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Cuprins

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Epigraphy and the use of ArcGIS to analyse inscriptions. A case study

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Abstract: The author presents the advantages of using ArcGIS for mapping the inscriptions. We selected, as a case study, the province of Moesia Superior. By applying GIS algorithms to epigraphic datasets, we can create various maps and make analysis that allows us to discuss distribution of inscriptions from many angles. Such an experience provided us with the possibility of a better visualization of inscriptions in a geographic context and allowed us to draw important conclusions.
Keywords: epigraphic databases, visualization, mapping, ArcGIS, Moesia Superior.

Epigrafia și utilizarea ArcGIS pentru analiza inscripțiilor. Studiu de caz. Autoarea prezintă avantajele utilizării aplicației ArcGIS pentru cartografierea inscripțiilor. Drept studiu de caz a fost selectată provincia Moesia Superior. Prin aplicarea algoritmilor GIS pe seturile de date epigrafice putem crea diverse hărți și face analize care ne permit să discutăm distribuția inscripțiilor din mai multe unghiuri. O astfel de abordare ne-a oferit posibilitatea unei mai bune vizualizări a inscripțiilor într-un context geografic și ne-a permis să tragem concluzii importante.
Cuvinte cheie: baze de date epigrafice, vizualizare, cartografiere, ArcGIS, Moesia Superior.

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Inscriptions are highly interesting and important material for studying ancient history. The analysis of inscriptions involves the examination of details related to "places": from data about archaeological discovery, the original location, the place of preservation, to any geographical or topographical references contained in the epigraphic text or related to its historical context. This article aims to provide a well-argued overview of the major practices and issues related to the Epigraphy and Geography/Topography in the digital environment, by examining a selection of spatial analysis provided by the ArcGIS software and particularly illustrative in this context. To support this thesis, I will present a geospatial contextualization

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of inscriptions discovered in Moesia Superior using distribution maps and spatial analysis.

Existing *corpora* of inscriptions in the bibliography, such as the 5 volumes of inscriptions dedicated to the Moesia Superior province (*IMS* I, II, III/2, IV and VI) are devoid of precise maps and geographical references. The exhaustive studies of A. Mócsy, dedicated to the Romanization of the province of Moesia Superior (Mócsy 1970; 2014) contain schematic maps, of which we mentioned: Figure 24 – Mines and *municipia* in Upper Moesia (Mócsy 2014, p. 132), Figures 1 and 2 – Borders of the province (Mócsy 1970, p. 10, 12), Figures 11 and 12 – Urban areas (Mócsy 1970, p. 34, 37), Figures 19, 23, 30 (Mócsy 1970, p. 63, 76, 94), which indicate the distribution of inscriptions in the territory of Scupi, Ulpianum and Naissus. However, these maps are handmade, and the points presented are not georeferenced, therefore the information presented is strictly indicative, and their usefulness is partial.

Using GIS technology, the original spatial and physical contexts of provenance of inscriptions can be better understood, thus allowing their analysis as a comprehensive whole (Elliott, Gilles 2009, p. 19-22). Inscriptions can be seen as monuments and as archaeological objects, or, on the contrary, as documentary, textual and historical sources, but what is unquestionable is that nowadays epigraphists are much more engaged with "places" – Geography and Topography. Displaying the inscriptions on a map allows a better visualization of epigraphic dataset and geographical distribution throughout the province, giving inscriptions a concrete spatial dimension.

Our first map will show the spatial distribution of inscriptions within the province of Moesia Superior (**Pl. I/1**). The data are categorized, and contain the following attribute fields: country, ancient find spot, modern find spot, chronological data, literature, type of monument, type of inscription, and material. The database used for the first map was downloaded in the CSV format from the Epigraphic Database Heidelberg[2] (see more information in Heřmánková, Vojtěch, Sobotková 2021). It is important to specify that there are numerous databases accessible online (Babeu 2011, p. 96-116), and their authors encourage scholars to download files and repurpose them to any interesting ends. The information can be displayed as a table and can be sorted alphabetically or quantitatively.

The main difference between an interactive map created in GIS and a traditional, static map is the idea of layers (Gregory, Ell 2007, p. 36-39). Multiple layers visible simultaneously can also facilitate a wide-ranging investigation of specific queries, *e.g.* individual mobility between communities, land routes, colonization

[2] https://edh.ub.uni-heidelberg.de/ (accessed on 07.06.2023).

or ethnicity linkages, distance from a specific centre, habitat typology etc. (Elliot 2019). Our example shows the geographical distribution of veteran's inscriptions in the province of Moesia Superior (**Pl. I/2**). By applying additional layers (ancient routes, towns, *vici*, and mining resources) we can determine the characteristics of the geographical distribution of inscriptions (**Pl. II/1-2**). Thus, the preferred areas where veterans are settled were the urban centres of the province, the areas with economic potential, but also the localities near the main provincial roads (Honcu, Varga 2023, p. 19).

