Calculating quantity of CO_2 fixation by urban trees applying 3-dimensional measurements

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1. Introduction

According to the IPCC, there is no room to doubt global warming, the major cause is the rise of the CO_2 density in the atmosphere, and there is an almost proportional relationship between the cumulative quantity of CO_2 emitted and the rise of the average air temperature.

Combining measures to reduce or restrict emissions to curtail CO_2 is an absorption source measure. Trees grow by fixing CO_2, so the Kyoto Protocol includes a mechanism which can withdraw the quantity of CO_2 absorbed from the quantity emitted by forests and green belts which satisfy specified standards, and the Ministry of Land, Infrastructure, Transport and Tourism coordinates the quantity of CO_2 fixed by the restoration of vegetation such as urban greenery. Japan is not participating in the second commitment period of the Kyoto Protocol, but must continue to reduce quantities in order to establish a new international framework.

2. Purpose of the research

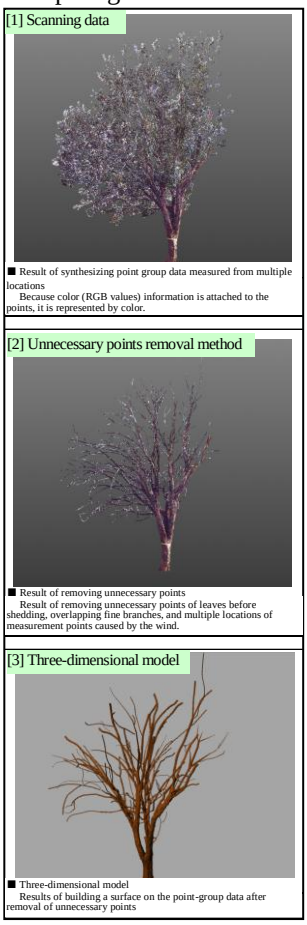
It is known that the carbon (C) content of trees is about 50% of dry weight of the woody part regardless of the species, so it is possible to estimate the quantity of CO_2 that a tree fixes based on the dry weight of the woody part. The speed of growth and density of trees vary between species, so it is possible to calculate the CO_2 fixation of any tree species by investigating the dry weights of various species at various ages. Until now, the NILIM has cut down trees and measured their volume and weight to calculate the CO_2 fixation quantities of camphor tree (*Cinnamomum camphora)*, bamboo-leak oak (*Quercus myrsinaefolia*), Japanese zelkova (*Zelkova serrata*), and gingko (*gingko biloba*), and others. But, because this loses valuable tree resources and the cutting etc. is time-consuming and costly, this research was intended to establish a CO_2 fixation quantity calculation formula for many species of trees by non-destructively and efficiently estimating the dry weight of trees without cutting them down.

3. Three-dimensional measurement of tree shapes

A three-dimensional laser scanner, which is an instrument which performs non-contact 3D geotagging of the surface shape of an object, is used to measure disaster sites or complex civil engineering structures, traces, etc. This method is used to estimate the volume of a tree to calculate its dry weight by finding the product of the volume and air-dried specific gravity of a sample.

Figure 1. Measurement of Tree Shape

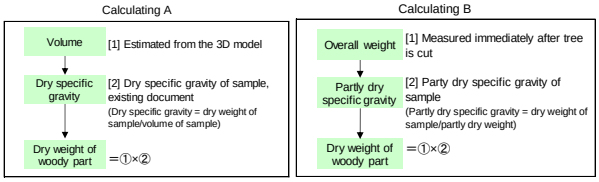
Figure 2. Processing of Preparing the 3D Model



To verify this method, dry weight A calculated by weighing and the dry weight B found by cutting a tree, removing its leaves, then measuring it were compared.

In the future, the number of tree species will be

Figure 3. Dry Weight Calculation Methods



increased and the precision verified, to calculate the quantity of CO_2 fixed within an error of 10%.

[Sources]
Landscape and Ecology Division web page: Calculation of quantity of CO_2 fixed by urban trees
http://www.nilim.go.jp/lab/ddg/naiyo/co2/co2.html