Project SLUCE: Spatial Land Use Change and Ecological Effects

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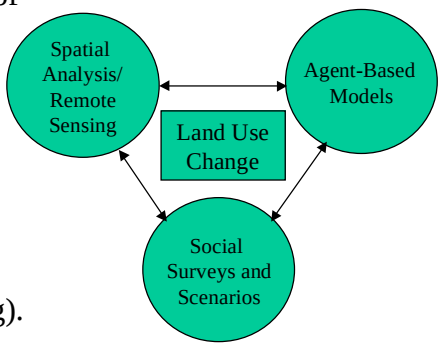
Timing and People

- Four-year project begins October 2001
- Involves faculty from: School of Natural Resources & Environment, Center for the Study of Complex System, Urban and Regional Planning, and the Institute for Social Research
- In addition to research questions, objectives include extending models, data, model results, and insights into UM classes and through internet communities.

The M Team:
Dan Brown, GIS, spatial analysis
Scott Page, economics, complex sys
Joan Nassauer, landscape architecture
Rick Riolo, complex systems
Bob Marans, survey research, urb. plan.
Carl Simon, mathematics, complex sys
Bobbi Low, behavioral evolution
Kathleen Bergen, remote sensing
David Allan, aquatic ecology

Basic Goals

- Focuses on land use dynamics at the urban-rural fringe (i.e., Metro Detroit) and their ecological effects.
- Develops agent-based models of land use that will be compared with recent (~50 yrs) changes and used for evaluating future scenarios.
- Explores and implements complementary methodologies (ABM, GIS, survey research, spatial analysis, remote sensing).



Research Questions

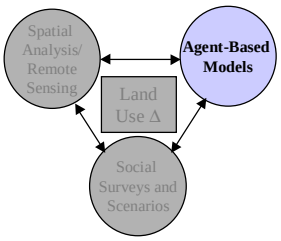
- What are the dynamics that determine the ecological impacts of land development?
- What feedbacks are most important in describing land pattern evolution?
- Are there dominant tipping points/processes in the land development process?
- What do system dynamics tell us about appropriate strategies for minimizing ecological impact?
- What are the multi-scale patterns and dynamics of the land use and cover evolution (i.e., township, field, yard/subdivision) and appropriate scales of intervention?

Methodological Questions

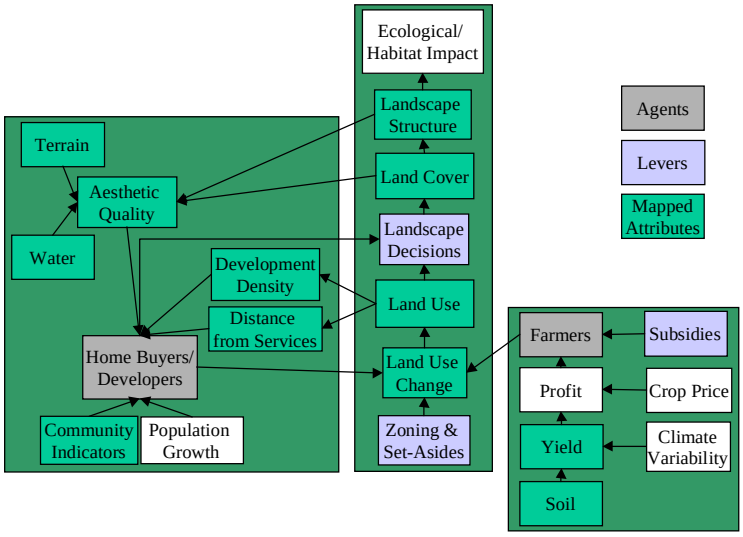
- How should we resolve the tension between the needs for model simplification on the one hand, to evaluate complexity and essential emergent properties, and model realism on the other, to facilitate scenario generation?
- How can we generate agent rules that reflect responses from social surveys and their heterogeneity?
- What land pattern descriptions best characterize emergent properties of system dynamics and ecological consequences?

Model Building Approach

- Begin using Swarm, adding tools as necessary.
- Develop hypotheses and research questions through group discussion.
- Include specific policy questions that can be addressed in the models.
- Build several models over the course of the project.
- Start with simple models to evaluate system dynamics, then build more complex models for scenario testing.

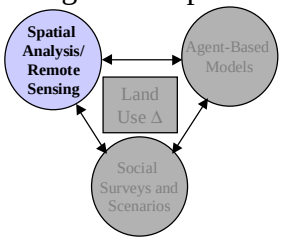


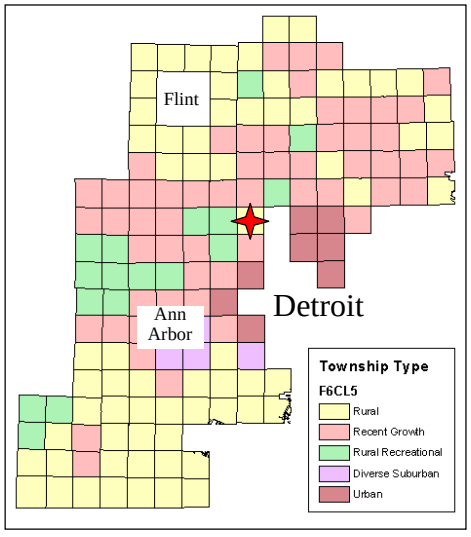
Initial System Description



Selection of Townships for Collecting Spatial-Temporal Data

- Typology based on 22 variables describing population (e.g., numbers and characteristics), housing units (incl. value), land cover, roads.
- Provides a framework for selecting townships for study.

