ISSN: 1857-9000
EISSN: 1857-9019
UDC: 528:004

Geo-SEE

INTERNATIONAL
SCIENTIFIC JOURNAL

Micro Macro & Mezzo Geo Information

14

June, 2020

SCIENTIFIC (2017): 5.416
JOURNAL (2016): 4.705
IMPACT (2015): 3.07
FACTOR (2014): 1.76

INTERNATIONAL SCIENTIFIC JOURNAL

ISSN: 1857-9000 (printed version)
EISSN: 1857-9019 (electronic version)
UDC: 528:004
Scientific Journal Impact Factor - SJIF (2017): 5.416

Micro Macro Mezzo Geo Information

14

June, 2020

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Geo-SEE Institute, Skopje, North Macedonia www.geo-see.org

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FUNDER of Issues 14 and 15 - Year 2020:
Ministry of Culture of the Republic of North Macedonia
Annual program for financing projects of national interest in culture in the field of publishing activities for year 2020
Str. Gjuro Gjakoviq, n.61; 1000 Skopje
www.kultura.gov.mk; info@kultura.gov.mk

PUBLISHER:
South-East European Research Institute on Geo Sciences
"Geo-SEE Institute"
adress: str. Djon Kenedi, 25/1-d3; 1000 Skopje, North Macedonia.
tel: + 389 2 6140-453; gsm: + 389 75 712-998
info.geosee@gmail.com, www.geo-see.org

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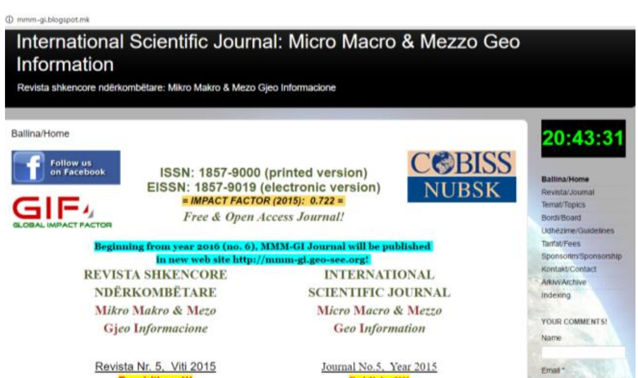

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CLASSIFICATION OF MULTIPLE NUMERICAL ATTRIBUTES IN ARCGIS ENVIROUMENT

Kristina KASTREVA[1] and **Penka KASTREVA** [2]

UDC: 519.85:004.6]:[528.9:616.83(497.2)

SUMMARY

The article presents the application of cluster analysis in solving practical problems in medicine. It can be used to detect models in the spatial or temporal distribution of a particular disease. Determining the location of spatial clusters is important when an epidemic of a disease occurs and can often provide guidance on what can cause it. The advantage of using cluster analysis in a GIS environment is that cluster mapping tools allow visualization of cluster locations.

In this paper, we focus on studying the clustering method that has been applied to datasets of a neurological disease. A database on the epidemiology of hereditary neuropathies in Bulgaria was used.

Key words: maps, neurological diseases, cluster analysis

1 INTRODUCTION

When mapping and analyzing statistical information, it is necessary to classify the dataset with an appropriate classification method. The most commonly used classification methods (Equal interval, Defined interval, Quantile, Natural breaks, Geometrical interval, Standard deviation) include grouping of objects / phenomena that have similar values for an individual attribute.

However, it is possible to classify objects based on multiple attributes (Slocum et all, 2005). Such process of classification (grouping) of the data is known by the term cluster analysis. It was first introduced in 1939.

Cluster analysis has long played an important role in the wide variety of fields of study such as: psychology and medicine, social sciences, biology,

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statistics, pattern recognition, information retrieval, and more. There are many applications for solving various practical problems. This analysis is useful when classifying a large body of information that is collected in the field of medicine. Cluster analysis can reduce the amount of data, making it more visible in tables and maps. In medicine, cluster analysis is used to identify patterns in the spatial and temporal distribution of a particular disease.

Clustering is a process of dividing the information into groups, known as clusters on the basis of many features (characteristics) simultaneously. The purpose of grouping is that each cluster contains similar objects (observations), and the objects from different clusters differ significantly. The similarity of the objects in the cluster is characterized by common properties (attributes). In this way, each object (observation) of the common data set will belong to a cluster with the closest average value (cluster centers).

