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An Operative Atlas as a methodological tool for geomapping and documenting the permanence of temporary settlements in post-earthquake Italy

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Abstract:

In the complexity of international poly-crisis phenomena, the emergency response to earthquakes involves a multifaceted process, from immediate relief to long-term reconstruction. Geoinformation, cartographic, and aerial data are essential in the fields of *Disaster Risk Reduction*, *Disaster Management, and Building Damage Assessment.* However, documenting early recovery architectures remains challenging during the in-between period and the reconstruction transition, despite advancements in knowledge platforms, data management, and rapid multiscalar information sharing encouraged by international scientific programs such as the *Integrated Research on Disaster Risk* and the *Sendai Framework for Disaster Risk Reduction 2015-2030.*

This contribution presents a core part of the author's doctoral thesis. It proposes the methodological framework for developing an Operative Atlas of temporary post-earthquake settlements and infrastructures, integrating architecture and geomatics as tools for analysis, digitalization, and spatial documentation. Geomatic and photogrammetric techniques are central to documenting the emergency process and projects across territorial, urban, and building scales, defining a common semantic and geometric codification for mapping temporary phenomena.

This research focuses on the long-term spatial impacts of all temporary solutions, which have significantly and permanently altered the post-seismic Italian landscapes, particularly in the regions of Central Italy that have been affected by a succession of catastrophic events in the last 25 years.

The research has revealed the lack of overall cartographic documentation of these interventions, which is responsible for new urban configurations, despite the collective planning, economic and regulatory effort made, and the digital technological potential available today. Existing documentation is incomplete, fragmented, and outdated, necessitating a systematic, evidence-based approach to bridge this gap.

The methodology combines diverse data sources – satellite imagery, UAV-based photogrammetry, and temporal and economic processual data – into a unified multiscale geospatial database organized within the GIS platform. This database serves as the conceptual model for the Operative Atlas, facilitating the visualization and analysis of emergency responses and urban infrastructure.

One key aspect of the research is the implementation of attribute specification in existing official cartographic data, developing a standardized terminology and classification system for mapping temporary interventions, and making them recognizable within the national and international cartography during and after emergencies.

By developing a conceptual and logical model, the research defines geometric entities in the GIS data structure to document and digitalize these provisional contexts. UAV point clouds are integrated with non-metric data to ensure detailed descriptions through a multiscalar approach. The methodology was validated in the study of Visso (Macerata), a small historical mountain village in Central Italy, where specific temporary interventions were effectively mapped and documented (Figure 1).

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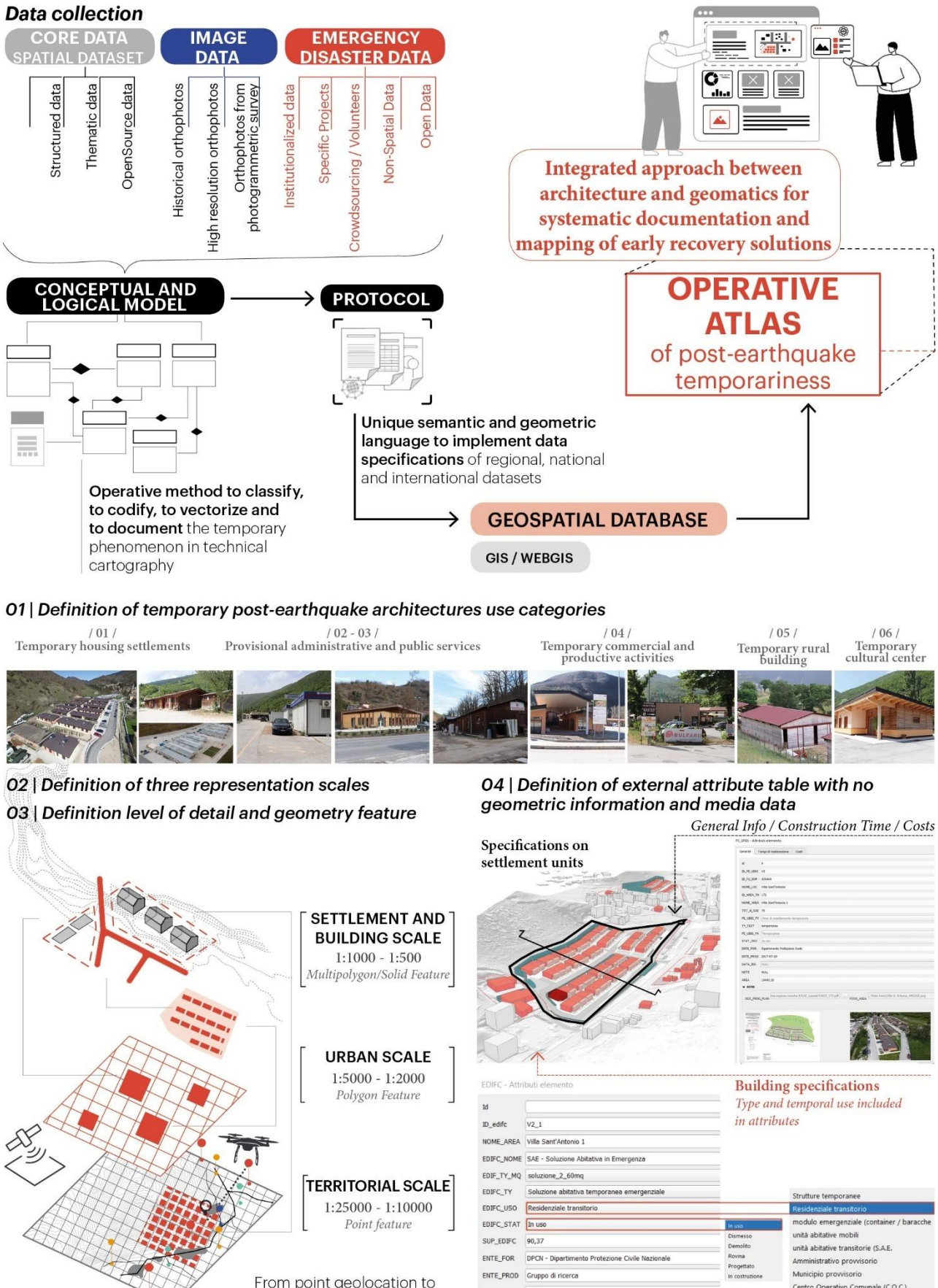

