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NEW TOPOGRAPHIC MAPS OF MACEDONIA IN SCALE 1:25 000

Нови топографски карти на Македония в мащаб 1:25 000

Between 1945 and 1991, all cartographic data for Macedonian territory as a part of former Yugoslavia has been produced by the Military Geographic Institute (MGI) in Belgrade. Its whole territory is covered by topographic maps prepared in several periods mainly by MGI..After that, until 2004, official state cartographic production of Macedonia was in stagnation.

The beginning of cartographic production in Real Estate Cadastre Agency (RECA) (former State Authority for Geodetic Works – SAGW) as National Mapping Organization (NMO) of Macedonia after the independence of Macedonia was the study for establishing of state base maps for GIS and the Global Mapping Project. Macedonian Global Map data have been published on internet as a part of Global Map on 8th March 2006 as a first official Macedonian cartographic product after its independence, and as the first European country included within the global map.

In the period from 2004 till 2006, Japan International Cooperation Agency (JICA) donated funds for the project for preparing new topographic maps in scale 1:25000, i.e. topographic spatial data infrastructure 25000. The final products of the project are printed and digital topographic maps in a GIS database for 60% of territory, as well as the black and white orthophoto with 0.5m resolution, photo materials and new GPS passive network for the whole territory of Macedonia. Macedonian GM data have been utilized as a background of the index map in a backside of topographic maps.

After the period of cooperation with JICA, Macedonian NMO has continued with the process for preparing of the other topographic maps with aim to cover the rest of the area, other 40% of the territory of Macedonia. Up to date, about 90% of the topographic maps are already produced and released for purchasing. The new topographic maps are available in Macedonian and English languages, which can

be found on the GIS Portal of RECA also. The final output formats of new digital topographic data are in GeoTIFF for raster and ArcInfo Coverage for vector data. The process of preparing of the other maps is ongoing, within the cartographic department of RECA.

1. INTRODUCTION

Preparing of topographic maps in several scales in a period between years 1945 and 1991, i.e. while Macedonia was a Republic within the Former Yugoslavia federation, has been done by the Military Geographic Institute (MGI) of Yugoslavia, with the central office in Belgrade. Other thematic and geographic maps for Macedonian territory in the same period were prepared by Geokarta, with the central office in Belgrade also. Both facts make clear that all cartographic works in former Yugoslavia were centralized in state level.

In that period, Real Estate Cadastre Agency – RECA (former State Authority for Geodetic Works – SAGW) was the responsible institution for establishing of local geodetic networks, cadastral surveying, preparing of cadastral maps, registration of real estates and updating of the cadastral information (maps and database). After independence of Macedonia, from 1991 to 2004, it was forgotten that in new independent country there is no other responsible governmental institution to carry out for cartographic works. All RECA's capacities were oriented in to developing of new cadastral system with registered property rights, i.e. RECA did not play the role of National Mapping Organization (NMO) of Macedonia. That period characterized with the stagnation of all cartographic works. In official utilization, were the prepared maps by MGI with the old date of publishing and with non-updated information. RECA had only the role of map seller.

First efforts of independent national cartographic production of Macedonian are the preparation works for developing of first Spatial Data Infrastructure 25000 (Study for establishing of state base maps for GIS in the Republic of Macedonia) and the Global Mapping project.

On 08th March 2006, in the web site of International Steering Committee for Global Mapping (ISCGM) was published the Macedonian GM data (www.iscgm.org, September 2009). It considers as first official Macedonian national cartographic product. Macedonia is 22nd country, as well as the first European country that has been released its data within the Global Map (Idrizi B., Biljarska N., 2007). Through participation in this project, i.e. the provision of base framework geographic dataset, Macedonia has contributed in the sustainable developing of globally homogenous geographic data set in scale 1:1.000.000 for vector data and 1km resolution for raster data.

