GIS OF OLD SOFIA – URBAN DEVELOPMENT AND ITS CULTURAL HERITAGE

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ABSTRACT *- up to 200 words /Times New Roman, 10, Italic/*

Historical GIS is a relatively new interdisciplinary field, which has been developing rapidly over the last 10 years. The main functional capabilities of GIS technologies which contributes to historical research are mapping; spatial analysis; building geodatabases, integrating, storing and managing various spatial and temporal information; visualization, etc. The purpose of the present work is to develop Historical GIS for the capital of Bulgaria - city of Sofia using GIS technologies, remote sensing and ground-based data. As a result of the study a geodatabase for conservation the cultural heritage and Historical GIS of the city for a period of a hundred years will be created. The historical GIS of Sofia is an innovative research for Bulgaria allowing the development of the urban environment to be analyzed. This research will popularize remote sensing and GIS technology as a tool for preservation and conservation of the cultural heritage in highly urbanized areas in Bulgaria.

Keywords: *Historical GIS, conservation, cultural heritage, urban areas*

INTRODUCTION

Historical GIS is a relatively new interdisciplinary field, which has been developing rapidly over the last 10 years [1], [2], [3]. Some of the key abilities of GIS which are often using in historical research are mapping and spatial analysis of the historical maps [4], [5]. Gregory *et al.* [6] identify three advantages of using GIS in historical research – storing spatial data, data visualization using maps or animations and virtual landscapes, and various forms of spatial analysis. The contribution of the GIS technologies to historical research has been examined by Ian Gregory through identifying and analyzing three aspects: the creation and dissemination of historical GIS databases, quantitative and qualitative analyses, and the underlying conceptual issues that underpin GIS in the existing literature [5]. Most of the studies are focused on the development of national historical GISs, including large amounts of information regarding the administrative boundaries' changes linked to large statistical databases that hold census data and other statistical information. These GISs usually contain data from the early nineteenth century (when regular statistical data collection has been started in many countries) to the present. Examples of such national historical GIS are the National Historical Geographic Information System (NHGIS) of USA [7], Great Britain Historical GIS (GBHGIS) [8] which holds census, vital registration and Poor Law data, labour market statistics, mortality statistics and information about the changing boundaries of the major administrative unit; the China Historical GIS [9], [10], which covers 2000 years of Chinese history. Other countries that have built national historical GIS systems include the United States, Belgium, Russia, South Korea, Nederland, etc. are summarized in the works of Gregory [11] and Knowles [3].

Besides national historical GIS, urban development is another field in which the application of geoinformation technologies and the development of historical GIS are significant. Such historical information systems have been developed for Tokyo, Sydney, London [5]. Each of them has a slightly different emphasis. The Tokyo GIS aims to be a comprehensive GIS of the major features of Tokyo from the nineteenth century to the present. It includes data on the physical landscape, administrative boundaries, data from population and economic censuses, information on commercial and industrial activities, information on the growth of the road and rail networks, and information on land ownership. The Sydney GIS is more focused on museum artifacts and locating these in space by complementing them with a variety of series of maps of the development of the city from the very early days of European settlement to the

present. The London GIS is more specifically based on the Charles Booth's maps of poverty in London in the late nineteenth century.

PURPOSE

The purpose of the present work is to develop Historical GIS for the capital of Bulgaria - city of Sofia using GIS technologies, remote sensing and ground-based data. The satellite images together with old maps are used for analysis of the changes and trends in the urban development. As a main output an integrated geodatabase for historical GIS and conservation of the cultural heritage of Sofia city for a period of a hundred years will be created.

STUDY AREA

District Sofia-city is located in the Sofia hollow at the foot of Vitosha Mountain, Southwest Bulgaria (Fig. 1). It includes only the Metropolitan (Sofia) Municipality (Fig. 2). The Sofia Municipality is an administrative territorial unit, which has also the status of a district [12].

