# Supplementary Information

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## Appendix A. Spatial distribution of physical assets and population exposure

Figures A.1, A.2, and A.3 provide additional information on the spatial distribution of physical assets and population exposure across Avellino Province. Buildings, population, and schools are generally not concentrated near the seismic sources. Consequently, residential building- and school-related DIMs can be higher in municipalities located farther from the hypocentre or rupture, where larger numbers of exposed assets and people may offset the effects of relatively lower ground-shaking intensity.

## Appendix B. The adjusted Italy-specific distributions of impeding factor delays

Table B.1 summarises the adjusted Italy-specific distributions adopted for the individual earthquake-related impeding-factor delays. The total earthquake-related impeding-factor delay, $IF_{\mathrm{EQ,tot}}$, is calculated as

$$IF_{\mathrm{EQ,tot}} = IF_{\mathrm{EQ,ins}} + \max\left(IF_{\mathrm{EQ,fin}}, IF_{\mathrm{EQ,con}}, IF_{\mathrm{EQ,per}}\right), \tag{B.1}$$

where $IF_{\mathrm{EQ,con}}$ is taken as the maximum of the individual structural ($IF_{\mathrm{EQ,con\_str}}$), interior ($IF_{\mathrm{EQ,con\_int}}$), exterior ($IF_{\mathrm{EQ,con\_ext}}$), mechanical ($IF_{\mathrm{EQ,con\_mec}}$), electrical ($IF_{\mathrm{EQ,con\_ele}}$), and staircase ($IF_{\mathrm{EQ,con\_sta}}$) contractor mobilisation

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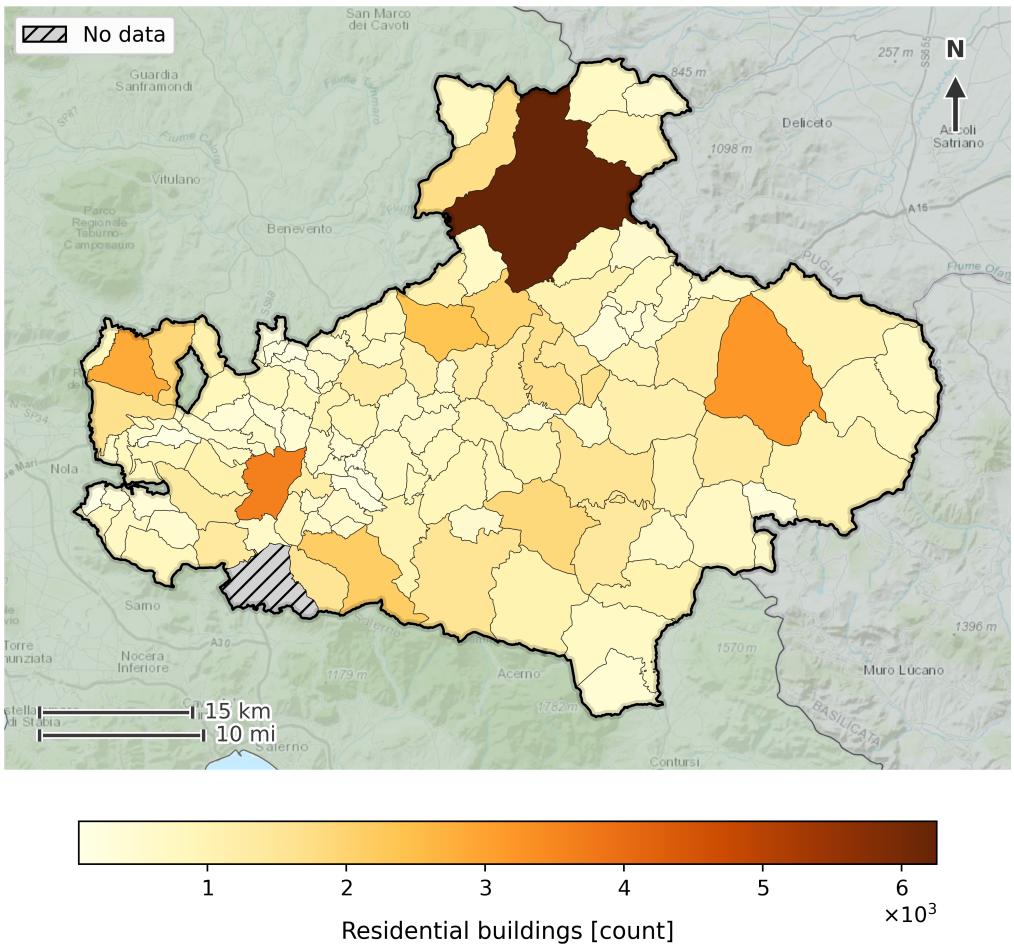



Figure A.1: Total building count of each municipality of Avellino province according to the 2011 Census.

