Analyzing Land Use Change In Urban Environments
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ABSTRACT
The following land use change, understanding what is land use change, modeling of land use change, and impacts of land use change.

Keywords: Land use, urban, modeling,

Abbreviations: USGS, U.S. Geological surgery, UDR, urban dynamic research.
INTRODUCTION
Expensive urban landscapes in Metropolitan areas in United States is result of growth at unprecedented rate. Since 1900 to the past 100 years, farmlands, wetlands, and forests have transformed into human settlements in America. Without a clear understanding of it, almost all have seen changes in their local environment. In order to measure the changes that have occurred and impact of these changes, we have to study the landscapes from a spatial perspective.

The U.S. Geological Survey's (USGS) Urban Dynamics Research (UDR) program studies the landscape transformations that result from the growth of metropolitan regions over time. Using sources such as historic maps, aerial photographs, and Landsat satellite data, USGS scientists first assemble retrospective urban land use databases that reflect several decades of change. These databases are then used to analyze the effects of urbanization on the landscape, and to model urban growth and land use change under alternative growth scenarios.

LAND USE CHANGE
Most major metropolitan areas face the growing problems of urban haphazard growth, loss of vegetation and open space, and a general reduction in the extent and connectivity of wetlands and wildlife habitat. People identify with these problems when they see residential and commercial development replacing undeveloped land around them. Urban growth rates show no marks of slowing, especially when viewed at the global scale, since these problems can be generally attributed to increasing population. Cities have changed from small, isolated population centers to large, interconnected economic, physical, and environmental features. Urban growth and the concentration of people in urban areas are creating societal problems world-wide. One hundred years ago, approximately 15 percent of the world's population was living in urban areas. Today, the percentage is nearly 50 percent. In the last 200 years, world population has increased six times, stressing ecological and social systems. Over that same time period, the urban population has increased 100 times, concentrating more people on less land even as the total land devoted to urbanization expands. Yet the temporal and spatial dimensions of the land use changes that shape urbanization are little known, even in the United States. In the United States, policymakers and the public continue to raise concerns about the effects that unchecked urbanization has on the landscape. In 1998, more than 200 communities across the Nation voted on, and the vast majority adopted, measures to manage urban haphazard growth. The UDR program provides basic data, predictions, and perspectives to help in forming sound policies for guiding environmentally sustainable growth.
MAPPING LAND USE CHANGE

Databases developed by the UDR program contain interpretations of urban extent, transportation routes, water features, and other important land uses. Selected regional studies are currently in progress across the Nation. Data source availability for each region, in conjunction with historical significance, determines the time periods that are mapped. Features are interpreted from diverse data sources including historical topographic maps, satellite images, census statistics, and aerial photographs. The resulting temporal database is a spatial record of the pace and extent of the urbanization process. A temporal database can be visualized as a series of maps, such as those shown above and on the next pages, or as computer animations. Sequential maps show urbanization as a static pattern that changes with each time period that is mapped. Animations illustrate the temporal dynamics, revealing patterns and trends that are not possible to discern from tabular data or static maps.
UNDERSTANDING LAND USE CHANGE

The geographic understanding of land use change in urban areas is a key aspect of the UDR program. By analyzing a temporal database for spatial patterns, rates of change, and trends, the UDR program can provide insight into how cities have developed under varying economic, social, and environmental conditions. This analysis requires understanding a region's land utilization history. Population data, timelines of historical events, and related information are all used to explain the mapped changes. Population data are correlated with the temporal database so that human movement can be tracked and factored into these interpretations. Population increases suggest economic growth and the availability of jobs in an area, and population declines suggest a decline in livability or economic issues that cause people to leave a region. Timelines of past events and other historical compilations aid in identifying the issues that affected the development of the region. In addition to gathering statistical and historical information, scientists must have a physiographic understanding of the place and its greater region. Topographic features, climate, and adequate supplies of water and other natural resources can limit or encourage growth and change.

