

A multiscalar research project, following an ancient *decumanus* in Montenegro

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Abstract – A multidisciplinary project is being carried out by an Italian-Montenegrin team in the Roman town of Doclea in Montenegro. Applying a multi- and interdisciplinary approach and multiscalar analysis to the site and its surrounding territory, it has been possible to identify traces of the *decumanus maximus*, not only in the public centre of the city, where the main road was partially already excavated, but also outside the walls of the town, even into the suburbs of the capital of Montenegro, Podgorica.

Keywords – Remote sensing, multiscalar analysis, Montenegro, Doclea, ancient Roman road, urban planning, landscape archaeology.

I. INTRODUCTION

Since 2017, a multidisciplinary project has been in progress at the Roman city of Doclea in Montenegro, carried out by an Italian and Montenegrin team. The project looks first to study, preserve and enhance the archaeological site of Doclea and then to hand it back to the local communities, given its importance for Montenegrin history and cultural identity, that it may act as a tool for enhancing socio-cultural and economic outcomes [1].

The involvement of a multidisciplinary team has been necessary given the difficulties attendant on so complex a site, excavated mostly at the end of the 19th century, largely unpublished and not sufficiently valorised [2, 3]. Working at Doclea is a great opportunity to analyse cultural heritage from different points of view and methodologies: employing historical and archaeological research, topographical survey data and satellite images, drone photogrammetry and geophysical investigations to achieve outcomes such as virtual reconstructions and smartphone applications. Archivists, historians, archaeologists, topographers, geophysicists, geologists, seismologists, architects are all working together to first acquire a better

knowledge of the site and then to fashion and carry through an improved design for a sustainable plan on its relaunch.

After establishing a diachronic reconstruction of Doclea and the cultural landscape of its valley from the Bronze Age to the medieval period, our ultimate goal is to make the territory more visible, making it more attractive for the application of new technologies. Through these last the knowledge gained can be circulated, the populace revitalized and cultural tourism encouraged.

Concerning the present paper, the results of a multidisciplinary, multitemporal and multiscale approach to the study of the city planning are presented. A crucial component for the urban development and the territorial organization of the town has been investigated, namely the *decumanus maximus*. The integration of aerial, satellite and drone remote sensing data with the results derived from archaeological surveys has made it possible to reconstruct the route of the *decumanus* in the eastern residential sector of the town, out beyond the city walls, where a long stretch of the road on the left side of the Morača river has been identified. Along the west side of the city traces of another road were found, but which have now disappeared. This road could be linked to an important Roman communication route.

A. The site

Doclea was built in the north-western sector of the wide Zeta plain in which the present capital of Montenegro, Podgorica, is located. Surrounded by low hills, the ancient city is built within a large trapezoidal plateau protected to the northern side by the stream Širalija and by the confluence of the rivers Morača and Zeta.

The city was located at an important crossroads of routes that led to the interior of the Balkans; it was also linked to the Roman road that starting from Naronā headed towards Skadar, coming down the river Zeta valley [4, 5]. The impressive walls of the town, dated to the 4th century AD and still clearly visible, delimit an area of about 25 hectares [6, 7] (Fig. 1).

Doclea was the second-largest city of Roman Dalmatia. Named after the Illyrian tribe the Docleati, it was a *municipium* created in the 1st century AD: a large *forum*, a *basilica*, various temples and buildings, *tabernae* and *thermae* are still visible. Destroyed by the Avars in the 7th century, Doclea had also important late antique and medieval phases, represented by three medieval churches [8]. Between 1947-1948, a railway was constructed, dividing the site into two parts [9].

Many archaeological structures were then permanently destroyed, but the absence of modern buildings and the lack of intensive agricultural activities make Doclea today an extraordinary open-air laboratory for innovative multidisciplinary researches [1].



Fig. 1. The Roman town of Doclea, Montenegro: in colours the main structures and in red the defensive walls.

II. METHODOLOGY

Our integrated methodological approach, with its different levels of analysis at different scales, moves from the top (highest) level of satellite, aerial and drone data, to archaeological survey and landscape archaeology on the earth's surface, and finally underground to geophysics prospections (Fig. 2).

The aerial photos acquired by drone (Phantom 4 Pro model), by air (World War II, 26/09/1942) and by Corona Satellite (23/06/1967) have been subjected to a pre-processing phase, in order to make them geometrically

appropriate to the chosen reference system (UTM, WGS84).

During the archaeological photo-interpretation phase of remote dataset, several processing techniques have been applied, to better emphasize the minimal differences among the pixel values in terms of hue, saturation, brightness and contrast of colour [10].