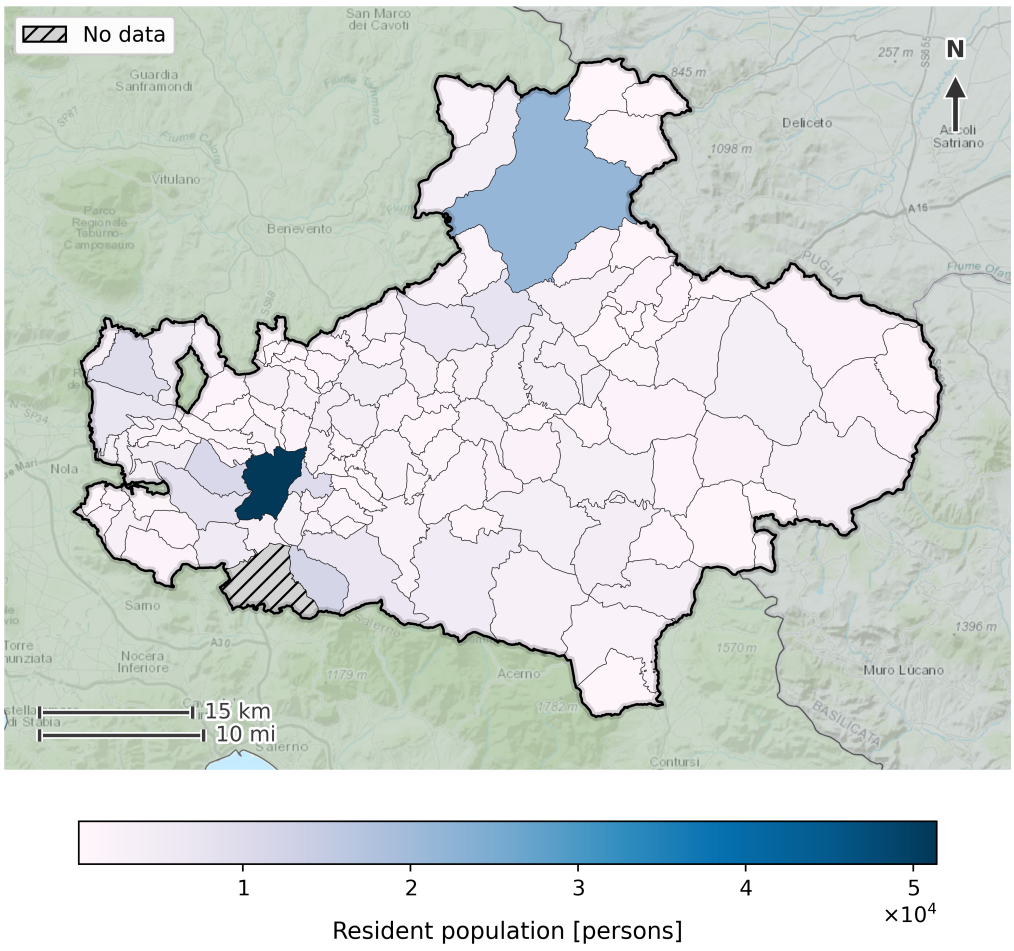



Figure A.2: Total population count of each municipality of Avellino province according to the 2011 Census.

