SIMULATION OF FUTURE DISRUPTIVE URBAN SCENARIOS USING VECTOR-BASED CELLULAR AUTOMATA MODELS AND PARTICIPATORY APPROACHES

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INTRODUCTION

This research presents a model of urban land use change to simulate different future scenarios combining modelling, vector Cellular Automata (CA) (Yao et al., 2017) and participatory approaches to develop appropriate policy packages in the urban planning and decision-making process. As a case study, the urban-industrial corridor of Henares (Spain) has been chosen.

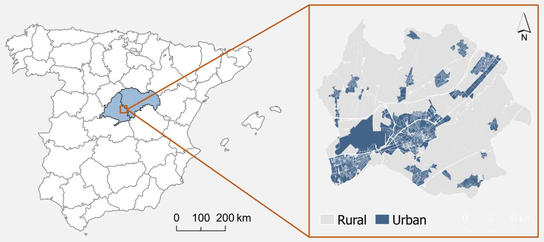


Figure 1. Case study.

The main **OBJECTIVE** is to develop a model capable of simulating exploratory future scenarios of urban land use change that can assist in the development of urban planning policies

METHODS

First step was to build future scenarios that would provide a vision of the distribution of land uses and the transport systems through **public participation** (Soria-Lara et al., 2021). As a result three narratives were obtained:

(1) Non-motorised city centres
(2) Overpopulation
(3) High insecurity levels in urban areas

Second, a **participatory mapping workshop** was developed (Molinero et al., 2021), where stakeholders and experts spatializing the narratives obtained to build scenarios.

Figure 2 and 3. Participatory mapping workshop

Finally, to simulate the three scenarios, a **vector-based CA model** was developed using *Python* programming language. This model uses vector Cellular Automata (CA) (Barreira et al., 2019) to reproduce disruptive future scenarios of urban development. The model was configured with the workshop data.

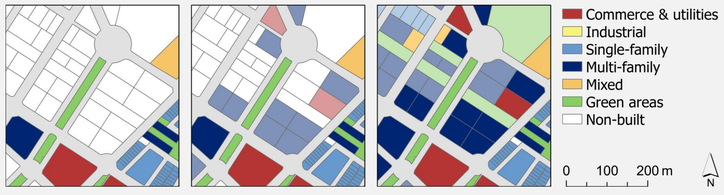


Figure 4. Graphical operation of the vector-based CA model of urban development.

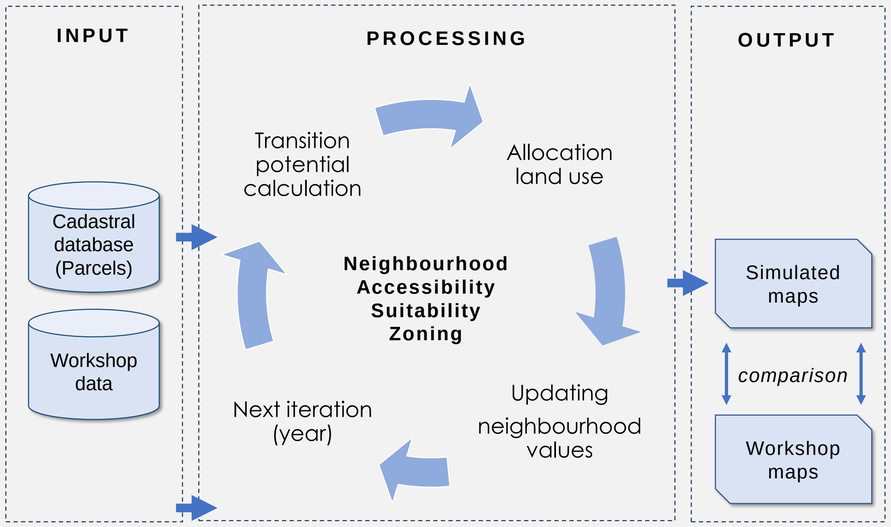


Figure 5. Iterative process of the model

RESULTS

The simulation model offers a combination of factors that can be configured to reflect the most relevant aspects of any envisaged scenario. Expansion, agglomeration, urban sprawl, mix, neighbourhood renewal, abandonment, etc. are some of the complex urban dynamics that the model allows to simulate.

