

A CARTIS-based approach to exposure modelling: investigating local building typologies

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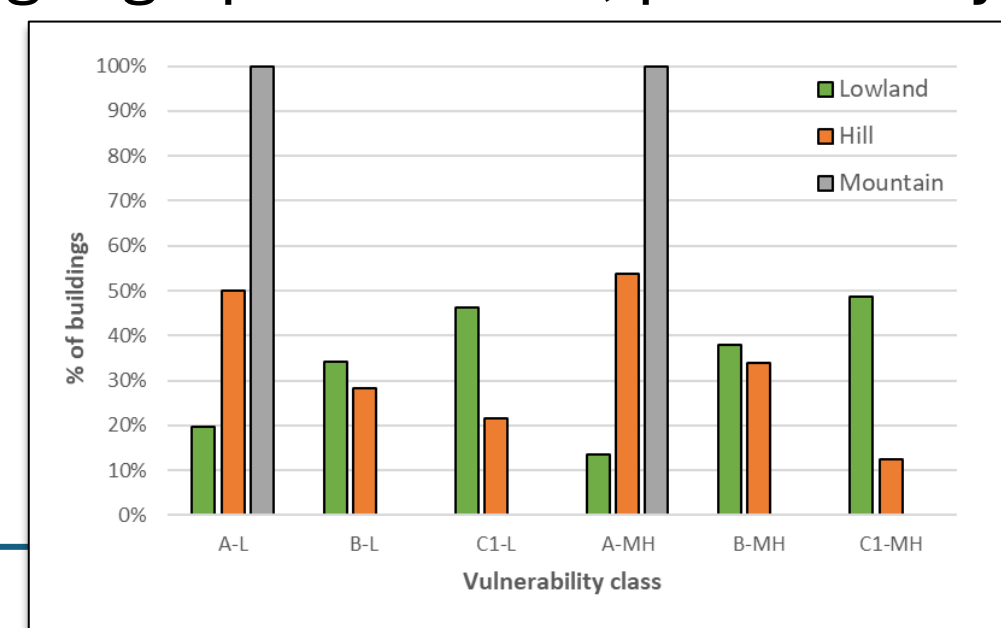
Task 2.3.7 ANALISI DI RISCHIO A SCALA TERRITORIALE - Task 4.1 ESPOSIZIONE: REGIONALIZZAZIONE DELLE TIPOLOGIE

RESEARCH OBJECTIVES

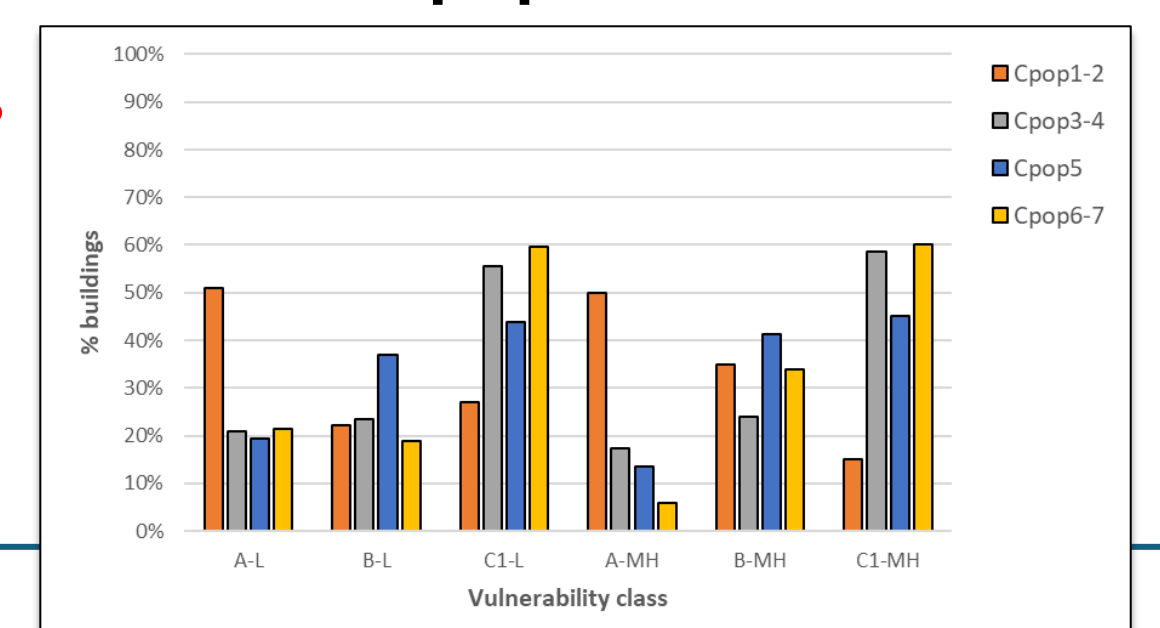
Building inventories are crucial for seismic risk assessments, categorizing structures into vulnerability classes based on structural details. Since such data are often unavailable, exposure/vulnerability models are used, estimating vulnerability based on factors like construction period and the number of floors. These models rely on post-seismic data and expert judgment but may not account for regional differences, especially in masonry buildings, leading to potential errors in vulnerability assessments.