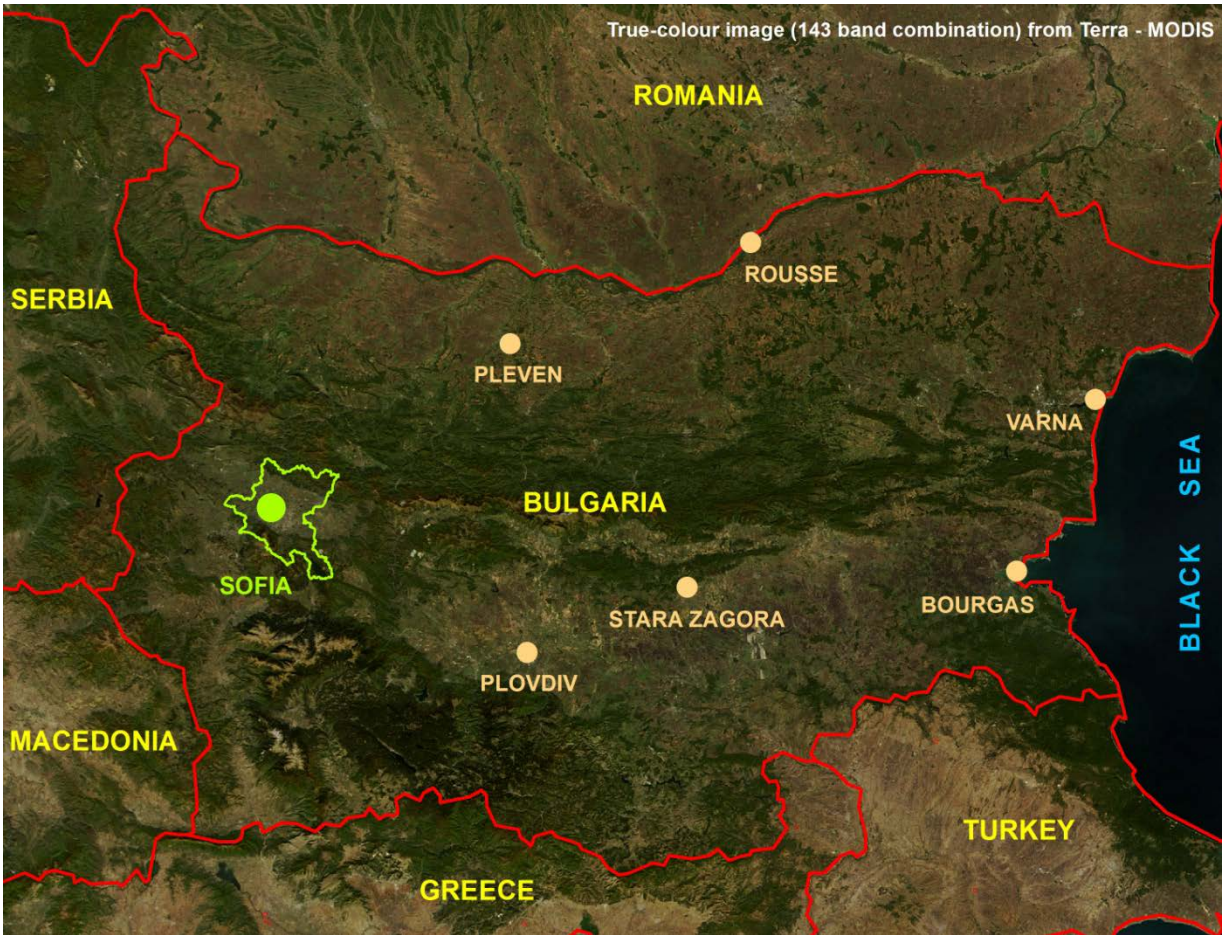

Fig. 1. *Location of the study area*

According to the physical-geographical position city of Sofia is located at the Sofia Hollow, surrounded by mountains (Vitosha, Plana and Lozen, Lyulin, Stara planina mountains). The favorable transport-geographic location of Sofia city has played a significant role in its historical development. Another major factor for its emergence as a settlement, which has been known for thousands of years, is the abundance of mineral waters in the Sofia hollow. District Sofia-city (Metropolitan Municipality) includes 38 settlements - 1 city (Sofia), 3 towns (Bankya, Novi Iskar and Buhovo) and 34 villages and covers an area of 1 349 sq.km [13], [14]. The territory of the compact modern city of Sofia covers approximately 250 sq. km (Fig. 2).