The results obtained consist of three scenarios integrating the future vision and knowledge of the population, the spatial and technical criteria of urban planning and transport experts and, finally, technical expertise in urban modelling.

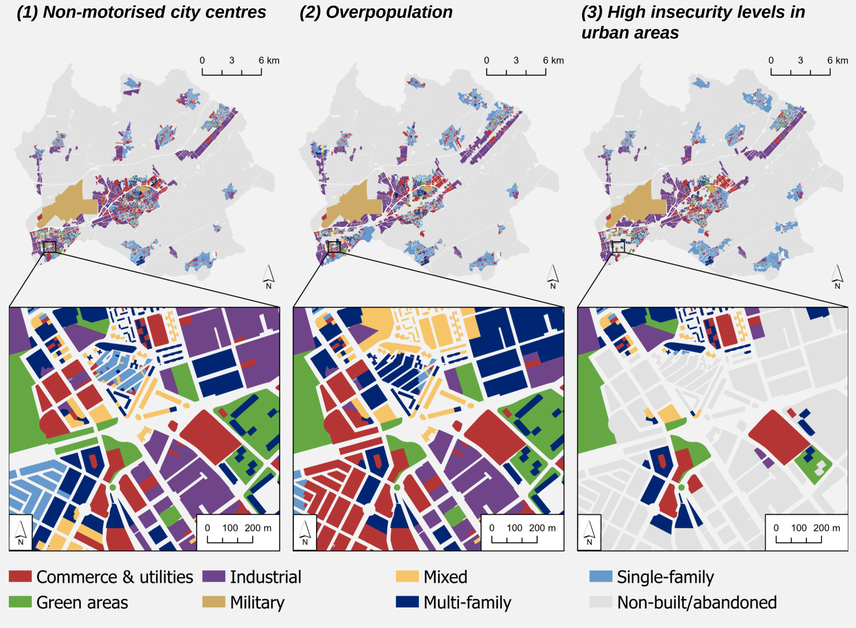
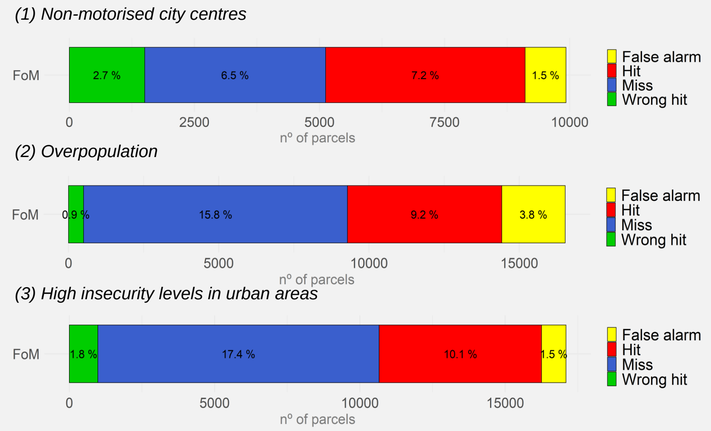


Figure 6. Simulated scenarios.



False alarms: reference persistence simulated as change
Hits: reference change simulated as change
Misses: reference change simulated as persistence
Wrong hits: reference change simulated as change to the wrong category

Figure 7. Three-map comparison: reference map (2018), workshop map (2050) and simulated map (2050)

CONCLUSIONS

In conclusion, this poster introduces a new model prototype able to simulate exploratory future scenarios of urban land use change. For this purpose, modelling tasks are combined with participatory approaches, engaging population and expert in the field of urban planning to be part of the process. The spatial representation of future scenarios allows urban planning policies to adapt to new emerging land demands, to anticipate undesirable situations or to protect the environment from possible uncontrolled developments.

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