Finally, all images have been interpreted from an archaeological and topographical point of view, trying to assign a precise interpretation to each single trace with the purpose of reconstructing the urban system and the organization of the surrounding area.

Several campaigns of archaeological survey have been conducted on the Doclea plateau, to verify the remote sensing data. The chosen territory has been completely surveyed, resulting in an almost total coverage of the area under investigation. Where walls emerged, they were positioned by means of a differential GPS Topcon GR5 that offers an accuracy of about 1 cm [11].

The next step was the implementation of a GIS, for a better reading and interpretation of the settlement model. Through the GIS, a large volume of data, also heterogeneous, related to the Roman city in all its natural and anthropogenic components, have been managed, analysed and processed (Fig. 2).

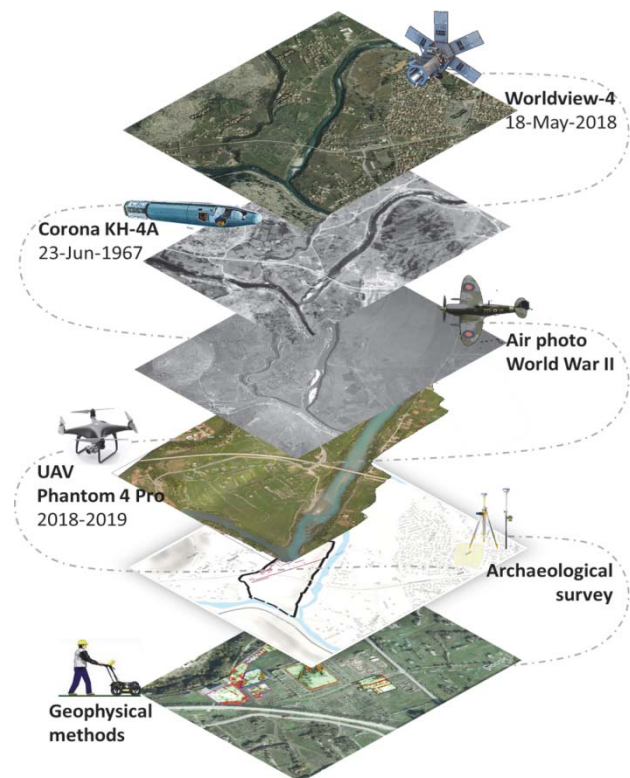


Fig. 2. The multiscale analysis at Doclea, Montenegro.

II. RESULTS

Through the remote sensing, we investigated the variations affecting both the vegetation and the soil's physical and other features, such as thermal conductivity and capacity.

The present study is based on the principle that any buried remains, either of human or natural origin, create over time anomalies in the soil, expressed in such as:

- vegetation-cover status;
- soil physical and chemical features.

The above factors are strictly connected and cause variations in spectral responses on the surface.

Numerous archaeological features have been characterized by analysing the vegetation status. The associated traces are produced by the different values of absorption and reflection displayed by the vegetation in the Visible and Near Infrared wavelengths [12].

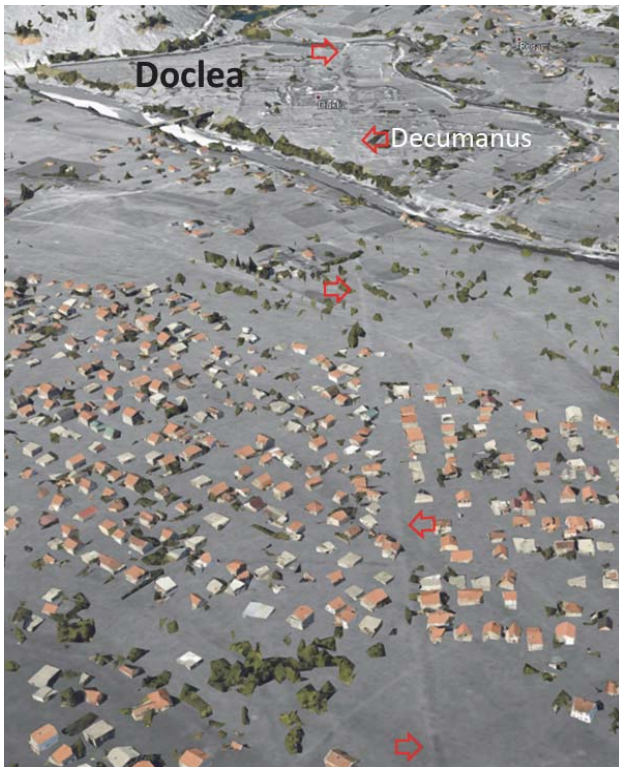


Fig. 3. Georeferenced air photo (1942) on 3D model view of satellite image. The trace of the decumanus from west, where the Roman forum of Doclea is located, to east, in the modern suburbs of Podgorica.