During the "Study for establishing of state base maps for GIS in the Republic of Macedonia", on year 2003, in cooperation between RECA and Japan International Cooperation Agency (JICA) teams, was realized a need for urgent establishment of new topographic maps in scale 1:25000 in printed and digital form, containing the latest geo-

graphic information suitable for use at the national level, as well as to acquire the techniques required for establishment of maps, and to disseminate geographic information at national level. As a result of the study, the implementation of projects was done in a period from March 2004 to November 2006, with in the fruitful cooperation between JICA and RECA. On November 2006, as a result of successful implemented project, around 60% of the territory of Macedonia was covered with the new topographic maps in scale 1:25000 and developed database for the same area (with blue colour in figure 1), and orthophoto with 0.5m resolution for whole territory of Macedonia (JICA, 2006). Production of the rest topographic maps is ongoing process within the RECA.

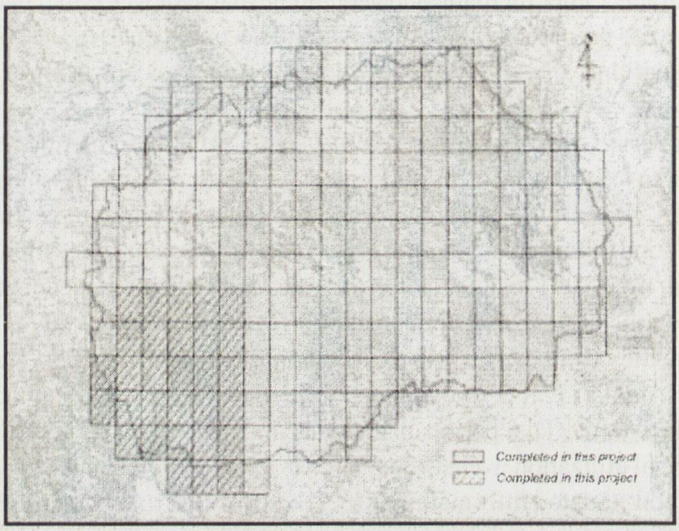

Figure 1. Covered area with new topographic maps 1:25000 prepared from 2004 till November 2006.

2. NEW TOPOGRAPHIC MAPS OF MACEDONIA IN SCALE 1:25000

"The study for establishing of state base maps in the Republic of Macedonia" present the beginnings of efforts for developing of Macedonian own national cartography. Due to the situation in previous period in the governmental responsible institution for mapping, foreign assistance was very important and necessarily. In year 2003, Japan International Cooperation Agency (JICA) started the research on actual situation with national mapping and GIS in Macedonia. After very fruitful cooperation between JICA and all governmental institutions, it was decided donation of founds for realizing a project for producing of topographic maps in scale 1:25000 followed by GIS database.

The whole project was realized in a period from March 2004 to November 2006, in which around 60% of territory was covered with new topographic maps, i.e. Macedonian

