

CHALLENGES AND BENEFITS
IN MODELLING ANCIENT LANDSCAPES COMPLEXITY
THROUGH RESILIENCE AND ANTIFRAGILITY.
RELOAD: A PROJECT ON LIMINALITY IN NORTHERN TUSCANY

1. INTRODUCTION

RELOAD (REthinking Liminality Open Access Data) is a post-doctoral research project funded by FSR-FNRS at UCLouvain (2022-2025). The project complements several decades of research projects focusing on Volterranean landscapes between the Roman conquest and Late Antiquity (CAVALIERI 2019; MENCHELLI *et al.* 2023), analysing the settlement evolution and the distribution of specific material classes in liminal areas between the centuries 3rd BC-5th AD (Fig. 1). The aim is to re-evaluate the crucial role of liminality in space organisation and perception, and in the processes of identity formation. The importance of Volterra as a case study is related to the fact that most of the changes in landscape organisation have occurred in its liminal areas but also to the paradoxical situation featuring its social and environmental development when approached from a diachronic perspective. Despite its geographical isolation, if compared to other cases of northern Tuscany and the lack of an actual political weight, Volterra benefitted from a surprising centrality in the macro-dynamics of the Roman Mediterranean (LIMINA 2021a).

1.1 *Goals, research questions, theoretical approaches*

Social groups interacted in a specific milieu through strategies of space adaptation responding to environmental contingencies and cultural practices, continuously redefining interests, powers, and borders. In the last decades, the idea of the frontier as a permeable meeting zone where to display shifting identities emerged (DERKS, ROYMANS 2009; CIFANI, STODDART 2012). Marginal areas delimited by physical boundaries could be considered liminal landscapes (CAMBI *et al.* 2015; DUBBINI *et al.* 2020). The term ‘liminal’ intrinsically conveys the idea of the Latin *limen*, while the anthropological ‘liminality’ (VAN GENNEP 1909; TURNER 1974; ANDREW, ROBERTS 2012) could be merged with the liminal areas conceived by landscape archaeology. The marginal zones featured by peculiar environmental conditions (springs, forests, mountains, swamps, etc.), implying the need to adopt specific ways of living and control, could be defined as liminal (HOLM *et al.* 2009). These marginal areas were permeable systems usually facing the challenges of cultural entanglements (STOCKHAMMER 2012).



Fig. 1 – RELOAD. A new project for ancient landscapes.

In this sense, liminal areas could be considered zones of real or perceived frontiers, where exchanging ideas, rituals, technologies, and practices occurred, representing privileged viewpoints to better understand past human behaviour and how it modified ancient landscapes. Investigating processes of identity formation through material culture is intrinsically connected to the analysis of settlement pattern evolution and material assemblages' distribution. It is significant that in northern Etruria, particularly in the *ager Volaterranus*, most of the changes in landscape organisation occurred in liminal zones, that is marginal zones featured by geothermal phenomena (DI PAOLA 2018), by extra-urban sanctuaries (ZIFFERERO 1995), the Roman centuriation (CIAMPOLTRINI 1981), the presence of imperial properties, and the early Christian worship places (CIAMPOLTRINI 1995). Why did all this occur in liminal zones? Was it because of peculiar environmental natural features? Or was this system of settlement and ownership permeable because it was marginal and, therefore, difficult to manage and control?

Moreover, there is much scope for detecting if and how the survival of local Etruscan traditions in material culture merged with innovations facing Rome in these permeable areas. Indeed, within the broader context of ancient Etruria, the northern district fiercely retained alive Etruscan identity in material culture, until the first century BC, at least (HADAS LEBEL 1988; BOURDIN 2012; LIMINA 2021a). Given the importance of Etruscan heritage in Roman culture until the end of the Western Empire (RAMELLI 2003) and the presence, in the 5th century AD, of individuals at the top rank of imperial hierarchies retaining estates in northern Tuscany – and often claiming descent from the



Fig. 2 – Ager Volaterranus: QGIS map.

same groups involved in the process of cultural integration with Rome – one wonders if the existence of a local Etruscan identity could be supposed. Thus, through the analysis of liminal landscapes evolution and family strategies, alternative interpretations about identity formation processes linked to a peculiar landscape organization could be prompted.

