

Cronache di Archeologia



42
2023

Rivista dell'Università di Catania

Cronache di Archeologia

Rivista annuale dell'Università di Catania

fondata da Giovanni Rizza

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eISSN 2612-0941

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via Ajaccio 41-43, 00198 Roma (Italia)

www.edizioniquasar.it

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Non-invasive archaeological research in Atella (Sant'Arpino-Campania, Italy). Preliminary results from the 2023 campaign

Rofoldo Brancato, Pier Matteo Barone, Giuseppe Scardozzi

Introduction

The aim of this contribution is to present the preliminary results of the non-invasive investigations started in 2023 in the archaeological area of Atella, located in Sant'Arpino municipality (Caserta). In antiquity, the site gained fame through the “fabulae Atellanae” but its general archaeological topography is still largely undefined. Indeed, the revival of archaeological research started with a reassessment of the analysis of remotely sensed data, coupled with a geophysical survey using Ground Penetrating Radar (hereafter, GPR) conducted between June and September 2023 in Fondo Guarino, the presumed monumental central area of Atella (fig. 1)¹.

The ancient city of Atella was located about halfway along the road from Capua to *Neapolis*, in the center of the Campanian plain, a wide alluvial plain originated by the rivers Volturno and Clanio, lying to the north of Mount Vesuvius and the volcanic caldera of Campi Flegrei². Due to its location, Atella had

same agricultural and commercial importance in the Roman period that is currently held by the rich city of Aversa, which arose in the medieval period 5 km to the northeast³. The archaeological site extends within the municipalities of Caivano, Succivo, Orta di Atella, Sant'Arpino (Caserta) and Frattaminore (Naples) on a quadrangular terrace (ca. 4 masl) of over 500 meters per side. The ancient urban area is still partially surviving within the contemporary landscape, preserving the configuration of the primitive settlement oriented according to the norms of the *limitatio* (fig. 2)⁴. The perimeter of the terrace is a fossil of the fortification walls, *opus quadratum* surrounded by a moat, dated between the mid-4th and the beginning of the 3rd century BC⁵. Still partially visible on the southern side of the site, the walls are characterized by a few remains in tuff blocks, laid without binder⁶. The walls layout is still visible in the remotely sensed data (fig. 3). In the urban area, three equidistant *decumani* with a non-astronomical orientation are well recognizable, along with various traces of orthogonal streets with a north east / south west orientation which differs from that of the centuriation⁷. Indeed, during the Roman age, Atella was connected with the major cities of Campania through a series of routes,

1 The research is part of the Atella Archaeological Project planned to investigate the buried remains of the omonym Campanian city, in order to understand its urban topography through an integrated approach combining legacy data digitization and integration with new survey data and the extensive geophysical prospections (concessione MIC_SABAP-CE_UO15|11/05/2023|0009757-P). The work is part of a wider project coordinated by the Department of Humanities Studies of University of Naples with the Soprintendenza Archeologia, Belle Arti e Paesaggio (hereafter SABAP) per le province di Caserta e Benevento and SABAP Area Metropolitana di Napoli to establish a digital and open access archaeological map of the remains of the ancient city and its *ager*. A review of the archaeological research on Atella is in BENCIVENGA TRILLMICH 1984; MATARESE *et alii* in press; on the geophysical prospections carried out in the site, see BRANCATO *et alii* forthcoming.

2 The volcanic deposits in the area surrounding the survey area have been laid down during the historic period (since c. 79 AD) and cover the earlier Pleistocene geologies, cf. DI VITO *et alii* 2013.

3 DE CARO 2012, with references.

4 RESCIGNO, SENATORE 2010; CERCHIAI 2019; cf. LA FORGIA 2007.

5 ELIA 1959; JOHANNOWSKY 1970, JOHANNOWSKY 1976; cf. BENCIVENGA TRILLMICH 1984, p. 6, n. 11.

6 BENCIVENGA TRILLMICH 1984, fig. 2.

7 RESCIGNO, SENATORE 2010, p. 429; cf. CHOUQUER *et alii* 1987.



Fig. 1 - Atella in the context of Campania region (central Italy) in Roman age (after TALBERT 2001).

whose topography is strictly related to the surrounding centuriated landscapes⁸ (fig. 3).

The research history

The identification of Sant'Arpino with Atella has been largely accepted since the mid-nineteenth century⁹. At the beginning of the twentieth century, the urban perimeter of the city was defined by the work of G. Castaldi, who described the topography of the area in light of archaeological structures visible in the countryside surrounding the town of Sant'Arpino and his excavation trenches (fig. 4). Discoveries related to the urban and funerary landscapes of Atella occurred in the '40s and '60s of the twentieth century, reported by G. De Franciscis (1945; 1967¹⁰) and W. Johannowsky (1967)¹¹. In the early '80s, C. Bencivenga Trillmich (1984) conducted emergency excavations as part of the construction of an aqueduct and a sewer along the main urban axis, Via Martiri Atellani¹².

So far, regarding the pre-Roman phase, scant remains have been found in the few sectors investigated. However, numerous data are related to the

Hellenistic and the early imperial ages, with traces of later transformations¹³. Archaeological evidence suggests the city's origins trace back to the end of the 5th century BC at least and its urban development throughout the 4th century BC¹⁴. Atella was allied with Capua in response to the Roman expansion in the Campanian plain, and after their defeat in 338 BC the city became a *municipium*, holding the status of *civitas sine suffragio* in relation to Rome¹⁵. In 211 BC, the city lost its autonomy and citizenship siding Hannibal in 216 BC and became a *praefectura* under the direct control of Rome¹⁶. However, by the 1st century BC, Cicero's writings indicate that Atella was recognized as a *municipium* with jurisdiction over *ager vectigalis* (Cic., fam., 8.7). By the first half of the 1st century AD, Atella was likely equipped with the set of public buildings typical of a Roman city (fig. 5). A theater must indeed have been a significant feature in the birthplace of the Atellan farces, although no ancient sources directly mention it¹⁷. The reference to an amphitheater was indicated by Suetonius (Tiberius, 3.75.3), in connection with the populace's wish to burn the body of Tiberius, who died in *Misenum* (37 CE), precisely in Atella. In late antiquity, the city was destroyed from a fire (late 4th-early 5th century AD) but continued to prosper as an episcopal seat until at least the 7th century AD¹⁸.

As for the extant public edifices, ruins of two thermal bath complexes have been identified. The ruins named as "Castellone", situated proximate to the presumed eastern gateway, are part of a bath complex dating back to the 2nd century AD, as evidenced by the extant structures and other architectural features (fig. 6)¹⁹. Another baths complex was identified between 2009 and 2010 during the excavations conducted in the area of Fondo Guarino, near the Municipio di Atella di Napoli, under the direction of SABAP²⁰. The building was

8 Today we have some elements to discuss the chronology, at least relative, of the structure of the agricultural landscape, thanks to the research conducted in the Acerra area (GIAMPAOLA 1997; GIAMPAOLA 2002) useful for understanding the Atella relationship and the division of the *ager Campanus*, cf. QUILICI GIGLI 2002; QUILICI GIGLI 2005; cf. § G. Scardozzi in this paper.

9 BELOCH 1890.

10 DE FRANCISCIS 1945; DE FRANCISCIS 1967.

11 JOHANNOWSKY 1967.

12 BENCIVENGA TRILLMICH 1984.

13 DE CARO 2012, with references.

14 DE CARO 2012, p. 87.

15 Livius, 26.16, 5; 33-34.

16 Festus, *De verborum significatu*, p. 262 in LINDSAY 1913.

17 The location for the Roman theater was hypothesized by M. MONACO and M. CLAVEL-LÉVÊQUE (2004), cf. § G. Scardozzi in this paper.

18 DE CARO 2012, p. 88.

19 DE CARO 2012, 89-90, fig. 96.

20 ARENELLA et alii 2015.



Fig. 2 - Sant'Arpino (Caserta), the study area from an aerial view (photo by L. Ceruleo).

