Monitoring the Impact of Urban Growth Scenarios on No Net Land Take of Wallonia, Belgium, Using a Cellular Automata Model

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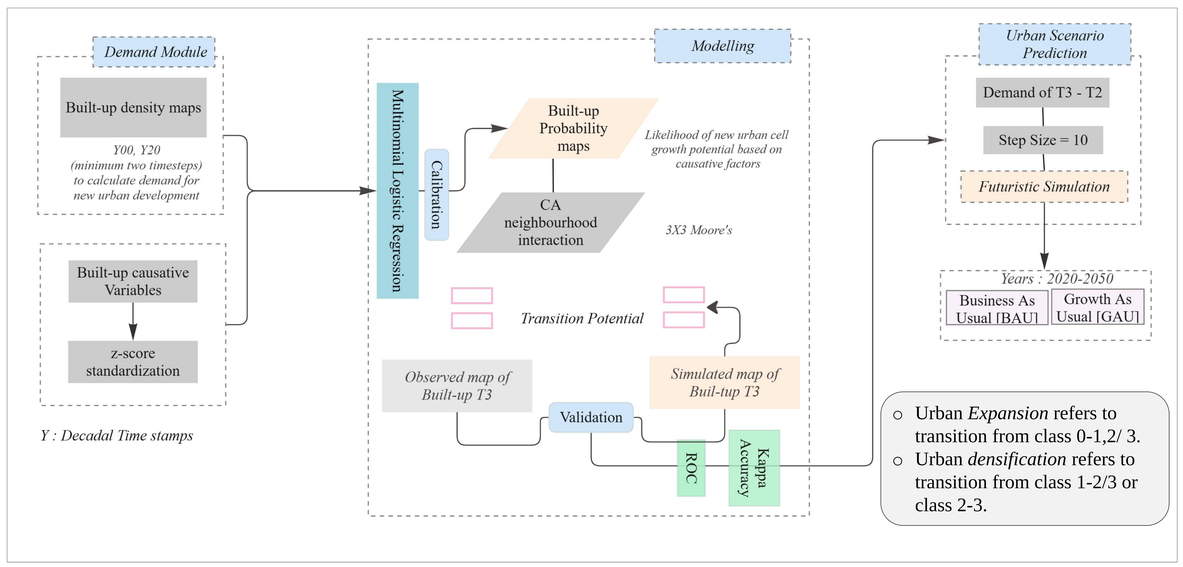
1. Motivation

- Urban **expansion** driven by population growth and economic activity continues to intensify land consumption, challenging sustainability targets. In response, the European Union's **No Net Land Take by 2050** policy promotes urban densification and regeneration. However, regions like Wallonia, Belgium, still experience significant sprawl despite new planning efforts.
- Understanding the **evolution of future urban growth** under varying development scenarios is essential for informed and effective strategic planning. However, significant uncertainties persist in projecting land take dynamics amid changing socio-economic conditions and policy interventions, necessitating the use of robust spatial simulation frameworks.

2. Objectives

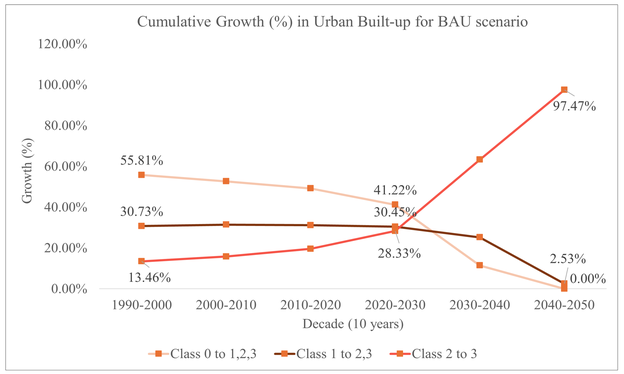
- To simulate future urban expansion in Wallonia under constrained and unconstrained urban growth scenarios up to 2050.
- To evaluate how different growth scenarios (Business-As-Usual vs Growth-As-Usual) impact the zero Land Take goals of Wallonia by 2050.
- To provide strategic support for sustainable urban planning and policy development.