25000 SDI. Up to September 2009, other H"30% of territory was covered with new maps, in total around 90% (figure 2).

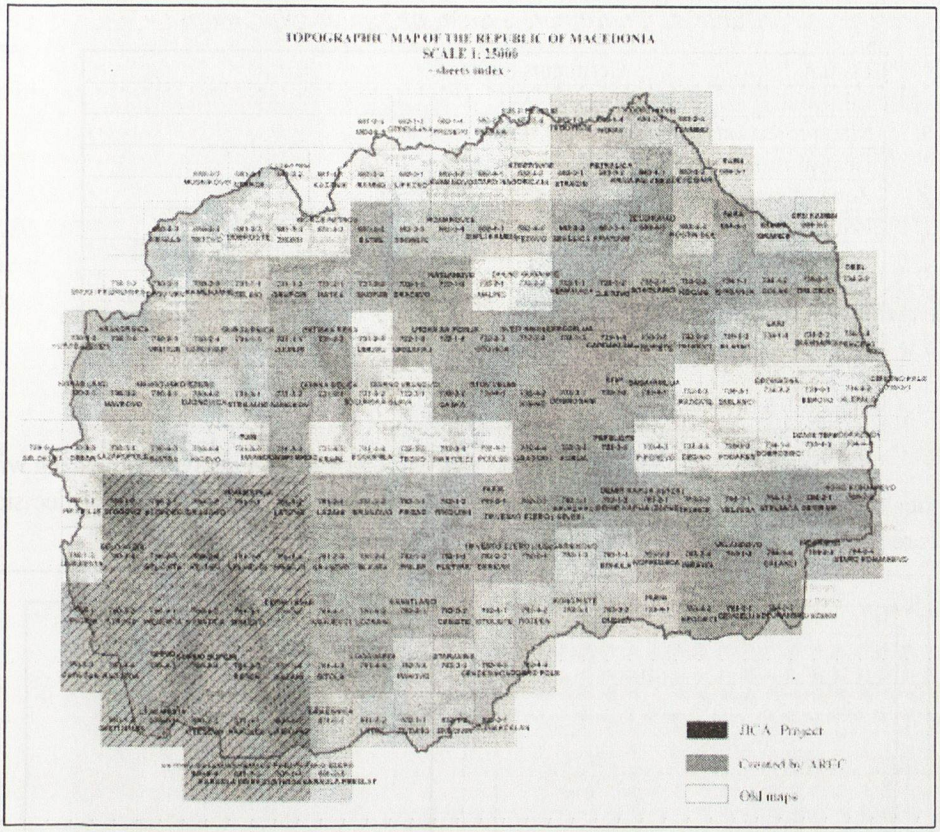

Figure 2. Coverage with new topographic maps 1:25000 (www.katastar.gov.mk, September 2009)

2.1. Technical details of new topographic maps of Macedonia in scale 1:25000

New topographic maps were prepared in parallel in Macedonian and English languages (figure 3). In Macedonian version, Cyrillic alphabet as official has been used for all contents. In the other maps in English language, the rules of translation are not the same for all contents in map. Only the legend of most used symbols was translated in English, and other text contents were transformed in Latino alphabet by transliteration method.

These maps are in the same coordinate system (table 1) and tiling system with old maps. There are new information's as legend, details for mathematical elements, data

policy, and important dates from the process of map preparing. They are open for utilization by all type of users, without any limitation.

Table 1. Coordinate system of topographic maps

Datum	Hermannskögel
Ellipsoid	Bessel (1841)
Map projection	Gauss-Krüger (3° zones)
Central meridian	21° E
Zone of projection	7
Prime meridian	Greenwich
Prime parallel	Equator
Scale factor	0.9999
False easting	500000m
False northing	0m
Elevation origin	Mean sea level – Molo Sartorio, Trieste, Italy.
Units	Meter (m)

New topographic key with 208 symbols has been defined also. In comparing with older one (328), around 30% less symbols have new maps. These kinds of decision decrease the quantity, as well as the quality of data presented in new maps.