Santo MAZZARINO (1957) identified the survival of the Etruscan culture as the aspect underlying the continuity of land management in Etruria between the Archaic and Lombard periods. Thus, it is not surprising that concepts such as ‘traditional’, ‘conservative’, ‘resistant’, ‘persistent’ (MUNZI *et al.* 1994; TORELLI 1995; TERRENATO 1998; AUGENTI, TERRENATO 2000) were used to define northern Tuscan elites and their management of territory. In the last decades, ‘resilience’ has been more and more adopted for reconstructing human-environmental interactions (REDMAN, KINZIG 2003; REDMAN 2005; TÖNER 2012; FAULSEIT 2016) and socio-political phenomena (TERRENATO 2019). Then, this concept has been used to interpret the dynamics of continuity and transformation featuring northern Tuscany landscapes (BERTOLDI, CASTRORAO BARBA 2021; CANTINI 2022) and elites (PADGETT 2010; CORTESE 2017). Despite this, especially for the case of Volterra between the centuries 3rd BC-5th AD, it seems that cycles of continuity were accompanied by substantial changes that, skilfully managed by those who negotiated the power at different levels, brought a secondary centre of the Roman world to a real improvement of its social and economic systems, leading to an unusual centrality in the ancient Mediterranean.

The concept of ‘resilience’ seems reductive to interpret the complexity of Volterra. Consequently, RELOAD aims to adopt an alternative concept,

‘antifragility’ that eventually could answer better to the peculiarities of the case study. Thus, the project intends to evaluate the benefits of approaches from the ‘hard sciences’ trying to prompt alternative reconstructions of the past.

1.2 Methodology

RELOAD adopts a multidisciplinary approach to investigate dynamics of change diachronically. The project collects the results of previous archaeological research and legacy data. Considering the difficulty of comparing data on settlement pattern, collected with different criteria, RELOAD includes new field surveys in Volterran liminal areas (Fig. 4). Focusing on significant sample zones, the new pedestrian field surveys, with intensive systematic methodology, lead to deepen knowledge on settlement pattern evolution. The open access databases by Regione Toscana (GEOScopia, CASTORE, RETORE) allow the analysis and integration of data on cartography, geomorphology, historical cadastre, aerial photos, LiDAR, toponymy, etc. The integration of this consistent amount of information with literary data and epigraphic sources, and management in QGIS, proves fundamental for reconstructing ancient occupation strategies and the distribution of archaeological materials.

