Southern Yucatán Peninsular Region

Integrated Land Science

Principal sponsorship

NASA-LCLUC   NSF-CISHDGE
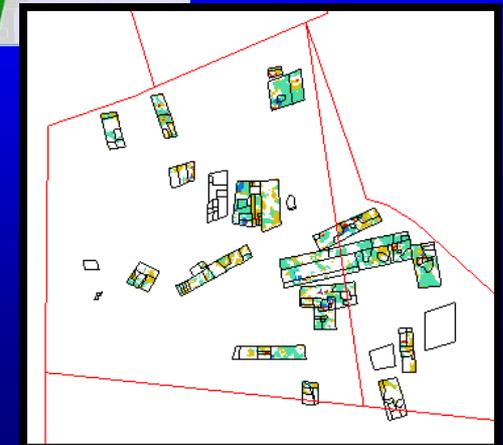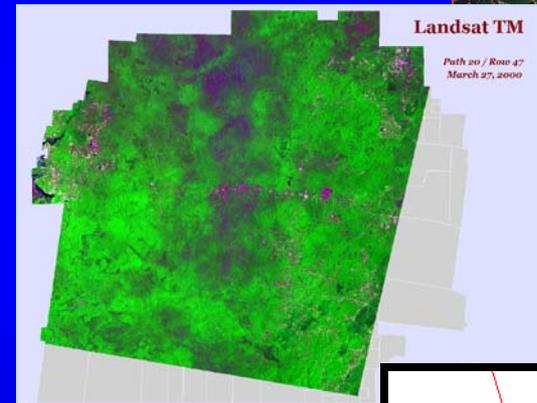
http://earth.clarku.edu/lcluc

Natural/environmental sciences

+

Social/human sciences

+

Remote sensing/GIS sciences

Landsat TM

Path 20 / Row 47
March 27, 2000

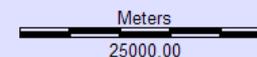➡ Land-use & land-cover
"in its own right"

[understand, model, and project]

Land Cover

90% Accuracy

Legend

- ■ Herbaceous Secondary ●
- ■ Shruby Secondary ●
- ■ Arboreous Secondary ●
- ■ Pasture
- ■ Bracken Fern
- ■ Tular
- ■ Milpa Cultivation
- ■ Selva Baja Inundable Seca *
- ■ Selva Mediana *
- ■ Selva Mediana y Baja Subcaducifolia *
- ■ Paved Roads
- ■ Water
- ■ Selva Baja Inundable *
- ■ Bare Surfaces
- ■ Selva Alta y Mediana *

"Extreme" detail

Note: TM imagery pushed to extreme land-cover detail; in this case 5 forest types & 3 stages of succession
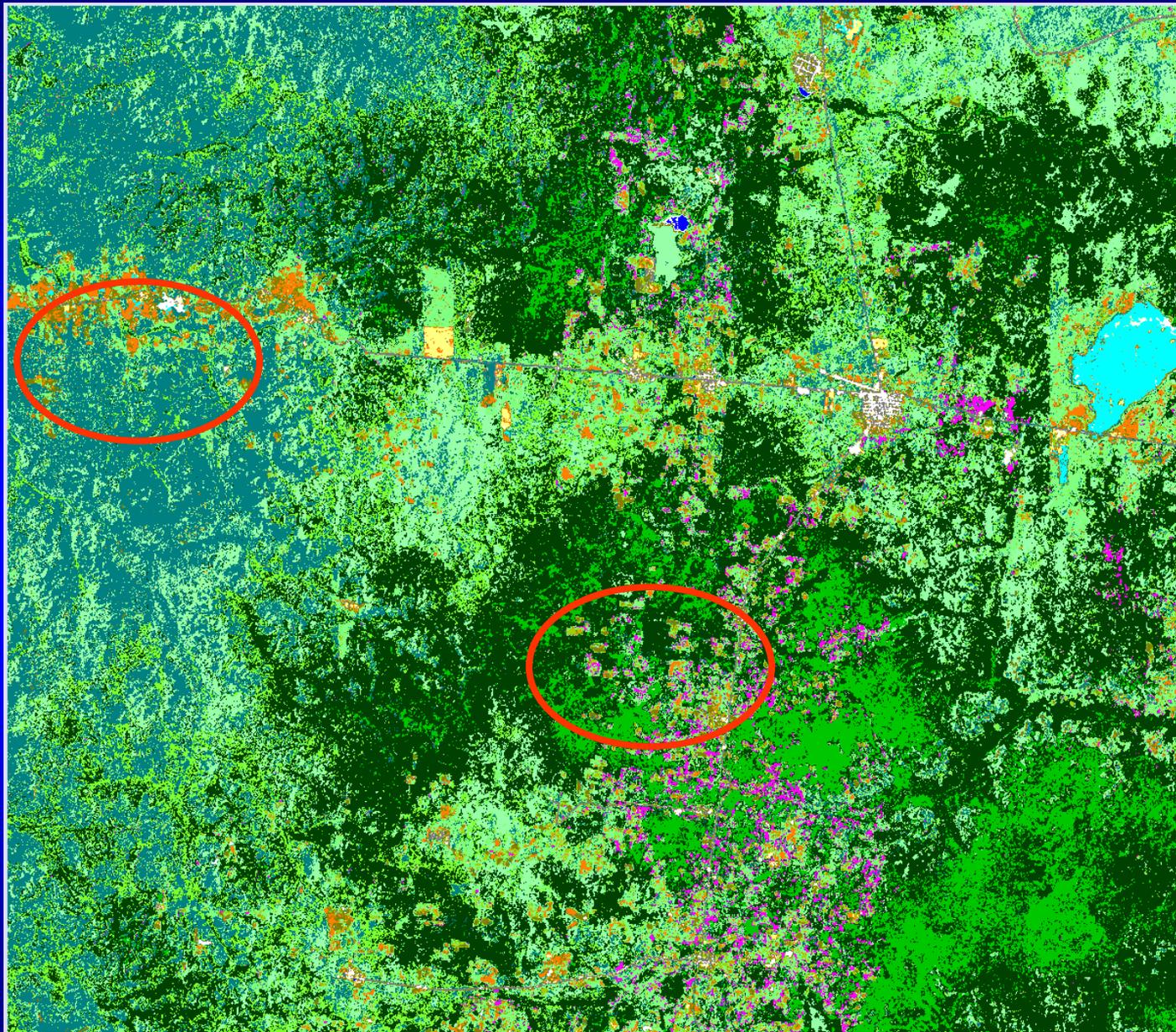
Meters
25000.00

