

TIME-SERIES FOREST CHANGE, LAND COVER / LAND USE CONVERSION AND SOCIO-ECONOMIC DRIVING FORCES IN THE PETÉN, GUATEMALA

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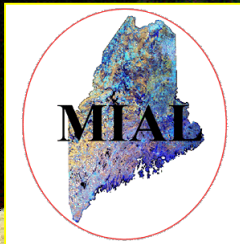
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Thomas Sever NASA - MSFC

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COOPERATORS:



<http://www.ume.maine.edu/~MIAL/>

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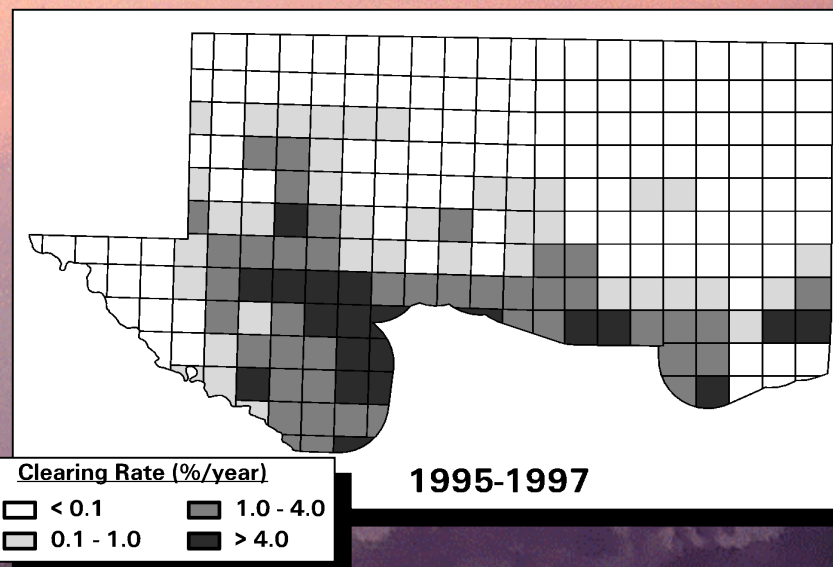
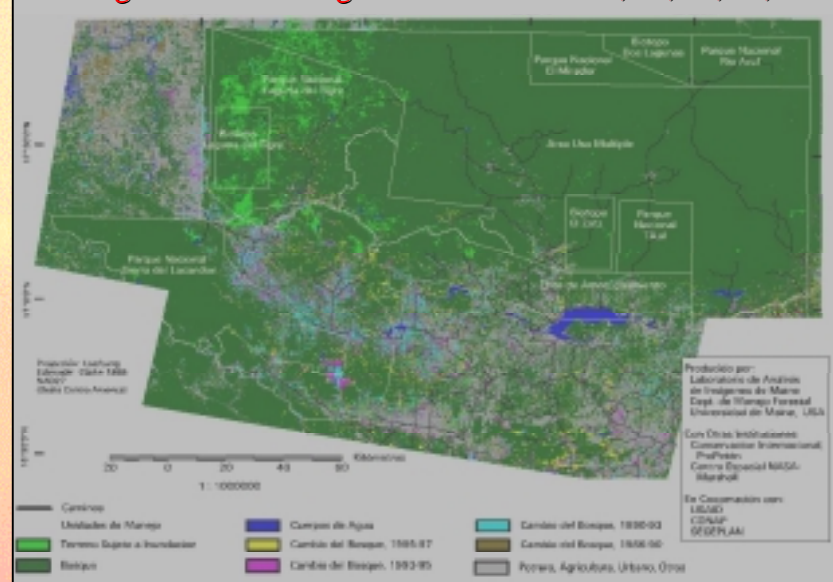
Goals

1. The continued update of Maya Biosphere Reserve (MBR) **Forest Change Maps** for NGO conservation planning and policy development (now six dates from 1986 to 1999);
2. a proposed **monitoring system** for the MBR integrating Landsat-Thematic Mapper (TM) at level 1;
3. the development and testing of satellite forest change detection techniques for transfer of technology to NGO's;
4. the development and analysis of a forest clearing and regrowth database;
5. analyzing the effects of landscape variables on forest clearing; and
6. the linking of community-level socio-economic data to the land cover / land use change analysis.

Approach

- Developed an accurate and efficient procedure for extracting land cover change data from time-series Landsat imagery;
- Assembled a forest conversion history database from 7 dates of Landsat imagery, spanning 1974 to 1997;
- Modeled landscape effects on forest clearing over time for a portion of the Maya Biosphere Reserve; and
- Linked land cover data derived from the satellite image database to household survey data at the community level.

