

Multi-model inference and selection: modelling land use change with GIS

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ABSTRACT

This paper develops an approach to modelling land use change that integrates model selection and multi-model inference with GIS. Land use change is frequently studied, and understanding gained, through a process of modelling that is an empirical analysis of documented changes in land cover or land use patterns. The approach presented here is based on analysis and comparison of multiple models of these patterns. The paper demonstrates a) model selection as a mechanism for rating among the many models that describe land cover or land use patterns, and b) inference from the set of models rather than from a single model. The approach is based on information-theoretic approaches finding increased use in modelling species distribution models in landscape ecology. A spatial database of rural housing for the period 1860 to 2000 in Gallatin County, Montana, USA, is used to develop a series of models based on spatial data related to choice of house sites and urban development in a rural landscape. A variety of alternate models describing the pattern of rural residential settlement are developed based on a series of drivers of change hypothesised to be important for land use change. These drivers are all readily computed with a GIS and include distance to roads, distance to forest, distance to water, landscape visibility, distance to the main urban centre, slope and agricultural and other land uses. Generalized Linear Modelling and Generalized Additive Modelling are used to construct a suite of alternative models based on these drivers. These models are then evaluated in a process of model selection and the relative importance of the different drivers assessed through both model development and multi-model inference. The models and results show the changing importance of different drivers and their impact on residential location over the 140 year study period. The role for this type of analysis in understanding coupled human-natural systems is discussed.

Keywords: Land use change, Generalized Additive Models, Generalized Linear Models, Model Selection, Multi-model inference.