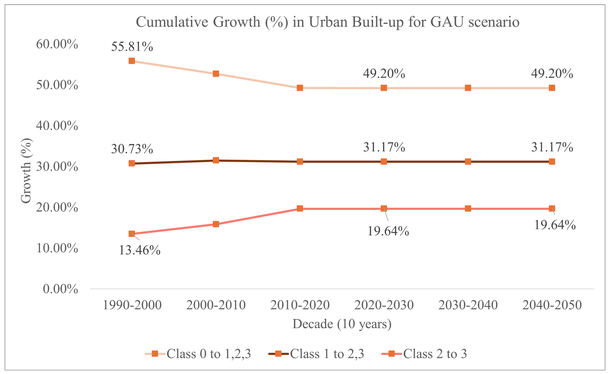
3. Materials & methods



- We used cadastral data from Belgian Land registry for 100x100 m built-up maps.
- Geophysical, accessibility and socio-economic and policy data were used to understand their impact on urban growth.
- BAU considers the historical trend of growth since 2000 till 2020.
- GAU considers the last observed growth of 2020.
- The consideration has been done based on https://www.iweps.be indicator of soil artificialization.

4. Results





Model Accuracy & Validation:

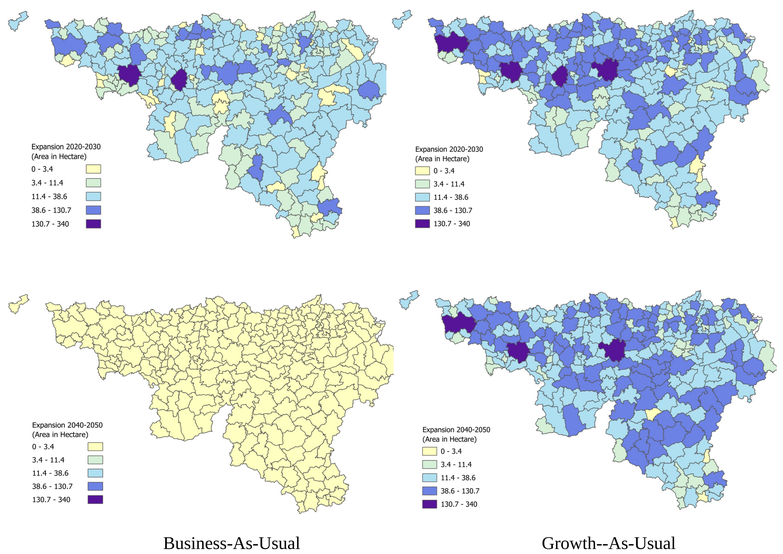
High Accuracy Achieved: MNL-CA model showed strong predictive performance (Kappa = 0.925, ROC for built-up classes > 0.9).

Scenario outcomes:

- In, BAU, land take drops to 0 ha/day by 2040, encouraging densification and resulting in a compact urban form (+2.9% growth).
- While, in GAU which assumes constant growth (2.5 ha/day), leading to sprawling expansion and fragmented urban patterns (+8.9% growth).
- The study highlights that BAU might encourage compact growth in cities like Liège and Namur; GAU pushes expansion into peri-urban/rural areas.

5. Key Takeaways

- The BAU scenario **aligns** with Wallonia's No Net Land Take (NNLT 2050) goals, through **increased densification** and reduced expansion.
- The GAU scenario highlights the **laissez-faire** approach of planning with risks of policy inaction.
- Findings underscore the need for **adaptive planning** strategies that account for both regulatory intentions and market-driven pressures such as housing demand and job accessibility.
- Containment is effective in **urban-centers**, while rural areas remain vulnerable, emphasizing the need for differentiated, location-specific interventions.



Business-As-Usual Growth--As-Usual

I. Chakraborty, A., Mustafa, A., & Teller, J. (2024). Modelling multi-density urban expansion using Cellular Automata for Brussels Metropolitan Development Area. ISPRS Annals of Photogrammetry, Remote Sensing and Spatial Information Sciences, X-4/W4-2024, 29–34. https://doi.org/10.5194/isprs-annals-X-4-W4-2024-29-2024.

II. El Saeid Mustafa, A. M., Heppenstall, A., Omrani, H., Saadi, I., Cools, M., & Teller, J. (2018, January). Modelling built-up expansion and densification with multinomial logistic regression, cellular automata, and genetic algorithm. Computers, Environment and Urban Systems, 67, 147-156. https://doi.org/10.1016/j.compenvurbsys.2017.09.009.