Land Cover

Legend:
- Herbaceous Secondary
- Shruby Secondary
- Arboreous Secondary
- Pasture
- Bracken Fern
- Tular
- Milpa Cultivation
- Selva Baja Inundable Seca
- Selva Mediana
- Selva Mediana y Baja Subcaducifolia
- Paved Roads
- Water
- Selva Baja Inundable
- Bare Surfaces
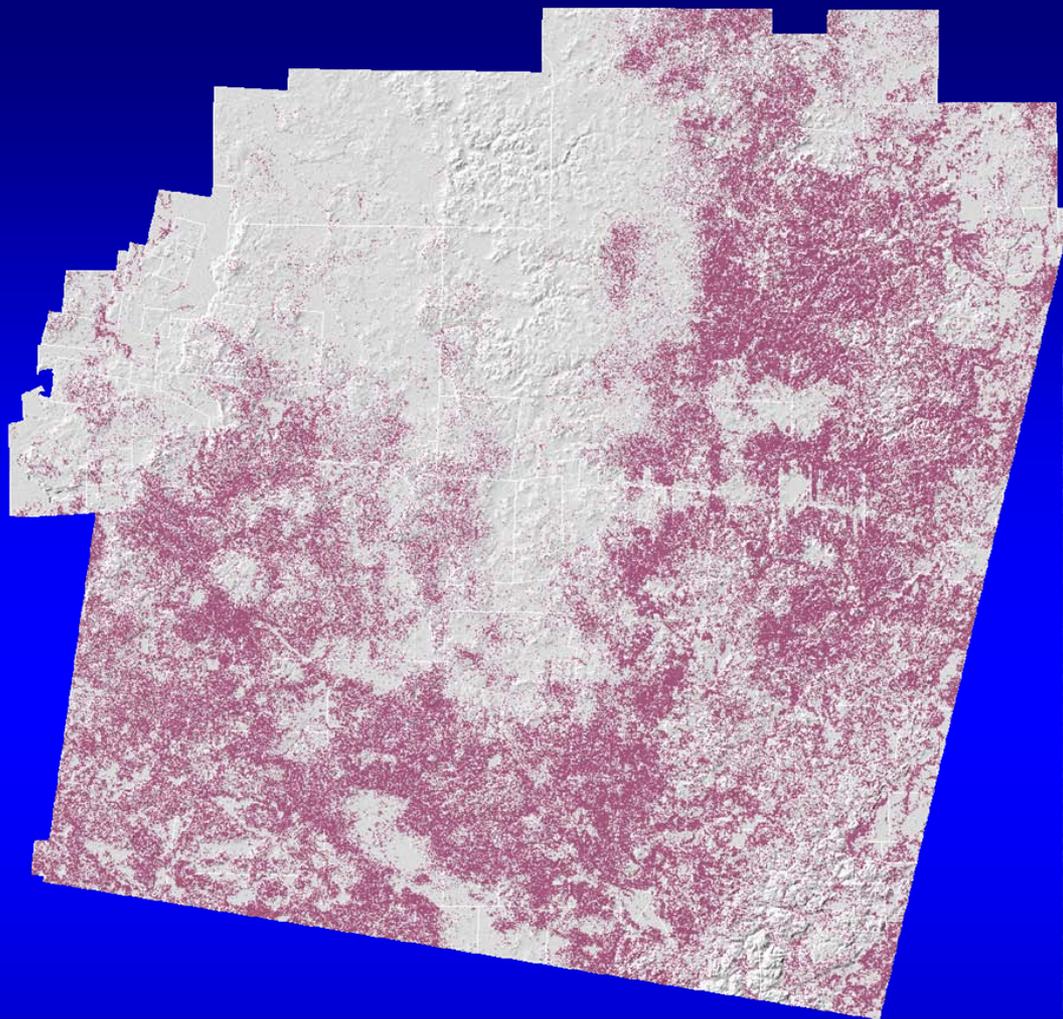- Selva Alta y Mediana

