EMPIRICAL OBSERVATIONS OF CHANGE

Changing Landscape Productivity

We have compiled land-use and land-cover histories for 13 townships within the Southeastern Michigan region between 1950 and 2000. The panels at right illustrate some of these data for one of our townships. As the township (Scio, which is immediately west of Ann Arbor) has developed cropland has declined and tree cover has increased.

The figure below summarizes the land-cover trajectories within the township. The increase in tree cover resulted from conversion of cropland, but leveled off as the township became increasingly developed.

The land-cover changes resulting from changes in land-use provide one possible explanation for increases in productivity (above). See the green area of tree cover in the graph (below).

Comparative Land-Cover Dynamics

Land-cover trajectories follow general patterns in relation to development.

- The most rapidly growing townships experienced dramatic increases in impervious surface and slight increases in tree cover.
- Tree cover in most developed townships stopped increasing in recent decades.
- Tree cover in growing, but still low density, townships has increased in recent decades.
- Low growth and low density townships have been relatively stable in land cover.

We plan additional analyses at the parcel level.

Project SLUCE: Understanding Biocomplexity at the Urban-Rural Interface

University of Michigan:
School of Natural Resources & Environment
Center for Study of Complex Systems
Institute for Social Research
College of Architecture and Urban Planning
http://www.cners.umich.edu/sluce/

NSF Biocomplexity in the Environment Program
Coupled Human-Natural Systems
Project BCS-0119804
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Changing Land Use and Land Cover

<table>
<thead>
<tr>
<th>Year</th>
<th>Cropland</th>
<th>Tree Cover</th>
<th>Developed Lands</th>
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<tbody>
<tr>
<td>1957</td>
<td></td>
<td></td>
<td>100%</td>
</tr>
<tr>
<td>1967</td>
<td></td>
<td></td>
<td>90%</td>
</tr>
<tr>
<td>1979</td>
<td></td>
<td></td>
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<td>1989</td>
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<td>70%</td>
</tr>
<tr>
<td>1999</td>
<td></td>
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<td>60%</td>
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Agent-Based Models (ABMs)

We are working with a group at Argonne National Laboratory (ANL) to develop tools for linking ABMs and geographic information systems (GIS).

<table>
<thead>
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<tbody>
<tr>
<td>1950</td>
<td>1000</td>
<td></td>
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<td>1970</td>
<td>2000</td>
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<tr>
<td>1990</td>
<td>3000</td>
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BUILDING BOTTOM-UP EXPLANATIONS

Typology of Residential Development

We classified residential development types according to both socioeconomic markets and landscape effects, then randomly selected lots within 6 of our townships and classified their developments according to our typology and the timing of development by decade. The types had clear differences in cost and changes in tree cover due to development.

We are applying survival analysis to study the spatial-temporal correlates of these subdivision types. The figure above shows changes in tree cover within the region for the three subdivision types.

Heterogeneity in Residential Preferences

We are testing alternative modes of representing heterogeneity in preferences (figures above) within our agent-based models. This will allow us to understand the sensitivity of landscape dynamics to heterogeneity in preferences and to how that heterogeneity is represented.

Scenarios of Landscape Change

We are using the agent-based models to evaluate scenarios of landscape change that incorporate assumptions about residential population, developer choices, and township planning strategies.

Our initial scenarios (at right) compare the amount of tree cover on the landscape under multiple amounts of preserved land and strategies for locating preserves (randomly, on farms with the most forest, and on farms with the least forest) and with and without developers of remnant subdivisions (the only type within which forest regrowth occurs in the model). The model produces maps of developments (results of one run shown below). The model was run 30 times for each case.

The results indicate that both the strategy for locating preserves and the presence of remnant subdivisions have significant impacts on the amount of tree cover. This early scenario suggests that our approach holds promise for developing clear explanatory linkages between process models of landscape dynamics and observed changes in landscape change.

Publications


