QUANTIFYING CARBON SEQUESTRATION IN FOREST MANAGEMENT USING CO2FIX V3.1 MODEL

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INTRODUCTION

Carbon sequestration and the role of forests has become an important subject because of its contribution in ameliorating global environmental problems such as atmospheric accumulation of greenhouse gases (GHG's) and climate change. Due to cost effectiveness, high potential rates of carbon uptake, associated environmental and social benefits, much attention has been focused on promoting tropical forestry for offsetting carbon emissions (IPCC 1992).

The basic idea of sequestering carbon through trees in forest is very simple. Trees take in carbon dioxide from the air through photosynthesis process and convert it (together with other elements from the soil and the air) into woody materials. Photosynthesis will take up carbon dioxide from the atmosphere and in that process convert carbon dioxide into carbon which is stored in roots, stems, leaves and the soil. As tree die and their components decompose, the carbon is released back into the atmosphere.

Therefore, the demand for a proper management practice of tropical forest is crucial in keeping the continuation of carbon cycle naturally.

RESEARCH OBJECTIVE

1. Determine litterfall for estimating C flow from plant pool to soil pool.
2. Determine decomposition rate of litter.
3. Quantifying carbon sequestration potential in tropical forest ecosystem using CO2FIX V.3.1.

RESEARCH METHODOLOGY

Research Methodology:

i) Study Area

The study site has been conducted in a 1 hectare plot of tropical rain forest at Sungai Lalang Reserve Forest, Selangor. Located about 101.85' East and 2.9' North.

ii) Research Procedure

a) Identifying Species in 1 hectare plot of study area

Species of trees in 1 hectare plot of study area has been identified (from dbh 5cm and above) to study their characteristic of growth.

b) Litter Sampling:

Twenty litter traps has been placed randomly under canopy in 20 different subplots. Traps will be positioned in the centre of each sub plot at 1 m above the ground. Litter has been collected for every month. All the litter materials are separated and dry weights has been recorded. Decomposition Test of Litter will be done every week and measurement of decomposition rate will be measured.

iii) Data Collection

Litter sample will be collected every month and decomposition rate will be monitored every week interval.

iv) Data Analysis

Modeling for Carbon Sequestration
Developing suitable eco-physiological model and validate the model for carbon sequestration. The microclimatic models utilizing eddy covariant formulation will be considered in modeling the carbon budget of the inland ecosystem.

Analysis of variances will be applied to analyze data and CO2FIX V3 model to do the prediction base on inventory data.

