Project SLUCE: Spatial Land Use Change and Ecological Effects

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Project SLUCE (Spatial Land Use Change and Ecological Effects), a new 4.5-year effort (2001-2006) funded under the NSF Biocomplexity and the Environment program, will investigate the dynamics of land use changes at the urban-rural fringe and their interactions with the natural environment and ecosystem function. The project builds on our separate, on-going projects on land use and land cover change, landscape scenario design and testing, and development and analysis of agent-based and other complex systems models. The model development and data collection efforts will be designed simultaneously to address specific questions about the interactions between land use decisions, social, cultural, political and economic structures, specific policy and design interventions, and impacts on ecological landscape patterns and function. Our initial focus will be on the interactions between agricultural and developed land uses. We expect to iteratively develop multiple agent-based models in the course of the project, working initially with Objective C and the Swarm libraries, and to develop several hooks that will link the models with empirical observations. Identification of specific agent types and behaviors is currently underway and will likely continue for the duration of the project, responding to the needs of the various questions posed.

The empirical focus of the project is the Detroit metropolitan area (~5.5 million people). Empirical data will link to the models for the purposes of (a) evaluating model behavior through back-casting exercises, (b) endowing agents with behaviors that are based, to the extent possible, on surveys of actual people, and (c) evaluating historical impacts of land use change on ecosystem structure through remote sensing. Most work will be done within specific townships, which are selected through stratification of the region according to demographic, economic, and land-use planning characteristics. We are focusing on observations of actual land use changes that have occurred from approximately 1950 to the present. Data, which include mapped parcel boundaries and owner identifiers together with aerial photography for interpretation of land use, are available on temporal resolutions of about decades. The model will likely have a finer temporal resolution and we expect matching model and data resolutions to be an on-going challenge. Surveys of land owners, home buyers, developers, and land use regulators are designed to evaluate the factors that affect residential location decisions, as well as the factors that restrict or affect the supply of land for development. We expect that the surveys will provide information about the relative importance of environmental and social factors for the location decisions. Historical time series of remotely sensed data on landscape structure will be compiled and compared with historical land use dynamics to begin the process of linking land use and land cover dynamics within the modeling framework. These landscape structure descriptions, and their relative degree of ecological impact, are important emergent properties of interest from land use change dynamics.

One of our goals is to use the models we develop to evaluate the potential for specific interventions in the land use change processes that might lead to more ecological benign and/or beneficial configurations. The kinds of interventions that can be tested include regulation or restriction by governing bodies, incentives of various kinds, educational initiatives, and widespread introduction of alternative landscaping approaches. We intend to use the working models of land use change to evaluate both the historical dynamics of the region, but also alternative possible futures that might come about under various scenarios.