Meters
5000.00

Note: "extreme" detail" critical to land-use dynamics and long term forest consequences

Age of Secondary Forest

330 m radius mean filtered within West/EjidoPol area

Years
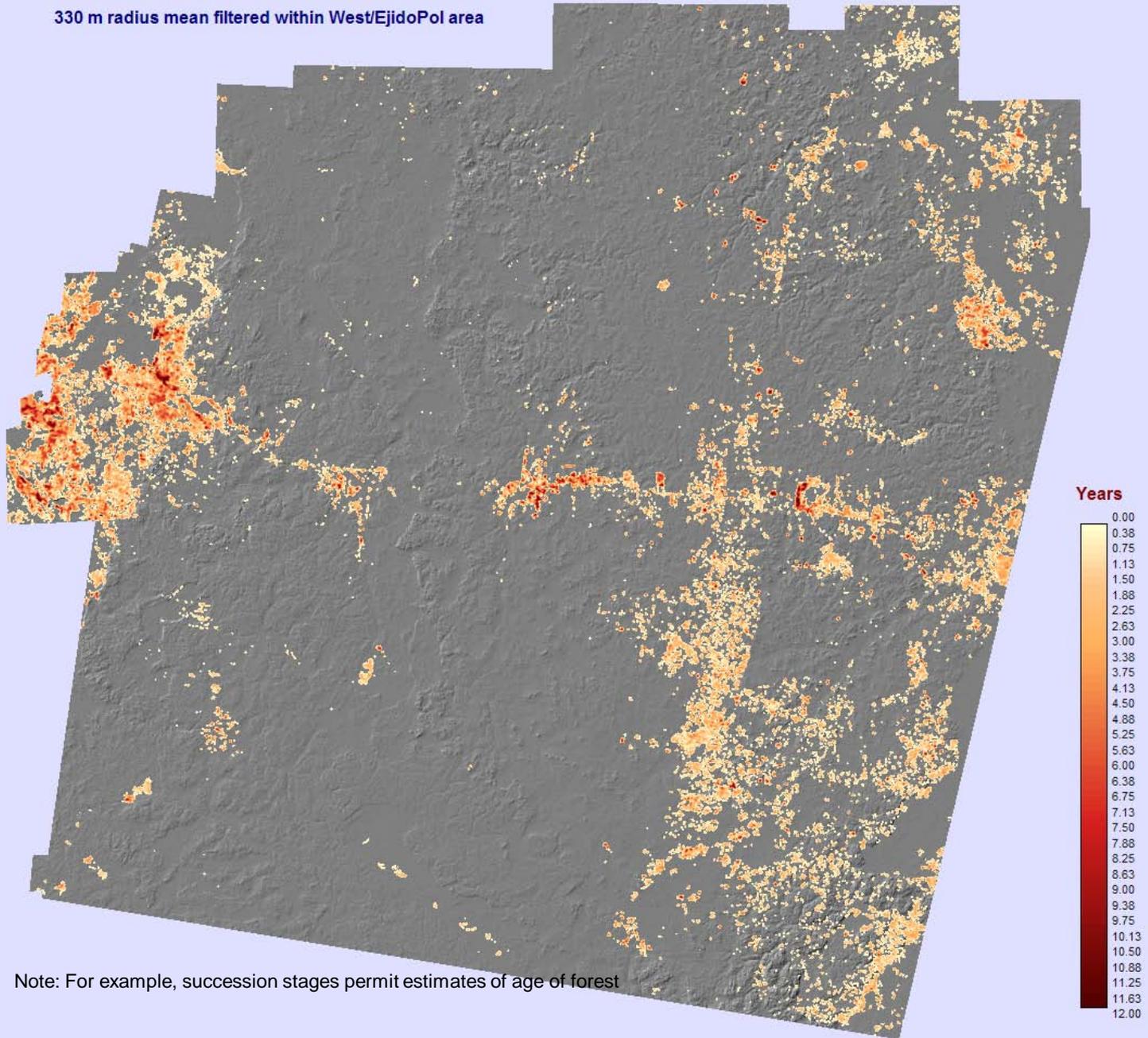
Note: For example, succession stages permit estimates of age of forest