We should think of GIS as much more than a tool for map-making. A final map is not the entire goal. Most of the features provided by GIS systems and most of the time spent working with them involves geospatial information management and spatial analysis directly on maps. GIS is used to test hypotheses and answer questions (Gregory, Ell 2007, p. 161-163). Spatial analysis functions interpolate together textual information and geographic data: *e.g.* overlay two different items like inscriptions and its context. The system allows us to create different database queries from spatial criteria (proximity, inclusion, buffer zone etc.). These statistics processes can be useful to improve both epigraphic and archaeological research. In the following, we will present two analyses applied to the distribution map of the veterans' settlements. Plate III shows the result obtained after applying the "buffer zone" analysis to the geographical distribution of veterans map (**Pl. III**). A buffer is an area that covers a certain distance from a spatial object point, line or surface. Buffer zones created give us a geographical distance between the veteran settlements, in our case, and residential communities or other attractions (**Pl. IV-VI**). The result shows a thematic layer with areas at a distance of 10, 20, 50 km around the veterans' settlements. For example, at a distance of 10 km from Ulpiana is the settlement of Donje Gusterica and at a distance of 30 km is the ancient settlement of Donje Stanovce. An important roman road crossed the Municipium Dardanorum, descending towards Ulpiana. The second analysis created a density map to the geographical distribution of inscriptions of veterans (**Pl. VII**). By calculating density, we distribute the values over an area. The higher value is at the point location and decreases with increasing distance from the point, reaching zero at the neighbourhood boundary. The Clustering tool works by detecting areas where points are concentrated and where they are separated by areas that are empty or sparse. The analysis answers questions such as 'where are the points centred?', 'how dispersed is the pattern?', or 'are the points clustered, evenly distributed, or random?' Optionally, the time of the points can be used to find groups of points that cluster together in space and time. Plate VIII shows the degree of clustering for veteran settlements (**Pl. VIII**).

Another advantage of GIS is the creation of spatial datasets for use by others. These datasets can be used by others because they are distributed free of charge under open license.

Briefly, what can GIS offer for the management of epigraphic studies? The creation of the geodatabase will allow textual information to be converted to vectors and to be displayed in raster maps (Gregory, Ell 2007, p. 27-30). It also provides more precise information about inscriptions and their context; quick comparisons between different types of epigraphic data and the possibility of merging of geographical, historical, and epigraphic information. By using spatial analysis, we can establish a scientific predictive model with a great accuracy.

Applying GIS technology to the analysis of the distribution of inscriptions in Moesia Superior province, we can draw the following conclusions. The aggregation coefficient of inscriptions in the surveyed area can be easily observed using interactive map: the largest amount of inscriptions was in the north and south of the province, in cities such as Viminacium and Scupi. The values of the degree of concentration of the sites highlight some large groups of concentrated settlements (**Pl. VII-VIII**). There are "polarizing" and dominant centres, constituted by settlements with a larger number of veterans/inscriptions located in *colonia* or *municipia* (Viminacium, Scupi), around which hang sites with a small number of veterans (Margum, Vinceia, Cuppae, Bardovci, Zlokukani, etc.). Areas of abandonment can be identified– roughly the centre-east of the province, and the zones of stability throughout the three centuries studied.

Acknowledgements. This work was supported by a postdoctoral fellowship of The Research Institute of the University of Bucharest, Romania.

Abbreviations

IMS I – Mirković, Miroslava, Slobodan Dušanić. Inscriptions de la Mésie Supérieure. Vol. 1. Singidunum et le nord-ouest de la province. Belgrade 1976.

IMS II – Miković, Miroslava. Inscriptions de la Mésie Supérieure. Vol. 2. Viminacium et Margum. Belgrade 1986.

IMS III/2 – Petrović, Petar. Inscriptions de la Mésie Supérieure. Vol. 3,2. Timacum Minus et la vallée du Timok. Belgrade 1995.

IMS IV – Petrović, Petar. Inscriptions de la Mésie Supérieure. Vol. 4. Naissus – Remesiana – Horreum Margi. Belgrade 1979.

IMS VI – Dragojević-Josifovska, Borka. Inscriptions de la Mésie Supérieure. Vol. 6. Scupi et la région de Kumanovo. Belgrade 1982.