Cluster analysis contains many numbers and different mathematical procedures. The more famous of them are: Euclidean distance, Manhattan distance, Chebishev distance and others. (Tan P. et all, 2019).

The cluster analysis methods are hierarchical and non-hierarchical. Hierarchical Cluster Analysis is used, when the number of clusters are not been previously determined. In the process of clustering, small clusters are consistently merged into larger clusters or large clusters split into smaller clusters.

Non-hierarchical cluster analysis is used for a predetermined number of clusters. The new clusters are formed by successive iterations, until a certain condition terminates the process of splitting or merging.

Three methods for non-hierarchical cluster analysis with a predetermined number of clusters are used: K-Means cluster analysis; Nearest neighbor method; Method of outermost neighbors.

K means clustering algorithm was developed to classify or group objects based on attribute properties into K number of groups, with K being an integer positive.

K – Means defines the center of gravity (centroid), which is the average of the group of objects, after which it is named. It applies to the classification of objects in a continuous n-dimensional space of attribute values. In this case, each object is perceived as a point characterized by a number of variables (attributes).

The clustering is done by minimizing the sum of squares of the distances between the data and the corresponding centroid of the cluster.

The choice of the initial centroids is a key step in the K-Means method (Tan P. et all, 2019). One approach to determine initial centroids is to select random centroids for each cluster numerous times. When the total mean squared error for all clusters has the smallest value, then we can choose the initial centroids.

The general approach is to use a hierarchical method for classifying data. In it, every object in the dataset is considered a cluster. For each cluster, the Euclidean distances between each point of the cluster and its centroid are calculated. For the smallest calculated distance between the cluster and any point, a new centroid cluster is formed, whose values are obtained as the arithmetic mean of the calculated distances of the old cluster.

2 METHODS OF STUDY

2.1 Theoretical Basis of K-Means Analysis in ArcGIS Environment

In ArcGIS, the Mapping Clusters tool contains various clustering algorithms: Cluster and Outlier Analysis, Hot Spot Analysis, andGrouping Analysis. The latter of them performs classification procedures that detect natural groups in the data. Grouping is based on attribute values of the objects and additional space or time constraints. When the "No spatial constraint" parameter is selected for the Spatial Constraints parameter, the analysis is performed with the K-Means algorithm. In this case, the objects are grouped using data only for Spatial proximity. In fact, the objects may not be in close proximity of one another in time and space in order to be part of the same group.

The successive steps in applying the K-Means grouping are (Tan P. et all, 2019):

- Choosing the number of clusters (groups), which is the parameter K;
- Repeatedly selecting randomly selected centroids for each cluster. Accepted for centroids those with minimum mean square error;
- Performing a first iteration in which the initial K number of centroids is the arithmetic mean of the values of each cluster;
- For each centroid is determined which points are closest to it by calculating the distances between them and the centroid;
- New centroids are recalculated by arithmetic mean from the calculated distances of the old cluster;
- The process continues until there is no a change in the centroids or there are no points (objects) to move from one cluster to another.

For the analysis below, we will use the terminology adopted in ArcGIS, which will help us to read correctly the report that is generated after grouping with the K-Means algorithm. For this purpose we have to implement the following remarks: The word cluster is replaced by "group", and by attribute in the attribute table we will mean "variable".

We will also make the following notations:
V - variable value

n_c - number of objects in the group;

n_v - number of variables in the group;

n_i - number of objects in the i^{th} group;
n - number of all objects in the data set;

V_{ij}^k - the value of the k^{th} variable of the j^{th} object in the i^{th} group (individual value of the entire data set);

$\overline{V^k}$ - the mean value of the k^{th} variable (centoid of the data set)

$\overline{V_i^k}$ - the mean value of the k^{th} variable in group i (centoid of the i^{th} group).

The Euclidean distance is used as a measure of proximity between two points. It is calculated as values between each point of the cluster and its centroid.