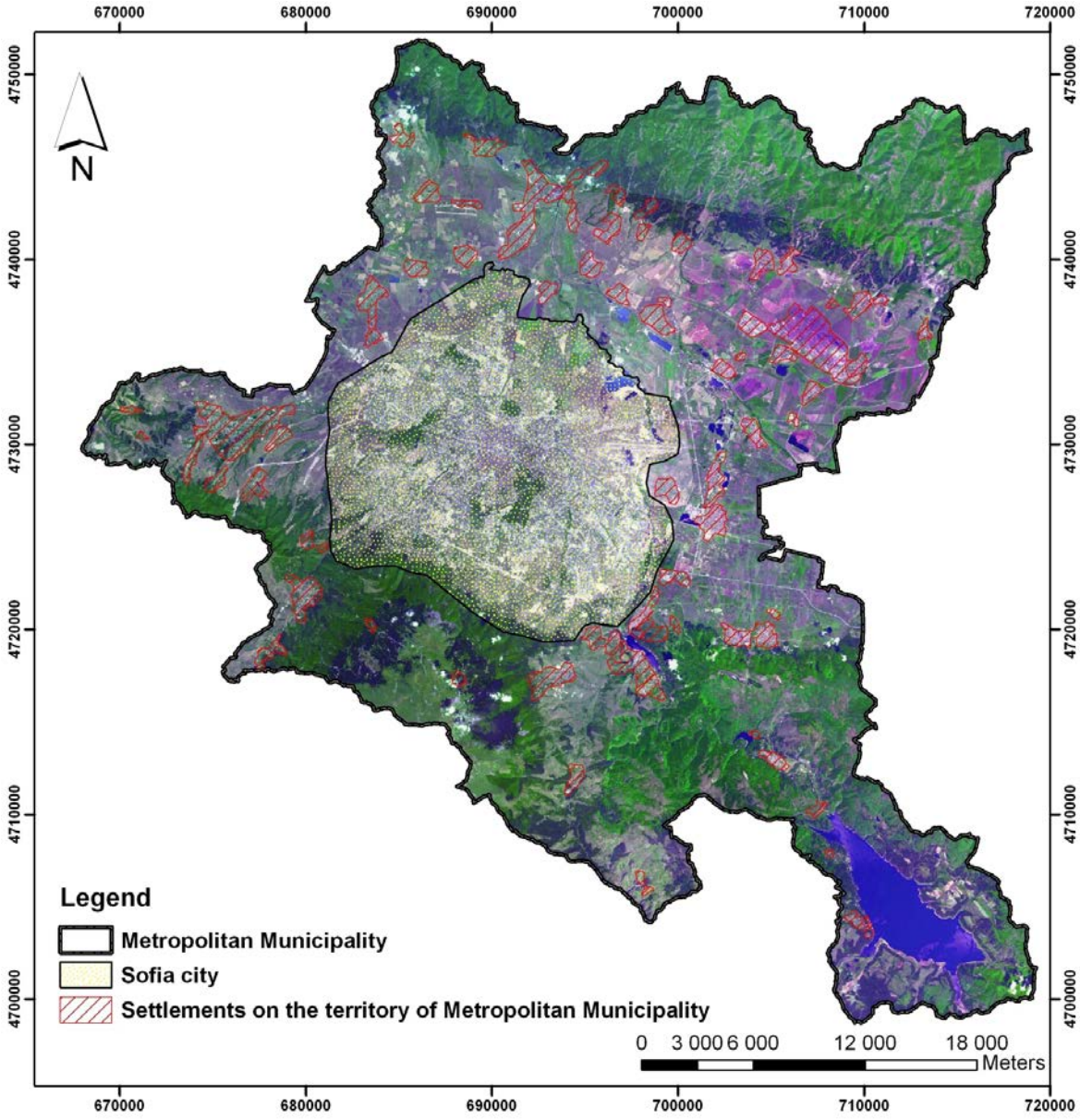

Fig.2. *Metropolitan municipality*

USED METHODS AND DATA

As a result of the study a geodatabase for conservation the cultural heritage and Historical GIS of the city for a period of a hundred years will be created. The required data include panchromatic and multispectral high spatial resolution satellite images, large-scale topographic maps, data from terrain studies and GPS measurements, photos of tourist sites, and the dynamics of urban development will be supplemented with geomorphologic and land use information for different periods of time. All obtained information will allow to asses recreational potential of the capital - the green areas and the concentration of tourist sites. The preliminarily results are based on an archive SPOT satellite image granted by Spot Planet Action Program and old plans and maps.

The working stages of the present study can be assembled into two groups – collection of the input information and data processing and analysis (Fig. 3). The used archive maps were scanned and then geo-referenced to allow their analysis through GIS. The maps were rectified to the UTM coordinate system, zone 34N, datum WGS84 using control points at the crossings correlated with the same crossings from the high resolution satellite images.