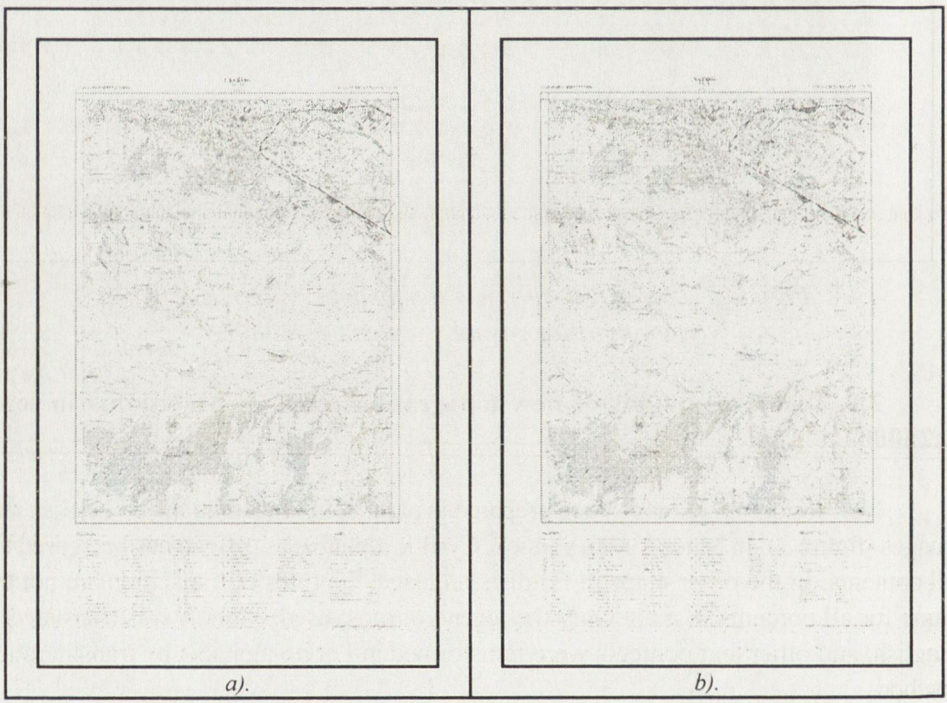

Figure 3. Example of new topographic maps 1:25000 in Macedonian (a) and English (b) language

2.2. Background of new topographic maps of Macedonia in scale 1:25000

With the aim to make more simple finding out the tile number and name of needed map, in a back site of all paper topographic maps is given the "sheets index" map for whole territory of Macedonia, based on tiling system of Macedonian topographic maps in scale 1:25000 (figure 4). The "sheets index" map has two categories of data, i.e. special and background. Special data represent the tiling system, and the background is obtained from the Macedonian GM data with the role to make more visible and clear which places in which topographic map can be found. Background is composed by four Macedonian GM layers, three vector layers and elevation data from raster layers. Vector layers have been used in total, except the boundary layer. From the boundary layer, only the national boundary has been used as a part of background of "sheets index" map (Idrizi B., 2008a).

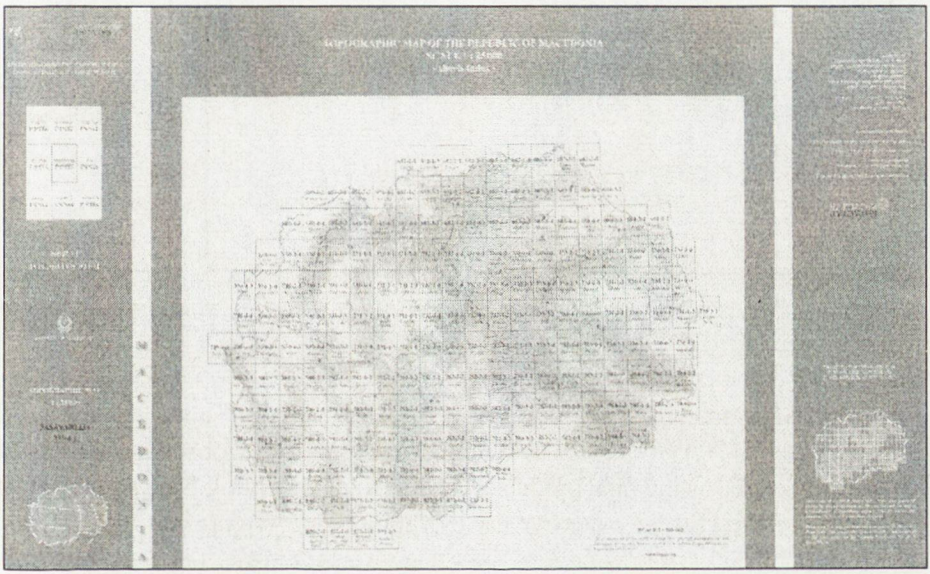

Figure 4. Back site of paper topographic maps

2.3. Macedonia 25000 SDI

The thorough consideration during "The study for establishing of state base maps in the Republic of Macedonia" has been paid through the entire process to adopt technical specifications that meet user needs and to establish the Spatial Data Infrastructure (Macedonian 25000 SDI) that can be widely used. Based on this rules, data structure of Macedonian 25000 SDI comprises the fundamentals of information infrastructure in Macedonia. It contents 10 layers, i.e railways, roads, land classification, administrative areas, spatial scheme, reference raster, annotations, topographic feature, small objects

and water spaces. Some of them are not shown in paper topographic maps, but they can be found in digital database. In next figure (5), can be seen the logical view of Macedonian 25000 SDI and the example of single dataset consists of 1 workspace and 12 coverage's as 1 map sheet except raster components (SAGW, JICA, 2006).

