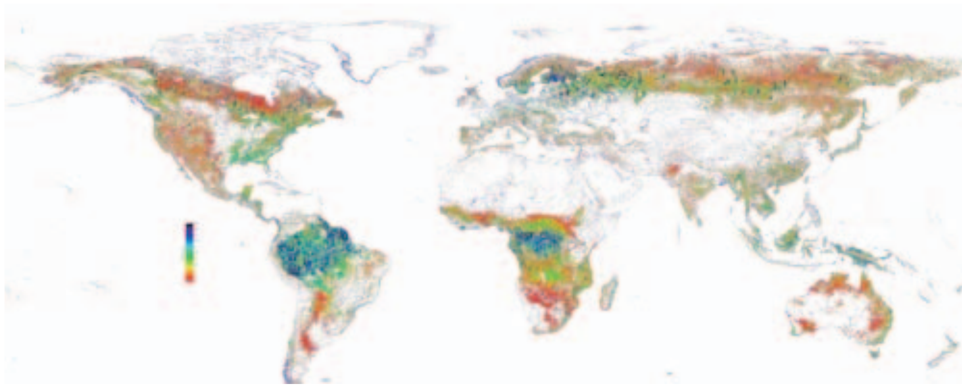

Figure 1: Global map of vegetation height.

3. REFERENCES

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