Selva Mediana

Note: each category of forest can be identified by pixel
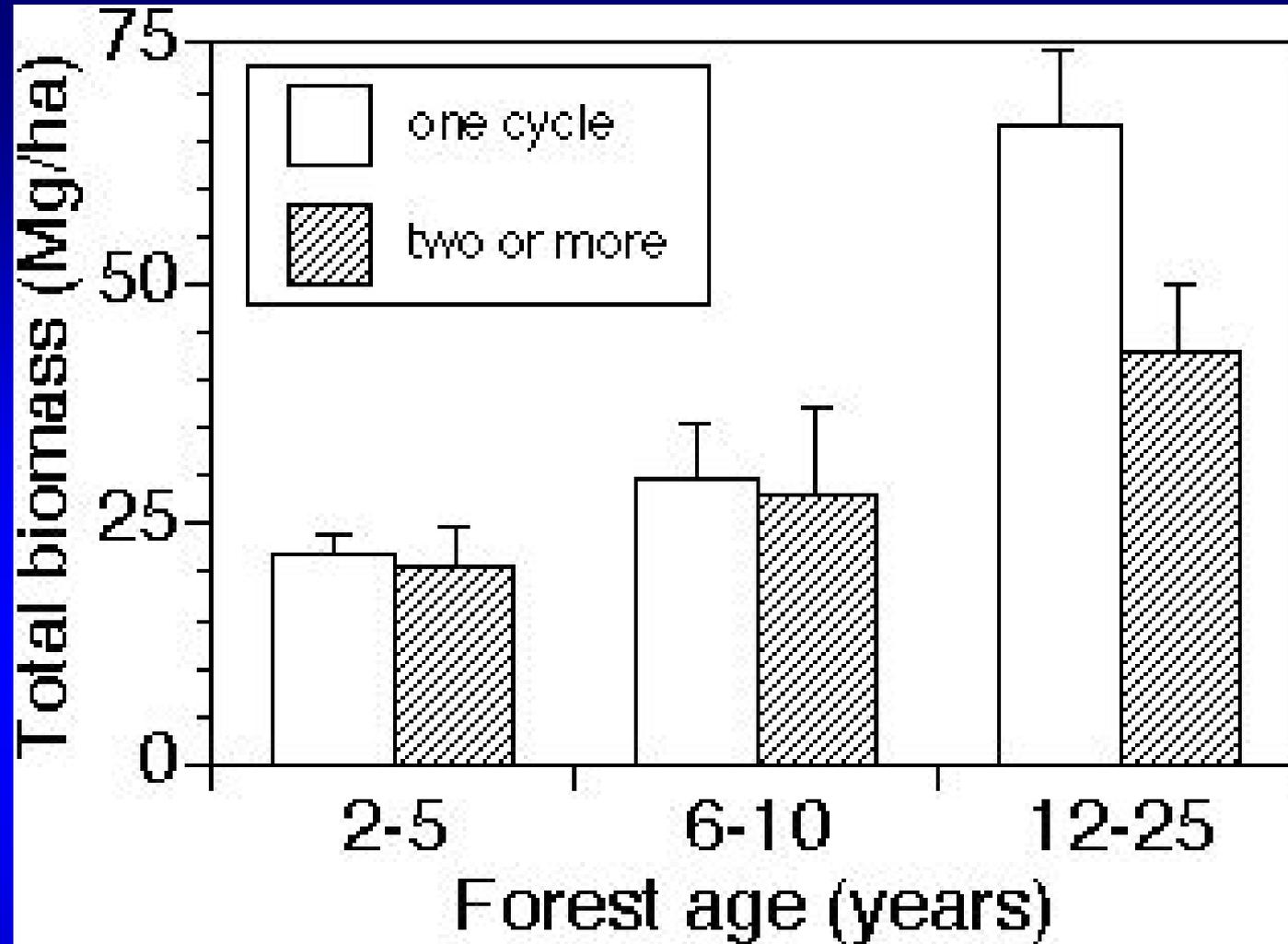
Total biomass as a function of age class and the number of prior swidden fallow cycles

Analysis of variance by region and number of prior swidden-fallow cycles, with age as a co-variate, showed significantly lower biomass with repeated cultivation (history effect, p=0.032).

Note: land affected by 2 or more swidden cycles = significant drop in biomass

Soil nutrient characteristics as function of disturbance (mature vs secondary forest) and location in the region