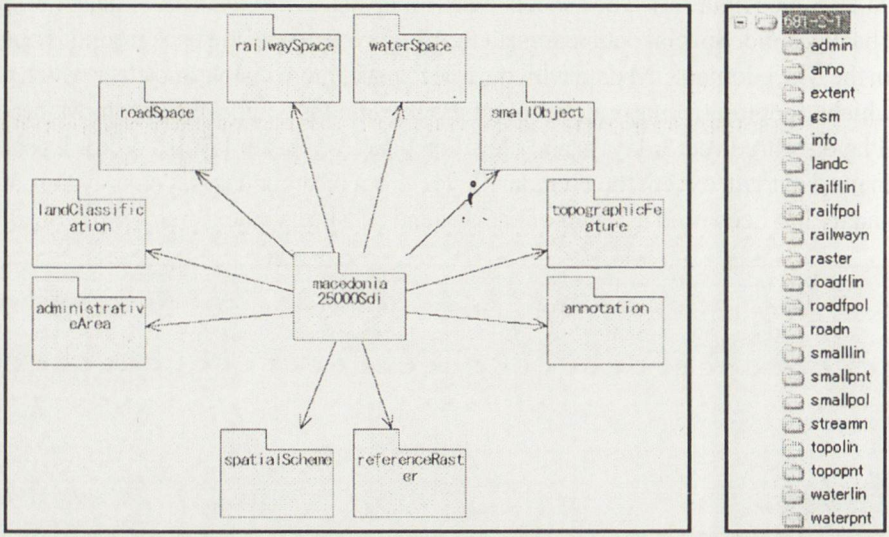

Figure 5. Macedonian 25000 SDI and ArcInfo Coverage structure of single dataset

From Macedonian 25000 SDI, several datasets such as Topographic Map GIS Database, Land use GIS Database and Ohrid Environmental Conservation GIS Database were generated as the final product. Also, the digital Printing Data and the Printed Maps were prepared for the extensive use by various users (figure 6).

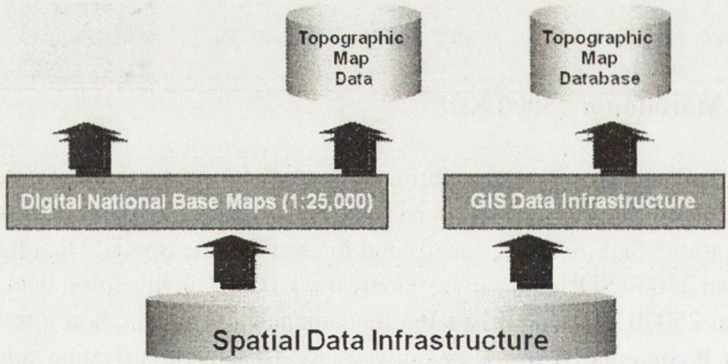

Figure 6. Outputs from Macedonia 25000 SDI

2.4. Overview on the process of preparing of new topographic maps-database

Over the period of the project implementation (March 2004 – November 2006) and after that (November 2006 – August 2008), numerous work items have been carried out by the RECA and the JICA study team with assistance of the related organizations for producing of national topographic maps in scale 1:25000. The process was started by defining of new specification for Spatial Data Infrastructure, and field works on reconnaissance of ground control points and installation of aerial photo signals.

Shooting of aerial photographs was realized on May 2004, followed by field works for surveying of ground control point and field identification of aerial photographs. After finished field works, the process was continued by office digital photogrammetrical works (aerial triangulation, digital plotting and compilation). With aim to eliminate accidently errors, supplementary field identification and digital compilation were done. At the end of process, preparations of data for printing have been done in Adobe Illustrator and ArcInfo Coverages in ArcGIS. Below is the summary of work items completed in this project (figure 7).