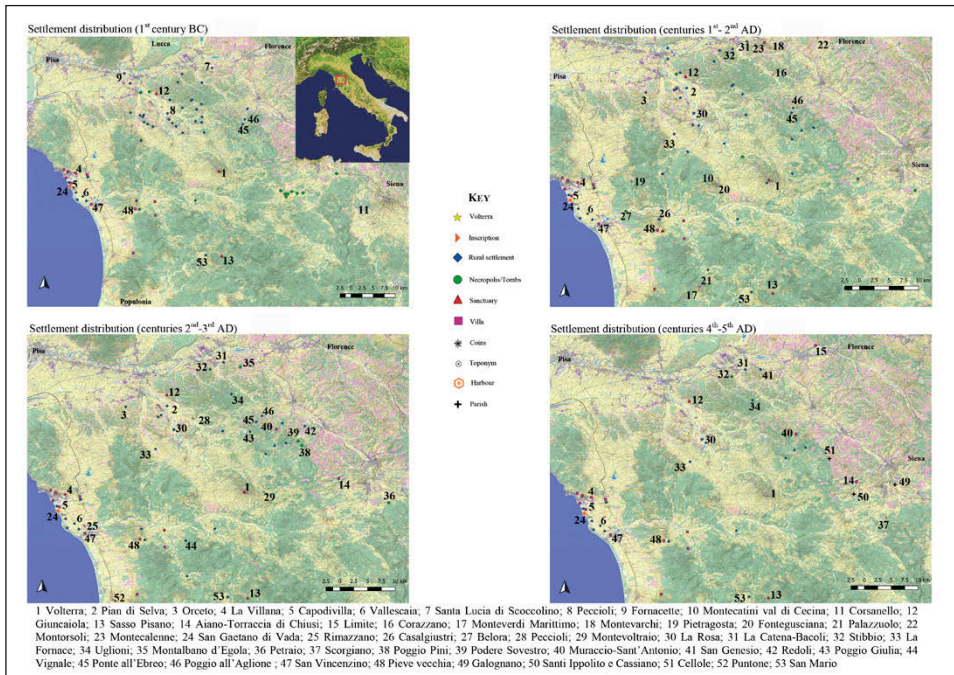


Fig. 3 – Settlement distribution (1st c. BC-5th c. AD): QGIS map.



Fig. 4 – New field survey campaigns in liminal areas of *ager Volaterranus*: QGIS map.

Concerning the materials analysis, the aim is not only to determine the site's chronology, but also to distinguish potential identity markers. The association of specific materials with toponyms and epigraphy will be analysed to understand whether their dispersal/concentration may have significance in relation with the owners' identity and the settlement patterns evolution. Data interpretation in the light of resilience and antifragility theories would be possible through an agent-based model simulation approach, crucial for a better understanding of landscapes as complex systems where individuals and environment interacted. Simulations will allow to assess the role of agents behaving in a resilient or antifragile way and, consequently, to reconstruct how human agency shaped Volterran landscapes.

2. THE CASE STUDY

As confirmed by literary sources, in the 3rd century BC Volterra was deeply inserted into the Roman orbit. The civil wars between Marius' and Sulla's factions before, Caesar's and Augustus' land distributions then, represented turning

points for the community and the territory organization. After 27 BC, Volterra received the title of colony (MUNZI, TERRENATO 1994). After 68-69 AD and Vespasian's rise to power a crisis affected the Italian peninsula and substantial changes occurred also in the *ager Volaterranus*. A moment of crisis, between the mid-2nd century and the beginning of the 3rd century AD could eventually be related to the Antonine plague. Diocletian's reorganization was an essential driving force for the local economy. In contrast to other cities, Volterra experienced a reorganization of local powers and a renovate monumentalization. In the 5th century, the city centre continued to be stage of local and religious powers while in the territory only a few sites from the previous settlement system survived in a wholly changed social and political context (LIMINA 2021a).

2.1 *Liminal landscapes over the longue durée*

The *ager Volaterranus*, delimited by the Cecina, Era and Elsa valleys bordered the territories of Pisa, Lucca, Florence, Siena and Populonia (Fig. 2). Integrating different sources and studying unpublished materials from previous surveys and excavations, it was possible to distinguish three phases of local ownership structure and settlement pattern development to be related to the events of the 1st century BC; to a reorganisation of local powers between the end of the 1st century AD and the 2nd AD; to a new social and political order between the end of the 2nd and the first half of the 3rd century AD (LIMINA 2021b). In the 1st century BC, hidden monetary treasuries and a settlement crisis proved a period of disorder following the reorganisation of the territory as a centuriated landscape (Fig. 3). Indeed, traces of Roman centuriation have been identified in marginal zones along the northern and western borders of the district (RISTORI, RISTORI 1993; BROGI 2007; CIAMPOLTRINI 2008; PASQUINUCCI *et al.* 2008), suggesting that areas obtained the status of *ager publicus* or belonged to the city.

Archaeology proves, since the mid-1st century AD, a new development of rural settlements in the district's northern and eastern marginal areas and epigraphy attests to the presence of new landowners. Between the mid-2nd century and the beginning of the 3rd century AD a progressive settlement deconstruction is attested in the Era valley, probably due to a demographic crisis linked with increasingly poor water management. This evidence would coincide with a moment of crisis that epigraphy could testify, attesting that new *gentes* arose in power while others died out. A general settlement deconstruction is attested in the marginal areas between the mid-3rd and the 4th centuries AD. However, since the 4th century AD, archaeology indicates the revitalization of the marginal areas and the survival of the coastal and internal villas until about the mid-5th century AD, in the context of a new reorganization of local powers. Since the mid-4th century AD, Christian individuals are attested by epigraphs.

