

Modeling the Scale Dependent Drivers of LCLU Dynamics in the Northern Ecuadorian Amazon

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Research Questions: Coupled Human-Natural Systems

What are the reciprocal pattern-process relations between population change, geographic site and situation, and landscape dynamics?

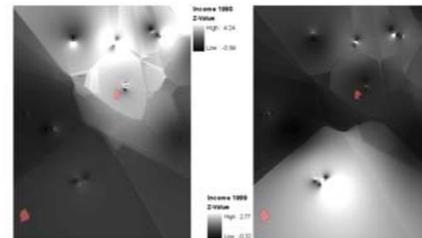
How do exogenous and endogenous factors mediate social, biophysical, and geographic relationships and their interactions?

How do theories and practices in the social, natural, and spatial sciences inform the studies of coupled human-natural systems?

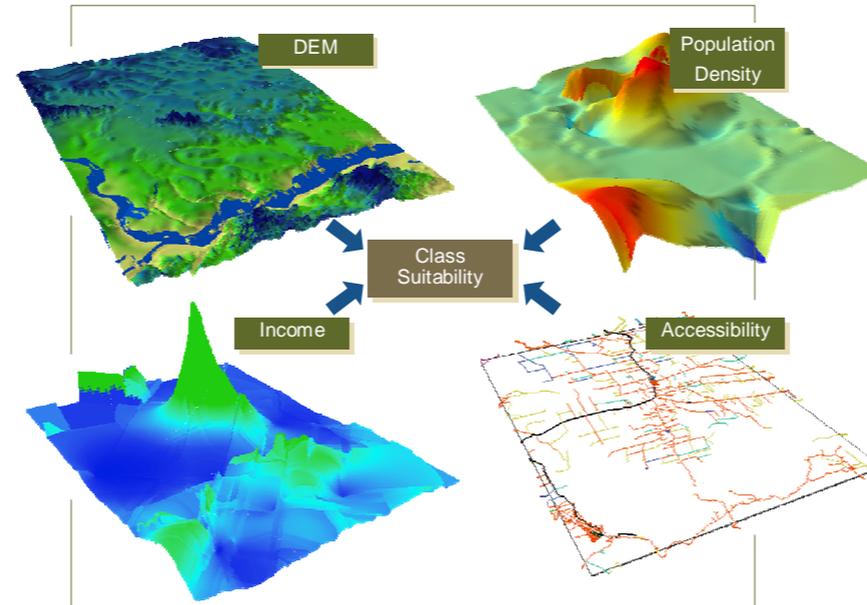
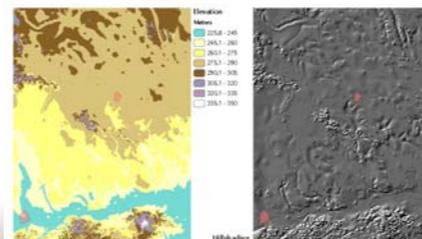
Spatial Simulation Models: Cellular Automata & Agent Based Models

- Goal: Generate LCLU simulations based upon actual conditions observed through the satellite time-series and extended in time & space through derived growth rules and neighborhood interactions.
- Approach: CA consists of a regular grid of cells, each of which can be in one of a finite number of K possible states, updated synchronously in discrete time steps according to a local, identical interaction rule. The state is determined by the previous states of a surrounding neighborhood of cells, and the rule is usually specified in the form of a transition function.

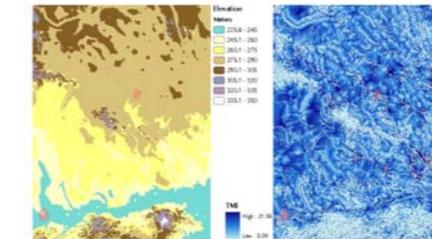
Northern Ecuadorian Amazon - SISA: Income at the Farm Level



Northern Ecuadorian Amazon - SISA: Elevation and Hill Shading



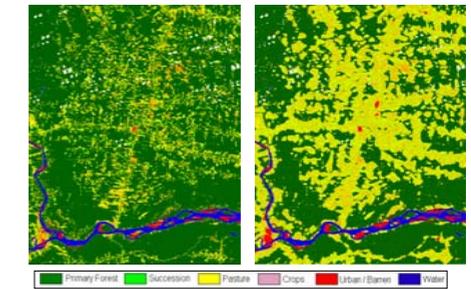
Northern Ecuadorian Amazon - SISA: Elevation & Topographic Moisture Index



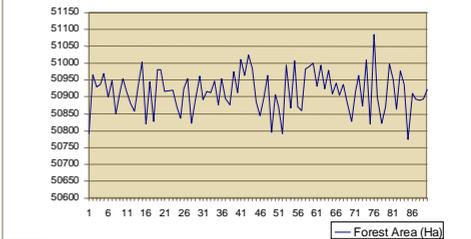
Forest to Non-Forest Vegetation

- Travel distance to nearest of 3 major communities; lower, greater change probability; computed as Euclidean distance to the nearest road and then simple distance along network to the community.
- Euclidean distance to nearest road; lower, greater change probability.
- Sector population; higher, greater change probability.
- Slope angle; lower, greater change probability.
- Soil moisture index; lower, greater change probability.
- Parameters: stochastic (0.06), kernel threshold (4 cells), masking threshold (0.4).

Northern Ecuadorian Amazon - SISA: Satellite vs. Model Characterizations



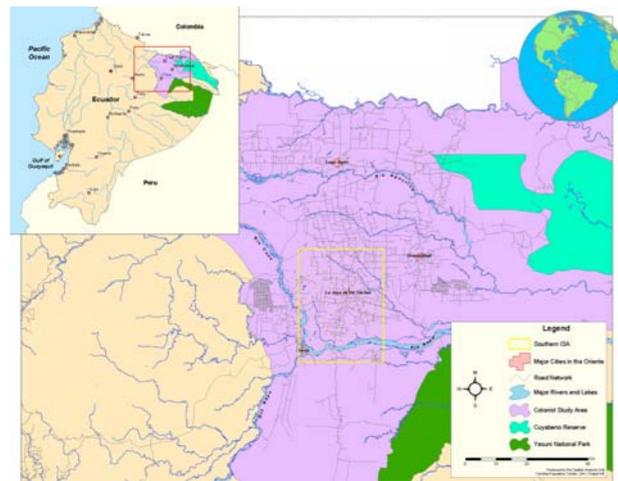
Northern Ecuadorian Amazon - SISA: CA Based Model: Sensitivity of Forest



Preliminary Findings

- Human frontier settlements exhibit self-organized complexity; feedbacks exist between spatial pattern and process.
- Emergent behavior of farmers is seen at macro-level development fronts.
- Spatial structure of LCLU and LCLUC patterns is related to farm size, year of establishment, size of household, population density, labor availability.
- Forest succession and fallow are linked to off-farm employment, male adults, and legal title.

Ecuador Study Area with South ISA Highlighted



Northern Ecuadorian Amazon - SISA: Slope Angle & Slope Aspect