The study aims to **improve regional vulnerability assessments by using the Cartis form to recalibrate empirical exposure models**. Previous research suggests that regional recalibration can significantly impact seismic risk analyses (Tocchi et al., 2022). By analyzing the distribution of structural characteristics (e.g., masonry type, vaults, floor rigidity) from the Cartis database in Campania, the study explores the relationship between these characteristics and demographic/geographic factors, particularly focusing on **altimetric zones** and **population class**.

Altimetric zone

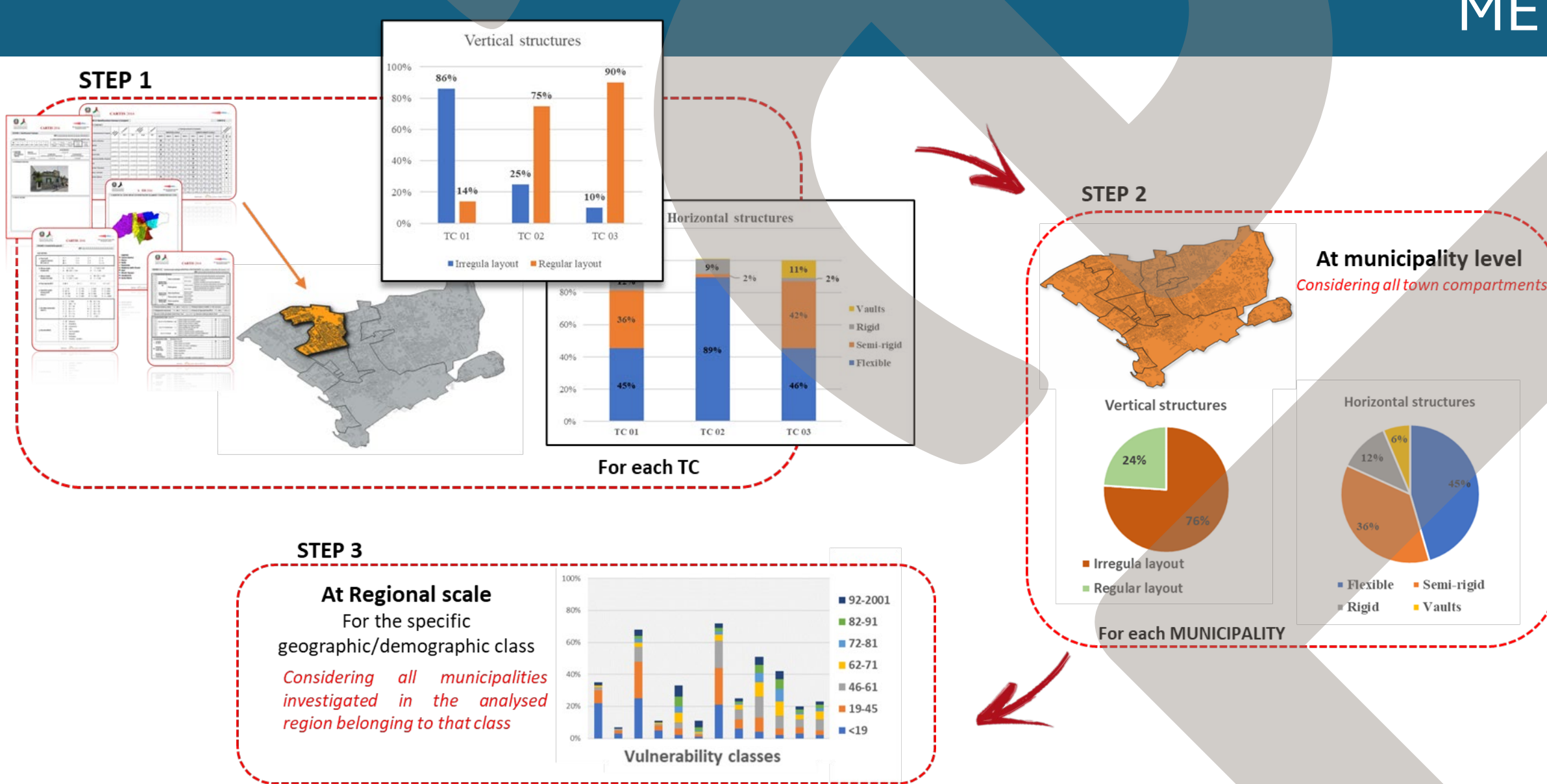


Population class



METHODOLOGY

This study analyzes the variations in vulnerability factors at the sub-regional level using the **Cartis** database for **Campania region**. It focuses on how the type