Even if a diocese was organized only in the second half of the 5th century AD, the Christian community became a more and more influential counterpart in the framework of the local elites. The location of the oldest known diocesan churches, dating to the 5th-6th centuries AD, at the borders of the territory (Fig. 3) is interesting because it could eventually relate to areas of previous *ager publicus* or within imperial estates, or areas confiscated from pagan temples, or of uncultivated lands from urban estates (LIMINA 2021a e 2021b). It seems clear that liminal areas of *ager Volaterranus* were the most effected by dynamics of change. Local elites continued to control and manage production and economic networks in these areas through their versatile family strategies (LIMINA 2021a). The extra-urban sanctuaries continued to survive as direct emanation (and visible presence) of the urban centre. The local epigraphy and place-names analysis indicate the presence of imperial properties in the marginal areas while on the same areas insist the first Christian holy places.

The diffusion, only in these liminal areas, of locally produced ‘Roman’ roof-tiles is relevant. Indeed, as demonstrated by E. Shepherd, these roof-tiles would indicate the presence of Roman soldiers in centuriated areas or the local access to military networks, or contacts through patronage (SHEPHERD 2016). The local production of roof-tiles in the ‘Roman style’ is confirmed by the study of archaeological materials from previous research and from the 2023 surveys (LIMINA 2021a e 2024). Local production implying the acquisition of technical knowledge different from the traditional one (WARRY 2006; SHEPHERD 2016; HAMARI 2019) could be proof of identity dynamics that currently escape us but are worth investigating. All this data from justifies RELOAD’s investigations for a better assessment of the landscape’s evolution in relation to liminality.

3. ALTERNATIVE CONCEPTS AND APPROACHES FOR ANCIENT LANDSCAPES

If ancient landscapes investigation is strictly linked to understanding complexity, simplification is the only way to deal with the challenges of interpreting the dynamics of change. Then, models, simplified representations of complex real-world phenomena, could be beneficial for landscapes’ reconstructions.

3.1 *Resilience and antifragility*

Resilience, defined as the ability of a system to maintain key functions in the face of stresses by resisting and then adapting to change, has been increasingly adopted in archaeology (REDMAN 2005; CUMMING 2011; DAEMS 2021). The application of resilience theory implies turning archaeological data into key variables, based on the idea that complex systems are controlled

by the adaptive cycle (BRATMOLLER *et al.* 2017). However, there is another concept that can be applied to complex systems, ‘antifragility’ (TALEB 2012), that has been used in economy (PLATJE 2015), psychology (MARKEY-TOWLER 2018), biology (DAVIS 2020), law (LAW 2021). Antifragility is fundamentally different from ‘resilience’ (MUNOZ *et al.* 2022). According to TALEB (2012, 430): «The resilient resists shocks; the antifragile gets better». Like all real systems, an antifragile one is characterized by complexity, randomness and ‘learning ability’, the ability to recover from a shock learning how to survive the next. In this way, the antifragile improves itself. Agreeing that the history of elites is most visible at the archaeological level and that settlement distribution reflects strategies of control and management of resources, it seems that Volterra responded in an antifragile way to dynamics of change.

Local elites managed to transform disadvantageous geographical and political conditions into opportunities for progressive integration into imperial dynamics. However, if ‘antifragility’ seems suitable at a narrative level, can it be verified from Taleb’s heuristic formula and archaeological data?

3.2 Preliminary data about the application of AMBS

ABM is a method of computer simulation based on agents moving in an artificial environment, governed by rules which specify how they respond to the system and relate with the other agents’ behaviour. RELOAD approaches modelling and simulation in NetLogo. To assess if the agents’ behaviour is fragile, resilient, or antifragile it would be necessary to setting values for the parameters to evaluate response to changes in the system. Applying the mathematical heuristic to detect fragility, if the value is positive, the system is fragile; when it is zero, the system is resilient; for negative values, the system is antifragile. RELOAD is still in a very preliminary phase of modelling but trying to simplify theorization: suppose we want to understand why the archaeological materials testify to a decrease in the number of rural sites after the 2nd century BC, in parallel with the restoration of Roman-style villas. Through the GIS extension in NetLogo it would be possible to build a virtual environment with actual characteristics of the archaeological context; then, it will be possible to simulate the local landowners’ behaviour by writing a code.

