

RECORDING AND ANALYSIS SYSTEM OF TERRITORIAL CHANGES OF THESSALONIKI'S REFUGEE SETTLEMENTS WITH THE USE OF CARTOGRAPHIC AND PHOTOGRAMMETRIC PRODUCTS

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ABSTRACT:

The analysis of urbanisation process, urban operations, forms and factors, development of network of cities and new settlements that were created in the beginning of 20th century in Thessaloniki, was the starting point for this documentation study. The application, on the one hand, of tools and methods, provided by Photogrammetry and Cartography, and also such techniques as Geographic Information Systems, and the existence and the accessibility, on the other hand, in historical data as maps, aerial photos, topographic diagrams, statistical data, contributed decisively in the diachronic study and examination of geographic space determined by Thessaloniki's refugee settlements. The analysis, the comparison, the superimposition and the composition of these data represented the basis of this documentation study that focused mainly on the following main axes:

Diachronic follow-up of territorial changes using historical charts, diagrams and photomaps that describe the area of interest.

Processing and integration of all cartographic and photogrammetric products in a completed recording and management system. Integration in this Geographic Information System (G.I.S.) of a Data Base providing information regarding the settlements such as the locomotion of refugees, countries and cities of origin etc.

Use of the recording system for the study of all parameters that influenced the organisation and the structure of refugee settlements (choice criteria and arrangement of settlements, general character of urban tissue, urban development, human activities) and also for the geographic and land-planning typology and classification of settlements (listing of differences and resemblances, explanatory comparisons of data and analysis of settlements).

1. INTRODUCTION

1.1 Study area

The obligatory exchange of populations and the installation of refugees in the beginning of 20th century in Thessaloniki changed the structure of urban space, while new settlements of refugees were arranged out of the old urban tissue and imposed new territorial and social variations. Thessaloniki was the main pole of attraction, after the compulsory exchange of minority population between Greece and Turkey, for the urban refugees that dramatically increased the population and put new pressures on the physical size of the city. The impact of the refugee settlement on the structure and life of the city was immense. The analysis of urbanisation process, urban operations, forms and factors, development of network of cities and new settlements that were created, constitutes an important field of research and study.

By 1922 some of the first refugees arrived in Thessaloniki and have been settled through years on a community basis, with the new communities often enough named after the old towns and villages from where the refugees come. By 1923 the Refugee

Rehabilitation Commission has been established to oversee the task of settling the refugees. The 1928 Greek census reports about 61 unmingled refugee settlements in Thessaloniki and another 14 mixed settlements (figure 1).

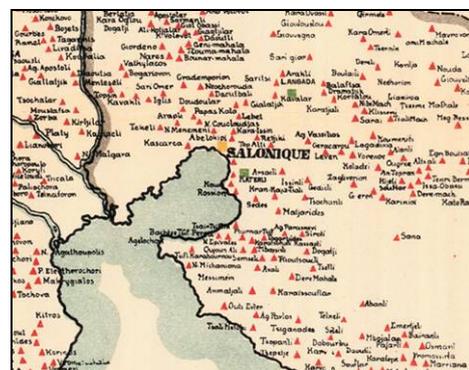


Figure 1: Detail of a French historical map showing refugee settlements in Thessaloniki during 1923-1926.

A series of new communities sprouted up on the outskirts of the city, to the west, after the swamps were drained beyond

Vardaris Square (1930) and the eastern sector expanded (Kalamaria, Aretsou etc). Most of them were shanty towns, thrown together in a hundred different ways but mainly closely packed and jerry-built, in order to provide shelter for some 117,000 refugees from Asia Minor, Thrace, the Black Sea (Pontus) and Bulgaria (figure 2).



Figure 2: Refugees' places of origin.

These settlements were either newly created (Nea Malgara, Agios Athanasios etc), or they pre-existed the arrival of the refugees (Thermi, Vathulakkos, Diavata, Sindos etc). An increasing number of settlements were established that became gradually part of the wider urban tissue of the city (Ampelokipoi, Kalamaria, Toumpa etc) and others that don't exist now because they were shattered only a few years after they were roughly created. High ground settlements (Panorama, Oraiakastro etc) and littoral settlements (Kalochori, Peraia, Neoi Epivates, Agia Triada etc) were also established near Thessaloniki and a variety of changes and a certain progress of urban forms and structures for these settlements took place through years.