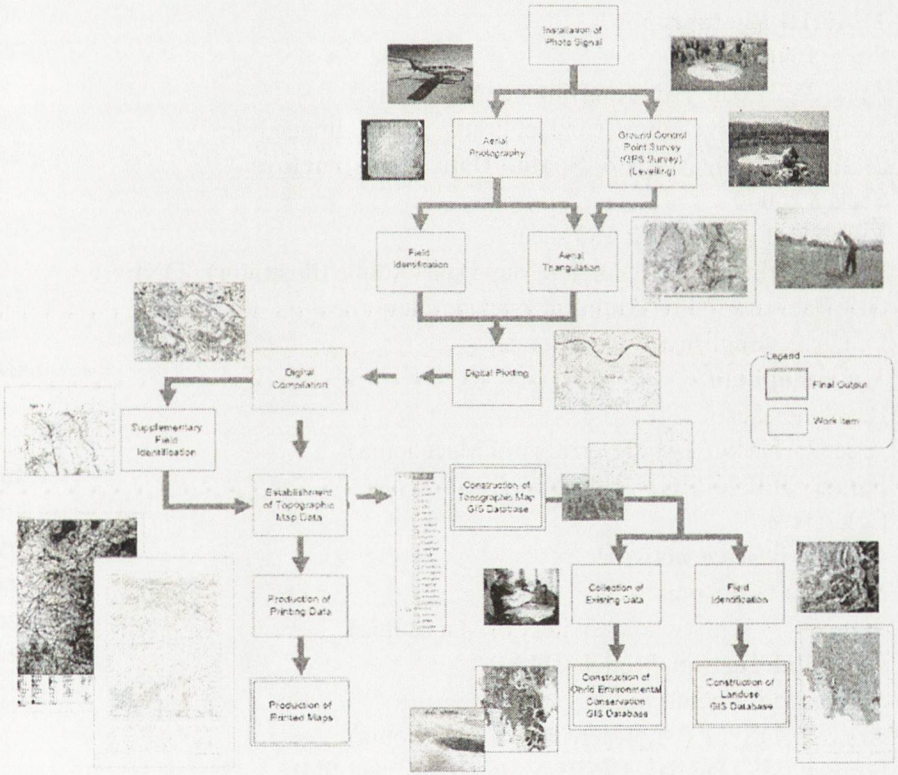

Figure 7. Work items during the project

2.5. Outputs from the project

As can be shown on above figure with works items, during the project have been develop Environmental GIS database of the lake Ohrid watershed area and digital land use maps in scale 1:25000 for the same area also. The objectives of this extended part of project were to: identify the need of GIS database through the discussions with Lake Ohrid Conservation Project, design the GIS database for environment management for the watershed area, collect necessary information and establish the GIS database for the watershed area, establish the digital topographic map for the watershed area, and establish the land use map for the watershed area (30 map sheets). The personal GeoDatabase (EGIS_OHRID.mdb) is organized in 6 datasets, i.e. Basemap, Drainage, Hydrography, EnvBack, EnvMonitor, and Thematic data. The whole extended part of project was done in ArcGIS also.

As a result of up to date done job in Macedonian independent topographic mapping, the products listed below were produced. They are the outcome of the successful technical transfer trainings and through cooperation of RECA with the other respective governmental organizations and national universities.

1) Aerial Photographs
Scale: 1:40000
Area: 25,713km^2 (whole territory of Macedonia)
Format: Negative Films / Contact Prints / Digital Image File

2) Topographic Maps & Spatial Data Infrastructure
Scale 1:25000
Number of map sheets: 180 sheets
Format: Printed Maps / Digital Map Data (Adobe Illustrator) / DXF / GIS Database (ESRI ArcInfo Coverage files)
Language: English and Macedonian

3) Orthophoto
Resolution 50cm
Area: 25,713km^2 (whole territory of Macedonia)
Format: JFIF (JPEG)
Color: B/W

4) GPS passive network
Number of GPS points: 59
Area: 25,713km^2 (whole territory of Macedonia)

5) Digital Terrain Model (DTM)
Model: grid of points in 20m
Area: 25,713km^2 (whole territory of Macedonia)
Format: GIS Database (ESRI ArcInfo Coverage file)

6) Digital Elevation Model (DEM)
Resolution: 5m

Area: 25,713km^2 (whole territory of Macedonia)
Format: raster dataset – esri grid

7) Topographic key

Number of symbols: 208
Format: ArcGIS style file, *.style
Language: English and Macedonian

