SUPTM 2024: 2nd Conference on Future Challenges in Sustainable Urban Planning & Territorial Management

Universidad Politécnica de Cartagena
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Proceedings

Implementation of Low Emissions Zones (LEZ) through soft traffic calming strategies: the case study of Cartagena (Spain)

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Abstract: Spanish Law 7/2021 on climate change and energy transition makes it mandatory for municipalities with more than 50,000 inhabitants to establish low-emission zones by 2023. On the other hand, the Sustainable and Accessible Urban Mobility Plan of the Cartagena City Council 'Cartago!', approved by the Local Government Board in 2021, recommended to develop low-emission zones in various areas of the city based on scientific knowledge and not on political priorities, limiting traffic restrictions only to cases in which they are necessary for technical reasons to improve mobility. This study proposes an innovative process using soft traffic calming strategies based on woonerf philosophy, applied to combine both requests. A spatial definition framework at a graphic level of the areas to be implemented as low emission zones was developed in two levels. The target areas for air quality improvement have been defined through a prior geostatistical analysis and the selection of the perimeter of action of the priority areas was established through a methodology based on geostatistics indicators applied through fuzzy AHP multi-criteria evaluation. The results obtained can serve as a basis for the development of low-emission zones in medium or small-sized cities.

Keywords: low emissions zone regulations; soft traffic calming strategies; Cartagena air quality; superblocks; GIS mobility monitoring; LZE; woonerf.

Citation: García-Ayllón, S.; Yepes, M. Implementation of Low Emissions Zones (LEZ) through soft traffic calming strategies: the case study of Cartagena (Spain). *SUPTM 2024 conference proceedings* sciforum-081408. https://doi.org/10.31428/10317/13643

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1. Introduction

Medium-sized cities in Spain have undergone a major transformation in the planning of their urban mobility in the last 20 years, thanks to the massive implementation of Sustainable Urban Mobility Plans, whose results have been uneven both from the point of view of traffic management and from the point of view of improving air quality [1].

However, since the approval in 2021 of the climate change and energy transition law, all cities in Spain with more than 50,000 inhabitants must implement low-emission zones that regulate the access of private vehicles to various areas of the city, restricting such access to the most polluting ones based on environmental labelling (Figure 1).

Figure 1. Existing categories of environmental labelling in Spain (zero, ECO, C and B; the non-availability of an environmental label is in practice a fifth, the most polluting category).

2. Area of study

The study area focuses on Cartagena, a medium-sized city located in the southeast of Spain with 220,000 inhabitants (Figure 2). The city has average levels of the QAI

indicator (good 18% of the days of the year and reasonably good 74%), except for specific cases (3%) of increase in the PM10 parameter due to sporadic episodes of Saharan dust.

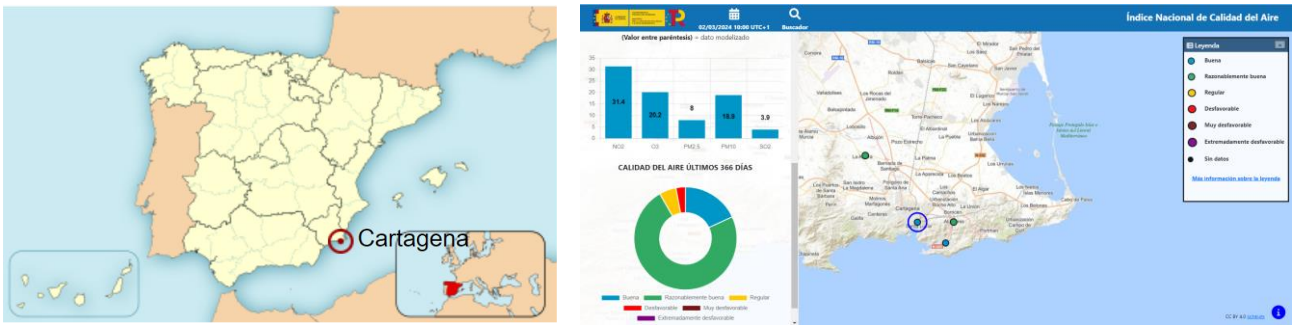


Figure 2. Location of the area of study (left) and average daily AQI values last year (right). Source: MITECO.

3. Methods and literature review

In the city, several previous studies [2–4] were carried out correlating the effects of the pandemic on the modal distribution, on the different urban mobility alternatives in the city and the levels of air quality in the different neighborhoods. The geostatistical analyses carried out detected the need to implement mobility actions in the historic centre and the first urban ring of expansion area to improve air quality (Figure 3).