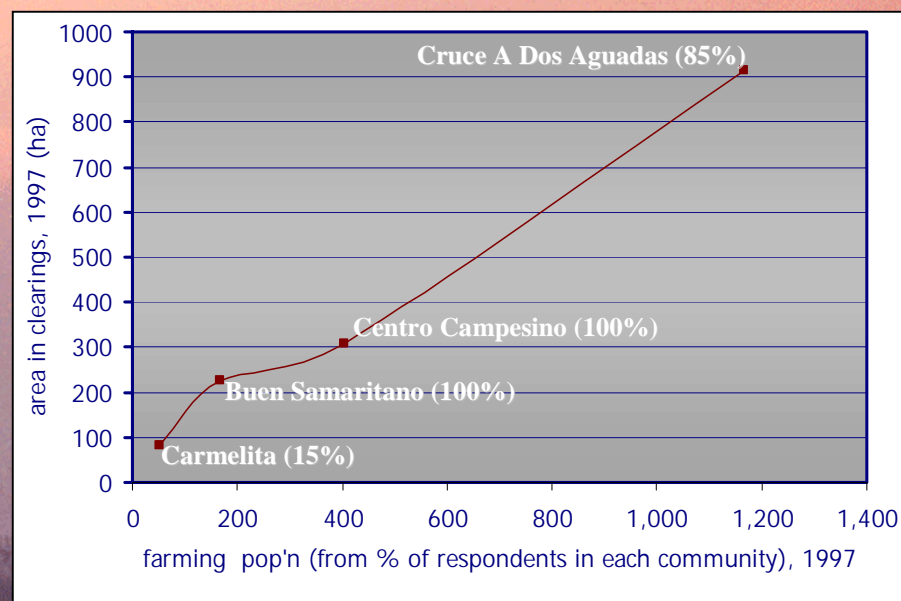
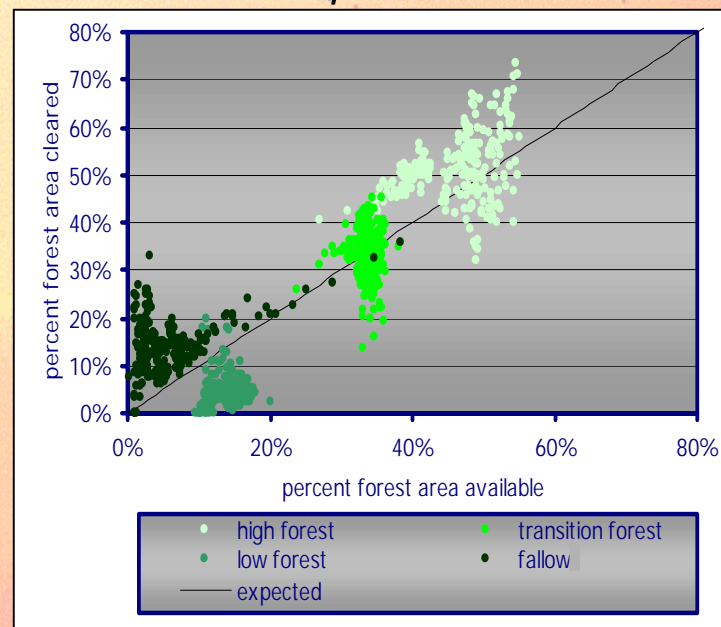
Change Detection Image for the MBR: 1986, 90, 93, 95, 97



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Significant Results

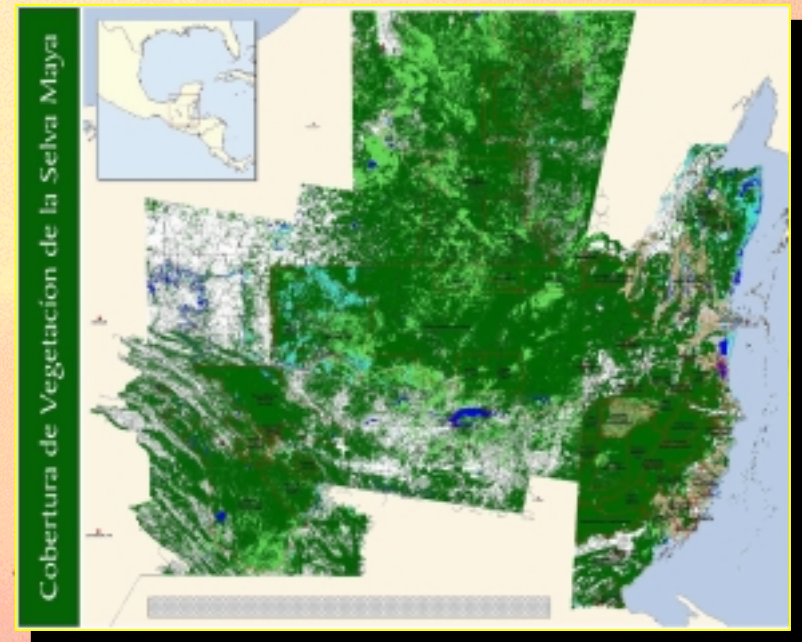
- The baseline survey and establishment of the UTM grid monitoring network identified deforestation "hotspots" and provides a framework for future satellite-based forest inventory and monitoring of the MBR;
- Accuracy assessment and comparison of three change detection methods provided justification for further use of the best techniques, and the RGB-NDVI classification method was preferred for its simplicity, ease in interpretation, and potential for technology transfer to local participants.
- The development of the time-series database from the satellite imagery allowed for the analysis of various dynamics of forest clearing over time, such as clearing rates, patch statistics, clearing to regrowth ratios, clearing and distance from access, and **clearing by forest cover type**.
- Landscape-level analysis combined with **socio-economic data** helped to explain land cover change and its driving forces; preference for clearing high forest over fallow fields as well as preference for pasture development were variable among four forest concession communities with different ethnic and religious backgrounds.