1.2 Scope of the project

The application, on the one hand, of tools and methods, provided by Photogrammetry and Cartography, and also such techniques as Geographic Information Systems, and the existence and the accessibility, on the other hand, in historical data as maps, aerial photos, topographic diagrams, statistical data, contribute decisively to the diachronic study and examination of geographic space determined by Thessaloniki's refugee settlements. The analysis, the comparison, the superimposition and the composition of these data represent the basis of the documentation study of these urban shapes.

The importance of studying the existing urban context of Thessaloniki's refugee settlements and its history and identifying the internal logic of its continuous transformations was the starting point in this study. Thus, the narration of this specific urban space as a dynamic form using methods and products, provided by Photogrammetry and Cartography, may lead to the understanding of a series of geometric typologies and patters that were generated through years and also the underlying set of interactions. For this purpose, this research focuses on the following main axes:

1. Diachronic follow-up of territorial changes using historical charts, diagrams and photomaps that describe the region of interest (finding and selecting products for the study, evaluation of these products according to the production chronology, the scales and the corresponding information that provide, the type and the quality of this information etc).

2. Processing and integration of all cartographic and photogrammetric products in a completed recording and management system (G.I.S.). Integration in this Geographic Information System of a Data Base providing information regarding the settlements such as the locomotion of refugees, countries and the cities of origin etc.

3. Use of the recording system for the study, on one side, of all parameters that influenced the organisation and the structure of refugee settlements and also for the geographic and land-planning typology and classification of settlements.

4. Visualisation of research results with the use of digital representation techniques. Narration of urban phenomenon and representation of its various aspects with map production.

2. CARTOGRAPHIC AND PHOTOGRAMMETRIC DOCUMENTATION

A significant number of historical maps and charts, diagrams and photomaps were used in this study in order to follow-up territorial changes occurred in Thessaloniki and its refugee settlements. Old maps and aerial photos providing a series of information for these settlements were actually the basis of the documentation study. The 4 major organizations providing most of the data of this research are the following: National Centre for Maps and Cartographic Heritage - National Map, The Hellenic Military Geographical Service, Lands and Mapping Service of Greece of The Ministry of Environment, Physical Planning and Public Works and The Ministry of Agriculture. The main task was to georeference all these products in the same coordinate system, so the comparison, the superimposition and the composition of these data would have been possible. For this reason, EGSA87 (GGRS87), the projection system that is used nowadays in Greece has been chosen.

2.1 Cartographic maps

A variety of different maps were used not only for the determination of geographical space of refugee settlements established in Thessaloniki but also of countries and places of origin of the refugees. Therefore, maps were used in this study as follows:

- Small-scale historical maps (figure 3), range from 1:500000 to 1:2500000, were the essential cartographic background that covered the whole area of interest (Asia Minor, Thrace, the Black Sea and Bulgaria), to determine countries and places of origin of the refugees.



Figure 3: Historical map of Balkan Peninsula and Asia Minor composed by James Wyld in 1877.

Up-to-date maps 1:50000 and historical maps, as well, were initially used to identify all refugee settlements and their distribution in the wider geographical space of Thessaloniki. Historical maps (figure 4), provided by National Centre for Maps and Cartographic Heritage - National Map, were a significant source of information regarding settlements that changed their name or don't exist anymore.



Figure 4: Historical map of Thessaloniki composed by Army Cartographic Service.

Up-to-date maps 1:5000, provided by The Hellenic Military Geographical Service, were next used for the geometric correction and georeferencing of aerial photos and the creation of orthophoto maps for these settlements.

All these maps were thoroughly studied before processing, taking all factors into consideration, such as scale, their integration in a unified cartographic system, transformations used between various projection systems, as well as the digitalisation method etc.

2.2 Old cadastre maps

Old cadastre maps, provided by The Ministry of Agriculture, showing the distribution of building plots and cultivated land in 23 settlements were used in this study. First of all, projection transformation from Hatt, the old coordinate system based on the Bessel ellipsoid (1841), to EGSA87 (GGRS87), the projection system that is used nowadays in Greece, took place. A complete mosaic of maps showing the distribution of building plots and cultivated land was created for all these 23 settlements.