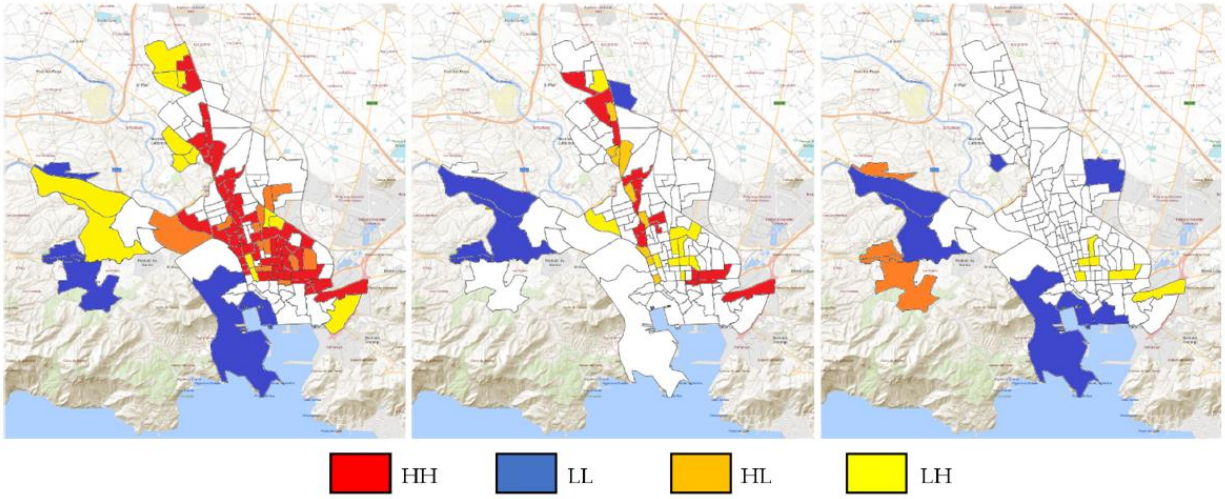


Figure 3. Results of the previous analysis of mobility modal sharing and air quality geostatistical correlation using statistically significant hot and cold spots with the Getis-Ord Gi* statistic. Source of data: [2], [3].

As a result of these studies, it was decided to implement two low-emission zones in the urban area of the city: the historic center and the first north urban expansion ring.

4. Design of the Low Emission Zones

For the design of the Low Emission Zones (LEZ), traffic data were considered, both at the level of density and at the level of distribution of the modal distribution in the city's road structure. For the selection of the perimeter of action of the priority areas, we established a methodology based on GIS indicators applied through fuzzy AHP multi-criteria analysis result of the integration of different tools successfully used in previous works for other fields of research [5,6]. The first area of action selected was the historic center. It is a mostly pedestrianized area in which the aim was to consolidate this mobility pattern due to massive influx of tourists, so for this case the room for improvement was relative.

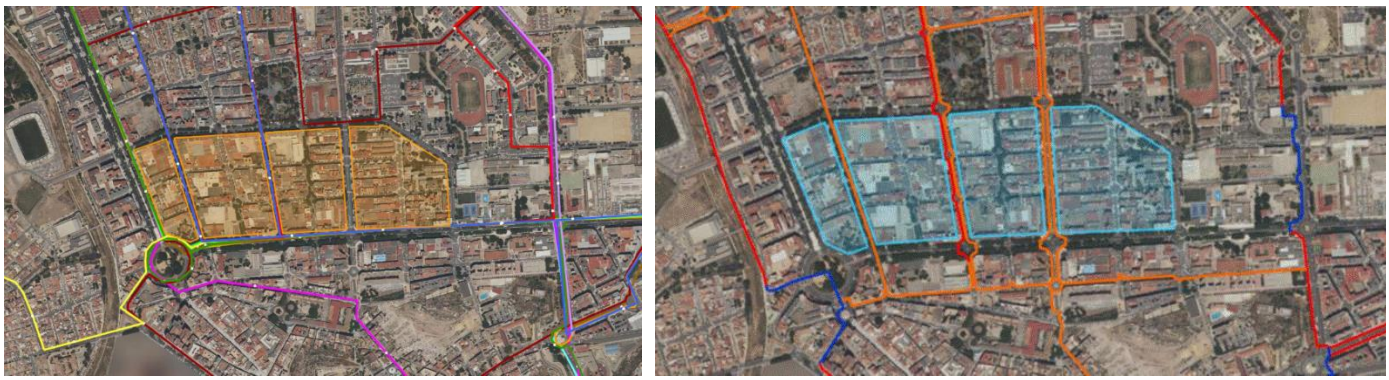
The second area selected was the first expansion of Cartagena to the north, a densely populated area due to having numerous buildings at the height, and with significant

intensities of private traffic throughout the day. This traffic was not hierarchical in its urban structure, overlapping in their inner streets float and finalist flows that generates traffic jams and reduces the level of quality of life in the neighborhoods (Figure 4).