v) Report Writing

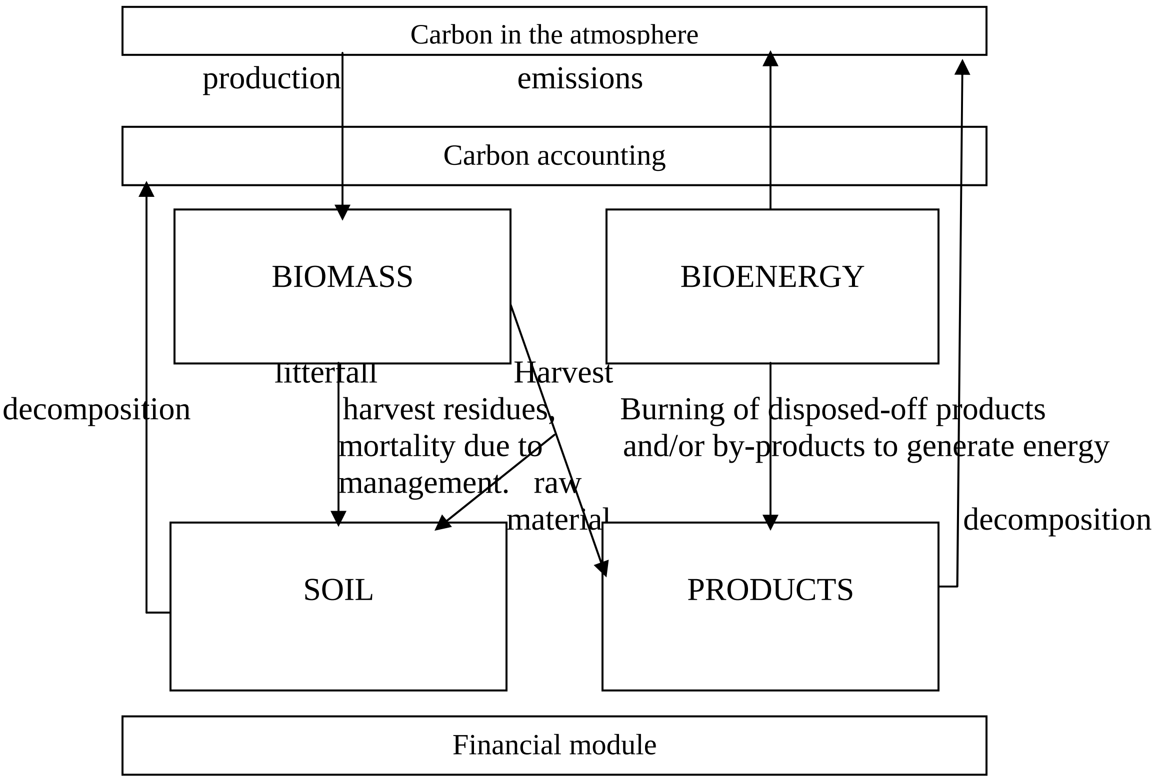


Figure 1. The modules of CO2FIX V3.1.

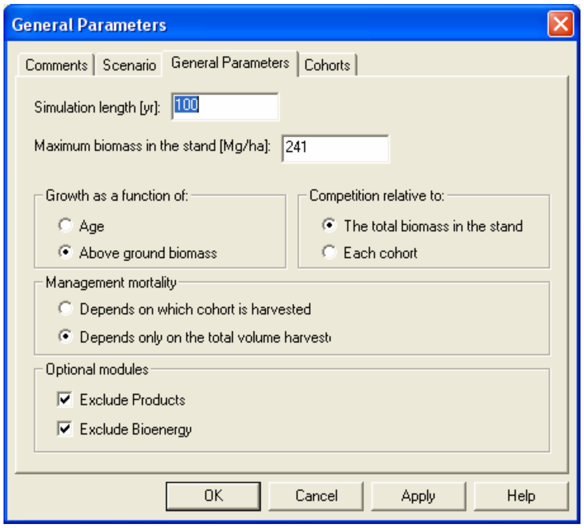
Figure 1 illustrates the modular structure of the model. The **biomass module** converts volumetric net annual increment data with the help of additional parameters to annual carbon stocks in the biomass compartment. Turnover and harvest parameters drive the fluxes into the soil and the products compartment. In the **soil module**, decomposition of litter and harvest residues is simulated using basic climate and litter quality information. The fate of the harvested carbon is determined in the wood products module, using parameters like processing efficiency, product longevity and recycling. In the bioenergy module, discarded products or by-products from the product module can be used to generate bioenergy, using varying technologies. The carbon accounting module keeps track of all fluxes to and from the atmosphere and determines the effects of the chosen scenarios, using different carbon accounting approaches. The financial module uses costs and revenues of management interventions to determine the financial profitably of the different scenarios.

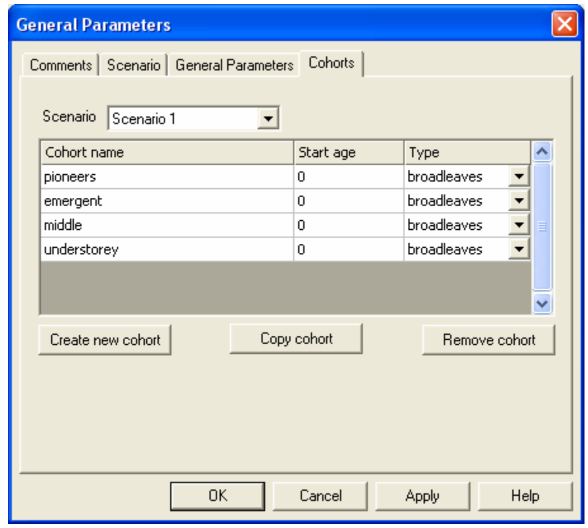
This easy-to-use model simulates stocks and fluxes of carbon in trees, soil, and -in case of a managed forest- the wood products, as well as the financial costs and revenues and the carbon credits that can be earned under different accounting systems. Stocks, fluxes, costs, revenues and carbon credits are simulated at the hectare scale with time steps of one year.