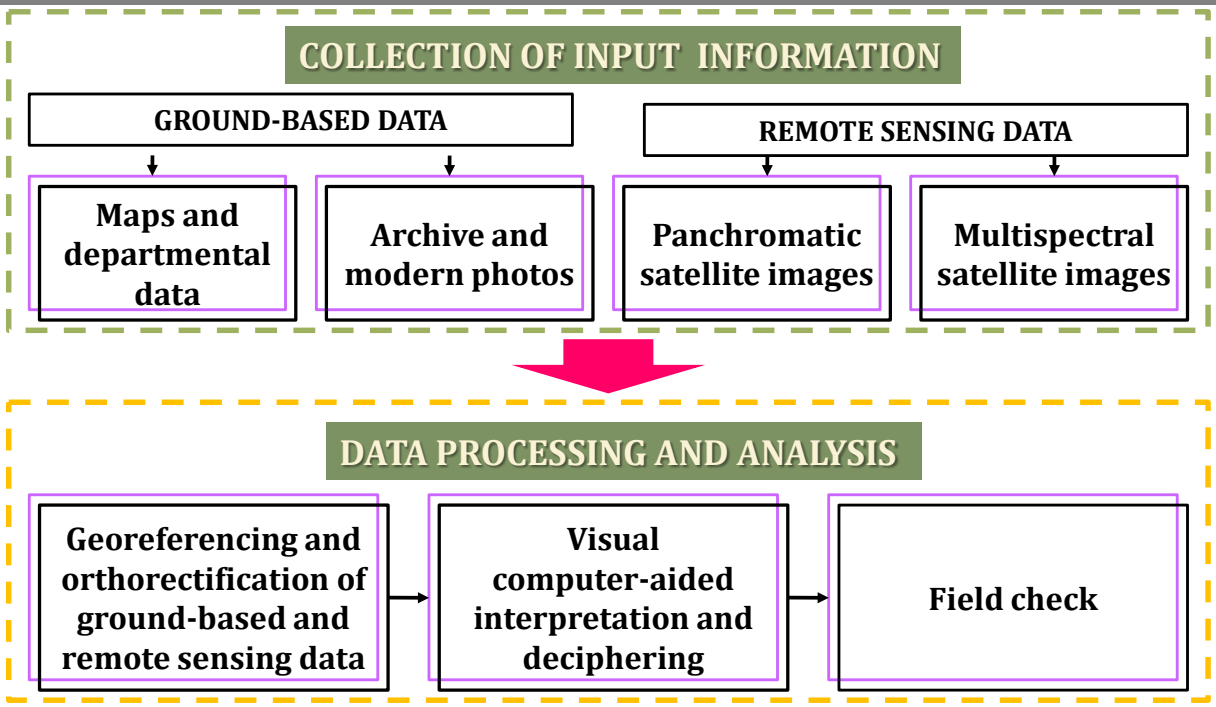

Fig. 3. *Working stages*

RESULTS

We analyze multiple old and modern maps and plans of Old Sofia, aerial photos and satellite images through GIS technologies and using them as a quantitative source for the study of urban historical development.

Sofia covered 2.49 sq km in 1888, and it reached an area of 6.64 - 8.9 sq km (according to various sources) in 1907. The information regarding the first regulation plan of the city in the literary sources are very discrepant. The first plan of the city was approved in 1879 [15], [16], [17], [18]. New plans of the city were elaborated in 1907 and 1910, including the newly-built and designed regions. This was followed by elaborated of a series of partial regulation plans in the period of 1912-1934 for land reclamation (Fig. 4). It has began a rapidly development of the city after the First and the Second World Wars.