The centroid is the mean of the i^{th} group and it is defined by Equation 1:

$$\overline{V_i^k} = \frac{1}{n_i} \sum_{V_{ij}^k \in i^{th} group} V_{ij}^k \, . \qquad (1)$$

The Euclidean distance is the error or the deviation of each point from the centroid of the group (cluster), with the condition that the sum of the squares of deviations be minimum. A new group is created where the smallest distance between two points appears. The new centroid is being recalculated, etc.

The K-Means algorithm in Arc GIS software calculates the parameter R^2, which reflects how much of variation in the original data was retained after the grouping process. The greater the value of R^2 for a particular variable is, the better the clustering efficiency is (https://pro.arcgis.com/en/pro-app/tool-reference/spatial-statistics/how-grouping-analysis-works.htm).

The value of R^2 is calculated by the sum of the mean squared errors and these are the differences between the value of each variable and its average in the group (Euclidean distances). In ArcGIS this difference is designated as SSE (Sum of Squared Error), called global minimum.

The formula by which this parameter is calculated is:

$$R^2 = \frac{SST - SSE}{SST} , \qquad (2)$$

where SST (Total Sum of Squares) is the sum of the mean square errors of the variable V in the entire dataset, and SSE (Sum of Squares Error) only in the group.

For them, the formulas are:

$$SST = \sum_{i=1}^{n_c}\sum_{j=1}^{n_i}\sum_{k=1}^{n_v}\left(V_{ij}^{k} - \overline{V^{k}}\right)^2 \tag{3}$$

$$SSE = \sum_{i=1}^{n_c}\sum_{j=1}^{n_i}\sum_{k=1}^{n_v}\left(V_{ij}^{k} - \overline{V_{i}^{k}}\right)^2 \tag{4}$$

The magnitude $\left(V_{ij}^{k} - \overline{V_{i}^{k}}\right)$ in Equation 4 is the deviation of each value in i^{th} group from its centroid.

The Share factor is calculated for each variable in the group. This coefficient is a proportion calculated by the range of data in the group to the range of data of the entire data set, or

$$Share = \frac{(max - min)^{group}}{(max - min)^{data\ set}} \tag{5}$$

This coefficient indicates what part of the values of a particular variable are contained in the group of the total range of values of the respective global variable.

2.2 Graphical Presentation of the Data

Data grouping is represented graphically as a map image, with individual groups displayed in different colors. Statistical calculations are presented in text and graphical form with a report automatically created by the software, which presents in summary the analysis of the data by groups and by variables.

For each variable, the following statistical values are calculated: Mean, Standard Deviation, Minimum, Maximum, the value of the parameter R^2, Share factor and boxplot graphics to them. These statistics are calculated for each group individually as well as for the entire data set called global values. In the report they are printed with different colors and correspond to the classification made on the map. The summary statistics are presented in black color.

Boxplot graphics in the statistical report show how the values in the group (indicated by color) are associated with the entire data set (shown in black).

Each + sign indicates the number of objects that fall outside the range of data in the group. The vertical lines of the black rectangle show, respectively, the lower boundary of the first quartile, the median, and the upper boundary of the first quartile. Outside the rectangle are the smallest and largest value for the entire data set shown with black vertical lines. The black dot indicates the location of the arithmetic mean.
Vertical color lines indicate the range of data (minimum and maximum) and the color dot is the arithmetic mean of the group.