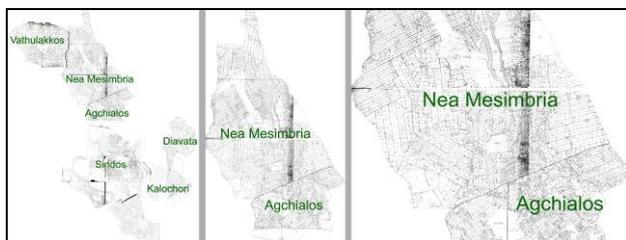


Figure 5: Mosaics of old cadastre maps 1:5000 showing the distribution of cultivated land for a number of settlements.

The number of old maps used overall is the following:

- 188 old cadastre maps 1:1000 showing the distribution of building plots (65 maps of the initial distribution of building plots, dated from 1939 to 1973 and 123 maps of supplementary distributions or changes, dated from 1952 to 1982).
- 156 old cadastre maps 1:5000 showing the distribution of cultivated land (71 maps of the final land distribution, dated

from 1930 to 1935 for the majority of the settlements, 23 maps of the land redistribution, dated from 1961 to 1980 for only 6 settlements and 62 maps of supplementary distributions or changes of final land distribution and redistribution, dated from 1941 to 1982 for all settlements).



Figure 6: Mosaics of old cadastre maps 1:5000 and 1:1000 for Nea Mesimbria settlement: a) Maps 1:5000 (distribution of cultivated land, dated 1935), b) Maps 1:1000 (distribution of building plots, dated 1969-71), c) Maps 1:1000, dated 1969-71, showing building plots, d) Maps 1:1000, dated 1969-71, showing building plots.

The processing of the maps, comprising of rectification, georeferencing to the appropriate projection system (EGSA87), mosaicking and image enhancement, was done with the commercial software package ERDAS Imagine.

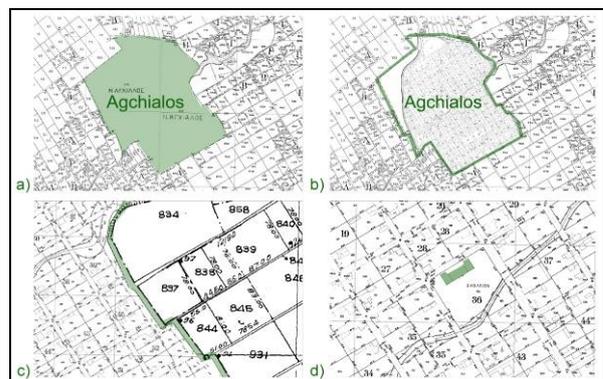


Figure 7: Mosaics of old cadastre maps 1:5000 and 1:1000 for Nea Agchialos settlement: a) Maps 1:5000 (distribution of cultivated land, dated 1935), b) Maps 1:1000 (distribution of building plots, dated 1968), c) Maps 1:1000, dated 1968, showing building plots, d) Maps 1:1000, dated 1968, showing building plots.

2.3 Aerial photos and photogrammetric products

A significant number of aerial photos were used for the description and analysis then of geographical space determined by refugee settlements established in Thessaloniki. All aerial photos were provided by Lands and Mapping Service of Greece of The Ministry of Environment and were apparently of different scale and capture date. All photos dated from 1938 to 1992 and a range of photo scales from 1:7000 to 1:42000 are observed.

The photogrammetric image processing of these aerial photos varied mainly according to the number of photos in each stripe, the available control points and the existence of camera's internal orientation parameters. 3d control points measured by

GPS or identified in up-to-date and old cadastre maps 1:5000 and 1:1000, provided by The Hellenic Military Geographical Service and The Ministry of Agriculture, were used for the geometric correction and georeferencing of aerial photos and the creation of orthophoto maps for these settlements.



Figure 8: Orthophoto map 1:5000 created from aerial photos dated 1938 at a scale of 1:15000.

The photogrammetric image processing of the data, comprising of the control and tie point measurement, bundle adjustment, DSM and orthophoto generation was done with the commercial software package LPS (Leica Photogrammetry Suite, Leica Geosystems), which offered functionalities for a complete photogrammetric working process. Therefore, aerial photos were used in this study as follows:

- 399 aerial photos, taken at different scales (photo scales range from 1:15000 to 1:42000), dated from 1938 to 1960, were initially used for the whole area of interest (Thessaloniki and its outskirts). In particular, 3 different mosaics were created using 293 aerial photos dated 1938 at a scale of 1:15000, 50 aerial photos dated 1945 at a scale of 1:42000 and 56 aerial photos dated 1960 at a scale of 1:30000.