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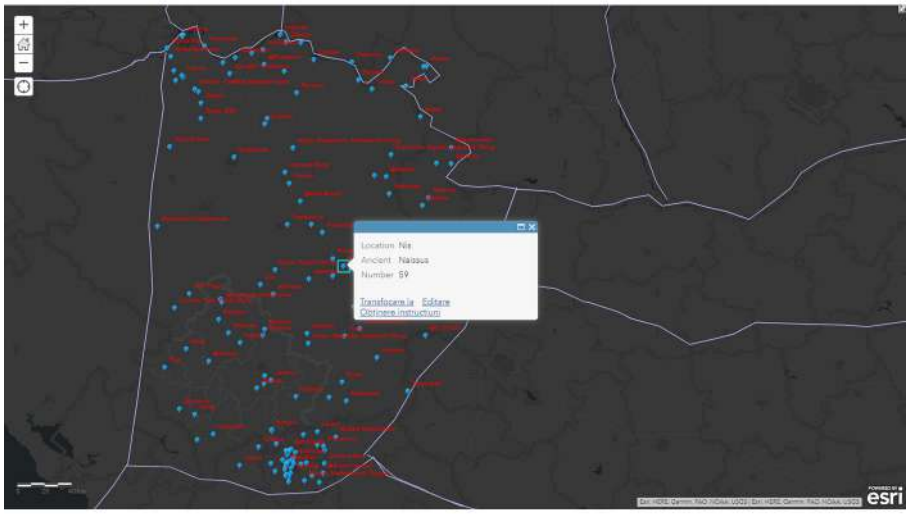
Mócsy 1970: A. Mócsy, *Gesellschaft und Romanisation in der römischen Provinz Moesia Superior*, Budapest, 1970.

Mócsy 2014: A. Mócsy, *Pannonia and Upper Moesia*, NewYork, 2014.



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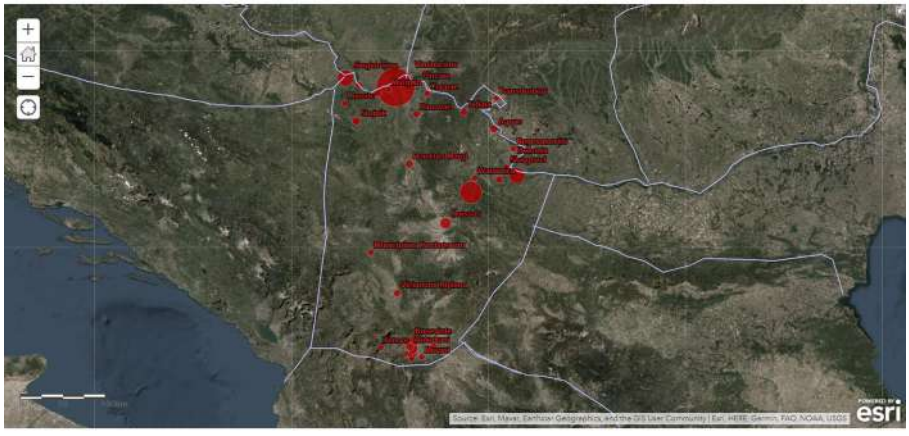
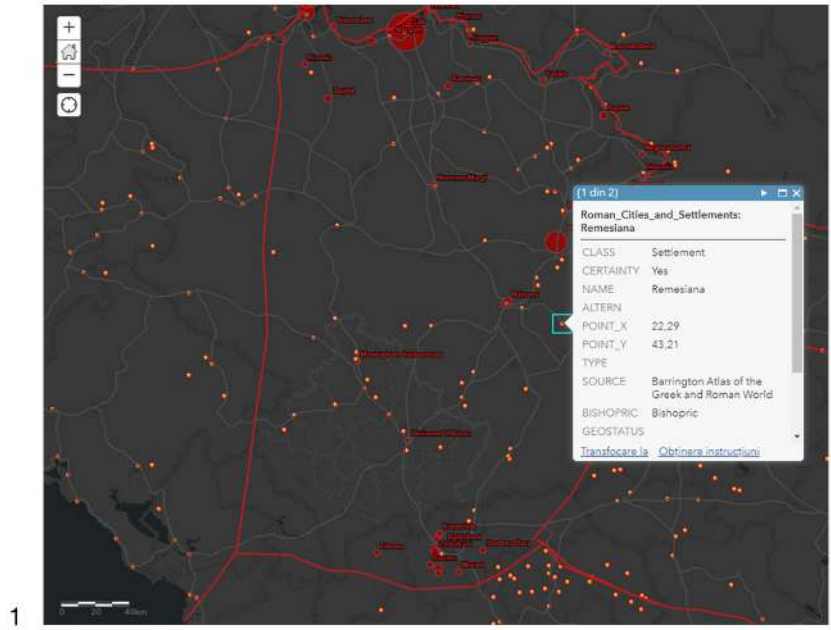


2

Pl. I. 1. Geographical distribution of inscriptions in Moesia Superior;
2. Geographical distribution of veterans' settlements.
Pl. I. 1. Distribuția geografică a inscripțiilor în Moesia Superior;
2. Distribuția geografică a așezărilor veteranilor.