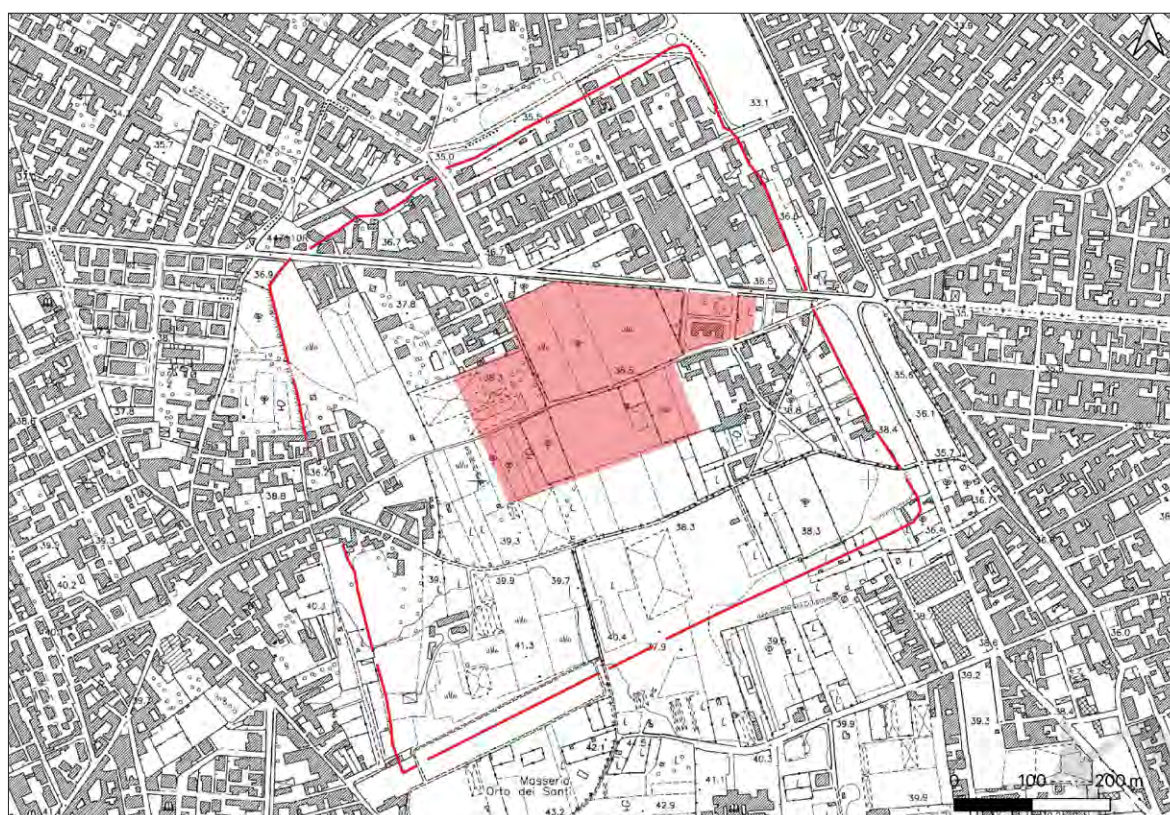


Fig. 3 - Sant'Arpino (CE), the study area plotted on a topographic map at 1:10,000 scale (CTR Regione Campania); the dotted line indicates the presumed line of the ancient city walls (elab. by R. Brancato).

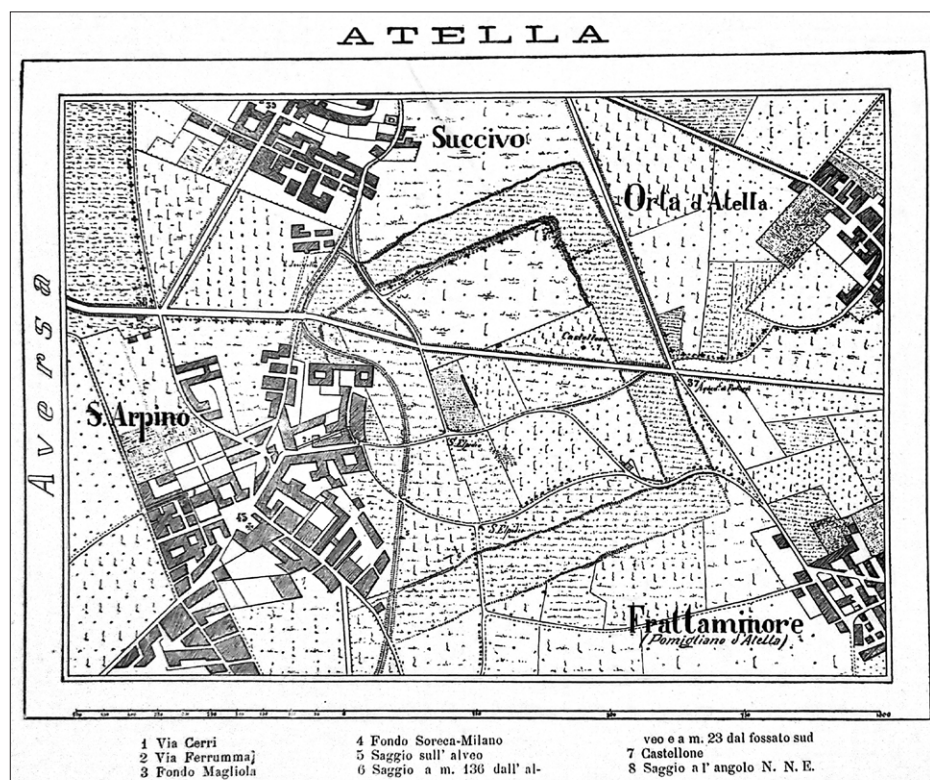


Fig. 4 - The topography of Atella represented in Castaldi's archaeological map in 1908.

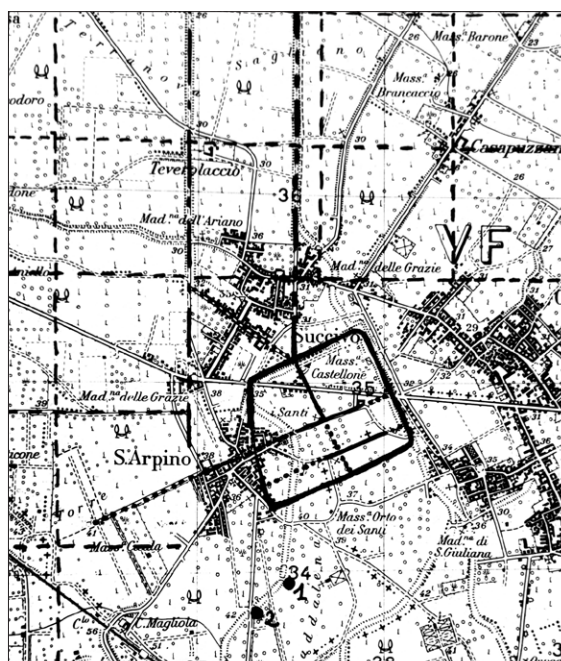


Fig. 5 - The archaeological topography of Atella and its extra-urban landscape on cartographic bases (scale 1:25,000, IGM F. 184 I NO "Aversa") (after BENCIVENGA TRILLMICH 1984).

founded in the Republican era and it underwent renovations until the 6th century AD. The recent excavations have allowed for the expansion of the investigation of a structure already partially brought to light in 1966 by W. Johannowsky²¹, clarifying that, in the imperial period, the building overlapped a Hellenistic *domus*, incorporating its tuff block walls (fig. 7). Although the structures brought to light constitute only a portion of the entire thermal complex, their vastness is perceptible: with a surface area of 1170 m². The rooms are organized along a north east - south west axis, according to the canonical sequence which provided for the passage from cold environments to gradually heated ones (fig. 8). The stratigraphy analysis points to the diachronic history of thermal complex, which has undergone various renovations over time. According to the scholars involved in the excavation²², it is possible to distinguish at least three periods (fig. 9).

²¹ JOHANNOWSKY 1967.

²² ARENELLA et alii 2015, figs. 2-3.



Fig. 6 - Sant'Arpino (CE), the so-called "Castellone" (Archivio Pro Loco di Sant'Arpino).

The Period 1 is datable to the Republican and proto-Imperial era; to it belong the structures in large blocks of tuff and the walls in *opus reticulatum* which will be incorporated or reused in the following period. During the Period 2, the area is occupied by a thermal complex, whose construction can be dated back at least the beginning of the 2nd century AD. It is difficult to say how long the complex functioned regularly, but it is presumable that the building was frequented at least until the 4th-5th century and perhaps a dating to the Constantinian age for the last construction phase of the complex cannot be ruled out, in relation with the construction activity carried out by *Celius Censorinus*²³.

The topographic survey

The archaeological research project in the site started in June 2021 with the topographical survey of the site²⁴. In the survey plan design phase, particular attention was paid to the integration of different survey methods in terms of complexity, costs, and

yield, both for acquisition and restitution phases²⁵. Preliminarily, all the new and legacy data were stored, annotated, georeferenced and, when necessary, vectorized in a GIS platform²⁶, the digital environment where archaeological data can be easily integrated and visualized on the basis of topography. Therefore, a new detailed and complete topographic survey as part of the field survey of the site was accomplished. This entails the recording of elevations across a grid of certain resolution, for instance m 10 intervals, but also the recording of points on known breaks of slope, to emphasis archaeological features in the landscape²⁷. Survey is undertaken by integrated use of the Total Station Leica TS03 5" R500 and the Global navigation satellite system (GNSS) Antenna Leica Zeno FLX100 plus to record the survey points. This approach allowed to integrate different datasets in a GIS environment to facilitate a deeper understanding of the archaeological landscape of Atella (fig. 10, A). The GIS system created for the Atella Project is then the adequate set out to provide the background for the geophysical surveys campaigns which complemented the remotely to proximally sensed data²⁸.