Figure 1. Framework of Operative Atlas. Elaboration by author

In conclusion, the research adopts an interdisciplinary and integrated approach to overcome the existing gaps in the documentation of post-disaster interventions. By combining architectural studies with geomatic tools, the Operative Atlas emerges as a valuable tool for managing heterogeneous geospatial emergency data. It offers digital visualization techniques to support, in different emergency phases, stakeholders involved in post-disaster development strategies, including local and national emergency management authorities, urban planners, and practitioners in facilitating the transition from emergency response to permanent settlement.

References

Bhanumurthy, V., Ram Mohan Rao, K., Jai Sankar, G. and Nagamani, P. V. 2017. Spatial Data Integration for Disaster/Emergency Management: An Indian Experience. In *Spatial Information Research* 25(2), pp. 303-314.

Boccardo, P. and Giulio Tonolo, F., 2015. Remote Sensing Role in Emergency Mapping for Disaster Response. In *Engineering Geology for Society and Territory - Volume 5: Urban Geology, Sustainable Planning and Landscape Exploitation*. (pp. 17-24) Springer International Publishing, Berlin, Germany.

Kurgan, L. and Brawley, D., (curated by) 2019. Ways of knowing cities. Columbia Books on Architecture and the City, New York, USA.

Paez, R., 2019. Operative mapping: the use of maps as a design tool. Actar Publishers, New York, USA.

Shaw, R., 2020. Thirty Years of Science, Technology, and Academia in Disaster Risk Reduction and Emerging Responsibilities. In *International Journal of Disaster Risk Science* 11, pp. 414-425.

Arnetoli, M. V., Chiacchiera, F., Tonti, I. and Vannelli, G., (curated by) 2024. TEMP- Temporaneità post-emergenza nei territori fragili italiani. ListLab, Barcellona-Trento, Italy.

Tonti, I., 2024. The permanent temporariness of the post-earthquake. Operative Atlas for emergency and reconstruction. Doctoral Thesis, Politecnico di Torino. (written in italian)

Tonti, I., Lingua, A. M., Piccinini, F., Pierdicca, R. and Malinverni, E. S., 2023. Digitalization and Spatial Documentation of Post-Earthquake Temporary Housing in Central Italy: An Integrated Geomatic Approach Involving UAV and a GIS-Based System. In *Drones* 7(7), 438.

Toschi, I., Remondino, F., Kellenberger, T. and Streilein, A., 2017. A Survey of Geomatics Solutions for the Rapid Mapping of Natural Hazards. In *Photogrammetric Engineering & Remote Sensing* 83(12), pp. 843-859.