Operationalizing GOFC in the Miombo Region and Questions of Carbon

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[Progress Report Year 2, Submitted April 30, 2002]

1. ABSTRACT

This pilot GOFC project for the Miombo Dry Tropical Region of Southern Africa is seeking to understand the role of Miombo in the carbon budget, as well as provide baseline land cover information to support ecosystem assessment and natural resources management. The overarching science goal is to quantify carbon in the Miombo system and estimate carbon fluxes due to land use/land cover changes, and explore the question about whether the Miombo region is a source or sink of carbon over a forest management horizon (10 to 20 years, using the 1990-2000 as an initial test period). Related to this, the project is exploring the feasibility of community-level carbon projects that would satisfy Kyoto forests.

This will be accomplished through

1. Mapping the miombo region using Landsat 7 data by working in conjunction with Southern African national mapping agencies;
2. Measurement of carbon densities in representative land cover/forest cover types of the region, while building upon existing forest inventory and national biomass studies;
3. Development of a carbon accounting model that will quantify carbon pools in the miombo region for 1990 and the year 2000, and the major C fluxes due to land cover changes;
4. Development of a regional spatial database for site characterization; and
5. Development of an information management system that will distribute satellite data for the miombo region, and serve as a database archive for field data about the miombo region, such as forest inventory records and site data for image classification.

The Miombo GOFC project will provide leadership in application of satellite data in the Miombo Network, and expects to engage as many user groups as possible. The acquisition and distribution of satellite data to as many user groups within the Miombo Network is a very important service to the community designed to maximize benefit from remote sensing.

Keywords:
1) Research Fields: carbon, land cover change, land use change
2) Geographic Area/Biome: Southern Africa; Miombo Woodlands, Savanna Woodlands
3) Remote Sensing: Landsat, Land Cover Mapping
4) Methods/scales: integrated modeling, landscape scale

2. GOALS

This project is addressing the following NASA ESE scientific questions:

a) what are the changes in land cover and/or land use (monitoring/mapping activities),
b) what are the consequences of LCLUC (in terms of carbon).

Proportion of social science used in study: 25%
Themes: Carbon (25%), GOFC mapping and monitoring of forest cover change (75%),

Goals for this period of performance and accomplishments

For year 2, the main goals/planned activities were:

- *Miombo GOFC Meeting to discuss applications of LCLUC in natural resources management*

A regional workshop was held in Manica, Mozambique during September 26-28th, 2001, and papers presented are being prepared for a workshop report.

- *Field Measurements of Forest Biomass*

Field sites identified in Manica and Nampula, Mozambique and measurements taken to continue work started in Year 1 for Nampula. A masters thesis (Sarah Walker at UVA) is being prepared.

- *Design of carbon models and links to land use*

A carbon model has been designed and was presented at a July 2000 workshop. A manuscript is in review for inclusion in a special issue of Forest Ecology and Management. A regional map for 1990 showing forest/non-forest coverage has been produced (derived from individual national maps). A running version of a land use change model (MELT) is available, and is being tested for the Zambezi River basin countries as part of the Millennium Ecosystem Assessment. Versions for Malawi, Mozambique, Tanzania, Zambia and Zimbabwe are expected during Year 3.

- *Data bundle for integrated assessment and modeling*

A GIS data bundle has been prepared and is being processed for final release during the World Summit in August. These data are already being used in the field by scientists in Southern Africa.

- *Participation at the IGBP Open Science Meeting in Amsterdam, Jul 2001*

Presented land use modeling results as part of a Miombo Network cluster of posters (total of 6 posters presented).

Timeline (milestones), Accomplishments

Annual workshops continue to develop useful outreach for the GOFC/GOLD activities in Southern Africa.

The data bundle is being used as a basis for Millennium Assessment activities in Southern Africa.

Gaps/Problems and Possible Solutions

- It took a while to secure Landsat 7 data for remaining sites, but this has been resolved and data have been ordered (expect delivery any time).

3. PROGRESS, SIGNIFICANT RESULTS AND NEXT STEPS

This study is making very good progress. An early regional workshop clearly established data needs, methods and regional partnerships for the GOFC network in Southern Africa. Emphasis in year two has been on completing distribution of Landsat data in media and formats that are useable in Africa. The availability of the Landsat 1990 mosaic from Earthsat has greatly enhanced our database. The mosaic data are being used to provide a 1990 baseline for further mapping. A strong network now exists in each Miombo country to implement GOFC/GOLD activities.

Special issue on African Global Climate Change published in August 2001 under "Climate Research" Volume 17 Number 3 (Inter-Research Publishers, Netherlands)

A regional land cover map and harmonized classification system was produced, and is being used in further land cover change studies.

A gis data bundle has been produced to update the LUCC Miombo CD-ROM produced in 1997.

Science findings are being published as a journal special issue in Forest Ecology and Management later this year, including methods for classifying Landsat, models of carbon, and models of land use change dynamics (MELT).

* New potential

- A Miombo land use change model (MELT) has been constructed and provides the integration of rural and urban economic forces prevalent in this region (formal and informal sectors). The model has the necessary spatial resolution to be useful in impacts studies of land use change on hydrology, carbon and land use planning. It is forming the basis for an integrated assessment model (for climate change) in Southern Africa. Early simulation experiments indicate a threshold in landscape fragmentation after which land use changes become monotonic. In general, the nature of land use change decisions make land use trajectories unstable – that is, equilibrium conditions are difficult if not impossible to achieve
- Move from pilot activity under GOFC/GOLD into operational mode - systematic mapping and monitoring of land cover change and dynamics.

- Validate land use change model (MELT) and apply to carbon studies in this region.

* New products
- Regional Map of Forest/non-Forest for 4 countries of the Miombo Region (see Figure attached as a jpeg – higher resolution image available).
- Southern African country-wide mosaics based on 1990 Landsat data from Earthsat available (processed from individual UTM panels provided by Earthsat). The country mosaics provide overlaying capabilities with other baseline information.
- GIS Data bundle for Southern Africa for integrated assessment and modeling.

Next Steps
- Finalize journal special issue
- Continue field observations to develop carbon densities relationships under different land uses
- Complete updating land cover maps using Landsat 7 data when complete coverage available later this year.
- Present Miombo Network GOFC/GOLD results at the World Summit on Sustainable Development in South Africa, August 2002.
- Participate in Millennium Assessment projects in Southern Africa.

CONCLUSIONS

The Miombo Network continues to be very active in Southern Africa with at least regional workshops every year. A workshop during 2001 exchanged methods in remote sensing and community natural resources management, while a training workshop further explored remote sensing methods and use of models to understand land use changes. Landsat data from the Earthsat 1990 Mosaic was acquired by the Network and distributed to national mapping agencies in the 5 countries of the miombo region (Malawi, Tanzania, Mozambique, Zambia and Zimbabwe; a total of over 200 scenes. Further Landsat 7 data acquired for about 50 sites were also distributed to regional scientists and students. These data are being used to update regional land cover maps and studies of fire. Based on this large archive of Landsat data, the Miombo Network will play a major role in Millennium Assessment activities in Southern Africa, ensuring the widest use of results by policy makers and managers in this region. The Miombo Network continues to advance GOFC goals in this region.