23 Cf. CAMODECA 2021, with references.

24 The paper presents the preliminary result of the on-site field workshop "Tecnologie e strumenti digitali per la conoscenza del paesaggio, June 2023, Sant'Arpino (CE)" organized by R. Brancato and C. Lamanna: the students selected for the intensive course (A. Bartiromo, A. Bottone, E. Canciello, L. Ceruleo, A. De Nardo, L. Di Falco, M. Di Matteo, G. Luongo, A. Mirabella, V. Nocerino, F. Perugino, C. Porciello, S. Sindoni) were actively engaged in all the activities, from data acquisition to the data processing, with relevant results.

25 PANSINI *et alii* 2018; cf. BRANCATO *et alii* 2023.

26 BOGDANI 2020; cf. BRANCATO 2019.

27 CAMPANA 2018, with references.

28 JOL 2009; BARONE 2016; BARONE, FERRARA 2016; cf. BARONE, WUESTE, HODGES 2023.

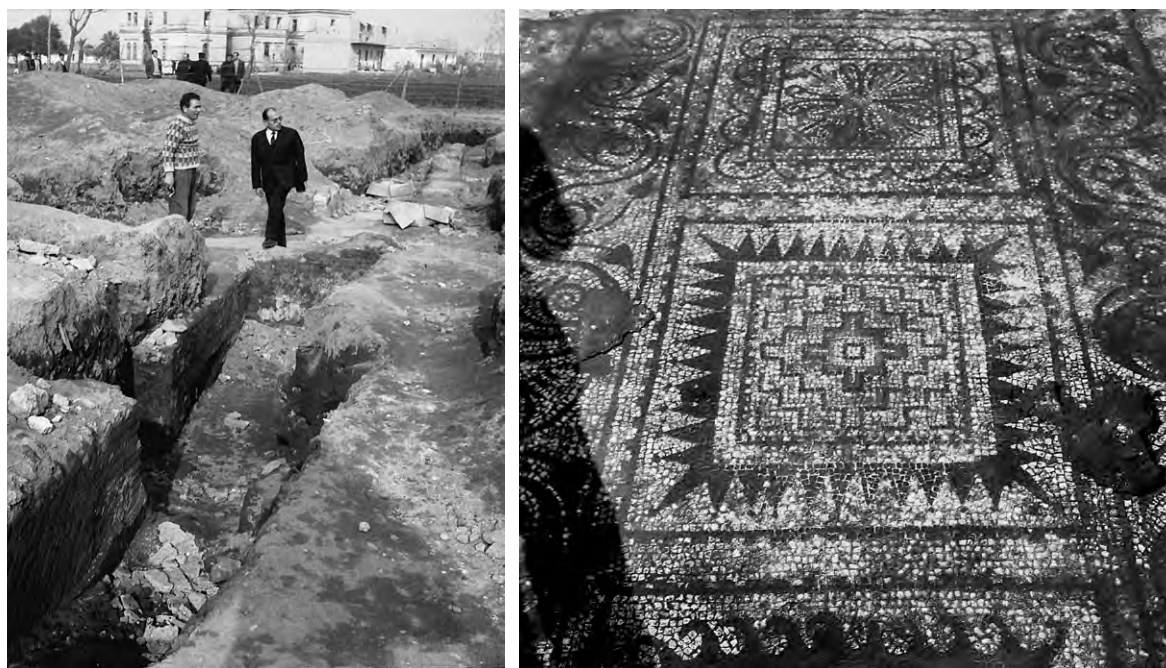


Fig. 7 - Sant'Arpino (CE), excavations of the baths complex conducted in 1966 by W. Johannosky (A); detail of the mosaic decoration of the floor (B).

Also the digital architectural survey techniques applied in Fondo Guarino (Sant'Arpino) were calibrated for achieving an efficient yet high-quality documentation aimed at the technical analysis of archaeological structures (fig. 10, B)). Comprehensive and detailed orthophotos (scale 1:5) were extracted from the model. Indirect surveying was planned with the use of traditional topographic tools (Total Station, GNSS antenna) for measuring functional topographic points supporting cartographic restitution for archaeological research. Celerimetric survey operations were carried out in the area, involving the creation of an open-type topographic polygon. The choice of an open-type topographic polygon was made to overcome the complex visibility problems caused by dense vegetation on the summit of the plateau, particularly on the northern slope.

In addition to the direct relief of the archaeological structures of the baths complex, a digital topographical survey was thus planned through an integrated acquisition system for the entire area selected for the 2023 campaign, with structure from motion (hereafter SfM) technology and proximity remote

sensing with unmanned aerial vehicle (UAV). The instrumental survey was aimed to create the digital high-resolution cartography for the site (geometric model) and the topographical basis for the three-dimensional (hereafter 3D) models planned for the needs of research, conservation and enhancement in cultural heritage research²⁹. To achieve these objectives, through the SfM application applied in the site, multi-scalar 3D digital models were created with the use of photogrammetry (Metashape) and cartographic (QGIS) software platforms (fig. 10, B). Indeed, from 3D models, digital topographical objects (*i.e.* orthophoto plans, sections and axonometric projections) can be extracted and used at various scales of representation (fig. 11)³⁰. Proximity remote sensing of the investigated building areas was conducted through systematic aerial coverage using a quadcopter drone operated by an operator. The aerial shots, taken periodically during activities, were anchored to other topographic operations through the registration of three-dimensional coor-

²⁹ LOCK 2003; FERDANI *et alii* 2019; cf. MOSCATI 2009.

³⁰ BEZZI, BEZZI, DUCKE 2010.



Fig. 8 - Sant'Arpino (CE), view of the baths complex uncovered in the 2010-11 excavations (after ARENELLA *et alii* 2015).

dinates of Ground Control Points (GCPs) positioned on the ground and clearly visible in the aerial photographs. For boths – from each architectural stratigraphic unit to the entire area – 3D modeling was carried out based on photographic documentation realized with students actively involved also in the data processing, conducted simultaneously with the excavation. All the acquired data, both at the macro and micro scales, were integrated into a workflow for the creation of three-dimensional and two-dimensional models, using photogrammetric software based on a Structure from Motion (SfM) technique, from which orthophotos used for planimetric surveys and the Digital Elevation Model (DEM) were extracted.

Through the new survey process, the main result is the identification of new archaeological units of the July 2023 mission. Moreover, the comparison data with the available legacy CAD data (plans and

sections) realized in 2011, has enriched our understanding of the structures and the area. The existing planimetric survey, although correct, is characterized by a strong subjectivity in the data collection, with an interpretation of the characteristics in the field and their representation in CAD not completely congruent with what is visible on the ground. The use of advanced technologies, such as global positioning systems (GPS) and survey tools such as photogrammetry, has helped improve accuracy and reduce the impact of subjectivity. Moreover, thanks to the new surveys, it is now possible to evaluate the state of conservation of the structures and coverings, identifying the progress of the state of degradation and allowing the adoption of measures to best preserve them.

The use of 3D modeling, through photogrammetry and LiDAR technology, made it possible to detect the wall facings in *opus testaceum*, relatable to the



Fig. 9 - Sant'Arpino (CE), plan of the structures brought to light in the 2010-11 excavations.

different construction phases, with great precision. These findings pave the way for a detailed analysis of the bricks, offering the possibility of identifying different types of bricks used in the various construction phases. The use of 3D scans, the cataloging of the architectural elements, unfortunately found in small numbers so far, has begun. The limited number of such elements in the archaeological area unfortunately testifies to a systematic plundering of the structures, already started in ancient times.

R.B.

Preliminary results of the 2023 GPR survey

The application of Ground Penetrating Radar (GPR) in Atella (June, September 2023; area covered 1,759 hectares) has represented a significant methodological advancement. The system employed, the Noggin SmartCart by Sensors & Software Inc., equipped with 500MHz antennas,

has enabled ground scans with unparalleled levels of detail (fig. 12). Penetrating through various layers of soil, the GPR has detected buried anomalies attributed to potential ancient anthropogenic elements, providing clear and detailed cross-sections and depth maps, opening new avenues of research. The capability of this instrument to penetrate different depths and detect minimal differences in soil composition has made it possible to identify ancient roads, building foundations, drainage systems, and other urban infrastructures, providing a detailed map of human activities spanning centuries within the first 3 meters.