Figure 9: Detail of the historical center of Thessaloniki on the orthophoto map 1:5000 created from aerial photos dated 1938.



Figure 10: Detail of the orthophoto map 1:20000 created from aerial photos dated 1945 at a scale of 1:42000.



Figure 11: Detail of the orthophoto map 1:10000 created from aerial photos dated 1960 at a scale of 1:30000.

- 303 aerial photos, taken at different scales (photo scales range from 1:7000 to 1:16000), dated from 1951 to 1992, were next used in this study for the city of Thessaloniki (42 photos) and for 21 settlements (261 photos). The names of these settlements are as follows: Adendro, Agia Triada, Agios Athanasios, Agchialos, Vathulakkos, Diavata, Eukarpia, Thermi, Kallikrateia, Kalochori, Mesimbria, Nea Malgara, Nea Michaniona, Nea Rodesstos, Neoi Epivates, Panorama, Peraia, Scholari, Sindos and Oraioakastro.

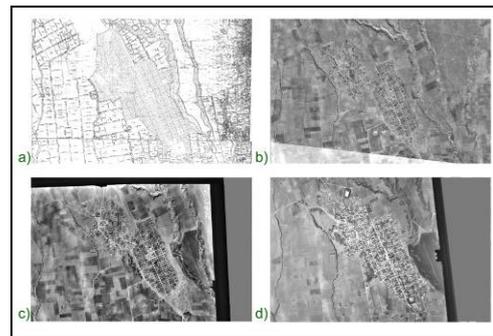


Figure 12: Cadastre map and orthophoto maps showing Nea Mesimbria settlement: a) Mosaic of old cadastre maps 1:5000 (distribution of cultivated land, dated 1935) and 1:1000 (distribution of building plots, dated 1969 and 1971), b) Aerial photo 1:42000 dated 1945, c) Aerial photo 1:13000 dated 1951, d) Aerial photo 1:15000 dated 1990.

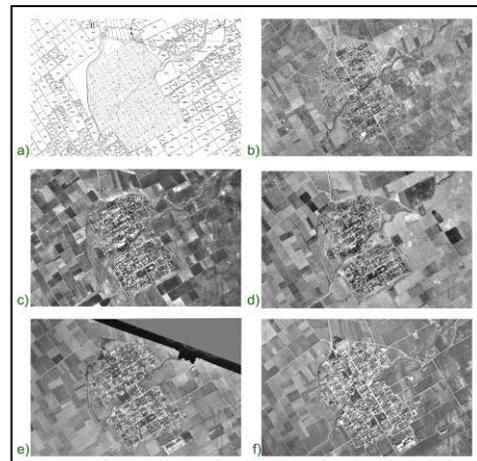


Figure 13: Cadastre map and orthophoto maps showing Nea Agchialos settlement: a) Mosaic of old cadastre maps 1:5000 (distribution of cultivated land, dated 1935) and 1:1000 (distribution of building plots, dated 1968), b) Aerial photo 1:42000 dated 1945, c) Aerial photo 1:30000 dated 1960, d) Aerial photo 1:30000 dated 1960, e) Aerial photo 1:30000 dated 1960, f) Aerial photo 1:30000 dated 1960.

Aerial photo 1:16000 dated 1962, e) Aerial photo 1:12000 dated 1983, f) Aerial photo 1:10000 dated 1990.

3. G.I.S. APPLICATION

The integration of all cartographic and photogrammetric products in a completed recording and management system followed the image processing and production of orthophoto maps for Thessaloniki and its refugee settlements. The Geographic Information System (G.I.S.) application gave the possibility to integrate, store, analyze and display geographic information for all refugee settlements, providing special tools to create interactive queries, edit data and maps, and illustrate the results of all these operations.

This G.I.S. application allowed also the linkage of the digital cartographic background and a Data Base providing information (Maravelakis M. J., Vakalopoulos A. E., The refugee facilities in the area of Thessaloniki, 1955, Vania, Thessaloniki) regarding the population of the settlements such as country, city and village of origin, population of village of origin, number of Greek families and of other ethnicities of each village of origin, mother language of refugees, occupation and faith of refugees, number of refugees, families and individuals, in each settlement, the locomotion of refugees from place of origin to destination settlement etc. The development of the G.I.S. application was made with the commercial software package ArcGIS.