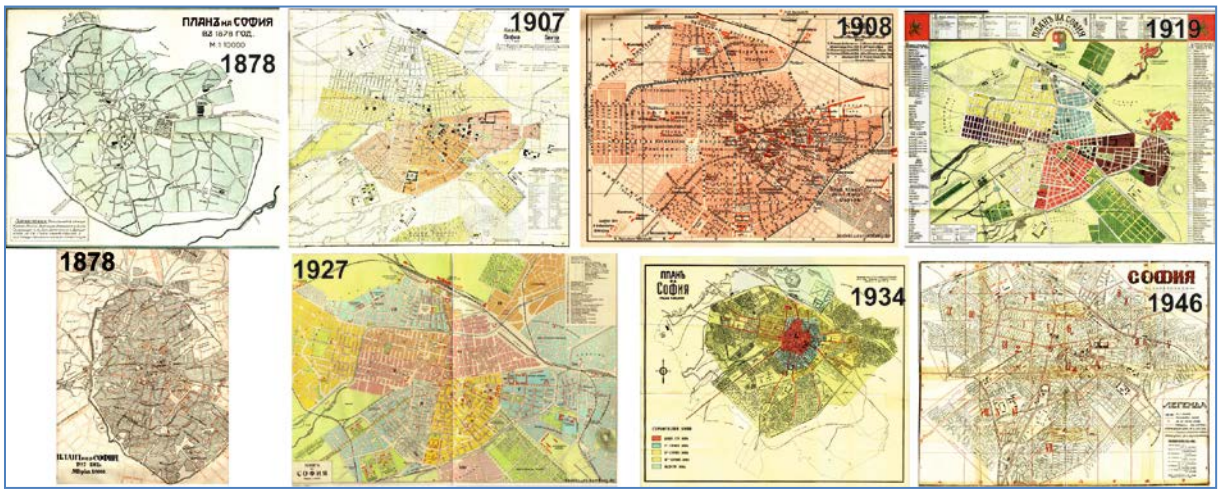

Fig. 4. *Old plans of Sofia city*

In the present study plan of Sofia City designed in 1907 was digitized and compared to urban sprawl detected on satellite image acquired in 2004. The territory of the city in 1907 outlines the boundaries of the modern Central city zone of Sofia. The built-up areas, together with the regions planned for building and the green areas are shown on the old plan of Sofia (Fig. 5).

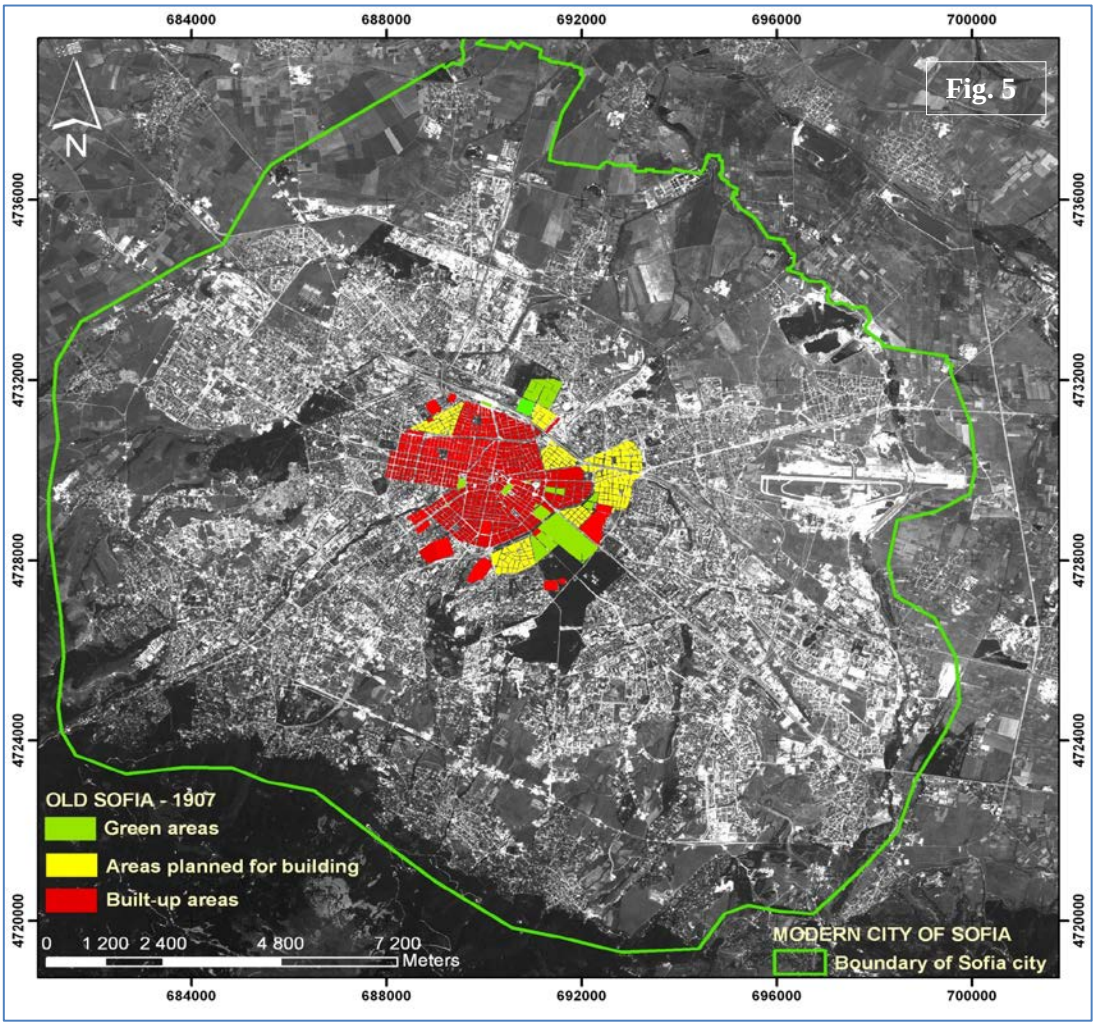
Fig. 5
N
684000
688000
692000
696000
700000
4736000
4732000
4728000
4724000
4720000
OLD SOFIA - 1907
Green areas
Areas planned for building
Built-up areas
0 1 200 2 400 4 800 7 200
Meters
MODERN CITY OF SOFIA
Boundary of Sofia city