In particular, the area located north of the excavated thermal baths has revealed a series of very interesting geophysical anomalies (fig. 13). As seen in figure 14 A, at a depth of approximately 0.5 meters, there is a clear and consistent flat reflector across the entire ground-penetrating radar map, oriented east-west. This buried anomaly runs parallel to the modern country road leading to the site, both

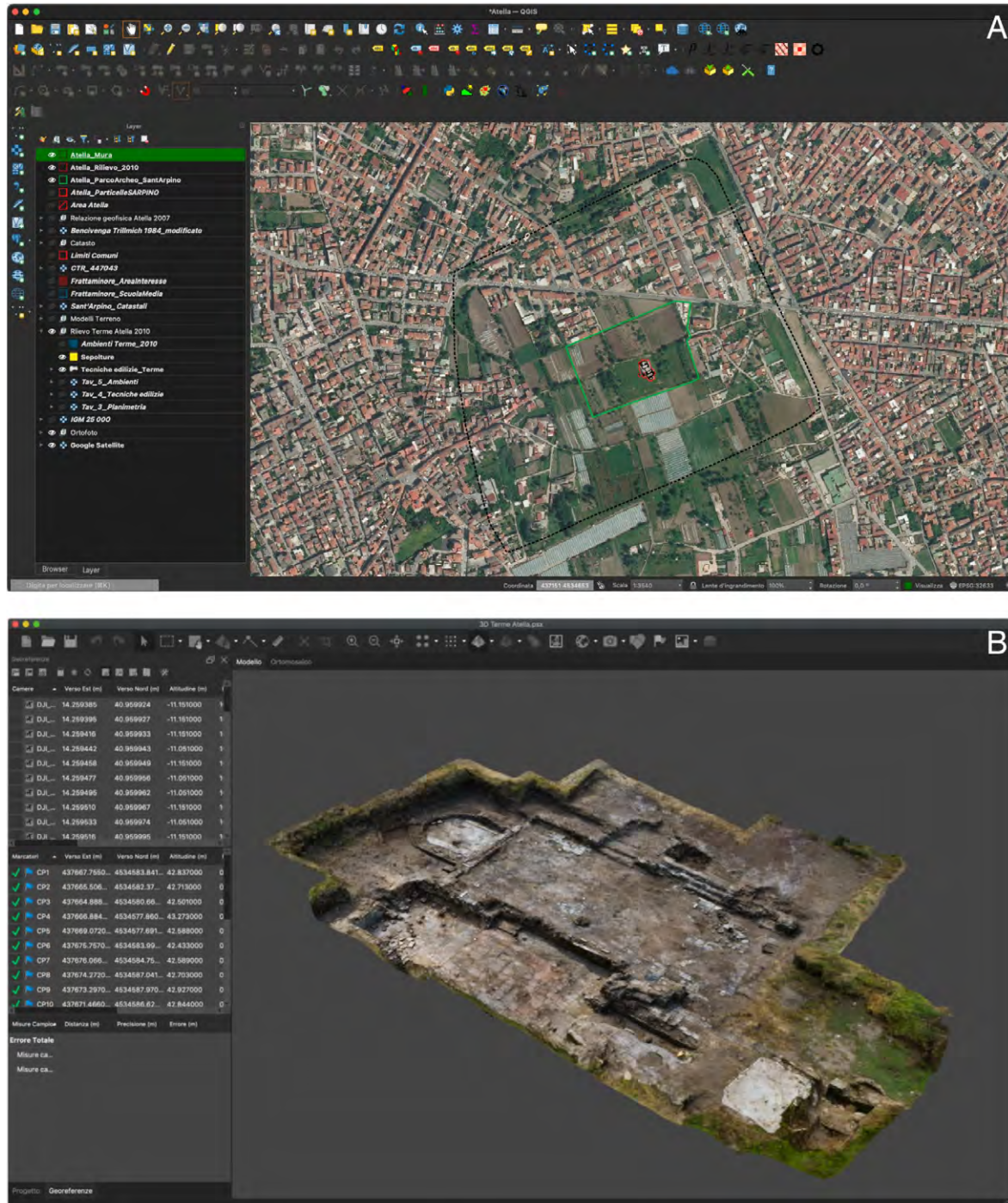


Fig. 10 - Topographic data processing in A) cartographic software platform (QGIS) and B) photogrammetry software (Agisoft Metashape) (elab. by R. Brancato).

its shape and position suggesting an ancient road. Additionally, as evident from figure 14 C, slightly deeper (between approximately 1 and 1.5 meters)

but with the same orientation as the previous one, there is a notable elongated anomaly that could be related to a buried ancient sewer pipe.



Fig. 11 - Sant'Arpino (CE), photoplan of the structures (elab. by L. Ceruleo).

Moreover, in an area south of the thermal baths, there are highly significant anomalies observed, oriented both parallel and perpendicular to the baths themselves, sometimes exhibiting alignments at 90°: these anomalies are found at various depths (approximately 0.5, 0.95, 1.5, and 3 meters), consistent with local stratigraphic units, and are certainly relevant to anthropic structures of various kinds (fig. 15).

The GPR as a non-invasive geophysical approach not only enhances the effectiveness of archaeological research but also leads to cost and personnel savings, precisely guiding archaeologists in their investigations and reducing the risk of da-

maging artifacts during excavations. The impact of GPR measurements on archaeological research in the Atella territory has proven to be crucial for planning further research. Indeed, the ability to accurately predict the location and depth of ancient anthropogenic remains before commencing excavations has transformed how archaeologists approach the discovery of new sites. This methodology not only allows for more efficient planning but also safeguards the integrity of archaeological sites, limiting the need for invasive and potentially destructive excavations. Furthermore, the ability to analyze and interpret data in real-time enables rapid adaptation of excavation strategies based on

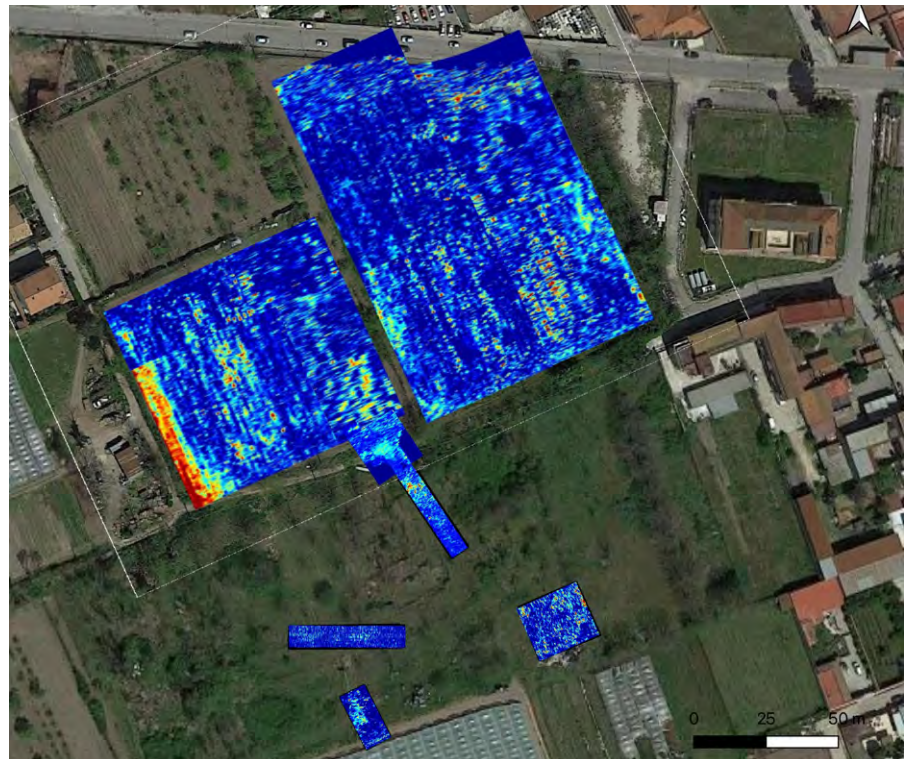


Fig. 12 - Sant'Arpino (CE), the entire area covered by GPR investigation with a series of anthropogenic anomalies related to buried masonry structures and alignments (elab. by P.M. Barone).