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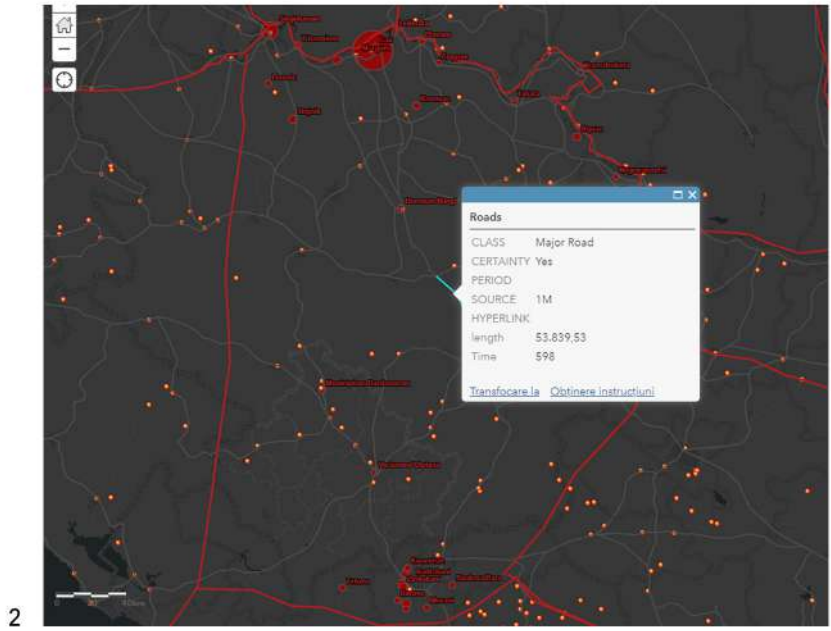