(**a**) (**b**)

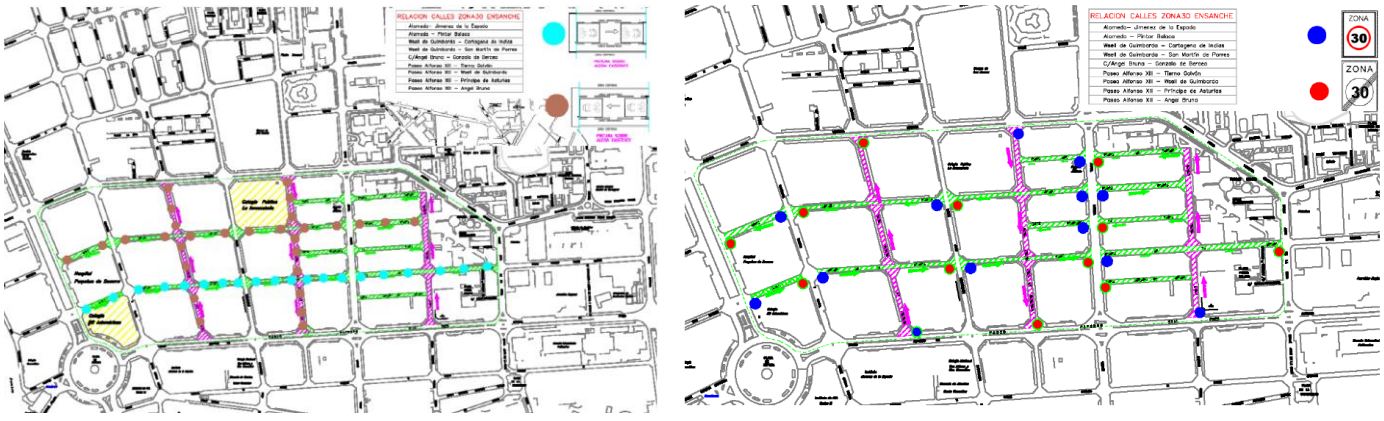
Figure 4. Scope of action for the areas selected as future LZE of the city: a) historic center and b) first north urban expansion ring.

To develop this second Low Emission Zone, a model has been designed that combines the road traffic hierarchization techniques implemented in Barcelona with the '*superillas*', taking advantage of the repetitive urban structure of these expansion area blocks, with the Dutch Woonerf philosophy of implementing traffic calming strategies through modification of the road layout. To this end, it has been necessary to carry out a large-scale reorganization of urban mobility in the rest of the city (Figure 5).



(**a**) (**b**)

Figure 5. Example of reorganization of the existing public transport network (**a**) and the network of bicycle lanes (**b**) for the implementation of the four initial superblocks of the Low Emission Zone pilot project in the expansion area of the city.



(**a**) (**b**)

Figure 6. Areas of action on expansion intersections (a) and points of modification of the layout or road hierarchy (b).

This soft strategy approach to the implementation of the Low Emission Zone avoids the 'border effects' detected in cities such as Madrid with the *Madrid Central* plan [7] and contributes to an improvement of public space quality, that combines mobility and tactical urbanism strategies. The transformation of the urban structure of this traffic calming strategy is especially relevant in the inner nodes of the superblocks, offering multiple possible configurations (Figure 6).