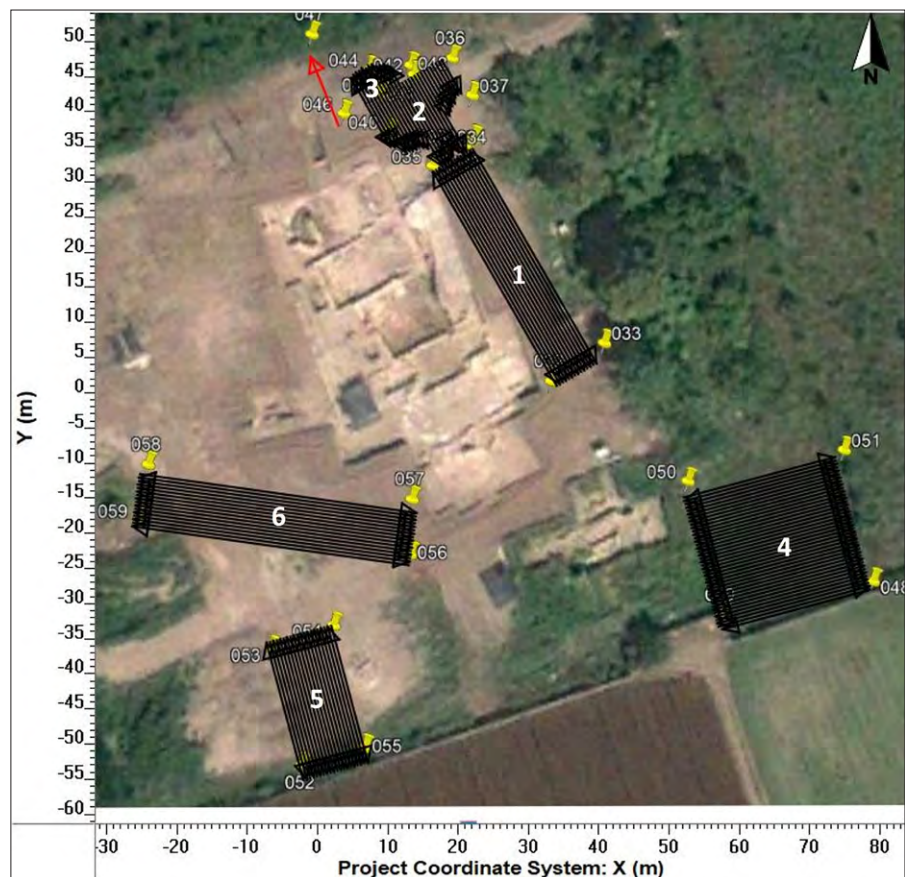


Fig. 13 - Sant'Arpino (CE), the grids covered by GPR investigation in Fondo Guarino (elab. by P.M. Barone).

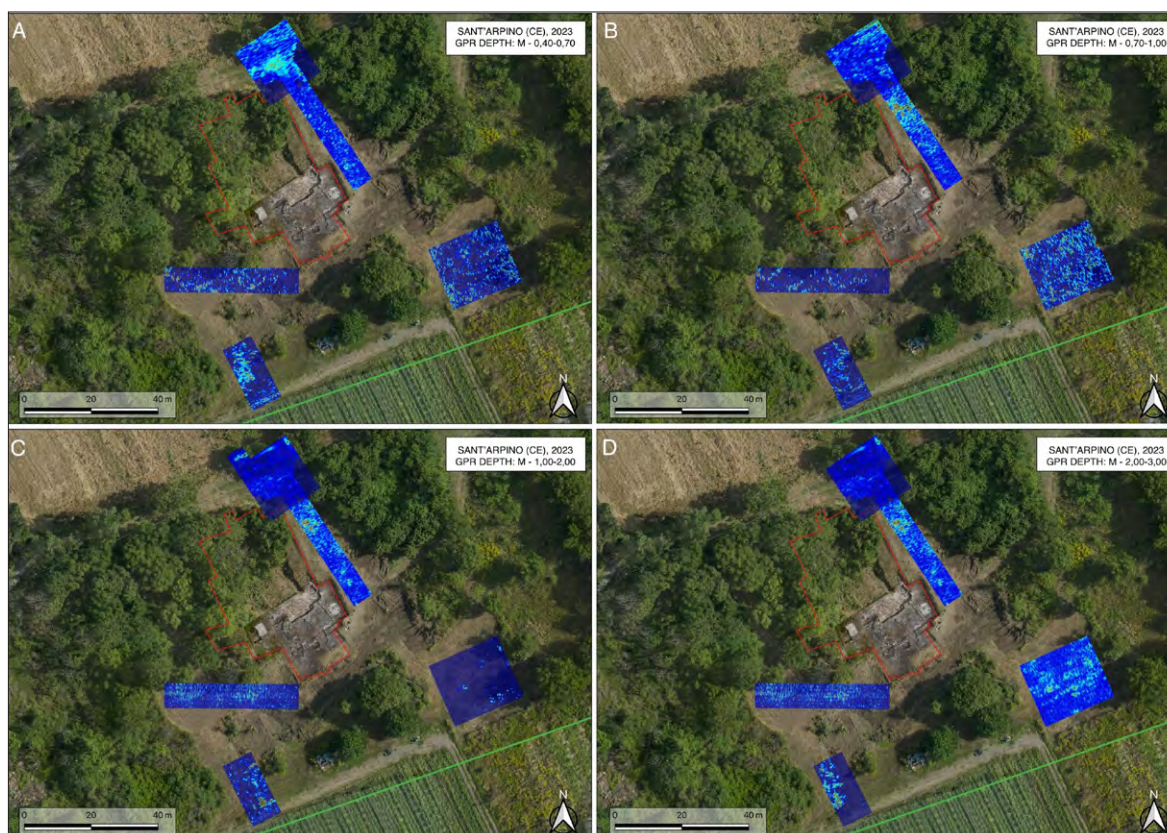


Fig. 14 - Sant'Arpino (CE), GPR map of Fondo Guarino with a series of anomalies related to buried masonry structures observed at various depths ranging from approximately m 0.9 to 3; the dotted line indicates the trench limits of 2010-11 excavations (elab. by P.M. Barone).

emerging findings, optimizing resources and time. This new approach not only enriches the understanding of the evolution of the Atellan landscape but also paves the way for future innovations and developments not only in the field of landscape archaeology in architectural and urban planning, promising to reveal even more details about the lives of the ancient inhabitants of Atella. The adoption of GPR measurements in the Atella territory not only signifies progress in the accuracy and reliability of archaeological research but also opens new perspectives for the conservation, protection, and development of historical-archaeological heritage. This advanced technology, complementing and enhancing previous prospections, allows for a deeper understanding of past civilizations without compromising the integrity of the sites examined. Furthermore, the use of GPR reflects a commitment to innovation and sustainability in archaeo-

logical practices, promoting a more respectful and informed approach to managing our buried past. The ability of this technology to unveil hidden details beneath the Earth's surface with unprecedented accuracy calls for reflection on the importance of continuously integrating new technological solutions into archaeology, in order to preserve and valorize our historical testimonies to the fullest extent.

P.M.B.

Atella in the remotely sensed data

For the archaeological site of Atella, the first phase of the remote sensing research focused on the recovery of historical aerial footage related to the selected area from the archives of the Istituto Geografico Militare (IGM) and the Aerofototeca Nazionale (AFN) of the Istituto Centrale per il Ca-

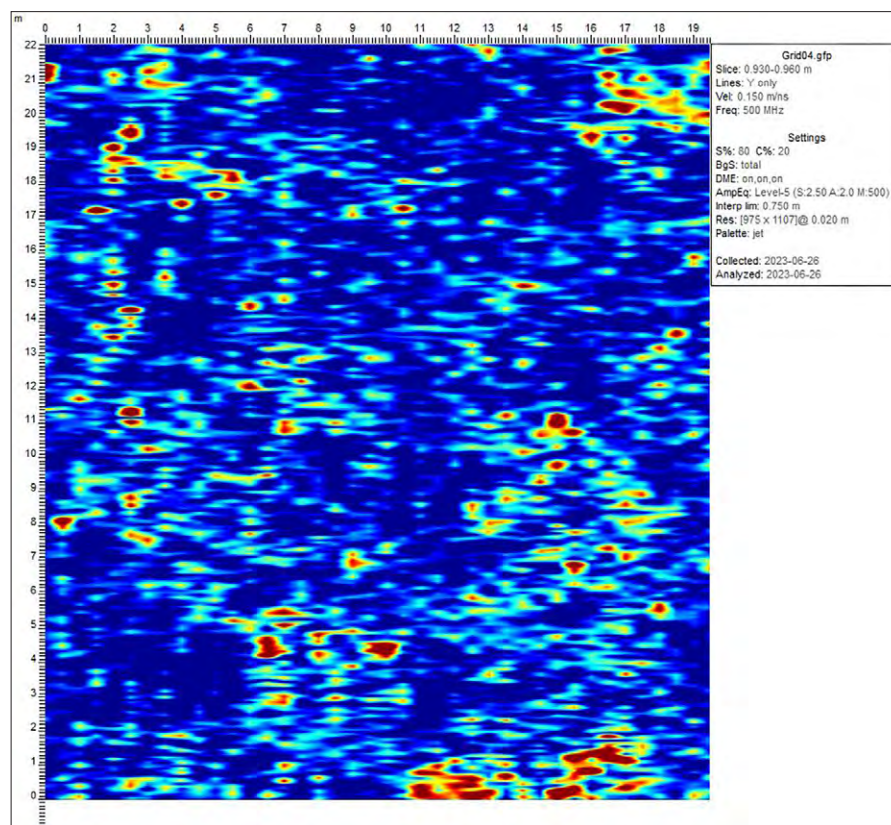


Fig. 15 - Sant'Arpino (CE), Grid 4 with anthropogenic anomalies observed at depths ranging from approximately m 0.930-0.960 (elab. by P.M. Barone).

talogo e la Documentazione³¹. The study of these aerial photographs aims at reconstructing the historical landscape and the significant transformations of ancient Atella territory during the last 80 years, as well as carrying out an archaeological photo-interpretation analysis aimed at identifying traces of buried ancient remains and ancient survivals in the current landscape.