8) Specification for topographic maps/database

Number of paper sheets: 84
Format: printed in paper / DOC / PDF
Language: English and Macedonian

3. GIS PORTAL OF RECA

Following the trend of publishing geospatial data on the World Wide Web, the RECA GIS portal was created and putted online, making its data (topographic maps also) viewable to the customers and wide public through a web browser. ArcGIS software was used in the process and it all started with creation of the RECA GIS database to hold the data that will be published online. Prior to creating the GIS portal, available data for viewing are:

– Global Map data in vector format 1:1000000 scale consisted of National Boundary, Municipalities, Digital Elevation Model (DEM), Population centers, Rivers, Roads, Airports, and Lakes (figure 9).

– Topographic maps in raster format in scales 1:200000, 1:100000, 1:50000 and 1:25000 (both new and old maps).

– Index maps in scale 1:200000, 1:100000, 1:50000, 1:25000, 1:5000, 1:2500, and 1:1000.

– Orthophoto with 0.5m resolution black and white raster for the entire territory of Macedonia, and 1:1000 color orthophoto for Skopje and Prilep.

This geospatial database is driven by ArcSDE and its role is to hold and effectively retrieve data according to a user query. By using ArcCatalog software and geo-processing tools data was imported in the database. ArcIMS was used to create a web service from the map layout capable of publishing the map on the internet (figure 8). This web service is responsible for receiving a user requests and sending it to the inner GIS database layer and then forwarding the data received by the GIS database layer back to the user (Idrizi B., Biljarska N., 2008).

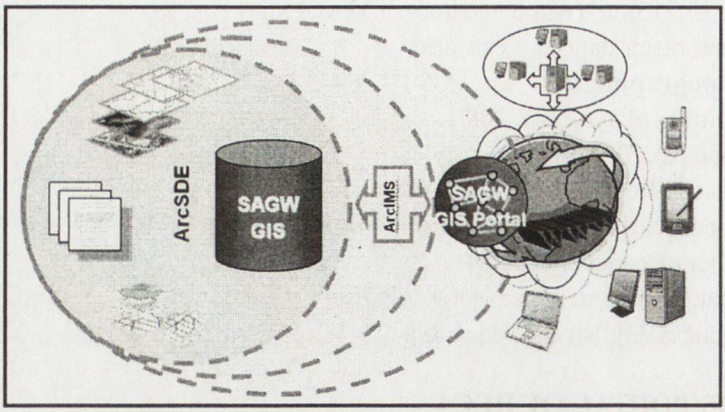

Figure 8: Underlying technology of GIS portal

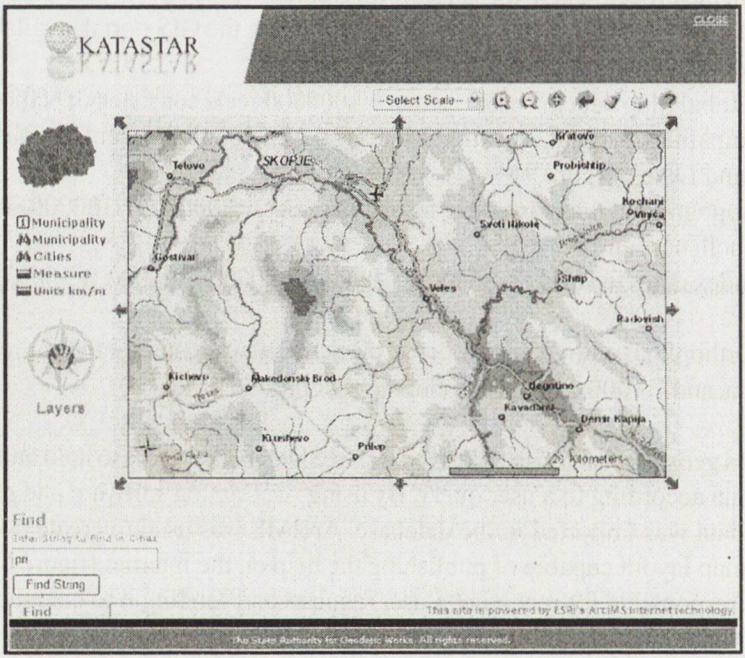

Figure 9: Layout of GIS portal (www.katastar.gov.mk/website/servistopokarti, September 2009)

4. ONGOING-FURTHER ACTIVITIES ON TOPOGRAPHIC MAPPING IN MACEDONIA

The process of preparing the rest 10% topographic maps in scale 1:25000 to cover of whole territory with new topographic maps is ongoing process within the RECA as a Macedonian NMO. Based on the results in past five years, with the existing capacities of Macedonian NMO, optimal period for completing of the rest topographic maps is the end of year 2010.