RESULTS AND DISCUSSION

4.1 CO2FIX V3 Model

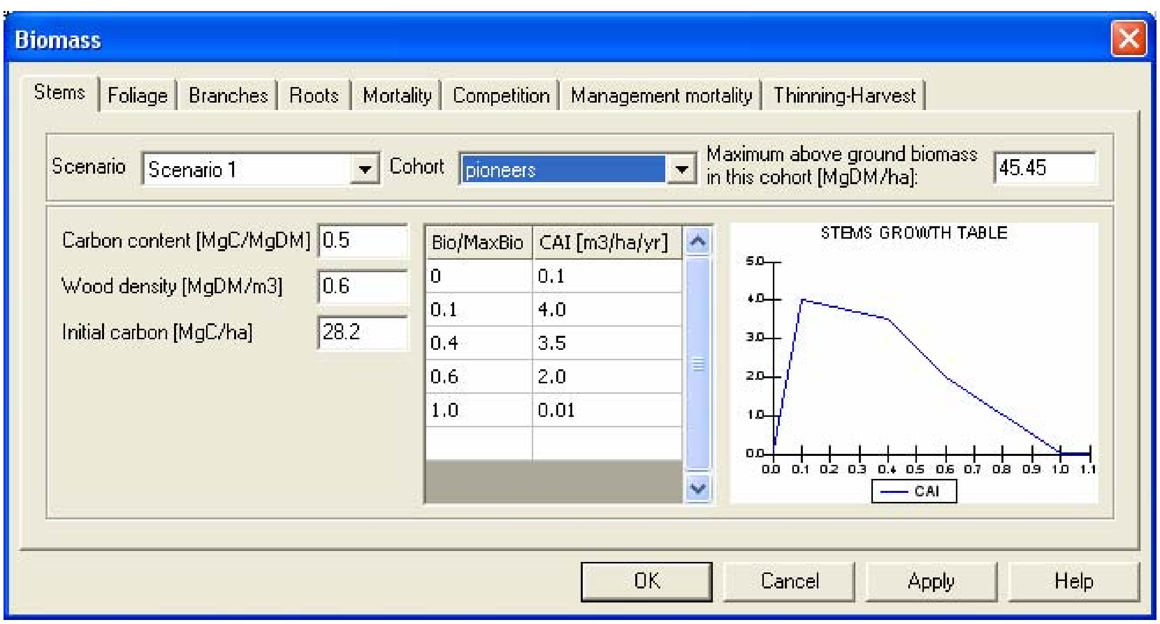
General Parameters





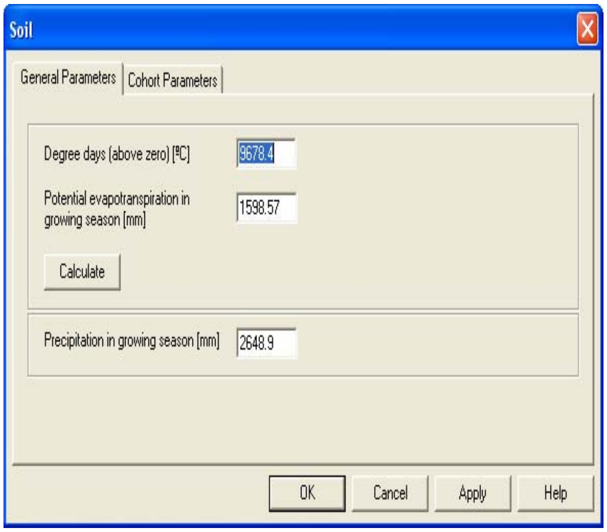
Biomass Module

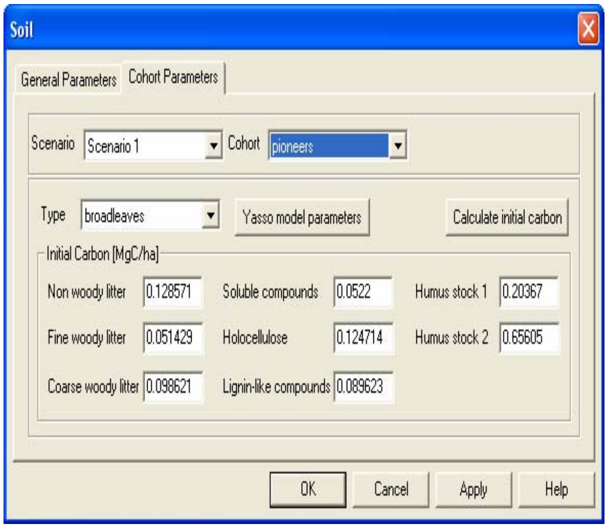
The biomass module converts volumetric net annual increment data with the help of additional parameters to annual carbon stocks in the biomass compartment. Turnover and harvest parameters drive the fluxes into the soil and the products compartment.