The first available image is an aerial photo of the Regia Aeronautica (RA) from 1943, which unfortunately only covers the area immediately south of Atella, the one that extends towards the Frattamaggiore Cemetery, partly affected by the presence of necropolis areas relating to the ancient city. We have also two flights conducted by the Royal Air Force (RAF) again in 1943 just days after the photo taken by the Regia Aeronautica. These images fully cover the site of the city of Atella, whose boundaries are indicated by the arrows (fig. 16, A-B). The ancient urban area, trapezoidal in sha-

pe, appears substantially free of modern buildings. In these images it is still clearly possible to recover elements of the ancient topography of the site still surviving in the modern landscape. A very interesting RAF aerial photo, taken in March 1945, shows clearly the boundaries of the ancient urban area of Atella, extended over a flat territory almost “embedded” between modern inhabited centers, which still have a very limited extension (fig. 16, C). For this reason, the images from the 1940s and 1950s allow us to read the relationship between Atella and the surrounding territory and thus to reconstruct, at least in broad terms, the historical landscape in which the city was set. As well as in the RA and RAF photos, this is particularly documented in the photographs from the flight of the Gruppo Aereo Italiano (or Volo Base) of 1954 and in the shots from an aerial coverage conducted in January 1957 by the United States Air Force (USAF) (fig. 16, D).

Another RAF aerial photo (May 1945) documents the position of Atella in relation to the centuriation of the *Ager Campanus*, whose survivals (consisting

31 For the method, MATRULLO, SCARDOZZI 2020.

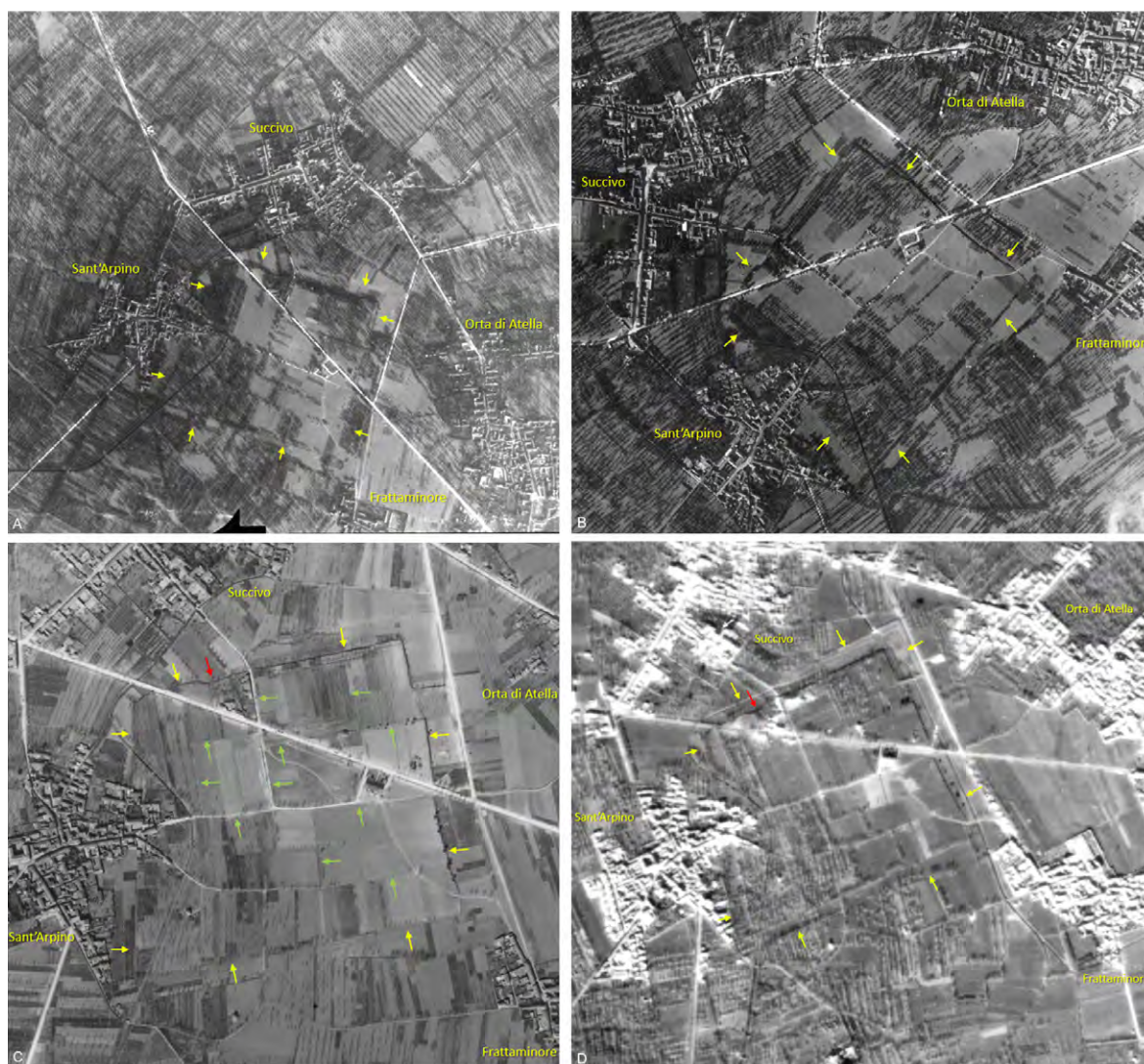


Fig. 16 - Atella: aerial photos taken by RAF on 25-8-1943 (A), 3-9-1943 (B), and 10-3-1945 (C), and by USAF on 22-1-1957 (D) (elab. by G. Scardozzi).

of roads and headland boundaries that trace the ancient centuriation limits) are very evident (fig. 17)³². Only a few of them are indicated, the most evident ones, but the limited urbanization of the territory allows for a careful examination to reconstruct the entire centuriation grid and its internal boundaries³³. Compared to this organization of the territory, consisting of orthogonal axes oriented in a

north-south and east-west direction, the divergent orientation of Atella's older urban layout, rotated towards north-west, can be noted, as also shown by the cartographic reconstruction proposed in 1984 by C. Bencivenga Trillmich (see above fig. 5). In this regard, it can be recalled how Marina Monaco highlighted that such orientation is consistent with that of the land division of the territory of Acerra, located just further east, dated to the 3rd century BC and therefore earlier than the centuriation of the *Ager Campanus*, visible in the territory of Aversa and further north, dated to the 2nd century BC.