Agents can abandon the sites, maintain their ownership without modification, or improve estates restoring them. ABMS is an iterative process, so the repeated decision-making and the stochasticity produce a pattern that changes at the macroscopic level in site number, type, and spatial location. By analysing the parameters, one can assess the agent’s behaviour as fragile, resilient, antifragile based on the variation in the number of changes in the unit of time, and the ability to recover from the number of unchanged, abandoned restored sites. Then, it would be necessary to compare the results with the archaeological data and repeat the simulations to validate/modify the model.

4. CONCLUSIVE REMARKS

Despite the increasing use of ABMS in archaeology, some sceptical points relate to the complexity and difficulty of using them, considering that a specific education in archaeologists' curriculum is still lacking (NAKOINZM 2018; DAEMS 2021; ROMANOWSKA *et al.* 2021). Aware of limitations due to methodology and data collection, the necessary simplification underlying modelling is a good practice for data standardization, while the opportunity to test results and what-if scenarios under different perspectives justify AMBS applications in archaeology. Using a specific computer program forces us to make explicit assumptions, to emulate a specific process that produced the observed archaeological evidence (WURTZER *et al.* 2015). For all these reasons, ABMS are beneficial to reinforce conceptual clarity, helping to understand how things changed; of course, emulating the past does not explain it, and only by iterative adjustments a model obtains a reasonable fit between its output and the archaeological evidence. In any case, the advantages of applying AMBS are evident: they are explicitly concerned with the time in process, they do not require mathematical formality, they include randomness variables as in natural complex systems.

RELOAD, ensuring open access to programming codes aims to promote the standardization of practices and the reproducibility of results, among the main challenges of landscape archaeology (ATTEMA *et al.* 2020). Approaching resilience and antifragility through ABMS, RELOAD takes the challenge to provide a 'scientific' endorsement over these concepts, above a suitable narrative. To conclude, the challenges of applying concepts from other disciplines, but always keeping central the archaeological *datum* and the historical perspective can only strengthen the approach of landscape archaeology by making the techniques of the 'hard sciences', tools that should be used not as new religions (ZUBROW 2006) but to open new research paths, or to analyse old problems with new perspectives.

VALENTINA LIMINA

FRS-FNRS, UCLouvain, INCAL
valentina.limina@uclouvain.be

REFERENCES

- ANDREWS H., ROBERTS L. 2012, *Liminal Landscapes. Travel, Experience, and Spaces In-Between*, New York, Routledge.
- ATTEMA P., BINTLIFF J., VAN LEUSEN M., BES P., DE HAAS T., DONEV D., JONGMAN W., KAPTIJN E., MAYORAL V., MENCHELLI S. 2020, *A guide to good practice in Mediterranean surface survey projects*, «Journal of Greek Archaeology», 5, 1-62.
- AUGENTI A., TERRENATO N. 2000, *Le sedi del potere nel territorio di Volterra: una lunga prospettiva (secoli VII a.C.-XIII d.C.)*, in G.P. BROGIOLO (ed.), *Atti del II Congresso Nazionale di Archeologia Medievale (pré-tirages) (Brescia 2000)*, Firenze, All'Insegna del Giglio, 298-303.

