PROJECT facts

U.S. DEPARTMENT OF ENERGY
OFFICE OF FOSSIL ENERGY
NATIONAL ENERGY TECHNOLOGY LABORATORY

Carbon Sequestration

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# APPLICATION OF LOW-COST DIGITAL ELEVATION MODELS TO DETECT CHANGE IN FOREST CARBON SEQUESTRATION PROJECTS

## CONTACTS


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## Background

Although combustion of fossil fuels is the major contributor to the buildup of carbon dioxide ($CO_2$) in the atmosphere, deforestation also makes a significant contribution. According to the Intergovernmental Panel on Climate Change (IPCC), burning associated with deforestation accounts for approximately 20 percent of the annual global emissions of $CO_2$. The IPCC also estimates that 12 to 15 percent of $CO_2$ emissions from the combustion of fossil fuels could be offset for the period from 1995 to 2050 through decreasing the rate of tropical deforestation, regeneration of tropical forests, and engaging in various forms of agro-forestry. Thus, forest management holds significant potential for decreasing the rate of increase in the $CO_2$ content of the atmosphere.

The $CO_2$ sequestration potential of a forest, as a direct result of the photosynthesis of $CO_2$, can be related to the amount of biomass that the forest contains. Mathematical models have been developed relating the amount of biomass contained in a tree to parameters, such as the height or diameter of the tree. These parameters are typically measured from the ground, which is quite time-consuming and costly.

Digital elevation models (DEM) can reduce the time and cost of obtaining the data necessary to quantify the biomass content of a forest. This technology involves flying an aircraft over a forest and photographing the area using special photographic techniques. The photographic information can then be analyzed to obtain data on tree

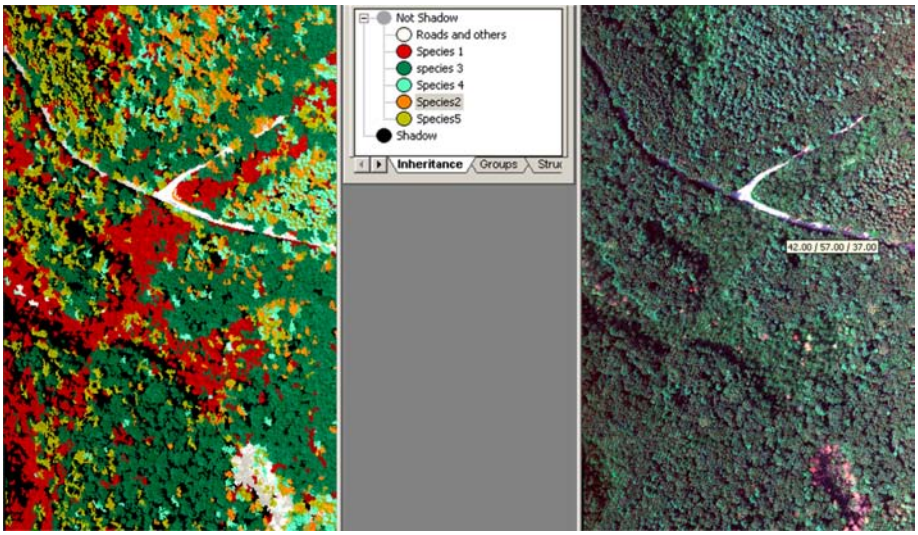


*Figure 1 - Sample Output from Digital Elevation Model (DEM)*

## PARTNERS

Winrock International

American Electric Power

## PERIOD OF PERFORMANCE

07/29/2005 to 07/31/2007

## COST

**Total Project Value**

$551,983

**DOE/Non-DOE Share**

$398,720 / $153,263

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height and crown area in a known area. This data can then be used with appropriate allometric equations to estimate the biomass and, consequently, the carbon inventory of the forest.

## Primary Project Goal

The primary goal of this project is to develop, test, and apply new low-cost technologies using three-dimensional (3-D) terrain reconstruction with multiple ranging lasers and multispectral imagery to detect changes in the carbon inventory in mixed hardwood forests.

## Objectives

The objectives of this project are to:

- Develop and test low-cost, optically derived Digital Elevation Models (DEM) of forest canopy using multiple ranging lasers.
- Develop and test software to detect changes in forest canopy by comparing DEMs produced at two different times on the same site to determine the effect of managed change.
- Assess the utility of the automated process in detecting carbon inventory changes.
- Estimate the cost of using this approach, compared to existing approaches, and the effect on the design and implementation of a monitoring and measurement plan.

## Benefits

This project will provide multiple benefits by providing an economical tool for measuring the carbon content of trees and other vegetation. Besides providing information critical to assessing the sequestration potential of various terrestrial sinks, digital elevation models enable:

- Vegetation change tracking
- Detection of illegal logging
- Documentation of forest certification
- Forest inventory

This will be very beneficial in planning, assessing, and verifying terrestrial carbon sequestration projects. Credits for terrestrial carbon sequestration projects can only be assigned if the increase in carbon inventory due to management activities can be accurately determined and verifiable.

## Accomplishments

- Completion of test measurements and comparative analysis.
- One test site had a difference of 3 percent between laser and ground-based measurements.
- Lasers allow for a true distribution of strata for a larger range than a ground-based plot.

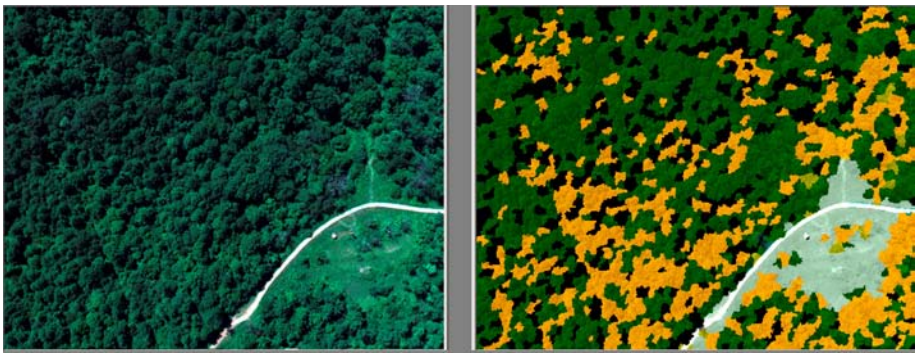

*Figure 2 - Output from DEM*