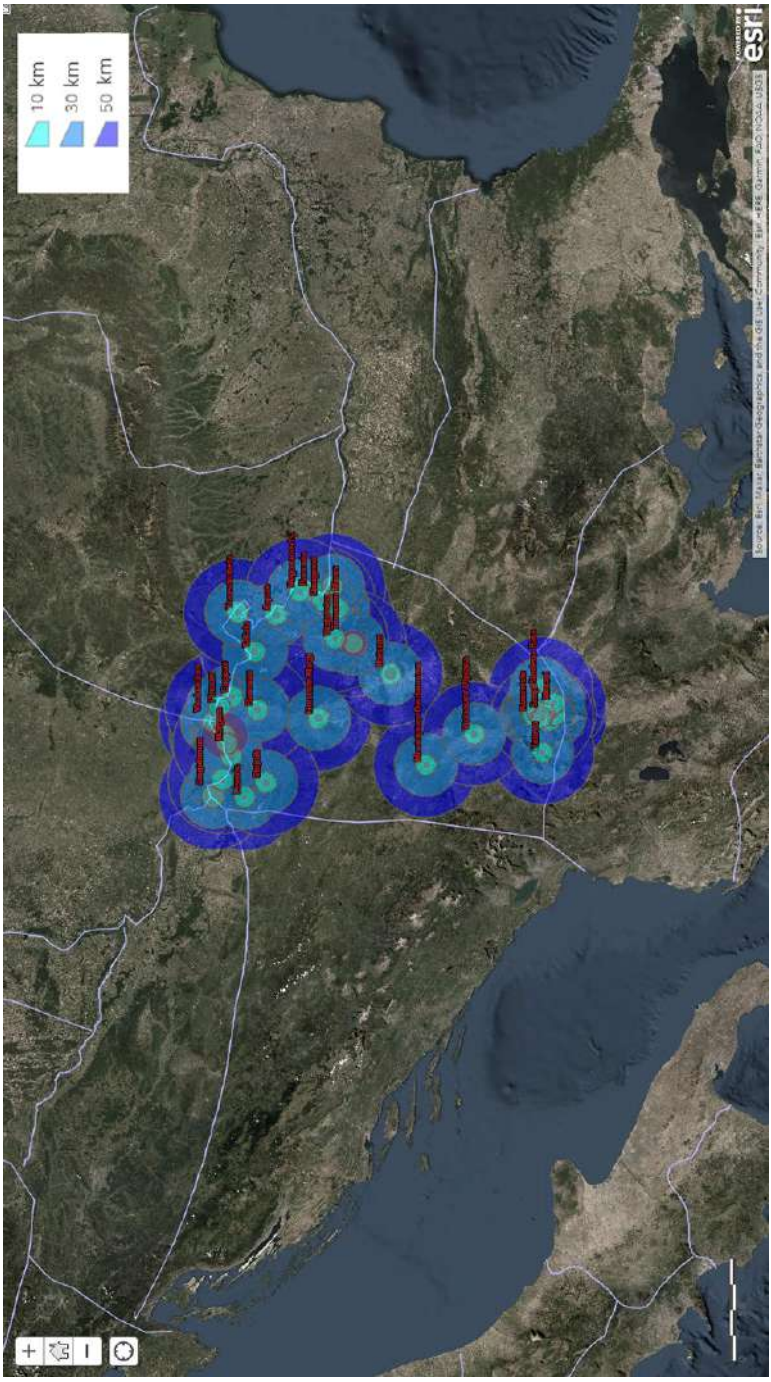
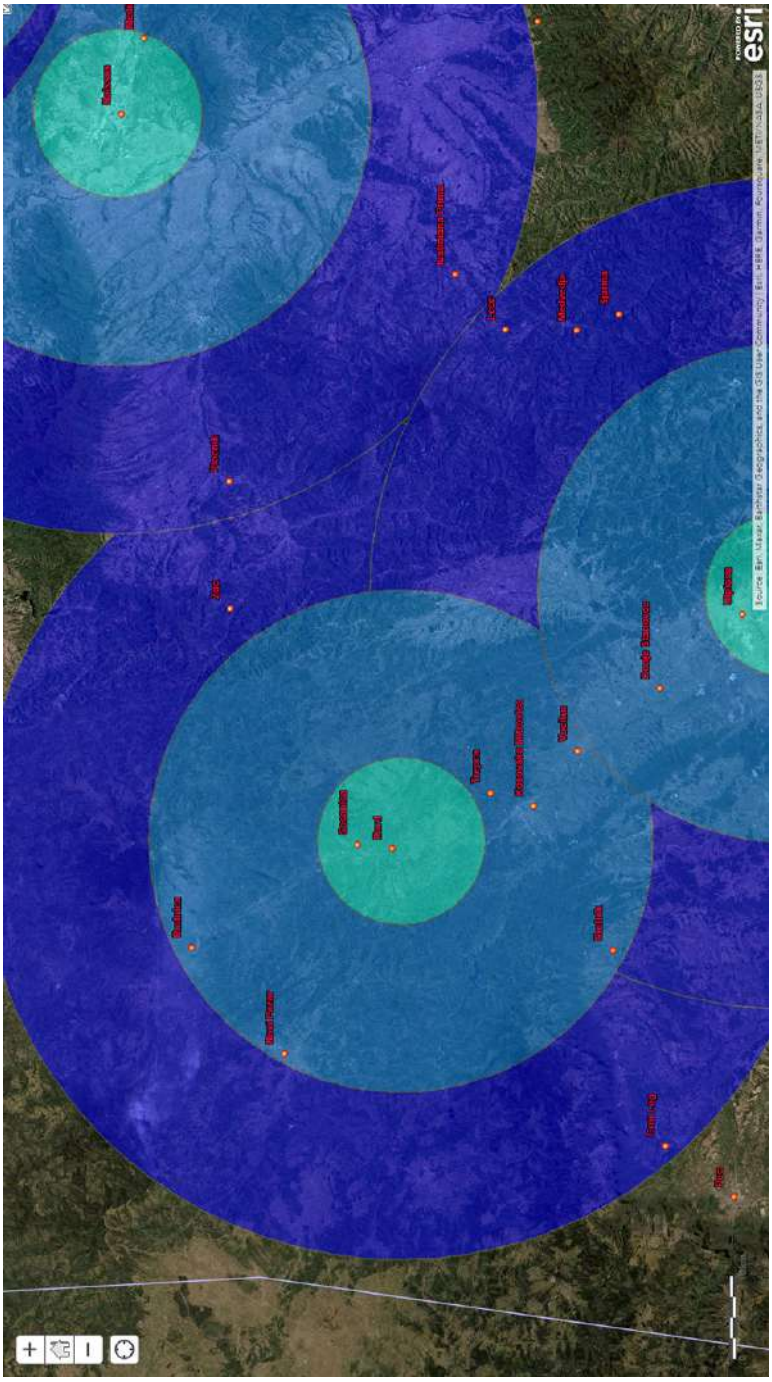