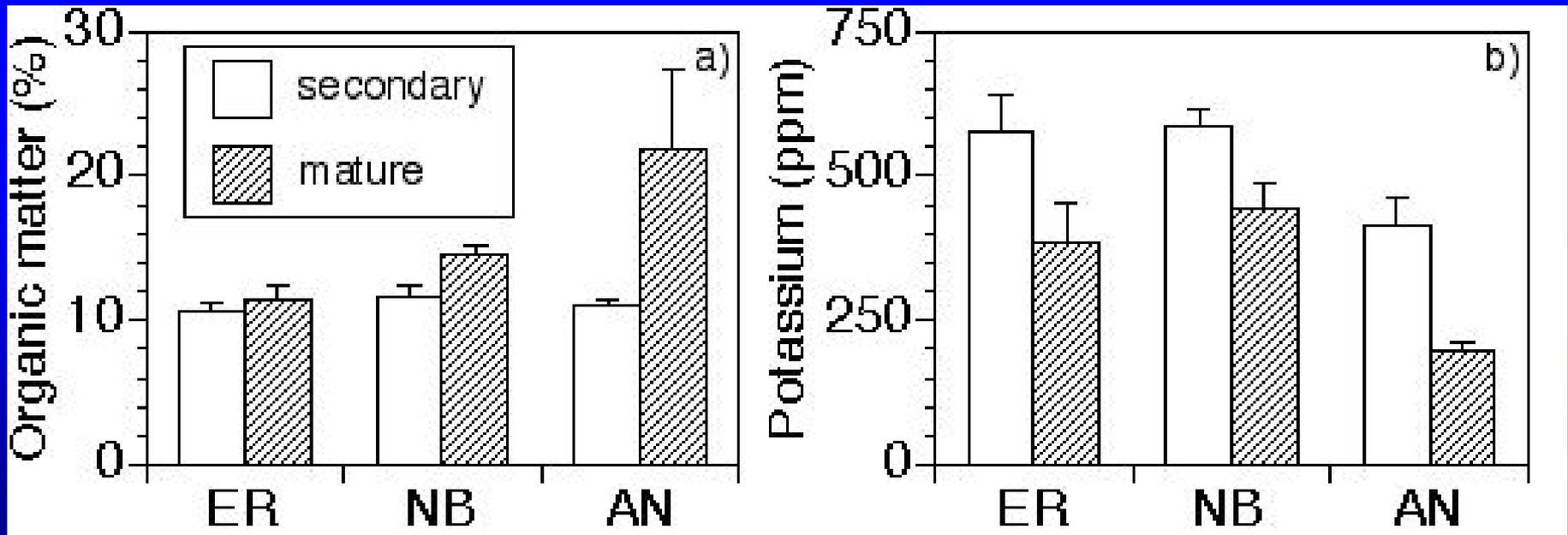A two-factor ANOVA demonstrated significantly higher soil organic matter in mature forests (p=0.003), and significantly higher potassium concentration in secondary forests (p=0.005). ER (El Refugio), NB (Nicolas Bravo), and AN (Arroyo Negro) represent study locations from the drier north to wetter south, respectively.

Note: forest age and precipitation affect soil nutrients and hence forest structure-function and agriculture

Bracken Fern

Difference in relative frequency from that expected according to the regional distribution of slopes

Class 6 : Bracken Fern
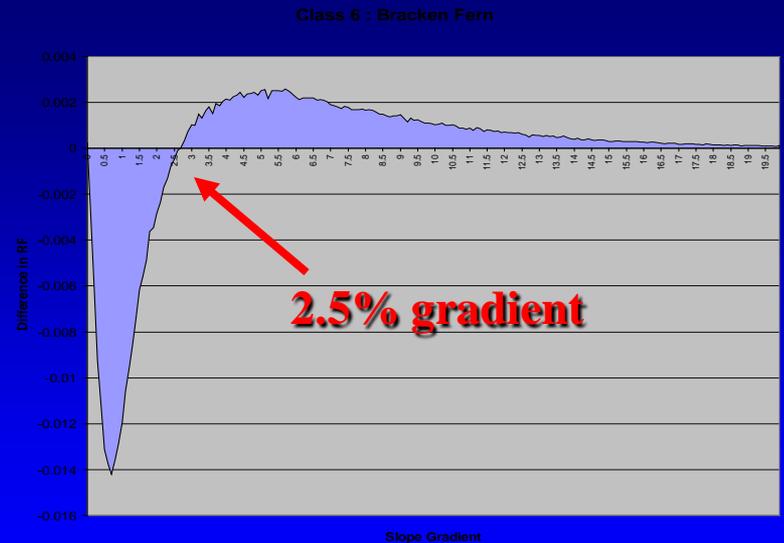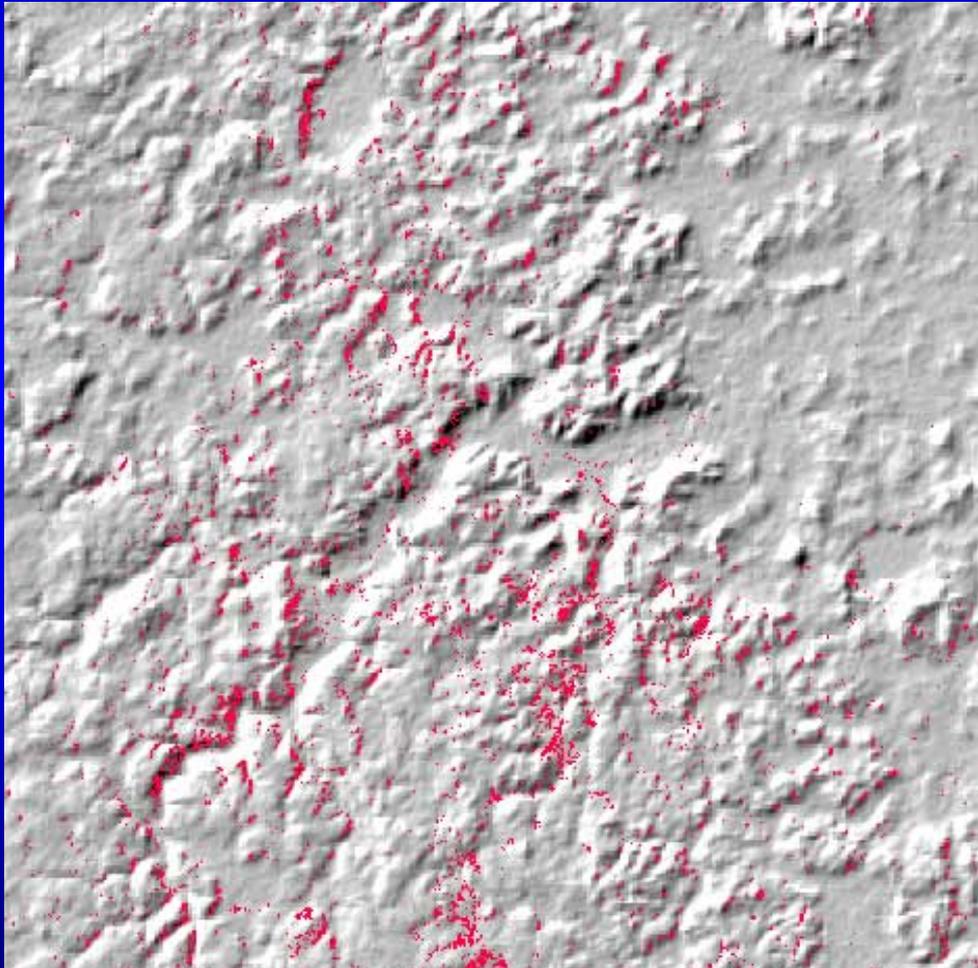
2.5% gradient