of vertical structure in masonry buildings (regular or irregular) varies with geographic (altitude) and demographic (population size) parameters across municipalities. Based on this analysis, the study proposes a recalibration of vulnerability models, specifically adjusting the models of *Rosti et al., 2021*, to better suit the Campania region's different altitude and population classes.

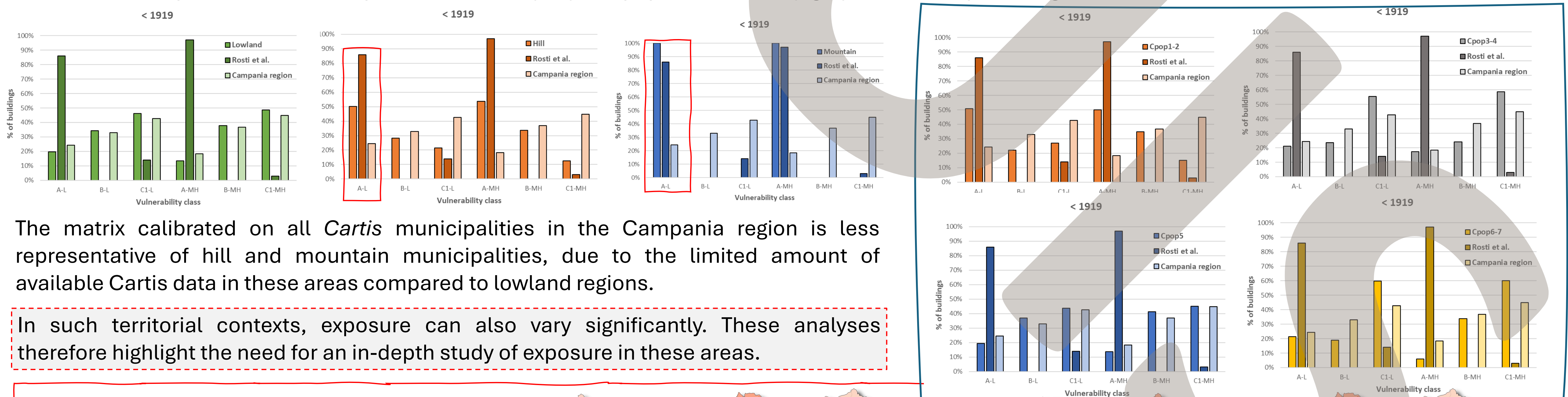


Class of height	Low						Medium-High					
	A-L	B-L	C1-L	A-MH	B-MH	C1-MH	A-L	B-L	C1-L	A-MH	B-MH	C1-MH
<19	86%	0%	14%	97%	0%	3%	20%	34%	46%	14%	38%	49%
19-45	45%	44%	11%	22%	78%	0%	8%	29%	63%	8%	41%	50%
46-61	9%	59%	32%	0%	75%	25%	3%	36%	61%	4%	33%	62%
62-71	5%	4%	91%	0%	18%	82%	3%	42%	55%	5%	24%	71%
72-81	0%	0%	100%	0%	0%	100%	1%	32%	67%	2%	27%	71%
82-91	0%	0%	100%	0%	0%	100%	0%	3%	97%	0%	0%	100%