2

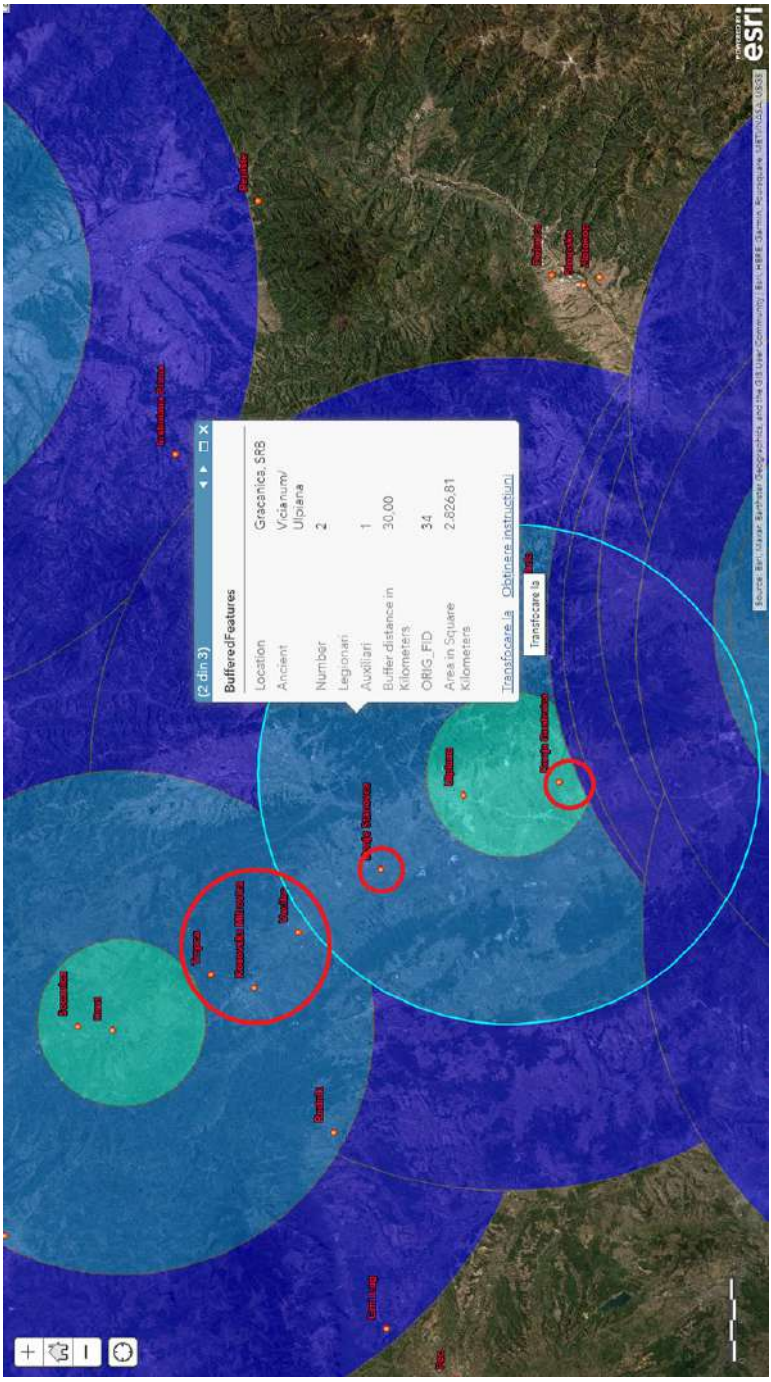
Pl. II. 1. Layer with ancient cities applied to the distribution map of the veterans' settlements; 2. Layer with roman roads applied to the distribution map of the veterans' settlements.
Pl. II. 1. Strat cu orașe antice aplicat hărții de distribuție a așezărilor veteranilor; 2. Strat cu drumuri romane aplicat hărții de distribuție a așezărilor veteranilor.