Starting from the public centre of the city, with the crossing of the *cardo maximus* and the *decumanus maximus*, the Doclea urban system was probably organized in blocks (*insulae*), some we were able to partially identify also on the ground [11]. Outside the walls city, a long bright trace following the alignment of the *decumanus maximus* was first identified by architect Elisa

Fidenzi, looking at a 1942 photo shot of the II World War [13].

This identification encouraged further researches. Following the trace on additional remote sensing images, crossing the Morača river, we identified some clues as to the passage of the ancient road. On the air photos and Corona image, the *decumanus* is visible for about 1100 m (Fig. 3), while on the Worldview satellite image it is partly covered by the modern street.



Fig. 4. Decumanus trace identified by the survey.

Later on, during the archaeological survey, we identified an alignment of very poorly preserved outcropping limestone blocks, still visible within a public park (Fig. 4).

Continuing east, a modern asphalted road follows the ancient path, visible on the 1942 and 1967 aerial photos and Corona image, dividing two blocks of modern private houses. In an uncultivated plot at the end of the modern road, a micro-relief (shadow sites) corresponding to the remote sensing anomaly was identified on the ground.

On the west, along the Zeta valley, a straight line following the right bank of the Zeta river was detected on the World War II aerial photo, that captured the territory before the transformations caused by the railway construction. On the image, this linear trace is visible, on its NW-SE orientation, as a paler colour, extending for a total length of about 1600 m.

The anomaly follows a rectilinear course up to the Late Roman necropoleis area, where it bends slightly southwards, so aligning itself with the NW gate of the

Roman city (Fig. 5).



Fig. 5. Georeferenced air photo (1942) superimposed on the 3D model view of satellite image (green vegetation). On the image are visible the Roman road traces (white arrows) up to Doclea and the necropoleis area (red square).

III. DISCUSSION OF THE RESULTS

The Roman city of Doclea has been investigated in a non-systematic way since the end of the 19th century. The Istrian scholar Piero Sticotti carried out research which still today constitutes the main source of information on the ancient town [3].

Until now, Doclea is known for its public sector remains, with little data existing for the city's residential quarters. Conforming to the geometric urban grids of Roman cities, the urban planning of Doclea is organised starting at the intersection of two main streets, the *decumanus maximus* and the *cardo maximus*.

The research conducted by the Italian-Montenegrin team between 2017 and 2019 has made it possible to propose a reconstruction of the urban layout: south of the *decumanus maximus* the city is organized in square blocks of 59 m per side orientated NNE/SSW [11]. Geophysical prospections on the site confirms the existence of this scheme and also proposes a larger urban module for the eastern sector, with blocks of m 75 per side (2 *actus*) [14]. The quadrangular form of the *insulae* corresponds to those in some Roman cities of the Italian peninsula dating back to the first Augustan age, when this type of extremely rational plan, very often based on a module of 2 *actus*, was introduced [15, 16].

The road axes of the city were presumably 8 m wide including pedestrian footpaths. The *decumanus maximus*, at least in the public centre of the town, where the *forum* and the main public buildings are located, was a monumental street, 10 m wide and flanked by a covered

walkway. The western and public stretch of the *decumanus* is well known: its dimensions and the presence of a colonnade along the southern side have been confirmed by recent excavation conducted by the Center for Conservation and Archaeology of the Ministry of Culture of Montenegro, as well as being based on geophysical prospections [6, 14]. The total width of the *decumanus*, including the road, the sidewalk and the southern covered walkway is 15 m (Fig. 6).



Fig. 6. The *decumanus maximus* in the public centre of Doclea. On the left are the remains of the basilica and the forum.

The excavation revealed three levels of the road. The first dates back to the 1st century AD, the second one at the end of the same century, when the city became a *municipium*, while the third level, of compacted earth, is from the 4th century AD [7].

The considerable width of the *decumanus* can be compared with that of some Augustan colonies in northern Italy characterized by a regular layout, but conditioned, as Doclea, by an important pre-existent communications network [11].