Class of height	Low						Medium-High					
	A-L	B-L	C1-L	A-MH	B-MH	C1-MH	A-L	B-L	C1-L	A-MH	B-MH	C1-MH
<19	20%	34%	46%	14%	38%	49%	20%	34%	46%	14%	38%	49%
19-45	8%	29%	63%	8%	41%	50%	8%	29%	63%	8%	41%	50%
46-61	3%	36%	61%	4%	33%	62%	3%	36%	61%	4%	33%	62%
62-71	3%	42%	55%	5%	24%	71%	3%	42%	55%	5%	24%	71%
72-81	1%	32%	67%	2%	27%	71%	1%	32%	67%	2%	27%	71%
82-91	0%	3%	97%	0%	0%	100%	0%	3%	97%	0%	0%	100%

APPLICATION AND RESULTS

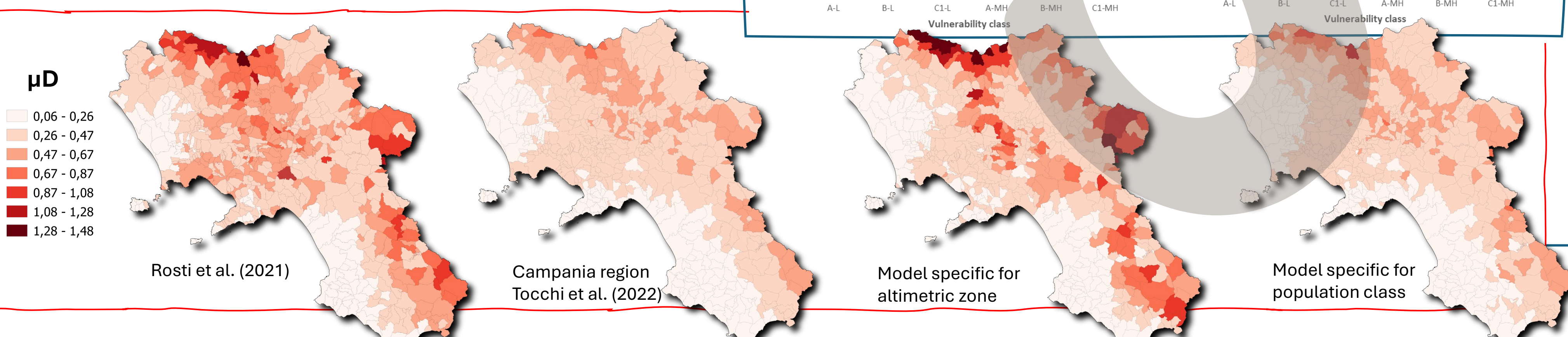
Comparison between the exposure models by Rosti et al. (2021), the recalibrated model for the entire Campania region (Tocchi et al., 2022), and the proposed model for municipalities classified by altimetric zone (left) and population class (right), for masonry buildings constructed before 1919.



The matrix calibrated on all *Cartis* municipalities in the Campania region is less representative of hill and mountain municipalities, due to the limited amount of available *Cartis* data in these areas compared to lowland regions.

In such territorial contexts, exposure can also vary significantly. These analyses therefore highlight the need for an in-depth study of exposure in these areas.

The effects of these exposure model recalibrations on damage estimates were evaluated using the IRMA platform (Borzi et al., 2020).



References

Borzi B, Onida M, Faravelli M, et al. (2020) IRMA platform for the calculation of damages and risks of residential buildings, Bulletin of Earthquake Engineering, DOI: 10.1007/s10518-020-00924-x.
Rosti, A., Del Gaudio, C., Rota, M. et al. (2021) Empirical fragility curves for Italian residential RC buildings. Bull Earthquake Eng 19, 3165–3183 (2021). <https://doi.org/10.1007/s10518-020-00971-4>

ReLUIIS 2019-2021

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ReLUIIS 2022-2024

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