- BERTOLDI S., CASTRORAO BARBA A. 2021, *Evaluating post-Roman resilience in Tuscan landscapes (5th-8th c. CE): Settlement dynamics and 'land use heritage'*, Abstract Book, *Landscape Archaeology Conference 2020+1 "virtually together"* (Madrid 2021) (<https://digital.csic.es/handle/10261/245655>).
- BOURDIN S. 2012, *Les peuples de l'Italie préromaine. Identités, territoires et relations inter-ethniques en Italie centrale et septentrionale (VIII^e-I^{er} s. av. J.-C.)*, Bibliothèque des Écoles Françaises d'Athènes et de Rome 350, Rome, École Française de Rome.
- BRADTMÖLLER M., GRIMM S., RIEL-SALVATORE J. 2017, *Resilience theory in archaeological practice. An annotated review*, «*Quaternary International*», 446, 3-16.
- BROGI D. 2007, *Contributo allo studio del territorio di Luciana e Santo Regolo*, «*Agri Centuriati: an International Journal of Landscape Archaeology*», 3, 35-57.
- CAMBI F., DE VENUTO G., GOFFREDO R. 2015, *Introduzione. Riconnettere i paesaggi, integrare la marginalità*, in F. CAMBI, G. DE VENUTO, R. GOFFREDO (eds.), *I pascoli, i campi, il mare. Paesaggi d'altura e di pianura in Italia dall'età del Bronzo al Medioevo*, Bari, Edipuglia, 5-11.
- CANTINI F. 2022, *The centres of public power between the cities and the countryside, in the light of the recent archaeology (Italian peninsula, Late 5th-9th century)*, in F. OPPEDISANO (ed.), *Between Ostrogothic and Carolingian Italy. Survivals, Revivals, Ruptures*, Firenze, Firenze University Press, 189-221.
- CAVALIERI M. 2019, *La villa tardoantica di Aiano (2005-2011/2014-2018). Bilancio di dodici anni di attività dell'UCLouvain in Val d'Elsa (San Gimignano, SI)*, in V. ACCONCIA, E.M. GIUFFRÉ, A. SALVI, J. TABOLLI, *Notizie dei cavi e degli scavi. Archeologia Sabap – Si 2018 – 2. Atti del Convegno Internazionale (Siena 2018)*, «*Bollettino di Archeologia*», 10, 3-4, 159-172.
- CIAMPOLTRINI G. 1981, *Note sulla colonizzazione augustea nell'Etruria settentrionale*, «*Studi Classici e Orientali*», 31, 41-55.
- CIAMPOLTRINI G. 1995, *L'insediamento tra Era e Elsa dall'età dei metalli alla tarda antichità*, in R. MAZZANTI (ed.), *Le colline di San Miniato*, «*Quaderni del Museo di Storia Naturale di Livorno*», Suppl. 1, 59-77.
- CIAMPOLTRINI G. 2008, *La Valdera romana fra Pisa e Volterra*, in G. CIAMPOLTRINI (ed.), *La Valdera romana fra Pisa e Volterra. L'area archeologica di Santa Mustiola (Colle Mustarola) di Peccioli. Atti dell'incontro di studio (Peccioli 2006)*, «*I Quaderni Pecciolesi*», Pisa, Pacini Editore, 17-29.
- CIFANI G., STODDART S. (eds.) 2012, *Landscape, Ethnicity and Identity in the Archaic Mediterranean Area*, Oxford, Oxbow Books.
- CORTESE M.E. 2017, *L'aristocrazia toscana. Sette secoli (VI-XII)*, Spoleto, Fondazione Centro italiano di Studi sull'alto Medioevo.
- CUMMING G. 2011, *Spatial Resilience in Social-Ecological Systems*, Dordrecht, Springer.
- DAVIS R. 2020, *Turkey tail mushrooms and the antifragility of immunity*, «*Journal of the American Herbalists Guild*», 12, 2, 31-37.
- DAEMS D. 2021, *Social Complexity and Complex Systems in Archaeology*, Oxon, Routledge.
- DERKS T., ROYMANS N. (eds.) 2009, *Ethnic Constructs in Antiquity. The Role of Power and Tradition*, Amsterdam, Amsterdam University Press.
- DI PAOLA G.M.F. 2018, *Central place and liminal landscape in the territory of Populonia*, in G. PAPANTONIOU, A. VIONIS, *Central Places and Un-Central Landscapes. Political Economies and Natural Resources in the Long Durée*, «*Land*», 7, 3, 94.
- DUBBINI R., CASTIGLIONI M.P., CURCIO M. (eds.) 2020, *Incontrarsi al Limite. Ibridazioni mediterranee nell'Italia preromana*, *Atti del Convegno internazionale (Ferrara 2019)*, Roma, L'Erma di Bretschneider.
- FAULSEIT R.K. (ed.) 2016, *Beyond Collapse. Archaeological Perspectives on Resilience, Revitalization, and Transformation in Complex Societies*, Carbondale, Southern Illinois University Press.