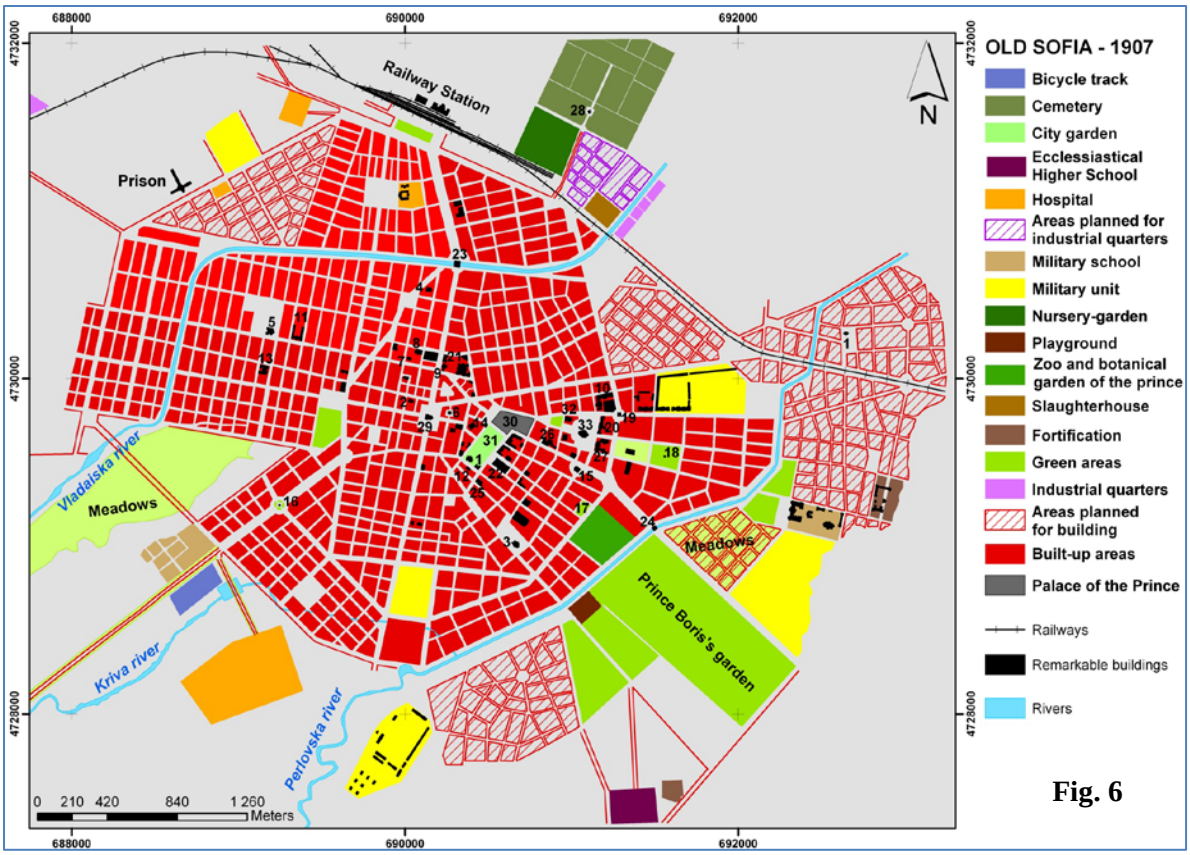
688000
690000
692000
4732000
4730000
4728000
N
Railway Station
Prison
Vladaiska river
Meadows
Kriva river
Perlovska river
Prince Boris's garden
0 210 420 840 1 260
Meters
OLD SOFIA - 1907
Bicycle track
Cemetery
City garden
Ecclessiastical Higher School
Hospital
Areas planned for industrial quarters
Military school
Military unit
Nursery-garden
Playground
Zoo and botanical garden of the prince
Slaughterhouse
Fortification
Green areas
Industrial quarters
Areas planned for building
Built-up areas
Palace of the Prince
Railways
Remarkable buildings
Rivers

