PREDICTION OF URBAN LAND-USE EVOLUTION USING TEMPORAL REMOTE SENSING DATA ANALYSIS AND SPATIAL LOGISTIC MODEL

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Abstract:

Urban growth is regarded as necessary transitional stage for a sustainable economy，but uncontrolled or arbitrary urban growth rapidly consumes rural resources and causes environmental pollution, ecological deterioration and infrastructure pressure. Understanding, modeling and forecast the trends of urban land use evolution is important to recognize and assess the impacts of urbanization at regional levels for resources managers and urban planners.

Urban land use systems are complex systems with components, factors, and agents from natural, environmental, social, economic systems related to land uses. Several frameworks have been built in the past five decades to model urban growth. Techniques such as regression analysis[1][2], cellular automata (CA)[3][4][5], artificial neural networks (ANNs)[6], and genetic algorithm(GA)[7] , etc, are employed in urban growth modeling and prediction respectively.

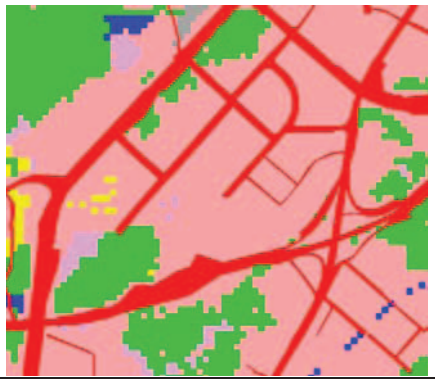
However, the complexity of urban systems makes it difficult to adequately address their changes using a model based on a single approach[8]. In this paper, we developed a remote sensing and GIS based integrated approach to modeling and prediction spatially explicit urban land use change. The model was built upon a temporal remote sensing data land use analysis coupled with a spatial multinomial logistic regression framework. The first procedure was applied to build Markov chain model by analyzing the historical urban transition probabilities, and to predict land use total amount in macroscopic scale. By computing the equation of the natural log of the probability of each land use category divided by the probability of being

others to find maximize the likelihood, the second procedure estimated the discrete choice probability of each patch in order to simulate urban spatial non-linear growth urban growth under different scenarios.

In the research, Shenzhen city of Guangdong Province was token as the case study area for model calibration and urban simulation. This land use data sets with a cell size of 40m×40m, which category includes fallow, plantation, woods, grassland, residential, transportation, water and etc, were derived from natural or semi-natural classification and interpretation on historical remote sensing data such as Thematic Mapper (TM) imagery of 1990, 1996, 2000 years, and China-Brazil Earth Resources Satellite (CBERS) approximately every year from 2002 to 2006. Therefore, there were 7 time-series data sets, covering a 26-year period, available for deducing Markov chain to predict land use total amount. Meanwhile, 7 independent variables for every time-series, i.e., population density, slope, distance to major roads, distance to railway, distance to central business district, distance to industry district and distance to education centers, which were used to measure physical suitability, accessibility to infrastructure and facilities, market factors and natural environment, were selected into spatial multinomial logistic regression for each land use category.

At last, by using comparing the results prediction with land use data from CBERS image interpretation and field investigation of 2008 year (for example figure 1), although its predictive power varied spatially and temporally with different types of land use, the forecast total accuracy was proved to be satisfactory with accuracy of 82.65% which met the need of urban land use early warning. The model was used to predict future urban growth in the region through the year 2020, and simulation urban growth under different scenarios has been applied into annual planning of land supply for Shenzhen Real Estate Research Center. It is concluded that integrating Markov model and spatial logistic model is an effective method of urban land use evolution.

a)The land use map located at Longgan town from interpretation by CB image and field investigation in 2008



(b)The prediction land use map in 2008 (Green color represents woods; yellow is cropland; blue is water; red is roads; and orange is residential buildings).

Figure 1. **The comparison forecast data with interpretation data by remote sensing of 2008**

Key words: land use evolution, spatial multinomial logistic regression, Markov model

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