

Regulatory Heterogeneity in Odor Impact Criteria: Insights from Comparative Dispersion Modelling

Francesca Tagliaferri^{1*}, Selena Sironi¹, Marzio Invernizzi¹

¹ Politecnico di Milano, Dipartimento di Chimica, Materiali e Ingegneria Chimica “Giulio Natta” - Piazza Leonardo da Vinci 32, 20133 Milano

* Corresponding author: Francesca Tagliaferri, francesca.tagliaferri@polimi.it; +39 02 2399 3149

Odour pollution has gained increasing attention in environmental regulation and policy discussions over recent years. In Europe, this growing awareness has culminated in the formal acknowledgment of odour as an atmospheric pollutant under the revised Industrial Emissions Directive (IED 2.0). Despite this progress, the absence of harmonized Odour Impact Criteria (OICs) across jurisdictions has led to markedly different approaches to odour impact assessment and management.

This study investigates the implications of such regulatory fragmentation through a comparative analysis of existing OIC frameworks and their application using dispersion modelling. The results demonstrate that differences in OIC definitions — including concentration thresholds, percentile values, and averaging times — generate substantial variability in predicted impact zones. Non-European countries generally show higher exceedance frequencies and more extensive isopleth areas, whereas European regulations tend to produce lower exceedance levels that are more spatially confined around emission sources. Nevertheless, considerable variability is also observed within Europe, including significant differences among regions within the same country, with some jurisdictions adopting particularly stringent criteria.

Socio-territorial factors emerge as statistically significant drivers of regulatory stringency, reflecting efforts to balance environmental health protection with industrial activity and economic development. While more stringent OICs provide stronger safeguards for affected communities, they may also entail increased compliance costs for operators; conversely, more permissive criteria risk compromising quality of life and property values. Overall, the findings underline the risks of implementing OICs without careful critical assessment and point to the need for harmonized standards—particularly within the EU—to ensure consistent environmental protection, regulatory coherence, and equitable treatment across jurisdictions.