32 CHOUQUER *et alii* 1987, figg. 70-71.

33 QUILICI GIGLI 2002, QUILICI GIGLI 2005; cf. MONACO 2004; MONACO, CLAVEL-LÉVÊQUE 2004.

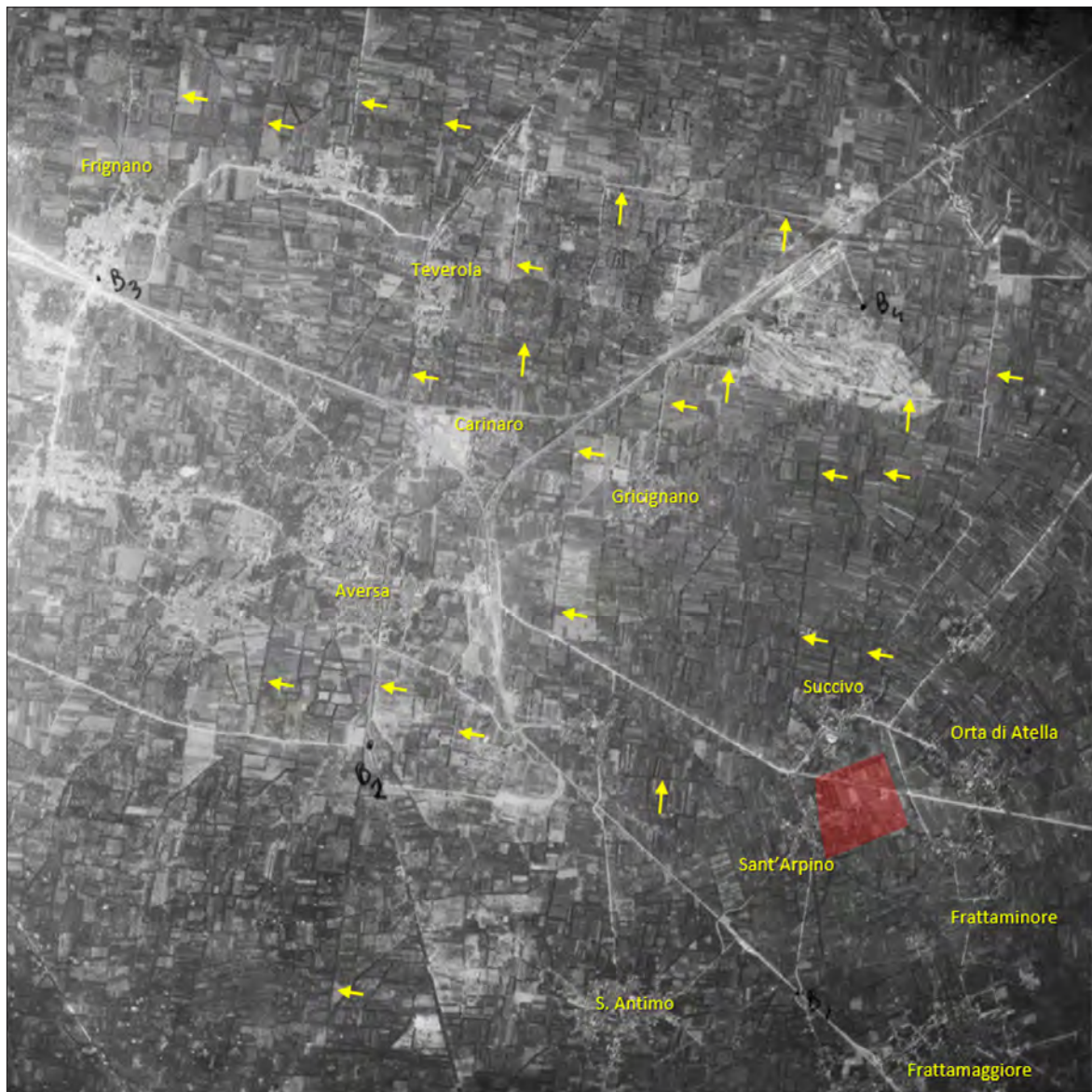


Fig. 17 - Territory north and west of Atella (in red the area of the ancient city): aerial photos taken by RAF on 18-5-1945 (elab. by G. Scardozzi).

Between the 1960s and 1970s, the strong and often uncontrolled expansion of urbanized areas began, progressively encroaching on the area of the ancient city, invading its surface, especially in the northern sector. The aerial documentation of these years is insufficient and it consists of only one flight by the IGM (May 1974) which does not fully cover the area of the ancient city, documenting only its central-southern portion.

In order to create a complete dataset of aerial images, in addition to the aerial photographs from the Military Aeronautics and the IGM taken between 1980 and 2003, images were also retrieved from other digital archives, such as the National Geoportal (which offers aerial shots from 1988, 1994, 2000, 2006, and 2012), or online platforms of high-resolution satellite images like Bing Maps and Google Earth.

The multi-temporal dataset built for the research project helps to mitigate the bias to which archaeological photo-interpretation is subject due to the randomness and seasonality of traces, which often also have a short duration. The numerous images taken in different years and months of the year therefore increase the chances of observing these traces. In a complex context, like the case-study, it is inevitable that it is precisely the so-called historical aerial shots, prior to building expansion, that provide the most significant archaeological data. The diachronic reading of these images is obviously facilitated by their georeferencing and implementation in the Atella GIS platform, which constitutes the virtual environment in which remotely sensed data from aerial platforms also integrate with archaeological data and geophysical data.

The preliminary analysis of the data and the archaeological photo-interpretation have already highlighted numerous traces of ancient remains buried and ancient survivals in the current landscape. The RAF aerial photos from 1943 and 1945 clearly show the circuit of Atella's walls (indicated by yellow arrows in fig. 16, A-C), built in squared tufa work in the second half of the 4th or at the beginning of the 3rd century BC; it indeed survives in the landscape of the forties, traced by field boundaries, rows of trees, and wall structures that follow its route. Also, evident within the city are the survivals of the ancient urban layout, marked by orthogonal road axes whose course is taken up by rural roads and land boundaries (indicated by green arrows in fig. 16, C). The same survivals are clearly readable also in the USAF aerial photos from 1957, which, thanks to the grazing light present at the time of the shots, also show various traces of micro-relief, among which, in particular, those of the wide moat outside the city walls (indicated by yellow arrows in fig. 16, D). The same aerial photos show an anomalous course of the north-western stretch of the city's perimeter wall, which at the point indicated by the red arrow (fig. 16, C-D) has a curvilinear direction. In this anomaly, M. Monaco has proposed recognizing the cavea of a theater: the area is today fully built-up, which makes it extremely difficult to verify the real

existence of this monument. Pending the acquisition of new elements in this regard, it is therefore necessary to suspend judgment on this hypothesis for the moment.

Also in the area subject to the non-invasive investigations, the results of the remotely sensed data analysis may help in the reconstruction of the urban landscape of Atella. Indeed, the trace of a large rectangular anomaly, about 52 meters wide and elongated in a north west - south east direction for about 113 meters, is clearly visible in the RAF aerial photos (March 1945: fig. 18), i.e. in the central sector of the city. It could be the perimeter of a large building or perhaps of a paved open space with an orientation consistent with that of the urban layout. The location of a rectangular structure in relation to the main ancient road network (in red in fig. 20) and the baths complex uncovered to the southeast in 2010-11 by Soprintendenza is noteworthy. These traces will certainly need to be interpreted in conjunction with the results of the Ground Penetrating Radar (GPR) surveys conducted in 2023 (in orange in fig. 20) and data from the magnetometry analysis conducted in 2007 by the British School at Rome³⁴ in the same area (in green in fig. 21).

G.S.

Discussion

The visible archaeological traces, the data from the GPR surveys results of the first campaign may allow to help in the reconstruction of the urban planning of Atella. Indeed, the aforementioned anomaly visible in the 1945 RAF photograph, could be substantiated by what was noted on the cartography of G. Castaldi at the beginning of the 20th century (fig. 4, n. 3): indeed, precisely in correspondence with this anomaly, the wall section (5 m) which he brought to light is represented in the map (CASTALDI 1908, fig. 1, n. 8) with an orientation consistent with what has emerged so far in the field, from above and from underground (fig. 20). The description of the wall is very precise³⁵ and enriched by the heights compared to the ground level (max height - 2.13 m),

³⁴ Cf. BRANCATO *et alii* forthcoming.

³⁵ CASTALDI 1908, p. 81.



Fig. 18 - Atella: A, aerial photos taken by RAF on 10-3-1945 (red arrow indicates a curvilinear anomaly along the north-western stretch of the city walls, in which M. Monaco proposed recognizing the cavea of the theatre; yellow arrows indicate a rectangular anomaly in the central sector of the city); B, a detail of the same photo concerning the central sector of the city (yellow arrows indicate anomalies probably linked to ancient buried structures); C, the same area today (yellow rectangle indicates the site of the anomaly showed by RAF aerial photo) (elab. by G. Scardozzi).

so much so that this structure could be referred to a multi-phase (*opus latericium* superimposed on a structure in *opus reticulatum*) monumental structure perhaps a *porticus* located on the eastern side of the *forum*.

Moreover, the discovery of a significantly thick partition wall and the potential identification of structures from the thermal complex underscore how geophysical surveys can provide valuable information to guide and optimize archaeological excavations. The use of GIS technologies for overlaying and analyzing geophysical data with excavation results and other ground investigations allows for a deeper understanding of the archaeological site and facilitates the reconstruction of ancient structural complexes (fig. 20). In the specific case, the confirmation through GPR surveys of the presence of buried structures at a certain depth adds another layer of information, supporting the hypothesis of structures belonging to the thermal complex and potentially indicating new areas of interest for future investigations.

R.B.

Conclusion

In summary, this multidisciplinary approach not only improves the precision and effectiveness of archaeological research but also opens new perspectives on understanding ancient sites, allowing for more informed hypotheses on their spatial and functional organization. This comprehensive approach, integrating data from different scales, sources and technologies, including aerial photography, satellite imagery and GPR surveys may provide a new understanding of the archaeological features of the site, including the newly identified rectangular structure, its relationship with surrounding structures and ancient road networks, and other potential archaeological features indicated by linear traces (fig. 20).

