Simulating Land Use Change with Rapid Urbanization under the Natural and Anthropogenic Driving Forces

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Land use/Land Cover Change (LUCC) significantly affects the structure and function of the ecosystem, including biodiversity, biogeochemical cycles, and the sustainability of resources. LUCC involves complex underlying mechanisms and diverse driving factors concerning both human activities and the natural environment. Therefore, understanding the LUCC processes under multi-dimensional driving factors to investigate the future tendency is of high research value. Accompanied by rapid urban population growth and socio-economic development, the world has undergone large-scale urban expansion. Many scholars have put effort into better optimizing urban planning and configuration to achieve urban sustainability. Spatiotemporal LUCC simulations are effective and reproducible methods for analyzing both the causes and consequences of future land dynamics under various scenarios. There is a growing body of approaches and software packages for modeling future LUCC, and many of them are empirical approaches based on historical data such as regression models, artificial neural networks, CLUE-S, and CA_MARKOV. This study has newly applied a patch-level land-use simulation model (PLUS) developed from the future land use simulation model based on the cellular automata (CA). A case study has been undertaken in the three metropolitan areas of Japan. By applying a land expansion analysis strategy (LEAS), we extracted the LUCC in the metropolitan areas of Japan between 2010 and 2015. Driving factors such as landscape condition, population, railway distance, and protected areas were considered to explore the effect of those factors on the change in different land-use types. Besides, we have simulated the land use of the study area in 2017 with a CA model based on multi-type random seeds integrated into the PLUS model. The simulation result corresponds well to the real land use map in 2017 with acceptable accuracy, suggesting that our approach can provide practical information for understanding land use alternation and contribute to the decision-making for sustainable urban planning. Future work will focus more on significant driving factors, regional differences, and the impact of climate change.

Keywords: land use and land cover change, urban expansion, driving factors, PLUS model, future scenarios simulation