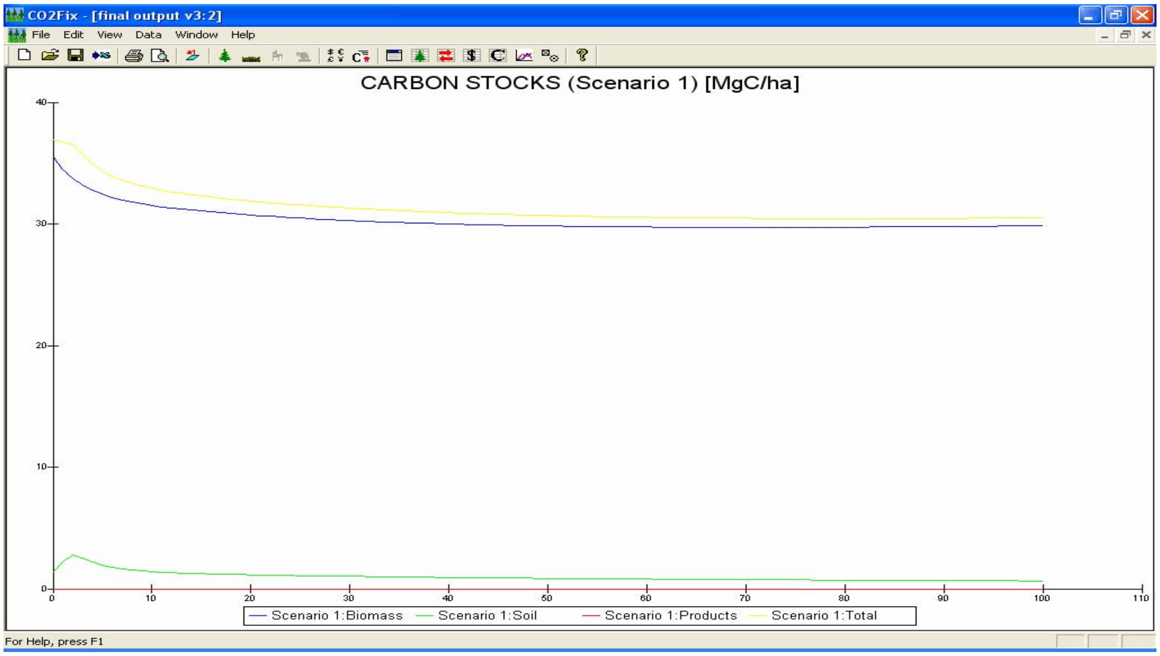


Soil Module

In the soil module, decomposition of litter and harvest residues is simulated using basic climate and litter quality information.







Carbon Stocks

The simulation from this model indicates that the long term (100 years rotation) carbon storage in soils range from 0.64 to 1.4 Mg C/ha while carbon stored in living biomass ranged from 35.5 to 28.84 Mg C/ha. All the values are predicted based on inventories in year 2000 to 2005 and some are according to standard values for tropical forest when no inventory data available (Schelhaas et al., 2004).

The carbon stored in living biomass in the tropical rainforest is relatively low compared to the other systems due to the previous logging history of the site. Also, the continuous logging on the site does not allow the biomass to reach higher values. Biomass turnover rates of foliage and fine roots caused a considerable variation in the soil C stock and sink. The addition of litter from ground vegetation to the total litter flow increased the total soil C stock with over 10%, but hardly affected the estimation of the soil C sink (de Wit et al., 2006). (explain climate condition that effect decomposition rate and carbon stock in soil).This might be because we assumed that ground vegetation primarily produces fine litter that is relatively easily degradable and comes into a steady state rather quickly. It suggests that including litter from ground vegetation is not critical for the certainty of the soil sink estimate. For overall observation, all the prediction values were reducing by year.