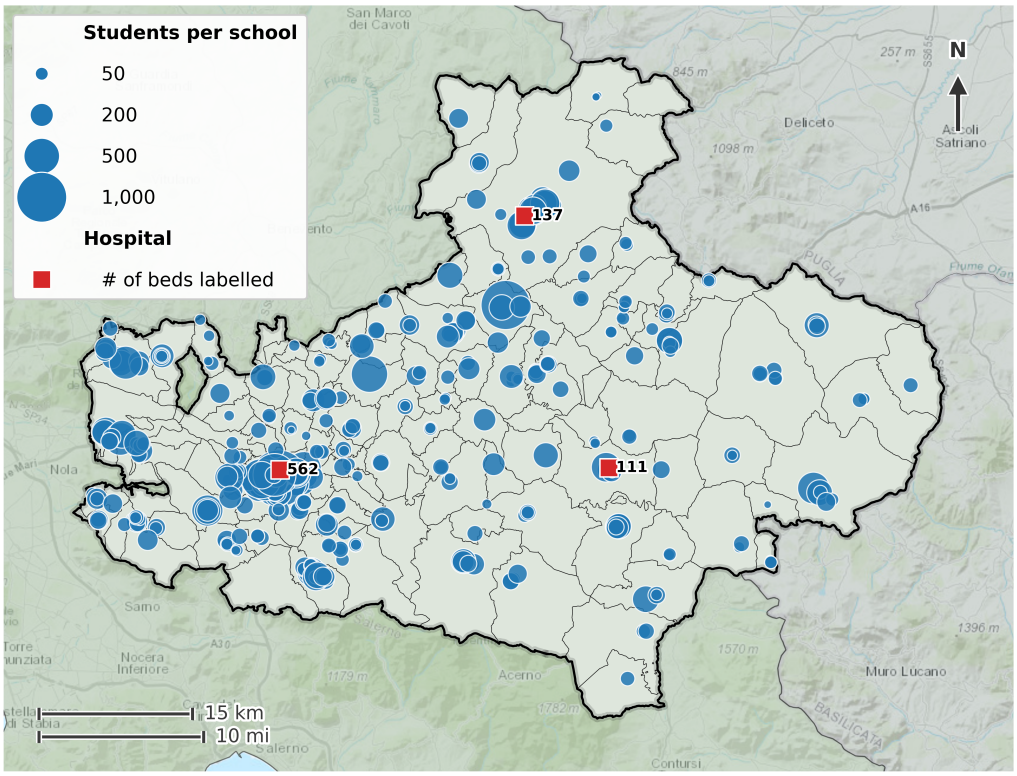



Figure A.3: Number of students at each school and number of hospital beds at each public hospital belonging to the emergency network identified by the Italian Ministry of Health, Avellino province.

delays listed in Table B.1. This formulation assumes that inspection must be completed before the other impeding processes, while permitting, financing, and contractor mobilisation proceed in parallel, consistent with Kourehpaz et al. [2]. Consequently, the longest of these three processes determines the additional delay before repair can begin.

Table B.1: Adjusted Italy-specific lognormal distributions of individual impeding-factor delays for earthquakes, using a scale factor of 0.782 [3, 1]. Values in parentheses, where applicable, correspond to damage state (DS) 1, whereas values outside parentheses correspond to DS> 1.

| **Impeding factor** | **Median (days)** | **Dispersion** |
|---|---|---|
| Inspection ($IF_{\mathrm{EQ,ins}}$) | 3.9 | 0.54 |
| Permitting ($IF_{\mathrm{EQ,per}}$) | 43.8 (5.5) | 0.32 (0.86) |
| Financing ($IF_{\mathrm{EQ,fin}}$) | 262.9 | 0.57 |
| Structural contractor mobilisation ($IF_{\mathrm{EQ,con\_str}}$) | 117.8 (78.9) | 0.33 (0.39) |
| Interior contractor mobilisation ($IF_{\mathrm{EQ,con\_int}}$) | 95.9 (39.4) | 0.43 (0.35) |
| Exterior contractor mobilisation ($IF_{\mathrm{EQ,con\_ext}}$) | 113.9 (71.8) | 0.81 (0.53) |
| Mechanical contractor mobilisation ($IF_{\mathrm{EQ,con\_mec}}$) | 105.7 (66.8) | 0.86 (0.47) |
| Electrical contractor mobilisation ($IF_{\mathrm{EQ,con\_ele}}$) | 61.9 (47.1) | 0.30 (0.43) |
| Staircase contractor mobilisation ($IF_{\mathrm{EQ,con\_sta}}$) | 94.8 (44.9) | 0.94 (0.39) |

## Appendix C. Spatial distribution of total- and mean-impact scores

Figures C.4 and C.5 present the municipality-level total and mean impact scores ($S_{\mathrm{total},j,m,p}$ and $S_{\mathrm{mean},j,m,p}$) under the current urban layout for the $M_w$ 5.0 and $M_w$ 6.9 earthquake scenarios, respectively. Under the $M_w$ 5.0 scenario, both metrics exhibit a compact hotspot in the southeastern part of the province, indicating that the spatial distribution of impacts is strongly governed by the localised ground shaking associated with the point-source event. Under the $M_w$ 6.9 scenario, impacts are substantially larger and more spatially widespread. In particular, the municipality with the highest total impact does not exhibit a similarly high mean impact, suggesting that