2.3 Application of Cluster Analysis

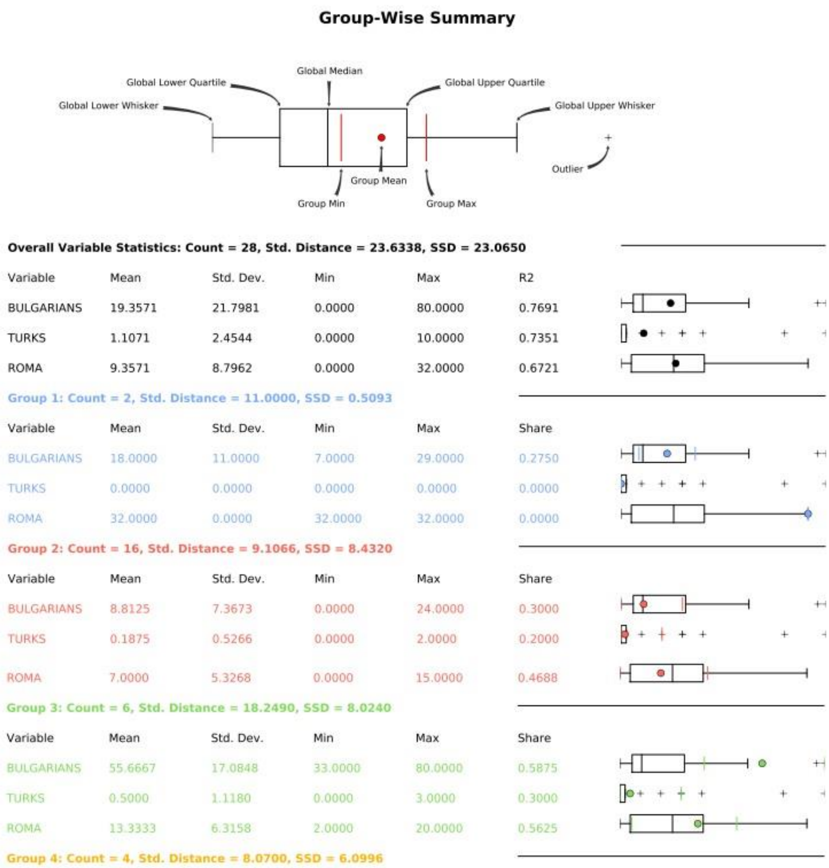
We will look at an example of classification of objects by three variables with different statistical distributions of data. Data on the number of patients with hereditary neuropathies for the three main ethnic groups in Bulgaria, divided by administrative units, were used. Numerical data represent a radically different statistical distribution. One dataset presents numerical values with a normal distribution of Roma patients. The other two variables represent an uneven distribution of data related to the Bulgarian and Turkish ethnic groups in Bulgaria.
In this study, the K –Means function was used to analyze which districts have similar characteristics with respect to the number of affected individuals. The classification was performed for the three variables simultaneously designated as "Bulgarians", "Roma" and "Turks". The cluster analysis was performed with ArcGIS software in two, three and four groups.
The K-Means function requires specifying the number of groups, the variables by which the classification and the similarity measure are carried out (Euclidean distance.) And, as mentioned above, for the Spatial Constraints parameter “No spatial constraint” should be selected.
The output file is a new vector layer in the map. It contains all objects and analyzed variables (attributes). A field (SS_GROUP) is added to the attribute table indicating to which group belongs each object.
At the request of the user, an analysis report in pdf format is also created.

3 RESULTS

From the data collected in the Bulgarian Patient Registry for hereditary peripheral neuropathies, a number of studies can be made for grouping by ethnicity, age, gender and others. Research into grouping patients by district for particular genetic forms of the disease is interesting. The results of the creation of groups of district containing similar data for the three main ethnic groups in Bulgaria are presented here.

- Results of the calculated statistics for the total dataset

The performed analysis of the grouping is presented with an automatically created (by the software) report. It consists of two parts. The first part is a summary of the analysis of the data by groups presented in (Figure 1) and the second by the variables (Bulgarians, Roma, Turks) presented in (Figure. 2).



Overall Variable Statistics: Count = 28, Std. Distance = 23.6338, SSD = 23.0650

Variable	Mean	Std. Dev.	Min	Max	R2
BULGARIANS	19.3571	21.7981	0.0000	80.0000	0.7691
TURKS	1.1071	2.4544	0.0000	10.0000	0.7351
ROMA	9.3571	8.7962	0.0000	32.0000	0.6721

Group 1: Count = 2, Std. Distance = 11.0000, SSD = 0.5093

Variable	Mean	Std. Dev.	Min	Max	Share
BULGARIANS	18.0000	11.0000	7.0000	29.0000	0.2750
TURKS	0.0000	0.0000	0.0000	0.0000	0.0000
ROMA	32.0000	0.0000	32.0000	32.0000	0.0000

Group 2: Count = 16, Std. Distance = 9.1066, SSD = 8.4320

Variable	Mean	Std. Dev.	Min	Max	Share
BULGARIANS	8.8125	7.3673	0.0000	24.0000	0.3000
TURKS	0.1875	0.5266	0.0000	2.0000	0.2000
ROMA	7.0000	5.3268	0.0000	15.0000	0.4688

