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Predict urban growth in a low-density context: Basilicata region study case

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This paper presents a spatiotemporal analysis to simulate and predict urban growth. It is important to study the growth of cities to understand their implications for environmental sustainability and infrastructure needs. The aim of this work is to predict future scenarios in low-density settlements in order to control and regulate the processes of urban transformation.

We applied an integrated approach based on the multinomial logistic regression (MLR) and the cellular automata (CA) for urban sprinkling modelling. Our case study is the Basilicata region, in southern Italy, which is affected by urban sprinkling literally defined as: “a small amount of urban territory distributed in scattered particles".

Built-up density maps were created on the basis of three regional building datasets (1989, 1998 and 2013) with four density classes: no built up, low density, medium density and high density. These sources were used for calibrating and validating the model as well as for future simulation of urban sprinkling. Two components were considered for the calculation of the transition potential from one density class to another. For the first built up development causative factors were calibrated using the MLR for the expansion and densification processes. The causative factors consider elevation and slope as physical factors, Euclidian distance to railway station, different type of street, large size city and medium size city as proximity factors, population density and employment rate as socio economic factors and zoning for land use policies in the study area.

The second causative factor is the CA neighbourhood effects that have been calibrated using a multi objective genetic algorithm (MOGA) as in (Mustafa et al., 2018). The transition potential was calibrated for the 1989-1998 time period and the calibration outcomes were used to simulate the 2013 map. The calibrated map was then used for the simulation of the 2013 map which was compared with the actual map of 2013 (validation). We then used our calibrated model to simulate urban growth in the year 2030.

The robustness of MLR has been evaluated with the Receiver Operating Characteristic (ROC) index. The Fuzzines index has been used for evaluating the validation process accuracy.

The results of the 2030 prediction show the greatest variations in class 1 (low density) that represent the sprinkling of urban cells in the territory.

Keywords: Low-density, Cellular Automata, Multinomial Logistic Regression, Urban Sprinkling, Basilicata Region.