LAND-COVER AND LAND-CHANGE (LCLUC)
IN THE SOUTHERN YUCATÁN PENINSULAR REGION (SYPR)

REFINING MODELS & PROJECTIONS OF DEFORESTATION WITH APPLICATION
TO THE CARBON CYCLE, BIOTIC DIVERSITY & REGENERATION CAPACITY,
SUSTAINABILITY & VULNERABILITY

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Abstract

The LCLUC-SYPR continues its design of “integrated land-change” study focused on one of the last tropical forest frontiers remaining in Mexico containing the Calakmul Biosphere Reserve and elements of the Mesoamerican Biological Corridor, but labeled by international organizations as a hotspot of deforestation. The project is developing spatially explicit land-change models, empirical findings of which inform an agent-based, dynamic spatial simulation model to be used for integrated assessments of various kinds. Phase 2 of this project: [1] continues ecological, socio-economic, and remote sensing studies that provide the empirical basis for synthesis and modeling; [2] adds uncertainty and subpixel classification analysis; [3] link to MODIS-Comparative Reserve LCLUC study; [4] add studies of institutions and species invasion; [5] rework and refine models; [6] couple the extant and new data and findings to generate [a] refined estimates of the magnitude, location and rates of deforestation-forestation in the region, [b] fine-tuned estimates of carbon (sink-source) and the costs of carbon sequestration, and [c] determination of the loss biota (ECOSUR unit of the project) and model projections of locations most vulnerable to further losses.

Key words:
Forest Conversion
Land Cover Classification
Land Use Modeling
Central America
Humid Tropical Forest
Tropical Dry Forest
AVHRR
LANDSAT
MODIS
GIS
In-situ Data
Integrated Assessments
The LCLUC-SYPR project seeks to document the land conditions and changes underway in the region down to the Landsat pixel level, explain the changes as function of the coupled human-environment systems operating there, and assess-project the consequences of the changes on the coupled system. It attempts to do this by the direct examination of certain problems (e.g., carbon flux) and by creating explanatory and scenario (integrated assessment) models that address the magnitude and location (pixel) of the changes and persistence underway.

The project is truly “integrated land-change science” in the sense that the expenditure of funds, research personnel, and actual research is roughly 1/3rd, respectively, social science, natural science, and remote sensing/GIS science.

The year two goals of Phase 2 of the project were: [1] to link to and supplement ECOSUR’s work on biodiversity and land change in the region; [2] supplement the nutrient dynamic work, working toward carbon assessment; [3] complete the phase 2 image classification; [4] complete work on invasive species and institutions; [5] complete the SYPR IA (integrated assessment model); [6] improve the regional binomial logit model; [7] link to the LCLUC Comparative Reserve Study; [8] advance funding for vulnerability assessment. These goals are addressed numerically below.

1. Biodiversity continues with ECOSUR which has begun a digitized, spatially explicit data base on its extensive biodiversity work in the area; field-data collections continue.
2. New plot-transect work on biomass and soils continues.
3. A new TM imagery classification should be completed by Fall; it has 27 land-cover classes, pushing the classification to the detail required for the various kinds of land-change science work. It has detailed forest-cover classification with particular significance for carbon and biodiversity.
4. Doctoral students have completed their study of institutions and are about to complete their study of invasive species.
5. SYPR IA Phase 1 model continues under development.
6. A new modeling approach is under preparation: a dynamic panel discrete choice regional model.
7. Work continues with the LCLUC Comparative Reserve Study on MODIS classification and activities on biodiversity analysis between ECOSUR and Montana State are beginning.
8. The advances made across all these fronts, link to other sources of funding, including other NASA units, were used to develop a “vulnerability” project based on SYPR IA model. This proposal received high marks from the competition entered and will be resubmitted this year.
9. OUTREACH. The project prepared and distributed through the auspices of ECOSUR an explanatory document on findings to the major organizations and *ejidos* that participated in phase one of the research. The *ejido* document was prepared in style that would be understandable to primary educated individuals.
New Findings
Phosphorus and precipitation appear to be the limiting factors in vegetation succession IF not affected by cultivation. Cultivating plots supercedes these biophysical limits.

Tentative work indicates that land changes are reconfiguring the structure of the forest towards short-lived species with fast decomposing litter.

TM imagery classification pushed to 27 land-cover classes backed by detailed ground truthing. This includes: 5 upland forest types, 2 wetland forest types, 3 wetland grass-sedge types, 2 water types, 4 agricultural types, fern, 3 succession vegetation.

New modeling efforts indicate the relative proportion of agent and structural factors that drive deforestation and forest persistence.

New Methods
1. A newly developed procedure for in-process classification assessment (IPCA) which uses Dempster-Shafer evidential reasoning to decompose uncertainty in the Maximum Likelihood classification procedure into three components – uncertainty arising from ambiguity in the training data, uncertainty because of the presence of mixed pixels, and uncertainty because the pixel appears to belong to an unknown class.
2. Use of knowledge fusion to support classification.
3. New dynamic panel discrete choice model under development.

New Products
1. Reports delivered to local organizations and local communities that worked with the project in the region.
Conclusions
The SYPR project is making major headway in all fronts: stronger than ever partnerships in Mexico; major new-version classification; almost complete IA model; new work on institutions, ecosystem fragmentation, carbon, nutrient cycling, invasive species, womens’s groups impact on cultivation, and chili cultivation underway; and preparation of new modeling efforts.

Publications during 2001-02 or In Press
SYPR Publications

OVERVIEW-INTEGRATED


MODELING


ENVIRONMENTAL


Read, L., and D. Lawrence (in press). Litter nutrient dynamics during succession in dry tropical forests of the Yucatan: regional and seasonal effects. *Ecosystems*

**HUMAN**