Group 3: Count = 6, Std. Distance = 18.2490, SSD = 8.0240

Variable	Mean	Std. Dev.	Min	Max	Share
BULGARIANS	55.6667	17.0848	33.0000	80.0000	0.5875
TURKS	0.5000	1.1180	0.0000	3.0000	0.3000
ROMA	13.3333	6.3158	2.0000	20.0000	0.5625

Group 4: Count = 4, Std. Distance = 8.0700, SSD = 6.0996

Figure 1. Analysis of data by groups

The general statistics Mean, Std. Dev., Min, Max, and R^2, marked in black, are calculated for the three methods of grouping of the districts for the three variables. They are used to compare with the statistics calculated for each group in order to determine in which districts the data for the three variables (number of patients from the three ethnic groups) are similar.

From the summary statistics of the whole dataset and their visualization in the Boxplot graphs, it is clear that the data for the Roma ethnic group are of a normal distribution, since the median (9.0) and the mean value (9.3571) are close, which is confirmed by the coefficient asymmetry (skewness) 1.0354. The median is indicated by a vertical black line in Boxplot and the mean value by a dot. For the other two datasets, Bulgarians and Turks, results show an uneven distribution with asymmetry coefficients of 1.4923 and 2.5138, respectively. For the same variables, the + signs indicate large differences in the values (outliers) in the data set.

The differences in the distribution of the three datasets are also judged by comparing their medians in each Boxplot. It is seen that they vary by location, but still for the variables Bulgarians and Roma, the data have a common range.

Variable-Wise Summary

BULGARIANS: R2 = 0.77

Group	Mean	Std. Dev.	Min	Max	Share
1	18.0000	11.0000	7.0000	29.0000	0.2750
2	8.8125	7.3673	0.0000	24.0000	0.3000
3	55.6667	17.0848	33.0000	80.0000	0.5875
4	7.7500	7.2586	0.0000	15.0000	0.1875
Total	19.3571	21.7981	0.0000	80.0000	1.0000

TURKS: R2 = 0.74

Group	Mean	Std. Dev.	Min	Max	Share
1	0.0000	0.0000	0.0000	0.0000	0.0000
2	0.1875	0.5266	0.0000	2.0000	0.2000
3	0.5000	1.1180	0.0000	3.0000	0.3000
4	6.2500	2.8614	3.0000	10.0000	0.7000
Total	1.1071	2.4544	0.0000	10.0000	1.0000

ROMA: R2 = 0.67

Group	Mean	Std. Dev.	Min	Max	Share
1	32.0000	0.0000	32.0000	32.0000	0.0000
2	7.0000	5.3268	0.0000	15.0000	0.4688
3	13.3333	6.3158	2.0000	20.0000	0.5625
4	1.5000	2.0616	0.0000	5.0000	0.1562
Total	9.3571	8.7962	0.0000	32.0000	1.0000

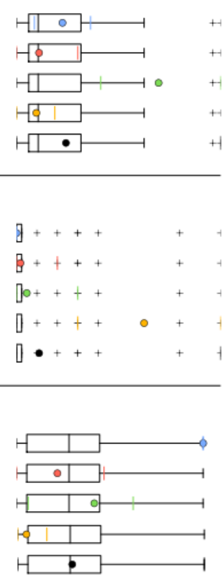


Figure 2 Analysis of data by variables

- Results of the grouping in two groups

In the first group fall 9 of 28 districts, and in the secoand group -19. In this case there is no similarity simultaneously of all three variables. In the second (red) group, the color points of only the two variables (Bulgarians and

Roma) fall in the black rectangles (total data range). In the first (blue) group, the district with the Turks variable are the most similar.

From the calculated statistics for the general dataset we can see that the highest value of $R^2 = 0.56$ is for the ”Bulgarians” variable. This indicates that for this variable, the districts are divided into groups most effectively.

- Results of the grouping in three groups

Similarly to the above considerations, the data are analyzed when grouped into three groups. In the first a group fall 15 out of 28 districts, in the second 4 and in the third group 9. In this case, the greatest similarity of the data for all three variables simultaneously is in the first (blue) group. The analysis by groups shows that the colored dots fall into the outlines of all three Boxplot boxes. From the analysis of variables, the claim of the highest similarity in the first group is confirmed.