- HADAS-LEBEL J. 1998, *La sopravvivenza della lingua e della cultura etrusca nelle iscrizioni bilingui etrusco-latine*, in L. AIGNER FORESTI (ed.) *Die Integration der Etrusker und das Weiterwirken etruskischen Kulturgutes im republikanischen und kaiserzeitlichen Rom*, Wien, Verlag der österreichischen Akademie der Wissenschaften, 298-312.
- HAMARI P. 2019, *Roman-period Roof-tiles in the Eastern Mediterranean: Towards Regional Typologies*, Doctor of Philosophy (PhD) Dissertation, Helsinki University.
- HOLM I., STENE K., SVENSSON E. (eds.) 2009, *Liminal Landscapes. Beyond the Concepts of 'Marginality' and 'Periphery'*, Oslo, Oslo Academic Press.
- LAW R.L. 2021, *State Antifragility: An Agent-Based Modeling Approach to Understanding State Behavior*, Doctor of Philosophy (PhD) Dissertation, Old Dominion University.
- LIMINA V. 2021a, *Poteri e strategie familiari di Volterra. Il caso di una comunità etrusca nel mondo romano*, Oxford, BAR Publishing.
- LIMINA V. 2021b, *Methodological Issues for the Integrated Analysis of Landscapes of Power: The Case Study of Volterra (centuries 1st BC-5th AD)*, in D. GANGALE RISOLEO, I. RAIMONDO (eds.), *Landscape: una sintesi di elementi diacronici. Metodologie a confronto per l'analisi di un territorio*, Oxford, BAR Publishing, 157-166.
- LIMINA V. 2024, *Relazione finale delle ricognizioni archeologiche di superficie: Survey RELOAD provincia di Pisa (Comuni di Capannoli, Peccioli, Ponsacco, Pontedera)*, Geoportale Nazionale dell'Archeologia (https://doi.org/10.60976/TOSCANA_2023_05).
- MARKEY-TOWLER B. 2018, *Antifragility, the black swan and psychology: A psychological theory of adaptability in evolutionary socioeconomic systems*, «Evolutionary and Institutional Economics Review», 15, 2, 367-384.
- MAZZARINO S. 1957, *Sociologia del mondo etrusco e problemi della tarda etruscità*, «Historia: Zeitschrift für Alte Geschichte», 6, 1, 98-122.
- MENCHELLI S., PASQUINUCCI M., SANGRISO P. (eds.) 2023, *Vada Volaterrana: gli horrea. Strutture, stratigrafie, materiali*, Pisa, Pisa University Press.
- MUNOZ A., BILLSBERRY J., AMBROSINI V. 2022, *Resilience, robustness, and antifragility: Towards an appreciation of distinct organizational responses to adversity*, «International Journal of Management Reviews», 24, 2, 181-187.
- MUNZI M., RICCI G.F., SERLORENZI M. 1994, *Volterra fra tardo antico e alto medioevo*, «Archeologia Medievale», 21, 639-656.
- MUNZI M., TERRENATO N. 1994, *La colonia di Volterra. La prima attestazione epigrafica ed il quadro storico e archeologico*, «Ostraka», 3, 1, 31-42.
- NAKOINZM O. 2018, *Models and modelling in archaeology*, «Historical Social Research», Suppl. 31, 101-112.
- PADGETT J.F. 2010, *Open elite? Social mobility, marriage, and family in Florence, 1282-1494*, «Renaissance Quarterly», 63, 2, 357-411.
- PASQUINUCCI M., LEONE N., MENCHELLI S. 2008, *Paesaggi antichi nella Valdera. Etruschi e Romani in località Le Melorie di Ponsacco (PI)*, in G. CIAMPOLTRINI (ed.), *La Valdera romana fra Pisa e Volterra. L'area archeologica di Santa Mustiola (Colle Mustarola) di Peccioli. Atti dell'Incontro di studio (Peccioli 2006)*, «I Quaderni Peccioli», Pisa, Pacini Editore, 41-74.
- PLATJE J. 2015, *Sustainability and antifragility*, «Economic and Environmental Studies», 15, 4, 469-477.
- RAMELLI I. 2003, *Cultura e religione etrusca nel mondo romano. La cultura etrusca dalla fine dell'indipendenza*, Alessandria, Edizioni dell'Orso.
- REDMAN C.L. 2005, *Resilience theory in archaeology*, «American Anthropologist», 107, 70-77.
- REDMAN C.L., KINZIG A.P. 2003, *Resilience of past landscapes: Resilience theory, society, and the longue durée*, «Conservation Ecology», 7, 1-19.
- RISTORI M., RISTORI S. 1993, *Le deduzioni coloniali romane dell'ager Volaterranus*, «L'Universo», 73, 4, 488-499.

