Estimation of land use maps considering spatial dependence in a spatial filtering framework

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The present study builds a spatial statistical model that estimates land use maps. We use the land utilization database of the National Land Numerical Information published by the Ministry of Land, Infrastructure, Transport and Tourism, in Japan, as the data source. Of the many approaches to modeling land use maps thus far proposed in the literature, representative method is using a multinomial logit model, in which the likelihood of placing each land use category into each zone is explained by selected attributes such as population and elevation. Because neighboring zones tend to be categorized into the same land use classes, considering spatial dependence among zones is important when applying a multinomial logit model for modeling land use maps. Although previous studies have attempted to take account of spatial dependence using spatial econometrics techniques, such methods require a computationally burdensome iterative calculation in order to estimate the parameters, for example the expectation-maximization algorithm or Markov chain Monte Carlo method. On the contrary, the present study employs a spatial filtering framework, based on a spatial statistical approach, in which the parameters are estimated using the standard maximum likelihood method in order to model spatial dependence. The obtained results suggest that compared with conventional non-spatial multinomial logit models, the predictive power in terms of the AIC is substantially improved when using spatial filtering.

Keywords: land use, spatial filtering, spatial dependence, multinomial logit model