The mean for the three variables in the first (blue) group are closest to their respective global values. For example, for the Roma variable, the mean of the group is 9.8667, and for the whole dataset it is 9.3571. In the second and third groups, these values differ significantly. For the same variable, we have the largest value for R^2 = 0.80, which is an indicator of the greatest similarity of the data in this group in terms of the variable Roma.

- Results of the grouping in four groups

When grouped into four groups, the districts with similar characteristics are allocated as follows. In the first group there are 2 districts, in the second group 16, in the third 6 and in the fourth 4. From the analysis by groups (Figure 1) it is obvious that in this distribution the districts into the second (red) group are the most similar for the three variables. The data similarity indicator with the highest value is R^2 = 0.77 for the ”Bulgarians” variable.

- Comparative analysis of the three ways of grouping

In order to properly analyze the distribution of the data, we need to evaluate which of the three clustering methods is most effective. To do this, we will compare the values of R^2 for the three variables in two, three and four groups.

As it is known, the value of R^2 indicates how much of the original data is retained after the grouping process. Table 1 shows that when grouped into two and three groups, the R^2 values differ significantly for the three variables. When grouped into four groups, in addition to the high R^2 values, they are observed to be almost identical for the three variables. This allows us to interpret the distribution of the data for this variant more accurately (in four groups).

Table 1. Values of R^2

Variables	Number of groups		
	2	3	4
Bulgarians	0.56	0.29	0.77
Roma	0.42	0.80	0.67
Turks	0.05	0.29	0.74

The analyzed data relates to all forms of hereditary peripheral neuropathies. The first group includes only two districts whose data are with mean for the group (18.0) close to the global mean value (19.35). We have similarities in the data of the Bulgarian and Turkish ethnic groups.
In the second group, the most numerous, are districts with similarity of data for all three ethnic groups. They fall within the range of the average number of affected individuals.
The third group includes districts with the highest number of patients, mainly from Bulgarian and Roma ethnic groups. The fourth group is dominated by data from the Turkish and Bulgarian ethnic groups.

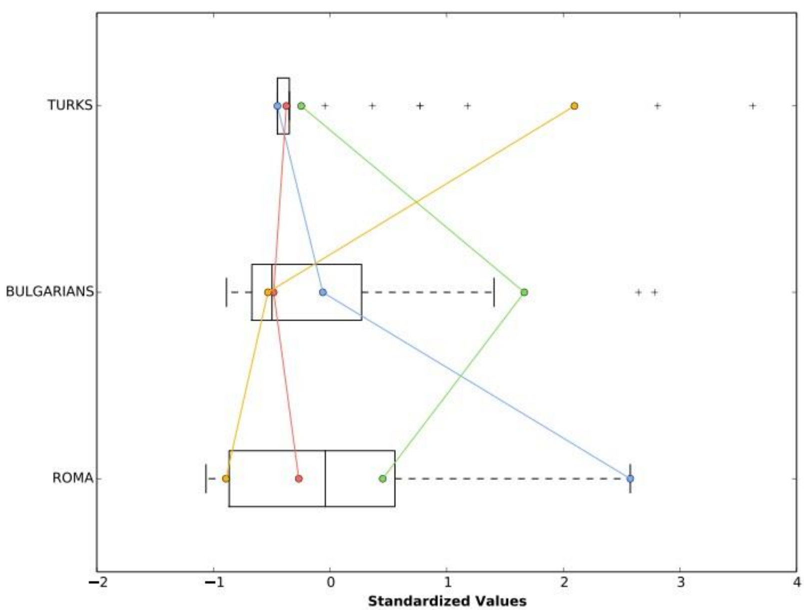


Figure 3 Parallel Box Plot

The parallel box plot graph (Figure 3) best summarizes the data, both the groups and the variables within them. The distribution of the high, medium and low values for the individual variables is more clearly distinguished here.

In the first (blue) group are the districts with the lowest number of sick patients from the Turkish ethnic group, the average values from the Bulgarian and the highest values for the Roma.

In the second (red) group, the number of diseased patients had averages for all three ethnicities, which is similar to the data for all three variables.

The third (green) group includes the districts with the highest number of affected for all three ethnic groups, but more Bulgarians.

The fourth (yellow) group reflects the districts with the highest values of the Turkish ethnic group, the average for the Bulgarians and the smallest number of affected are from the Roma ethnic group.