Fig. 6

The detailed land use classes according to the plan from 1907 are represented on fig. 6. Most of the cultural heritage sites are located in modern Central city zone of Sofia. The remarkable buildings are numbered and shown in black color in the map of the Old Sofia in 1907 (Fig. 6). The list of the remarkable building is shown on table 1. The street network of the modern central zone of the city has not been changed significantly, which allowed us easily to georeference the old plan of Sofia, elaborated in 1907.

Table 1. Remarkable building of Old Sofia /according to the plan of 1907/.

REMARKABLE BUILDINGS

1. Church St. Petka	12. Girls' school	23. Lions' bridge
2. Church St. Spas	13. Technical school	24. Eagles' bridge
3. Church St. Sedmochislenici	14. National museum	25. Main Post Office
4. Church St. Kiril and Metodious	15. Monument Tzar Liberator	26. Military Club
5. Church St. Nikola	16. Russian Monument	27. Academy of fine arts
6. St. George RotundaChurch	17. Mausoleum Al. Batenberg	28. Cemetery Church
7. Romanska Church	18. Doctoral Monument	29. Church St. Nedelya
8. Synagogue	19. Monument Vasil Levski	30. Royal Palace
9. Mosque Banya Bashi	20. State Printing-Press	31. City Garden
10. First male school	21. Public Mineral baths	32. Hagia Sophia Church
11. Second male school	22. National teathre	33. St. Al. Nevsky Cathedral

ARCHIVE AND MODERN PHOTOGRAPHS OF SOME CULTURAL SITES AND FAMOUS PLACES IN SOFIA

During the last 100 years the shape and appearance of the central zone of the city has been changed – some cultural sites and old buildings has been destroyed, the architectural style has been changed. Some old buildings with specific architectural or cultural meaning have been announced as monuments of the cultural heritage. The changes can be tracked by analyzing the urban development of Sofia city and comparing archive and modern photographs of famous places and cultural monuments.

Sofia Public Mineral Baths

It is a cultural heritage monument with national importance located in the centre of Sofia, a city known for the mineral springs in the area. It was built in the early 20th century near the former Turkish bath and was used as the city's public baths until 1986. Nowadays it is partially reconstructed and thoroughly cleaned and it is planned to accommodate the Museum of Sofia and a healing centre.

Central Railway Station

It is the largest railway station of the country, which was built in 1888. Later, in 1974, the old building was completely demolished and a new railway station was opened.

The Monument to the Tsar Liberator

It is an impressive equestrian monument in the centre of Sofia, which was erected in honour of Russian Emperor Alexander II who liberated Bulgaria of Ottomans during the Russo-Turkish War of 1877-78.

"St. George" Rotunda Church

"St. George" Rotunda Church, an Early Christian red brick rotunda, is the oldest architectural monument in Sofia which dated as far back as the Roman Empire. It was built by the Romans in the 4th century CE. Its construction coincides with a moment of a remarkable flourishing of Serdika as one of the largest and most considerable Roman towns on the Balkan Peninsula.

CONCLUSION

The historical GIS of Sofia is an innovative research for Bulgaria allowing the development of the urban environment to be analyzed. This research will popularize remote sensing and GIS technology as a tool for preservation and conservation of the cultural heritage in highly urbanized areas in Bulgaria. The final results and the created geodatabase will be used for further analyses and research in the field of application of the remote sensing data for conservation in urban areas.

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