Modeling Land Use Scenario Dynamics Based on Land Use/Cover Change in Tianjin City

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Since the beginning of the 21st century, urban areas have been expanding rapidly in the world. With this rapid urban growth, serious environmental and social problems have appeared (Zhao & Murayama, 2006). Modeling land use scenario changes and its potential impact on ecosystem structure and functioning in a typical region are helpful to deeply understand the reciprocal mechanism between the land use system and ecosystem (Weng & Lu, 2008).

In this study, taking Tianjin city, China as a study area (Fig. 1), an attempt is made to study the LULC changes and modeling variables. The primary objective of this study is to investigate the land use/cover (LULC) changes of Tianjin city and simulate future LULC to support urban planning initiatives. The final goal is to predict the LULC development in 2025, 2035 and 2055 under the three LULC scenarios: the spontaneous, the environment protecting and the economic orientation.

The study uses Landsat data of three-time points (1995, 2005, and 2015) to prepare LULC maps and detect the spatiotemporal LULC changes in Tianjin city. Remote Sensing and Geographical Information Systems are useful tools for detecting geographical objects and phenomena changes. Landsat images as a primary database are used in this study. In ArcGIS software, the pixel-based supervised classification technique employing the maximum likelihood classification algorithm is available to perform classification. Markov and Cellular Automata models were employed to simulate changes in LULC at a very variety of spatial scales. IDRISI Terrset software is useful for analyzing summary statistics, Markov probabilities, and cellular automata simulation. For the scenario prediction, the Multi-Criteria Evaluation (MCE) module was used in this study.

The results show that Tianjin city is experiencing fast spatial expansion with urbanization and industrialization. In the outcome of the simulation maps in 2025, 2035 and 2055, under the spontaneous scenario, most of the cropland areas are transforming into the built-up. Grass and forest areas are stopped for increasing under the environmentally protecting scenario. While under the economic orientation scenario, built-up area is mainly concentrated in city center and expands to the suburbs. The simulation result can give useful recommendations to policy makers and city planners who are aware the potential challenges and risks brought by this process, such as food security, pollution, urban climate and water resource constraint.

Fig. 1. Study Area: Tianjin, China.