Slope Gradient

Note: The major invasive species persistence favors slope (agriculture) and high summer sun

Aspect

108° azimuth

Note: significant flux in land-cover by year & statistically linked to [1] chili market ups and downs and [2] policy shifts
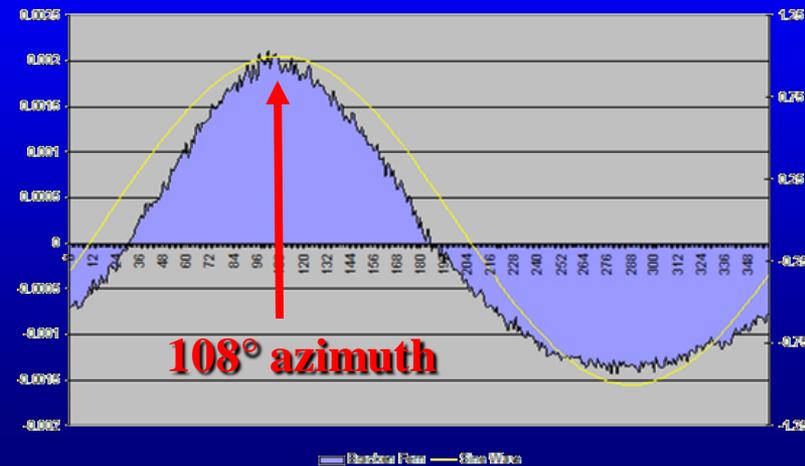
1987　　　　　**1992**　　　　　**1995**

Note: significant flux in land-cover by year & statistically linked to [1] chili market ups and downs and [2] policy shifts

