Estimating Carbon Stock in a Eucalyptus Plantation Using Remote Sensing and a Process-based Model

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Abstract: With increasing industrialization and increase of world population, global carbon budget holds utmost importance in determining the overall condition of our mother earth. In an effort to decrease the increasing carbon content in our atmosphere, various NGOs, governments and private enterprises are involved in plantations of exquisite species of trees, such as Eucalyptus Globulus, which can absorb carbon at a much faster rate than usual trees and can also contribute to various production industries upon maturity. Estimating the carbon stock in these plantations, thus, gives us an accurate idea on how much they are contributing towards the reduction of this global problem and help us determine the eco-economical status of the same.

In this study, a methodology is proposed, to estimate the carbon stock in a Eucalyptus Globulus plantation in Chile by integrating remote-sensing with a simple process-based model. The model requires few parameter values and only readily available input data to calculate net primary production, from which carbon stock can be estimated. Based on the radiation use efficiency model, it calculates the utilizable absorbed Photosynthetically Active Radiation (PAR) from supplied values of fraction of absorbed PAR (fPAR). Temporal LandsatTM imageries are used to calculate fPAR spatially in the plantations using a calibrated NDVI-fPAR relationship. With other required climate data, the model was able to estimate the carbon stock at the site quite effectively upon integration with remote sensing. Spatial distribution of the above ground biomass at different growth stage can be estimated and visualized well upon the incorporation of remote sensing data, which is otherwise not possible with the conventional use of the point data values. Integration of the remote sensing data also makes the model more effective by constraining it with at-ground growth conditions.

Keywords: Carbon forestry, remote sensing, forest growth model, integration.