不同样本方案下遗传元胞自动机的土地利用模拟及景观评价

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Land use simulation and landscape assessment by using genetic algorithm based on cellular automata under different sampling schemes.

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摘要

利用元胞自动机（cellular automata，CA）模拟土地利用情景，有助于理解其变化机理，并为土地资源持续利用提供空间决策支持.本文基于生物进化过程的遗传算法（generic algorithm，GA）将CA参数编码成为染色体，在模拟结果与真实结果差异值的引导下，通过选择、杂交和变异算子使最优的染色体得以遗传和保留，从而建立智能优化的元胞自动机模型.以浙江省嘉兴市1992—2008年土地利用变化为例，分别利用6%（66个·km^{-2}）和3%（33个·km^{-2}）两种样本方案构建遗传CA模型进行土地利用变化模拟，并通过混淆矩阵、Kappa系数和景观指数对模拟结果进行评估.结果表明： 遗传CA模拟结果能在数量、位置和景观格局上以超过80%的水平接近真实分类，且大样本量构建的遗传CA的模拟精度更高；2008年的模拟精度和景观综合指数低于2001年，表明遗传CA的模拟精度和景观综合指数随模拟时间而衰减.

关键词： 土地利用模拟   元胞自动机   多重样本   遗传算法   景观评价

Abstract：

Simulating land use change scenarios with cellular automata (CA) can help to the policy makers in understanding the mechanisms of land change, and support the spatial decision-making for the sustainable use of land resources. Genetic algorithm (GA), an intelligent approach originally conceived from the biological process of evolution, has the capability of minimizing the difference between simulated and observed land use patterns with optimum chromosomes (*i.e.*, feasible CA parameters) obtained through a set of selection, crossover, and mutation operations. In this paper, GA-based CA model was developed, and applied to simulate the land use change in Jiaxing City of Zhejiang Province in 1992-2008. This model was calibrated with 6% (66 samples·km^{-2}) and 3% (33 samples·km^{-2}) samplings, and the simulation results were evaluated based on confusion matrix, Kappa coefficient, and landscape metrics analysis. Over 80% of the land use features generated by the GA-based CA model matched the observed classification of land features geographically, and much higher simulation accuracy could be obtained with a larger sample. The simulation accuracy and the landscape metrics for 2001 were better than those for 2008, suggesting a tendency that the model's accuracy decreased over the simulating process.

Key words： land use simulation   cellular automata   multi-samples   genetic algorithm   landscape assessment

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