A series of elements has been studied through the G.I.S. application for the whole number of settlements: changes through years of settlements' boundaries, built and unbuilt environment, urban tissue, road network, blocks, buildings plots and cultivated land etc (figure 14, 15). The ruins of old refugees' houses were also spotted in orthophoto maps and the photographic documentation of a number of these houses followed (figure 16).

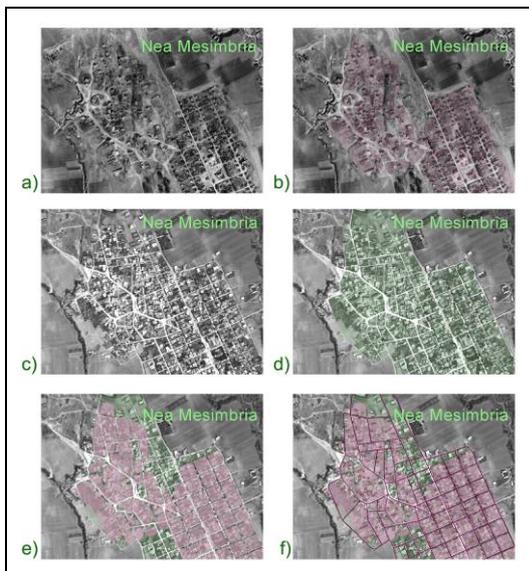


Figure 14: GIS application for Nea Mesimbria settlement: a,b) Aerial photo 1:13000 dated 1951, showing the distribution of buildings and blocks (b), c-f), Aerial photo 1:15000 dated 1990, showing the distribution of blocks (d), changes in blocks (e) and road network (f).

The G.I.S. application proved to be an indispensable tool for the study of all parameters that influenced the organisation and the structure of refugee settlements (choice criteria and arrangement of settlements, general character of urban tissue, urban development, human activities) and the geographic and land-planning typology and classification of settlements (listing of differences and resemblances, explanatory comparisons of data and analyses of settlements). The G.I.S. application allowed finally the visualisation of research results, the narration of the urban phenomenon and the representation of its various aspects with map production.

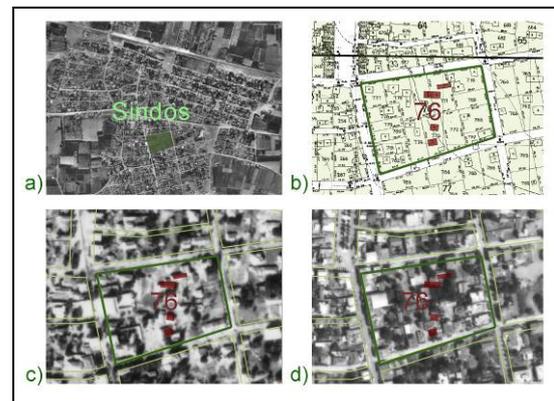


Figure 15: GIS application for Sindos settlement a) Aerial photo 1:30000 dated 1960, b) Old cadastre map dated 1950 (focusing on block 76 and the ruins of old refugees houses), c) Aerial photo 1:16000 dated 1959, showing the distribution of buildings and blocks, d), Aerial photo 1:15000 dated 1990, showing the distribution of buildings and blocks.



Figure 16: Old refugees' houses in Sindos settlement showing signs of decay (block 76).

4. CONCLUSION

In this study different cartographic and photogrammetric products, varied in scale, production date, projection system etc, providing information of different levels of detail, were used to record and analyse territorial changes of Thessaloniki' refugee settlements. As a result, a whole number of methods, techniques and principles related to maps georeferencing process, image geometric correction, orthophoto map creation and G.I.S. application were put into practice. Consequently, different kinds of problems were solved during each phase of the research.

The main problem during the georeferencing process of the available maps was the different and sometimes the unknown projection system. For example, small scale maps were georeferenced, using known shape files showing the coast line. Respectively, the main problem during the geometric correction and orthophoto map process of the available old aerial photos (before 1960) was to define the unknown elements of internal

orientation. For that reason specific methods were used that led effectively to the creation of orthophoto maps using old aerial photos.

The G.I.S. application for Thessaloniki' refugee settlements proved to be an indispensable tool to record and analyse the structure of refugee settlements, their geographic and land-planning typology and classification and also to visualize the research results. The integration in this G.I.S. application of other cartographic and photogrammetric products and Data Bases, providing useful information for refugee settlements, will give in the future new approaches and resources regarding this field of research.

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