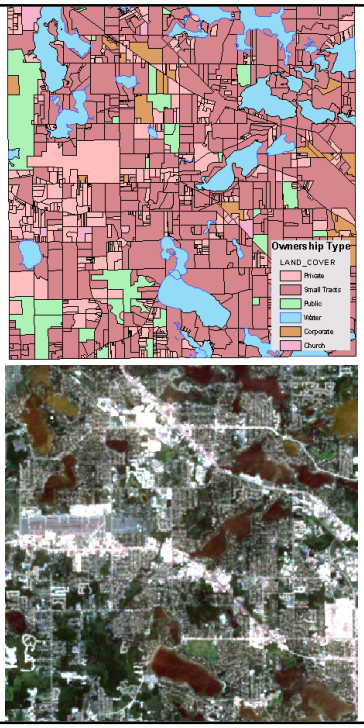




Land Use Data Sources

- Parcel maps created at approx. 10 year intervals, showing ownership
- Images of multiples scales (e.g., aerial photos, satellite images)
- Interpretation of land use facilitated by overlaying parcels on images.

Waterford Twp., Oakland Co.



Time Series Data for a Township

Waterford Township, Oakland County

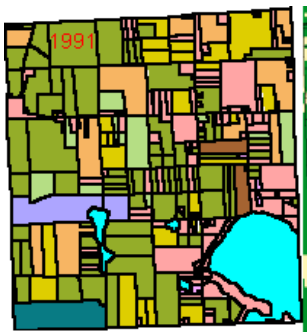
Land Use			Land Cover
Plat Maps		*Photos*	*Landsat Images*
1997	⟷	1995/2000	1999/2000
1988	⟷	1987	1996
1977	⟷	1976	1992
1970	⟷	1970	1988
1956	⟷	1957	1984
1940	⟷	1940	source: Landsat
1872		source: USGS, SEMCOG, FSA	
↓			

Others available: 1920, 1908, 1857, 1836

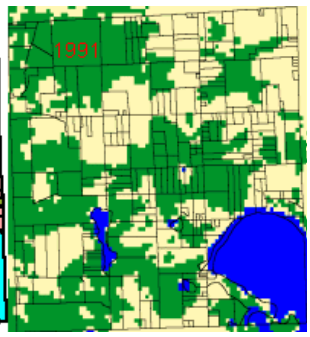
source: Rockford Publishers, Map and Bentley Libraries

Example Site (1 of 136)

Land Use



Land Cover



Land Use Legend

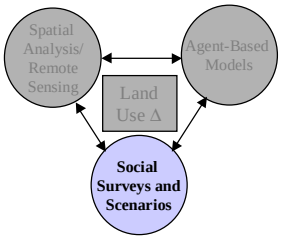
- Residential
- Commercial
- Trans/Utility
- Recreational
- Agriculture
- Open/Grass
- Old Field/Yng Forest
- Forest
- Open Water
- Wetland

Land Cover Legend

- Forest
- Not Forest
- Water

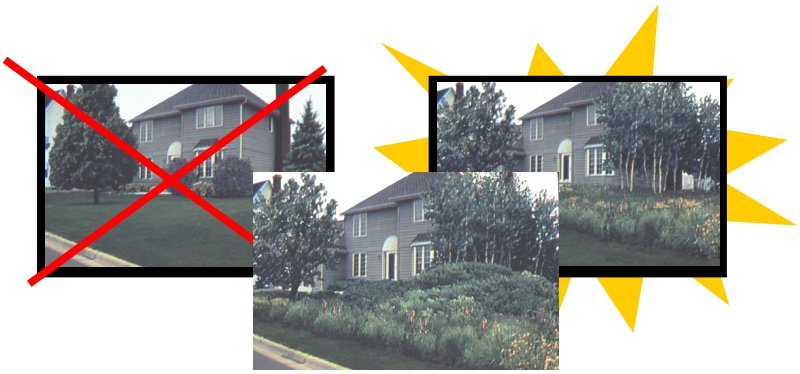
Survey Research

- Detroit Area Study (DAS) 2001: Interview and mail surveys of residents' perception of quality of life on a number of social and environmental indicators. Includes information about residential location decisions (over 4000 respondents).
- Landscape Architecture: Web-based and interview surveys of residents' cultural acceptability of various, including innovative, landscape designs.



Landscape Survey Results: Yards

- At the yard parcel scale:
  - Yards with some ecological benefits were the most attractive across all respondent groups.



Landscape Survey Results: Subdivisions

- Subdivision scale designs with the most beneficial ecological function - less lawn area and more forest or prairie - were most attractive across all respondent groups.