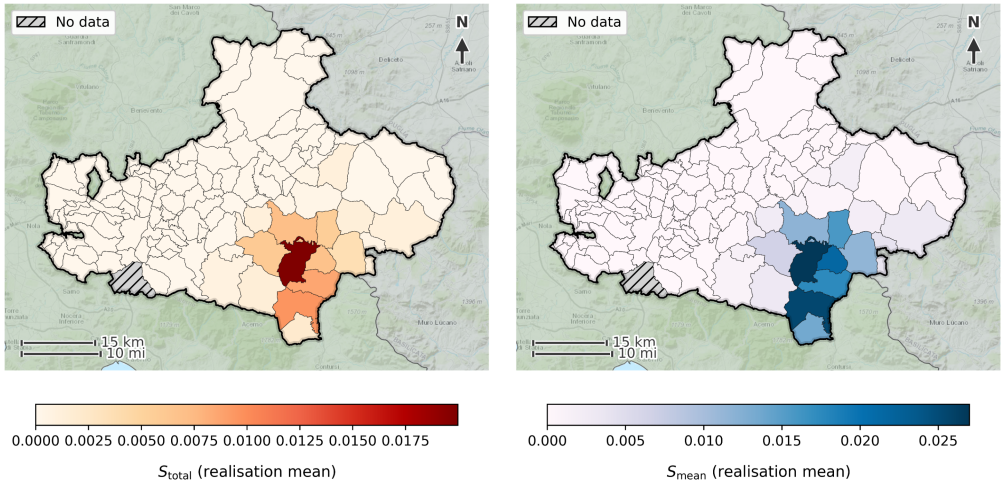



Figure C.4: $S_{\text{total},j,m,p}$ (left) and $S_{\text{mean},j,m,p}$ (right) of each municipality in the $M_w$ 5.0 earthquake scenario.

its aggregate burden is driven primarily by the number of exposed assets. Conversely, several municipalities with high mean scores have only moderate total impacts, indicating severe mean consequences across a comparatively smaller exposed portfolio.

## References

[1] Cardone, D., Flora, A., Picione, M.D.L., Martoccia, A., 2019. Estimating direct and indirect losses due to earthquake damage in residential rc buildings. Soil Dynamics and Earthquake Engineering 126, 105801.

[2] Kourehpaz, P., Galasso, C., Molina Hutt, C., 2026. Enhancing resilience through recovery modeling in multi-hazard contexts. Communications Engineering .

[3] Molina Hutt, C., Vahanvaty, T., Kourehpaz, P., 2022. An analytical framework to assess earthquake-induced downtime and model recovery of buildings. Earthquake Spectra 38, 1283–1320.

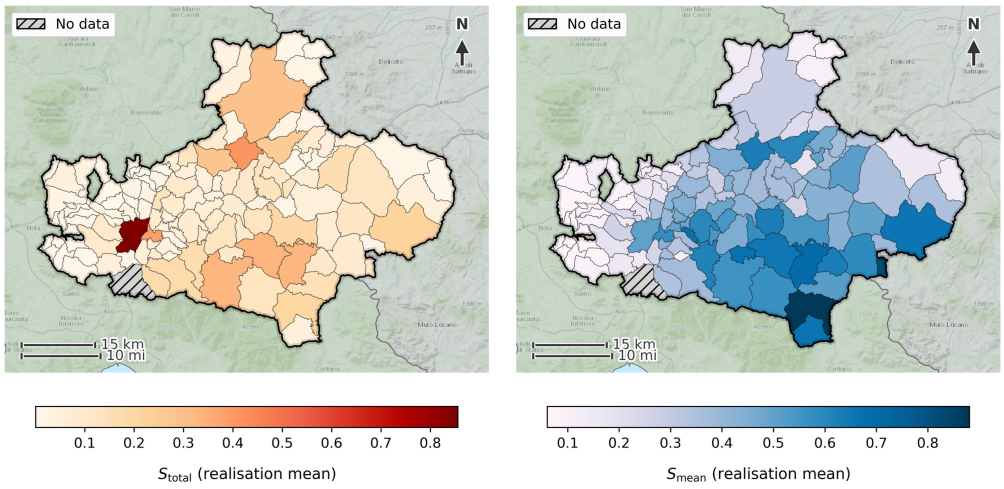



Figure C.5: $S_{\text{total},j,m,p}$ (left) and $S_{\text{mean},j,m,p}$ (right) of each municipality in the $M_w$ 6.9 earthquake scenario.