The existence and accessibility of transportation routes have often dictated patterns of urban growth. Urban areas that were established in the 18th and early 19th centuries were usually located along waterways, reflecting dependence on shipping for the transport of goods and people. By the middle of the 19th century, railroads began to connect existing towns and spurred the growth of new urban areas. The post-World War II era saw not only an increase in the population of most metropolitan areas, but also the emergence of a society dependent on the automobile. The proliferation of the private automobile led to expansive development at the edges of many urban areas. The development of the Interstate Highway system in the 1950's spurred the wide spread construction of roads. As road networks expanded and became more complex, urban development followed. As in the past, most recent urban growth has occurred along transportation corridors. The UDR program provides the data and geographic information necessary to do current past land use change. By looking to the past, communities and regions are better informed and equipped to plan and prepare for the future.
LAND USE CHANGE MODELING

Historical land use patterns, together with current trends in a region, are used to model future land use. Results from modeling urban growth and land use change can be used by the people, land utilization planners, and policy designers to anticipate and plan for the future. Land use change models can also generate alternative landscape predictions on the basis of different land use policies and environmental constraints. These land use change models use simple parameters including present urban extent, major transportation routes, topography, and protected lands. Other factors, such as employment opportunities, land prices, and the millions of personal decisions people make, are not considered in this modeling approach. The primary focus of the modeling effort is to account for physical controls on land use. Acknowledging the uncertainties of models, the USGS uses statistical methods to predict probabilities of urbanization.

IMPACTS OF LAND USE CHANGE

Urban Dynamics research in landscape characterization, urban growth models, and geographic understanding provides the data necessary for analyzing the impacts of population growth and land use change. This information can be used to
analyze the causes of urban suffocation, pollution, and loss of natural resources. Each of these impacts is linked to changes in the extent of urban, agricultural, and forested lands, and (or) transportation systems. Planners use Urban Dynamics data to evaluate environmental impacts, to delineate urban growth boundaries or service areas, to develop land use zoning plans, and to gauge future infrastructure requirements. Traffic suffocation, a common malady of urbanization, is the result of urban growth, increases in population density, and out-dated transportation infrastructure. By evaluating trends associated with land use change over time, solutions to traffic congestion may be obtainable. Another specific application of UDR data is the correlation of air pollution records with the temporal database to determine if control strategies for reducing pollution have been effective. Many pollution control strategies have been used in the past three decades. Correlation between land use change and pollution helps researchers establish positive or negative trends that indicate whether pollution control strategies have been successful. With this information, policy makers, resource managers, and the public can make appropriate changes for the future. Hydrologists can use Urban Dynamics data to evaluate new water sources for future urbanization and to analyze water pollution – a problem common to urban areas, industrial sites, and agricultural lands. The amount and degree of water pollution in rivers, lakes, and bays can be predicted on the basis of past and future trends in land use change. A study currently underway in the Patuxent River Basin in Maryland focuses on the sources of water pollution over time. In this study, temporal change maps of urban, agriculture, and forest lands are used to identify and quantify historic trends in sediment and nutrient loads in waters draining into the Chesapeake Bay. Geologists use data on land use change to evaluate the availability of building materials, such as sand, gravel, and cement. Geologists also use data on existing hazards to correlate with the UDR data to predict the impacts of future natural disasters and the potential damage they may cause.
Policy makers can then use these damage or hazard projections to direct future development away from the most at-risk areas. Finally, biologists also use land use change data to compile maps on habitats, species distribution, and land management. Predictions about future urbanization are critical to the protection of ecosystems and the sustainability of communities.

PRODUCTS
The UDR program provides temporal land use databases, analyses of land use change, and landscape change predictions. Databases for study sites contain digital maps of urban extent, transportation routes, water features, and other significant land uses compatible for use in geographic information systems (GIS). Digital animations are available to help visualize the temporal patterns inherent in the data. A land use change model and documentation are also available. Interpretive papers and maps based on the data and models are published in a variety of formats.

STUDY SITES
UDR projects are underway in the metropolitan regions of Washington, D.C., Baltimore, Chicago, Milwaukee, Portland, Vancouver, New York, Philadelphia, San Francisco, and Las Vegas. Additional work is being done in the Detroit River corridor, California’s Central Valley, the Front Range corridor of Colorado, South Florida, and in the Middle Rio Grande Basin in New Mexico.
COLLABORATION

The UDR program is a joint activity between the USGS and the University of California, Santa Barbara. The Baltimore-Washington study was also supported by the University of Maryland, Baltimore County, NASA's Mission to Planet Earth, U.S. Census Bureau, Library of Congress, Smithsonian Institution, and Maryland Historic Trust. We are actively seeking the participation of organizations in new project areas as partners and clients.

REFERENCE


