Influences of Humans, Climate, and Fire on Forest Ecosystems and Carbon Dynamics in West Kalimantan, Indonesia

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LCLUC Abstract

The tropical forest regions of Indonesia represent a significant terrestrial reservoir for atmospheric carbon. The source/sink dynamics of this reservoir have changed dramatically over the past three decades in response to a variety of forcing factors, including human-caused deforestation, changes in land use, climatic variations, fire, and patterns of forest recovery after disturbance. While the influence of these factors on the carbon source/sink relationships is generally known, these factors have not been quantified to the degree necessary to determine the role of these forests in terms of regional and global carbon budgets.

The goal of this proposal is to develop new approaches to quantify carbon source/sink relationships in the forested regions of West Kalimantan, Indonesia. In accomplishing this goal, we will address four objectives: (1) develop a regional-scale database that can be used to quantify variations in terrestrial carbon storage as a function of the major forest cover and land use types found throughout the region; (2) develop approaches to use information derived from Landsat imagery to: (i) map vegetation and land cover in support of Objective (1); (ii) assess spatial/temporal patterns of deforestation and land cover change associated with human activities; (iii) assess patterns of damage from fires that are common during ENSO events; and (iv) map patterns of forest recovery after disturbance; (3) develop a suitable modeling framework that will enable us to incorporate the regional carbon model developed in (1) with the land-cover information derived in (2) to assess carbon fluxes as a function of the factors driving land cover change in the study region; and (4) exercise the model to assess past, present and future trends in carbon source/sink relationships in the study region.

To achieve these objectives, the project team will build upon the extensive field experience, databases, and collaborations with Indonesian scientists and land-use planners developed by the PI over the past 15 years. These collaborations, along with exploitation of Landsat imagery, will provide the basis for Objective 1. We will obtain a large volume (approximately 50 scenes) of Landsat imagery for the study region and create a large-scale Landsat mosaic at the University of Maryland (Objective 2 (i)). We will then process these data to produce a land-cover map for the region. In addition, we will conduct intensive studies of time-series Landsat imagery at selected study sites to address Objective 2 (ii) to (iv). We will use the PI's expertise in Indonesian forestry policy, land-use and forest ecosystem dynamics along with expertise of the Co-Is in terrestrial carbon budget modeling to address Objectives 3 and 4.

The results from this project will provide a much clearer understanding of the role of the Indonesian tropical forests in the global carbon budget. In addition, we will develop an approach to integrate the variety of natural and human factors controlling carbon source/sinks in tropical forests of this region, which, in turn, will allow us to assess the relative influence of each of these factors on the carbon cycle.