

# ESTIMATION OF CARBON STOCK FROM VOLUME AND BIOMASS EQUATIONS IN A MONTANE CLOUD FOREST ECOSYSTEM IN NORTHEASTERN, MEXICO



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## Abstract

An indicator of climate change is the global warming, produced by the increment of different greenhouse gases concentration in the atmosphere such as the carbon dioxide (CO<sub>2</sub>), the methane (CH<sub>4</sub>), the oxide nitrous (N<sub>2</sub>O), the sulfur dioxide (SO<sub>2</sub>) and the chlorofluorocarbons (CFC), being the CO<sub>2</sub> responsible for the greenhouse effect. The use of fossil fuels and the change of soil use are considered as the two main sources of CO<sub>2</sub> in the atmosphere. The CO<sub>2</sub> is incorporated to the plants by the photosynthesis and participates in the composition of the tree structure (stem, foliage, branches, crown and roots). This investigation was developed in the Biosphere Reserve El Cielo, northeastern Mexico. Sample plots were taken randomly (1000 m<sup>2</sup>). With the field data the volume and biomass determination was carried out for different species. To estimate the tree volume the following models  $V=a_0*(d)a^1$  (hardwood) and  $V=a_0+a_1*d_2+a_2*h+a_3*d^2*h$  (softwood) were used. To determine the biomass was applied the equation  $b=a_0+(d)$ , and the carbon equation was  $C=0.69322*d(2.3427)$ , where  $V$  is tree volume,  $b$  is biomass dry weight (kg),  $C$  is carbon stock (kg). This model had the best adjustment in tree species of the cloud forest ( $r^2=0.95$ ). The carbon stock was estimated in the tree stems obtaining 56.7 MgC ha<sup>-1</sup> for this forest ecosystem. With this procedure we can evaluate the carbon stock in different Montane Cloud Forest ecosystems in northeastern Mexico.



## Results

### Volumetric and Biomass Functions

The volumetric and biomass determination in different species was carried out, using mathematical models described for deciduous and conifer species. We proceeded to divide the trees according to dimensions by species, obtaining a better volume location. The mathematical models that presented better adjustment in R<sup>2</sup> and F value are:

a) Volumetric function for hardwood species.  $V= a_0 * (d)^{a1}$

b) Volumetric function for softwood species  $V= a_0 + a_1*d^2 + a_2*h + a_3*d^2*h$

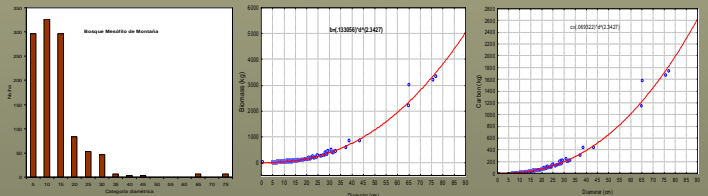
The Wood density values for the arboreal species were not found. We decided to use a value of specific density of 0,46 g/cm<sup>3</sup>. After it was obtained the biomass values in all the species, it was proceeded to determine the carbon values in level species, in tree deciduous species it was used a constant of 0,531 and in the conifers of 0,521 like a carbon conversion factor.

### Diametric Categories

We have found that the diameter categories had a tendency to heterogeneity, where most of the trees were presented in the first categories and only a few tree were presented in the higher diameter categories. These conditions locate to the ecosystem (cloud forest) in a phase of highly dynamism.

### Biomass

After the volume determination we proceeded to calculate the biomass for specie, it was applied the not lineal model, obtaining a R<sup>2</sup> by species, over 0,95, except for *Ficus* spp and *Podocarpus reichei*, with 0,92 and 0,9.



## Conclusions

### Carbon Inventory

The allometric model proposed to estimate biomass in tree stems of the cloud forest in Mexico was adjusted with high values of R<sup>2</sup>=0.95, using only the variable diameter (d). Once specific the biomass values by diameter category in all species, we proceeded to determine the carbon values by species level. The quantity of carbon stored in the component of the cloud forest was 56,7 Mg C ha<sup>-1</sup>.

### Acknowledgements

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## Objective

The main objective of this study was the estimation of carbon stock in the cloud forest ecosystem. A pilot experiment designed to generate an allometric model to estimate the individual biomass and carbon in dominant species was established.

## Study area

The investigation was developed in the Biosphere Reserve El Cielo, which is located in northeastern Mexico. This protected area has 3 different ecosystem types: Montane Cloud Forest, Tropical forest and Mixed Pine-Oak Forest. The arboreal species are *Podocarpus reichei*; *Carpinus caroliniana*, *Liquidambar styraciflua* and *Quercus xalapensis*; and with smaller frequency are: *Acer skutchii*, *Ceiba pentandra*, *Illicium floridanum*, *Magnolia tamaulipana*, *Melia azedarach* and *Senna guatemalensis*.