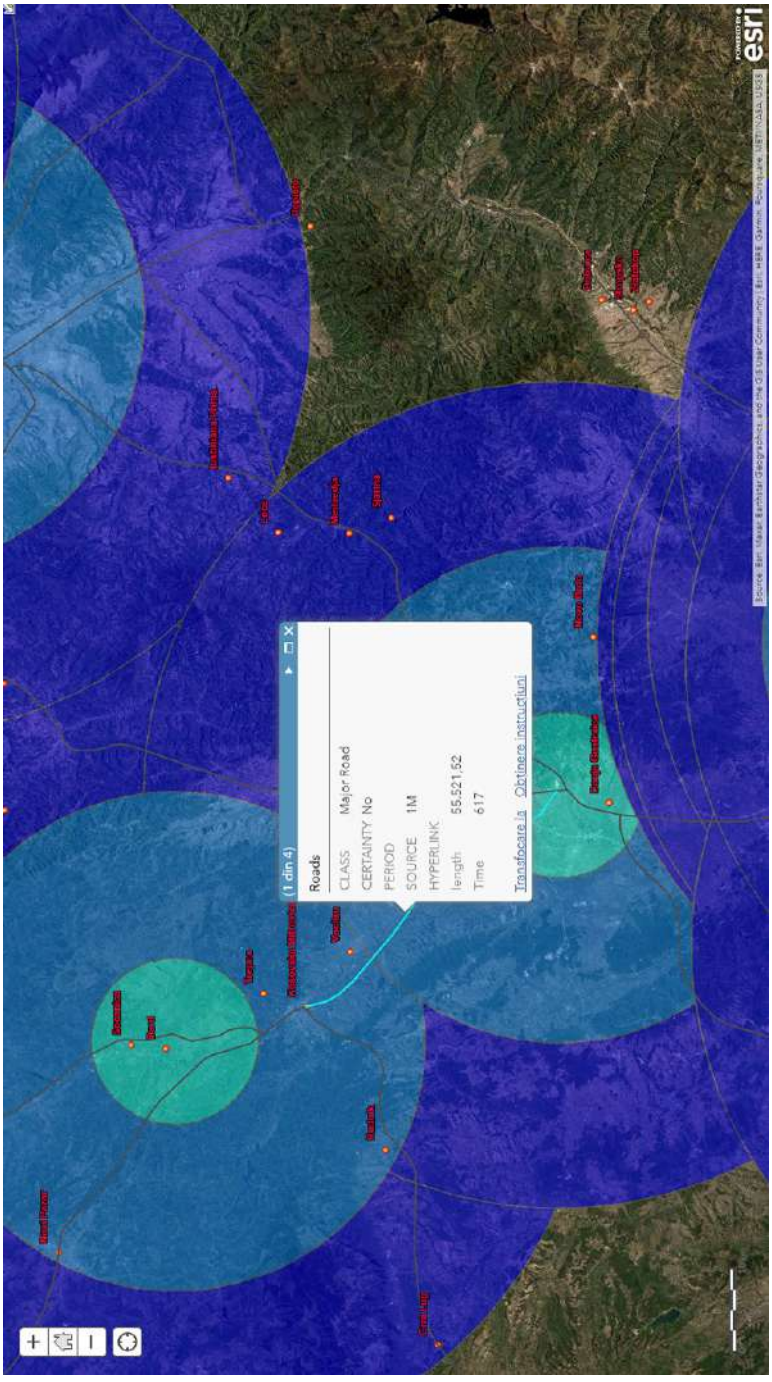
Pl. III. Buffer analysis.
Pl. III. Analiza "Zone tampon".