1999   **2001**   **2003**

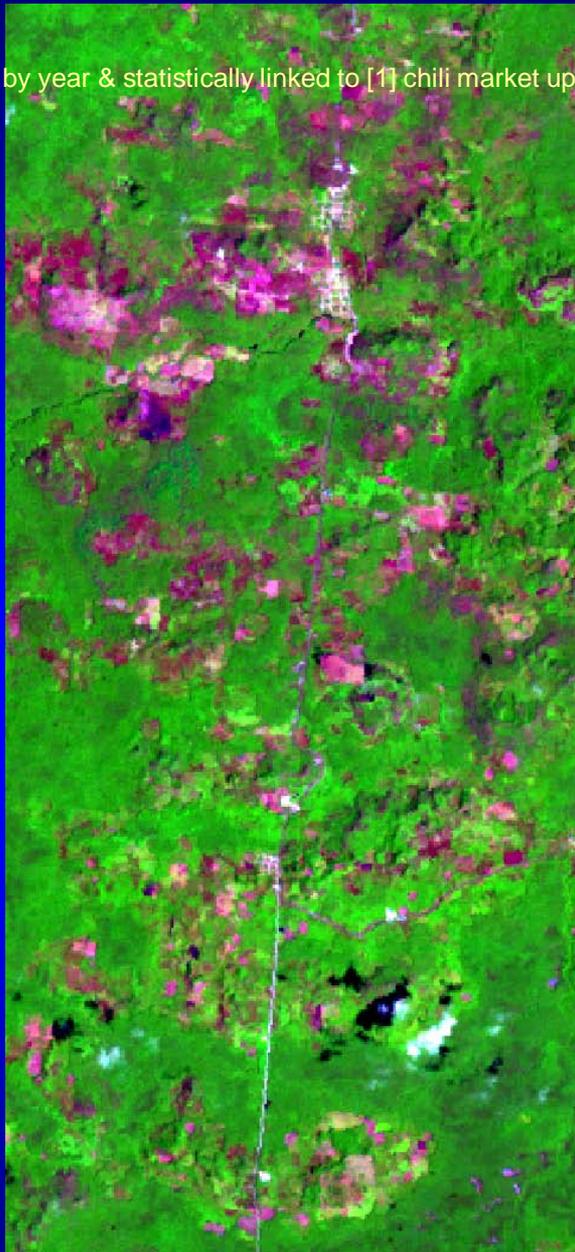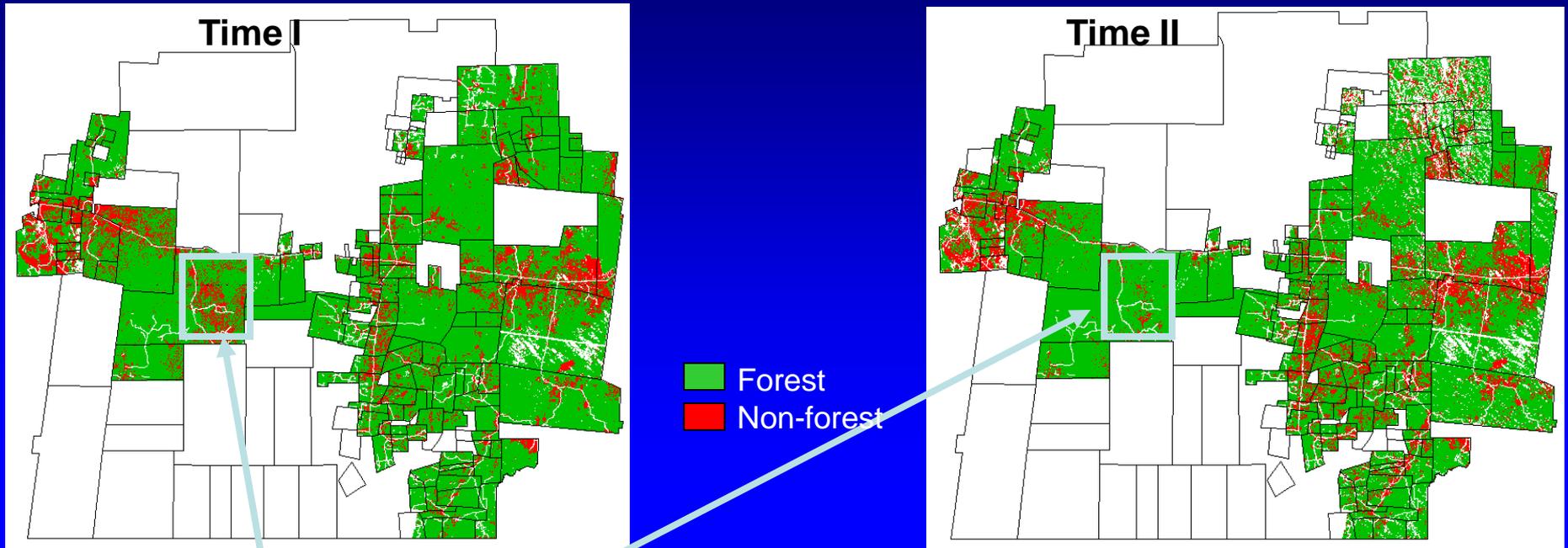| DEPENDENT VAR	AGENCY-BASED MODEL	STRUCTURE-BASED MODEL	JOINT STRUCTURE-AGENCY MODEL
Milpa	R^2=0.6387 *Entitlement* **Family size**	R^2=0.5577 **PROCAMPO**	R^2=0.8625 *Tenancy* *Labor/Consumer ratio* **Labor (no buy, no sell)** **Net worth livestock** *Chili income last year* **Forest use** **PROCAMPO** **RPS** *PRONASOL* *Extension* **Links to unions** **Ejido-level sociopolitical cap.**
Tornamil	R^2=0.7873 *Entitlement* **Net worth livestock** **Forest use**	R^2=0.6668 **Not significant**	R^2=0.8909 *Tenancy* *Family size* *Labor/Consumer ratio* **Net worth livestock** **Forest use** **QOL subsidies**
Chili	R^2=0.8237 *Mestizo* **Family size** **Labor/Consumer ratio** **Labor (buy, no sell)** *Labor (sell, no buy)* *Net worth livestock* **Chile income last year**	R^2=0.6180 **RPS** *QOL subsidies* *PRONASOL* **Links to NTFP coops** **Ejido-level sociopolitical cap**	R^2=0.9557 *Mestizo* **Labor (no sell, no buy)** **Net worth livestock** **Chili income last year** **Off-farm wage income sources** **Forest use** **PROCAMPO** **RPS** **QOL subsidies** *Extension* **Links to NTFP coops**

Note: combined agent and structural models score better in regard to individual kinds of land use than individual models; social science must not focus on one kind of model over the other owing to ideology.