Orientation of capacities for the period after 2010 is very important, because preparing of topographic maps in scale 1:25000 does not present all topographic mapping. New topographic maps in scales 1:50000, 1:100000 and 1:200000 are very important for completing of first set with own state topographic maps. Due to date of existing aerial photographs (May, 2004), updating of new topographic maps is very important process also.

In other way, NMO of Macedonia needs to assist on preparing of topographic maps in scale 1:50000 with NATO standards. During this project, changing of geographic coordinate system has to be done.

5. CONCLUSIONS

In a period from 1991 to 2004, Real Estate Cadastre Agency (former State Authority for Geodetic Works - SAGW) has been playing the role of map seller of cartographic products prepared by Military Geographic Institute from Belgrade before year 1991. During that period, there are not any activities related to national map production in Macedonia.

From the above four chapters, can be summarized that official national cartography in Macedonia is so young, i.e. in its beginnings. Up to date, Macedonian Global Map data and around 90% of new topographic maps in scale 1:25000 were completed in total. New topographic maps have the data based on the aerial photographs from year 2004, which means that the last produced maps have not the latest information (around 3-5 years old). Preparing of the rest 10% of topographic maps 1:25000 is ongoing process.

New topographic maps are available in Macedonian and English language, and they are open for all type of users.

Old maps in scale 1:25000 of uncovered area with new maps are still in official utilization. Together with topographic maps in other scales (1:50000, 100000 and 200000), they are almost available for purchasing as a paper maps and in digital form as georeferenced raster data in GeoTIFF format.

The differences between new and old topographic maps 1:25000 are essential (table 2). New maps represent the latest information, they are in digital and paper format, GIS database has been created, they have legend of most used symbols, in back site they have map of Macedonia in scale 1:500000 based on Macedonian GM data and the index

sheets map with the information for tile and name of topographic maps. Older ones have the historical largeness only.

Table 2. Differences between topographic maps prepared by MGI before 1991 year and RECA with JICA after 2004 year (Idrizi B., 2008b)

Changed categories	Old maps	New maps
Year of production	1970-1990	2004-2009
Covered area	100%	90%
Data format	Paper	Paper and digital (ArcInfo Coverage, GeoTIFF, Ai, DXF)
Language	Serbo-Croatian	Macedonian and English
Prime meridian	Greenwich or Paris	Greenwich
Alphabet	Latino	Cyrillic and Latino
Way of delivery of paper maps	Not folded	Folded and not folded
Information outside the margins	Scale line, coordinates	Map legend, scale line, Mathematical elements, preparation, Survey method, coordinates, legend
Background	Don't have	Sheets index map, tiling, information for SAGW
Data policy	State secret	Open for all type of users
Price of one sheet paper map	130euro	2.6euro
Symbols	328	208

During realizing of project in a period May 2004 - November 2006 from JICA study team, close to preparing around 60% of topographic maps 1:25000, technology transfer and training of several teams were realized. As a result of technology transfer, RECA has the departments for digital photogrammetry, digital cartography, GIS and surveying, and as a result of trainings, today RECA have very high quality trained human capacities in those departments. The technology which is in using and the human capacities, gives the guaranty that the topographic mapping has a good future in Macedonia.

Step forward is the creation of the GIS portal for the purpose of informing stakeholders, customers and clients for cartographic/GIS products of RECA, i.e. topographic maps through the internet. This step demonstrates the Macedonian NMO efforts to make itself an open institution by placing geospatial information it possess online available to the world for viewing 24/7. In future this will be developed to become an order and purchase site.

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