The analysis of the multiscalar images has made it possible to follow the *decumanus* route also in the city sector located east of the *cardo maximus* as far as the walls. In that area, systematic archaeological surveys have been conducted, which have provided important results. Numerous outcropping walls following the orientation of the *decumanus* and probably to do with residential buildings were identified and detected with the differential GPS. Recent excavations carried out in this part of the city have confirmed the formulated hypothesis, bringing to

light many walls and layers very rich in archaeological material dating between the 2nd and the 3rd centuries AD [17].

East of the city walls, the continuation of the *decumanus maximus* is interrupted by the Morača river. Over the river, the *decumanus* can be identified on the remote images as a NW-SE long bright line, delimited on both side by darker ones.

At the point where the *decumanus* encounters the city's eastern walls, Sticotti placed an internal defensive tower, built to protect a supposed bridge, while, beyond the Morača, he identified the remains of an aqueduct [3].

The existence of a bridge at this point remains to be investigated. At the supposed point of crossing, however, the opposite banks of the Morača are quite a way off today, steep and lacking any possible means of descent towards the waterway. The characteristics of the area does not seem favourable for the construction of a bridge or for any other easy means of crossing the river (wooden, disassembled bridge).

This puzzling problem, together with the fact that neither on the aerial photo of 1942 nor in the most recent satellite images, can any signs of centuriation or other type of land exploitation be recognised in Doclea's territory, will require analysis in future research.

On the western side, the condition of the terrain presents a very different situation: exactly in front of the supposed monumental entrance of the town, a rise of only few meters in the land occupies the space that could be the continuation of the *decumanus* outside the city wall (Fig. 7). On this low hill or maybe embankment (?) occupied today by professional vineyards, three Late Antiquity necropoleis were found. Here the *decumanus* is not detectable, but going north-west, along the Zeta valley, is the straight line, albeit on a different orientation, that we recognized from the World War II aerial image: this could be the trace of an ancient Roman road. As a matter of fact, the important arterial road connecting ancient Naronā to the Skadar Lake, through Nikšić, passes somewhere nearby. It is not certain if that road traversed Doclea or was sited a few kilometres south [4]. In any case, the visitors coming to Doclea from the north were obliged either to pass through the necropoleis area or to follow the actual road running along the low hill: in both cases, it is possible to suppose it was something of a surprise when suddenly there appeared the main gate of the town, quite invisible from further off.

IV. CONCLUSIONS

The city of Doclea, little known for its urban and territorial organization, is particularly suitable to be studied through integrated techniques of remote sensing, geophysics, archaeological and topographic survey.

The integrated analysis of remote multiscale data has increased the information available on the urban organization of the Roman city and its surrounding territory. Of particular importance was the identification of an ancient Roman road representing the continuation of the *decumanus maximus* into its south-eastern territory. Its identification, and especially that part outside the circuit of the walls, has demonstrated the existence of urban and territorial planning at the time of the city's foundation (Fig. 7).

In the next years, the study of this ancient planning and its tangible signs in the territory throughout the historical development of the settlement will be the first goal of our Italian-Montenegrin research group.

The Doclea project has become both an exemplary model of work and interaction between researchers drawn from different scientific fields and a methodological illustration of conducting study with innovative tools. The result is data management for the purpose of the protection and enhancement of cultural, territorial and environmental heritages.

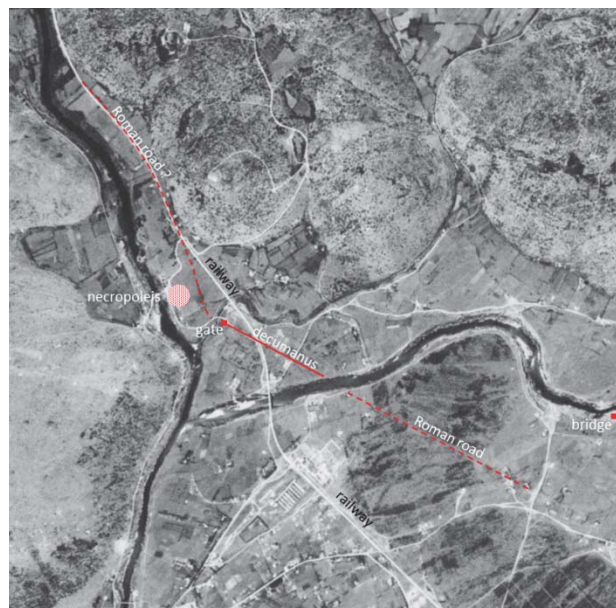


Fig. 7 The 1967 Corona image with ancient and modern information about the urban and territorial organization of the area.

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