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Policy Connection

- This research has a strong cooperative component with government agencies as well as international and local non-governmental organizations, including **Conservation International**, CONAP, and USAID.
- Methods have been developed to facilitate technology transfer of satellite-based forest monitoring to **local participants**, and workshops and training have been provided.
- The regularly updated forest change detection maps are considered by CI and USAID to be their "most powerful monitoring tool" and a key component of CI's forest monitoring and evaluation program.
- Satellite monitoring based on the UTM grid network developed in this research has been proposed by CI as the first level in a multi-level ecological monitoring scheme for the MBR and other conservation programs in Latin America.



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Manuscripts

Hayes, D. J., 1999, Remote Sensing for Monitoring Land Cover and Land Use Change in the Maya Biosphere Reserve, Guatemala. Unpublished M. S. Thesis, University of Maine, Orono.

Hayes, D. J. and S.A. Sader, Change Detection Techniques for Monitoring Forest Clearing and Regrowth in a Tropical Moist Forest (submitted to *Photogrammetric Engineering and Remote Sensing*, January 2000).

Hayes, D. J., S.A. Sader, and N.B. Schwartz, Analyzing a forest conversion history database to explore the temporal and spatial characteristics of forest change (submitted to *Landscape Ecology*, May 2000).

Reining, C.P., P. Kristensen, D. Irwin, S. Sader, J. Musinsky, C. Soza, J. Nations, T. Sever, Land use / land cover change detection: using remote sensing and aerial photography to monitor landscape level deforestation trends in Guatemala's Petén region. In: Ottke, C., P.J. Kristensen, D. Maddox and E. Rodenburg (eds.), *Monitoring for Impact: a Handbook with Lessons from 13 Conservation NGOs*. Joint Publication of World Resources Institute, Conservation International, and Global Forest Watch, Washington, D.C. In Press.

Sader, S.A., D.J. Hayes, M. Coan, J.A. Hepinstall, T.L. Sever and C. Soza, Forest change monitoring of a remote biosphere reserve, *International Journal of Remote Sensing*. In Press.

Sader, S.A., 1999, Deforestation trends in northern Guatemala: a view from space, Chapter 4, pp. 26-30, In *Thirteen Ways of Looking at a Tropical Forest: Guatemala's Maya Biosphere Reserve*, Nations, J.D. (ed.) Conservation International, Washington, D.C., 108p.

Sader, S.A., C. Reining, T. Sever, and C. Soza. 1997. Human migration and agricultural expansion: a threat to the Maya tropical forests. *Journal of Forestry*, December 1997: 27-32.

Schwartz, N.B., 1998, Time series changes in land use: social science report, phase 1. Submitted to University of Maine, Orono. NASA LCLUC Program, Contract NAG5-6041. 78pp.

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Seminars and Lectures

S.A. Sader, Land cover and land use change research in Guatemala, and new initiatives in Central America, Environment and Development in Latin America, Florida International University (invited, February 1999).

Sader, S.A., D.J. Hayes, and C. Soza, The utility of Landsat-TM satellite imagery for Level I forest monitoring of the Maya Biosphere Reserve, Nuevas Perspectivas de Desarrollo Sostenible en Petén: en Cuentro Internacional de Investigadores, Facultad Latinoamericana de Ciencias Sociales (FLASCO), Santa Elena, Guatemala (invited, December 2-4, 1999).

Sader, S.A., E. Bernaldes, D.E. Irwin, and H. Tuy, Satellite estimates of 1997-1999 forest clearing in the Maya Biosphere Reserve, Nuevas Perspectivas de Desarrollo Sostenible en Petén: en Cuentro Internacional de Investigadores, Facultad Latinoamericana de Ciencias Sociales (FLASCO), Santa Elena, Guatemala (invited, December 2-4, 1999).

La Biosfera Maya Desde El Espacio: una vision actual (National press conference with Conservation International and Consejo Nacional De Areas Protegidos, Guatemala City, November 1998)