The connection between the thermal complex investigated in 2010-11 by Soprintendenza and the *forum*, as suggested by G. Camodeca through his insightful analysis of epigraphic material from excavations, is further supported by the photointerpretation of anomalies from remotely sensed images. This hypothesis, in conjunction with the

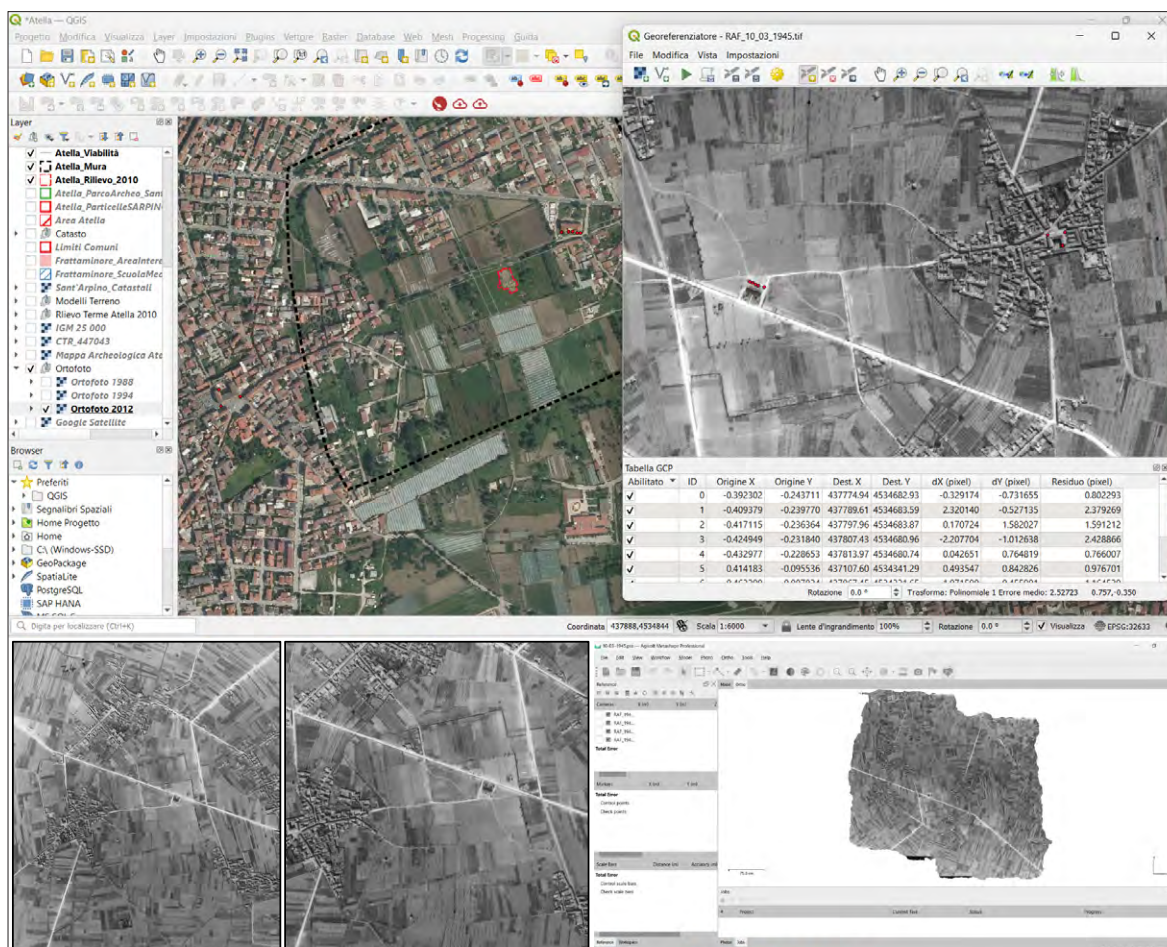


Fig. 19 - Georeferenced aerial photographs in the Atella GIS platform (elab. by R. Brancato).

general structure inferred from the palimpsest of anomalies derived from the GPR geophysical prospecting and the recovery of topographical evidences from legacy data (referenced by G. Castaldi), enables the proposal that this rectangular anomaly could be identified with the *forum* of the city of Atella. The identification of such a crucial urban feature like the forum not only provides significant insights into the urban planning and architectural development of Atella but it also highlights the importance of integrating various archaeological methodologies.

R.B., P.M.B., G.S.

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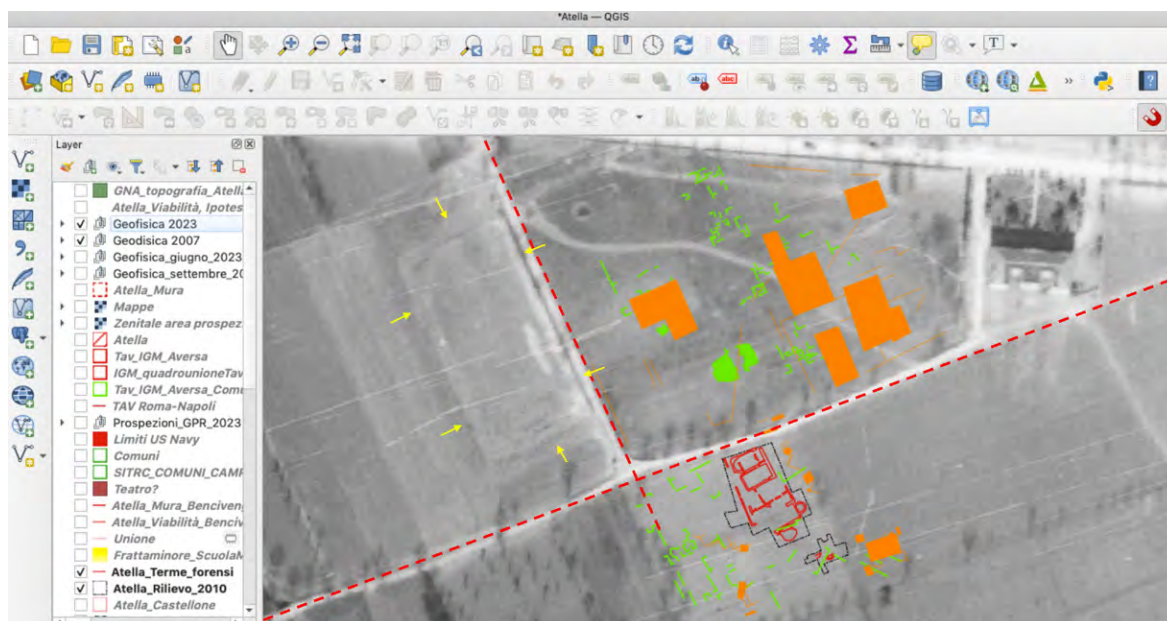


Fig. 20 - Atella GIS platform: the rectangular anomaly visible in the RAF aerial photo (March 1945) in relation to the ancient road network and the baths (in red), and the geophysical anomalies measured in 2007 (in green) and 2023 (in orange) (elab. by R. Brancato).

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RIASSUNTO - Questo articolo intende condividere i risultati preliminari delle indagini non invasive avviate nel 2023 nel sito archeologico di Atella a Sant'Arpino-Caserta guidato dal Laboratorio Digitale di Topografia Archeologica dell'Università degli Studi di Napoli Federico II. Situato circa a metà strada tra Capua e Neapolis, Atella e il suo territorio circostante si trovano nel settore centrale della Piana Campana, vasta pianura alluvionale formata dai fiumi Volturno e Clanio, a nord del Monte Vesuvio e della caldera vulcanica dei Campi Flegrei. Storicamente rinomato per le 'fabulae Atellanae', il sito presenta una topografia archeologica ancora ampiamente ignota. Il progetto di ricerca è iniziato con una nuova valutazione dei dati da telerilevamento remoto, ha incluso la ricognizione intensiva e sistematica sul terreno e la prospezione geofisica dell'intera area (Ground Penetrating Radar). La campagna del 2023 è stata condotta da giugno a settembre presso il Fondo Guarino-Sant'Arpino, settore del sito che si ritiene comprenda l'area monumentale centrale di Atella.

SUMMARY - This paper aims to share the preliminary results from the non-invasive investigations initiated in 2023 at the archaeological site of Atella in Sant'Arpino-Caserta led by the Archaeological Digital Mapping Lab at the University of Naples Federico II. Located about halfway along the road from Capua to Neapolis, Atella and its surrounding territory lie in the central sector of the Campanian plain—a wide alluvial plain formed by the rivers Volturno and Clanio, north of Mount Vesuvius and the volcanic caldera of the Campi Flegrei. Historically renowned for the 'fabulae Atellanae,' the site's overall archaeological topography remains largely uncharted. The new archaeological project began with a renewed evaluation of remotely sensed data and included an intensive field survey and geophysical prospection using Ground Penetrating Radar. The 2023 campaign was conducted from June to September in Fondo Guarino-Sant'Arpino, which is believed to encompass Atella's central monumental area.

Parole chiave: Topografia antica; indagini non invasive; Campania; Atella; archeologia romana.

Key-words: Ancient Topography; non invasive Surveys; Campania; Atella; Roman Archaeology.