DEPENDENT VAR	AGENCY-BASED MODEL	STRUCTURE-BASED MODEL	JOINT STRUCTURE-AGENCY MODEL
Nescafé milpa	R^2=0.5748 *Mestizo* *Entitlement* **Family Size** **Labor/Consumer ratio** *Send and receive remittances* *Off-farm wage income sources*	R^2=0.7257 **QOL subsidies** *Links to unions* **Links to NTFP coops** **Ejido-level sociopolitical cap.** **Seasonal employment**	R^2=0.9560 *Mestizo* *Tenancy* *Entitlement* *Family Size* **Labor (sell, no buy)** *Labor (buy, no sell)* **Net worth livestock** *Off-farm wage income sources* **RPS** **QOL subsidies** *Links to unions* **Links to NTFP coops**
Actively managed fallows (agrofor. & reforest.)	R^2=0.5411 **Tenancy** *Labor (sell, no buy)* **Labor (buy, no sell)**	R^2=0.8476 **RPS** **Supported AF/ref** **Links to unions** *Seasonal employment*	R^2=0.9684 **Entitlement** *Labor (no sell, no buy)* *Labor (sell, no buy)* *Off-farm wage income sources* **Supported AF/ref** **Extension** **Links to unions** *Links to NTFP coops*
Passively managed fallows ("natural" succession)	R^2=0.8680 **Tenancy** *Family size* **Remittances (send, no rec)** **Remittances (receive, no send)** *Labor (no buy/sell)* **Net worth livestock**	R^2=0.5580 **PROCAMPO** *QOL subsidies*	R^2=0.9268 **Tenancy** **Labor/Consumer ratio** *Labor (no buy, no sell)* *Labor (buy, no sell)* **Net worth livestock** **PROCAMPO**

Regional Logit Model

Time I

Time II

Time III

Forest

Non-forest

30 km

Boxed area
shows importance
of swidden cycle
dynamics to model
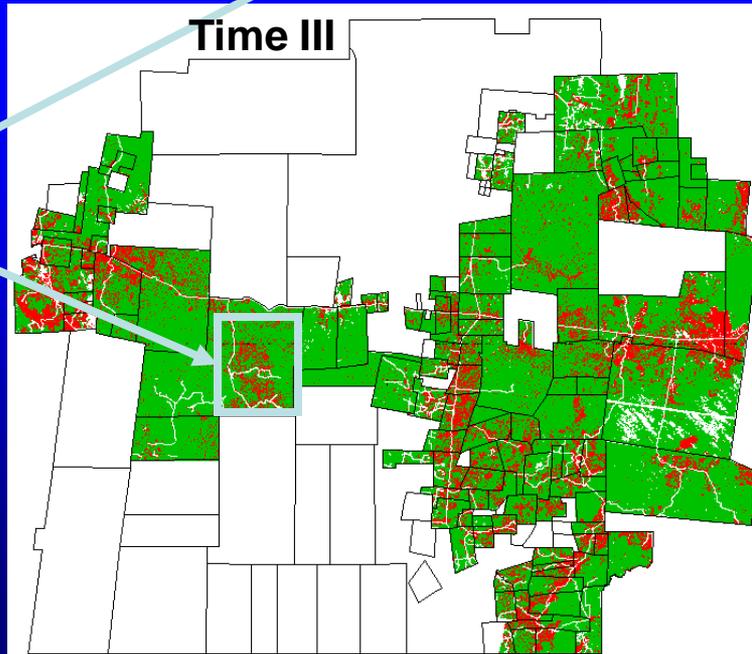
- Geospatial variables
more important than
census variables
- Choice of dependent
variable matters
- Location + timing of
multiple land uses =
key

Genetic Program

Start → $i, j := 0$ → Initialize Population K_i → $i = G$

$i = G$ — No / Yes → End

$i := i + 1$

Determine Fitness f_k for Individual $K_{i,j}$ → $j := j + 1$

$j = M$ — No / Yes → $j := 0$ → $j = M$ — Yes / No

Select Operator

P_c → Select Two Parents → f_k → Crossover → $j := j + 2$ → Insert Offspring into Population

P_r → Select One Parent → f_k → Reproduction → $j := j + 1$ → Insert Offspring into Population

P_m → Select One Parent → Random → Mutation → $j := j + 1$

New advances in agent-based modeling linked to environment and synergy.

OXFORD

Integrated
Land-Change
Science and Tropical
Deforestation in the
Southern Yucatán

Final Frontiers

B. L. TURNER II,
JACQUELINE GEOGHEGAN,
AND DAVID R. FOSTER

The Clarendon Lectures in Geography and Environmental Studies

OXFORD

OVERVIEW

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- Diego Pérez-Salicrup, UNAM (Mexico), ecology
- Sophie Calmé, ECOSUR Mexico), ecology
- Francisco Gurri, ECOSUR Mexico), ecology
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- Basil Savitsky, Florida St. U., GIS*

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- Diego Pérez-Salicrup, UNAM (Mexico), ecology (above)
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- Yelena Ogneva-Himmelberger, Mt. Holyoke College, geography*
- Sergio Cortina Villar, ECOSUR (Mexico), remote sensing*

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- Lucy Diekmann -- U. Virginia, ecology
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- Emily Harvey – Clark U., IDCE

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