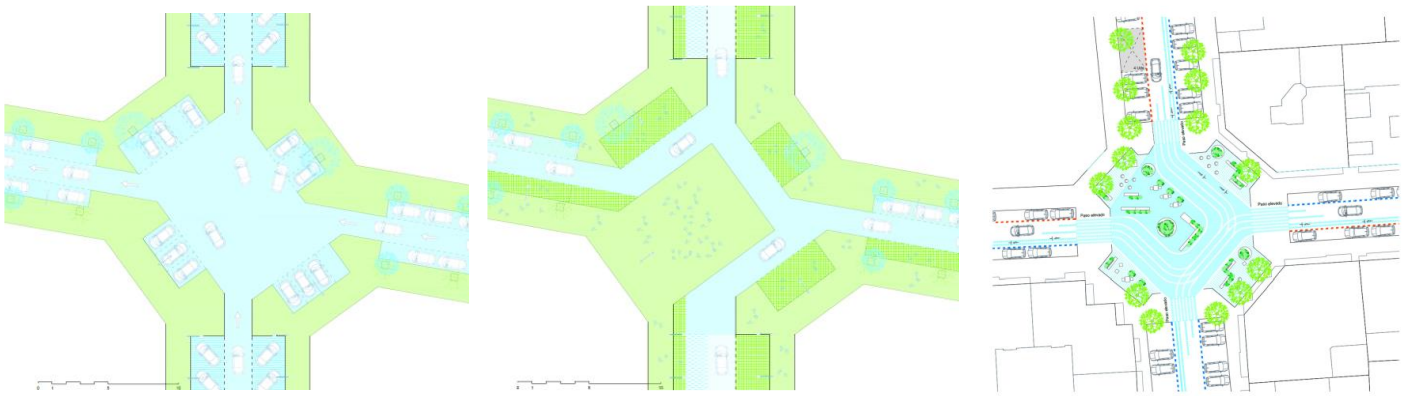


Figure 6. Example of application of the 'woonerf philosophy' in the strategic crossings of the superblocks in the northern area of the city's expansion: transition from the current situation (left) to new combinations of reorganization of traffic directions (center) and finally incorporating improvements in public space through tactical urban planning solutions (right). Source: Cartagena City Hall.

4. Conclusion

The work carried out shows an innovative proposal for soft implementation of low emission zones in the city of Cartagena (Spain). By means of approaches exempt from traffic restrictions based on GIS indicators applied through fuzzy multivariate AHP criteria, it has been possible to comply with the regulations aim through soft traffic calming strategies. This approach may be interesting for the future implementation of Low Emission Zones (LEZ) in small or medium-sized cities without relevant pollution issues.

Funding: This research received no external funding.

Acknowledgments: The authors would like to thank the Cartagena city council staff Pedro Yepes for the data provided and mobility councilor Cristina Mora for the institutional support.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. Garcia-Ayllon, S.; Hontoria, E.; Munier, N. The Contribution of MCDM to SUMP: The Case of Spanish Cities during 2006–2021. *Int J Environ Res Public Health* **2022**, *19*, doi:10.3390/ijerph19010294.
2. García-Ayllón, S. Air Pollution Derivatives Linked to Changes in Urban Mobility Patterns during COVID-19: The Cartagena Case Study. *Environmental Sciences Proceedings* **2022**, *24*, doi:10.3390/ECERPH-4-13108.
3. García-Ayllón, S.; Kyriakidis, P. Spatial Analysis of Environmental Impacts Linked to Changes in Urban Mobility Patterns during COVID-19: Lessons Learned from the Cartagena Case Study. *Land (Basel)* **2022**, *11*, doi:10.3390/land11010081.
4. Salvador, G.-A.V. New Perspectives for the Diagnosis and Planning of Urban Mobility after COVID-19: The Case Study of Cartagena. In Proceedings of the SUPTM 2022: 1st Conference on Future Challenges in Sustainable Urban Planning & Territorial Management; Universidad Politécnica de Cartagena, January 11, 2022.
5. Bianco, F.; García-Ayllón, S. Coastal Resilience Potential as an Indicator of Social and Morphological Vulnerability to Beach Management. *Estuar Coast Shelf Sci* **2021**, *253*, 107290, doi:https://doi.org/10.1016/j.ecss.2021.107290.
6. Tomás, A.; Ródenas, J.L.; García-Ayllón, S. Proposal for New Values of Behaviour Modifiers for Seismic Vulnerability Evaluation of Reinforced Concrete Buildings Applied to Lorca (Spain) Using Damage Data from the 2011 Earthquake. *Bulletin of Earthquake Engineering* **2017**, *15*, 3943–3962, doi:10.1007/s10518-017-0100-3.
7. Moral-Carcedo, J. Dissuasive Effect of Low Emission Zones on Traffic: The Case of Madrid Central. *Transportation (Amst)* **2024**, *51*, 25–49, doi:10.1007/s11116-022-10318-4.