- ROMANOWSKA I., WREN C.D., CRABTREE S.A. 2021, *Agent-Based Modeling for Archaeology: Simulating the Complexity of Societies*, Santa Fe, Santa Fe Institute Press.
- SHEPHERD E. 2016, *Tegole di copertura in età romana: questioni di forma, posa in opera e impiego*, «Costruire In Laterizio», 168, 54-59.
- STOCKHAMMER P.W. 2012, *Conceptualizing cultural hybridization in archaeology*, in P.W. STOCKHAMMER (ed.), *Conceptualizing Cultural Hybridization. A Transdisciplinary Approach*, Berlin-Heidelberg, Springer, 43-58.
- TALEB N.N. 2012, *Antifragile: Things That Gain from Disorder*, New York, Random House.
- TERRENATO N. 1998, *Tam Firmum Municipium: The romanization of Volaterrae and its cultural implications*, «Journal of Roman Studies», 88, 94-114.
- TERRENATO N. 2019, *The Early Roman Expansion into Italy: Elite Negotiation and Family Agendas*, Cambridge, Cambridge University Press.
- TONER J. 2012, *I disastri di Roma antica. Calamità e resilienza*, Gorizia, Leg Edizioni (trad. italiana 2018).
- TORELLI M. 1995, *Studies in the Romanization of Italy*, Alberta, University of Alberta.
- TURNER V. 1974, *Liminal to Liminoid in play, flow, and ritual: An essay in comparative symbolism*, «Rice Institute Pamphlet-Rice University Studies», 60, 3, 53-92.
- VAN GENNEP A. 1909, *Les rites de passages: etude systématique des rites*, Paris, Éditions A. et J. Picard [1981].
- WARRY P. 2006, *A dated typology for Roman roof-tiles*, «Journal of Roman Archaeology», 19, 246-265.
- WURZ G., KOWARIK K., RESCHREITER H. (eds.) 2015, *Agent-based Modelling and Simulation in Archaeology*, Cham, Springer.
- ZIFFERERO A. 1995, *Economia, divinità e frontiera: sul ruolo di alcuni santuari di confine in Etruria meridionale*, «Ostraka», 4, 2, 333-350.
- ZUBROW E.B. 2006, *Digital archaeology: A historical context*, in T.L. EVANS, P. DALY (eds.), *Digital Archaeology. Bringing Method and Theory*, London-New-York, Routledge, 8-27.

ABSTRACT

RELOAD intends to re-evaluate the marginal areas of northern Tuscany to demonstrate their central role in the dynamics of management and perception of space between the Roman conquest and late antiquity. Considering that landscape archaeology, complemented by an anthropological perspective, allows a deep understanding of the linked dynamics of social and ecological systems, the project is expected to fill a gap of knowledge about ancient landscapes in northern Tuscany analyzing the case of Volterra to provide innovative interpretative models through a multidisciplinary methodological approach and a diachronic perspective. Integrating all available sources with new data collection, RELOAD approaches landscape complexity in a flexible way. Introducing for the first time in archaeology the concept of 'antifragility', RELOAD engages in the wider debate about adopting concepts and techniques from different fields for archaeological and historical reconstruction. The paper presents the project and preliminary data regarding the challenges and the potential benefits of applying agent-based model simulations to test the validity of approaching the past through the lens of 'resilience' or 'antifragility' leading to alternative reconstructions of the human-environmental interactions.