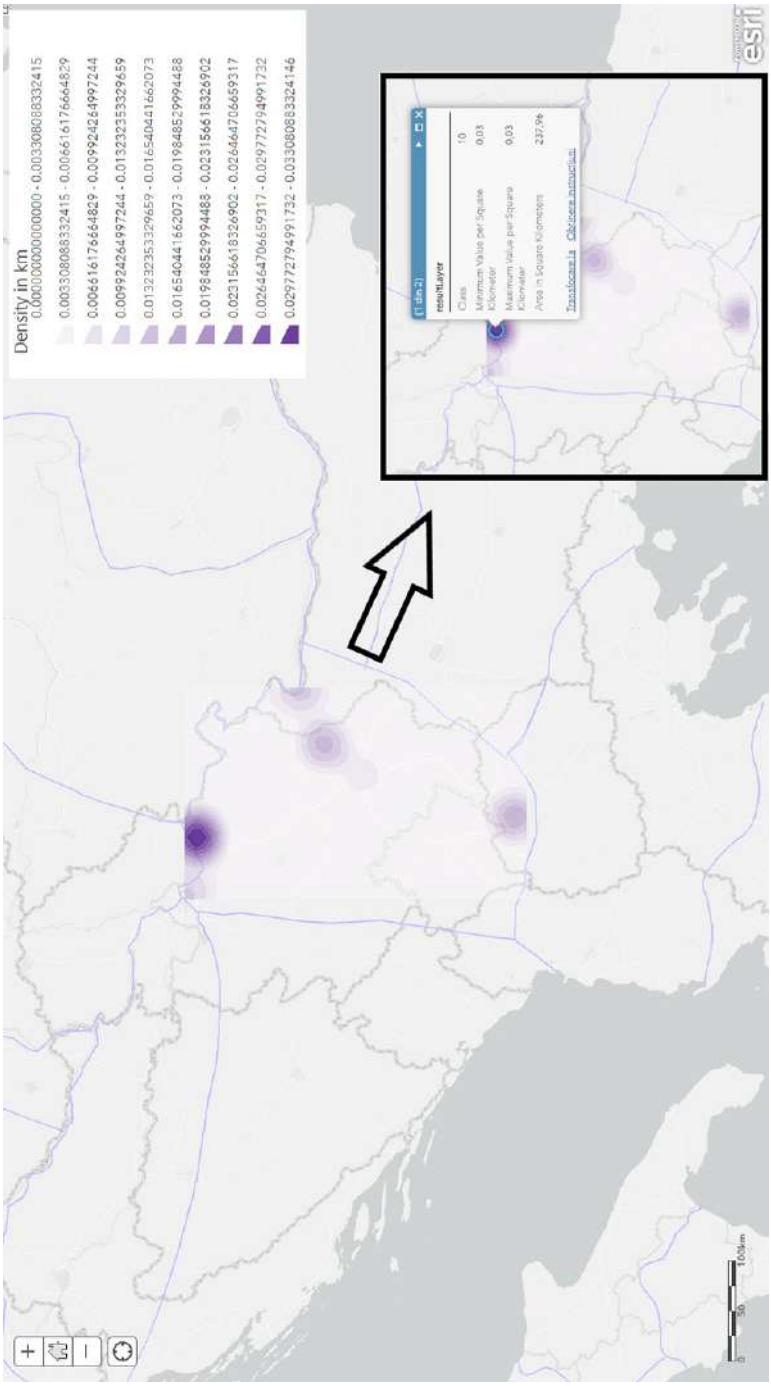
Pl. IV. Detail with buffer analysis.
Pl. IV. Detaliu cu analiza "Zone tampon".



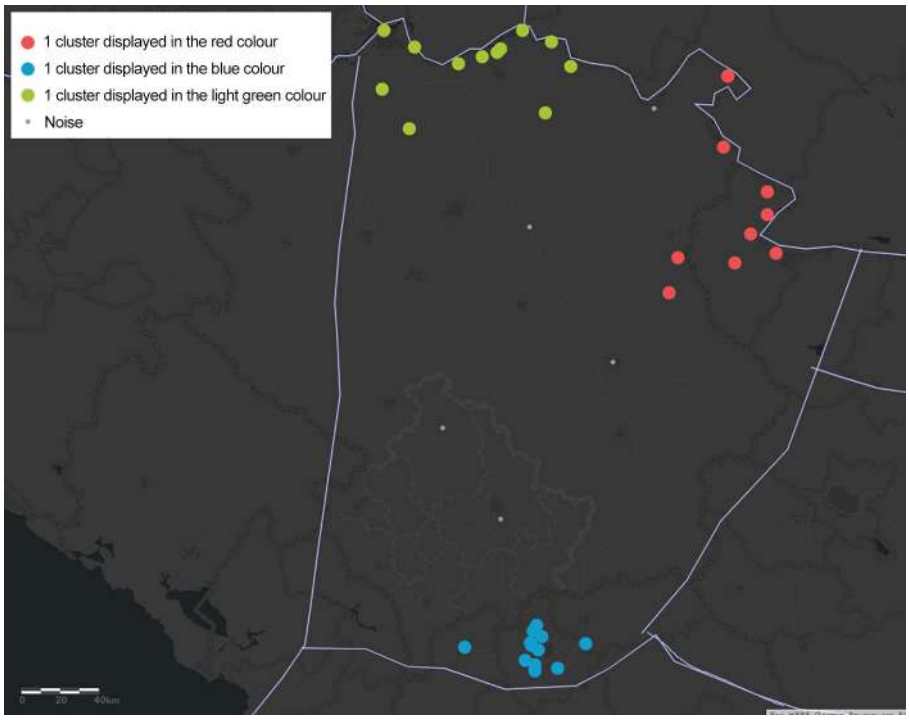
Pl. V. Ancient settlements located in a buffer (at distances of 10, 30 and 50 km).
Pl. V. Așezări antice situate într-o zonă tampon (la distanțe de 10, 30 și 50 km).



Pl. VI. Facilities (Major Road) located in a buffer.
Pl. VI. Facilități (drum principal) localizate într-o zonă tampon.



Pl. VII. Density analysis of veterans' inscriptions.
Pl. VII. Analiza densităţii inscripţiilor veteranilor.



Pl. VIII. Cluster analysis.
Pl. VIII. Analiza de tip *cluster*.