From the presented grouping options is obvious that the most accurate analysis is performed by grouping into four groups. This proves the importance of knowing well the data that we are analyzing in order to select the number of groups that will give us an insight of the data. In this case it is visible from the parallel boxplot chart and the compiled map that the districts colored in red have the most balanced distribution of patients in terms of their ethnicity. In the remaining districts there is a disproprotion of the affected individuals where in the yellow districts the most patients are from Turk ethnicity, in the blue from Roma ethnicity and in green from Bulgarian ethnicity.

4 CONCLUSIONS

The presented method of analyzing datasets gives us the opportunity to compile a more detailed map (Figure. 4) of the ethnic distribution of the affected individuals with hereditary peripheral neuropathies in the different districts of the country.

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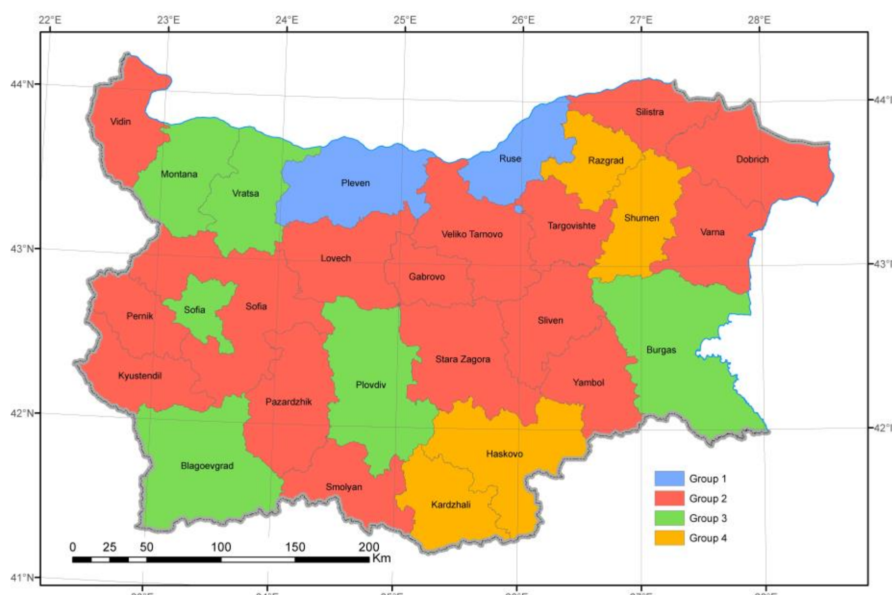

Figure4. Distribution of patients with hereditary peripheral neuropathies by group

ISSN: 1857-9000, EISSN: 1857-9019

DEVELOPMENTS OF CARTOGRAPHY IN ALBANIA

Pal NIKOLLI [1]

UDC: 528.9(496.5)

SUMMARY

The paper estimates that the first thematic map and the first economic map were created in the 4th century BC, and not respectively, in the seventeenth century AD and in the nineteenth century AD (year 1872), as defined by today's cartographic literature.
The first geological maps of Albania, which are considered the first thematic maps of our country, were created in the years 1828 - 1879 by the naturalist A. Boue and the geologist A. Vuquesnel. But, for the first time, a complete geological map of Albania was published by Novak in year 1929, in Salzburg. In the following years, geological maps at scale of 1: 200000 were continuously published. Albania's last geological map was published in 2002.
In addition to geological maps, ethnographic, economic, etc. maps have also been published. Ethnographic maps have been published by foreign authors such as: Lejean (1861), Saks (1877), Kiepert (1876, 1882), etc., but also by Albanian authors such as: N. Lako, A. Gashi, N. Kosturi etc., which are distinguished for a somewhat objective presentation of reality. During the time interval 1847-1913, 17 ethnographic maps were published.
In the National Library of Albania (NLA) there are about 180 different thematic maps in large scale, such as: physical map, map of animals and birds, tectonic map, hydrogeological map, map of forests and pastures, land cover map , political-administrative maps, seismic map, etc., and atlases such as: climatic atlas, etc., all for Albania.
Economic maps occupy a special place in the cartographic fund of the National Library of Albania (about 38 large-scale maps). The first economic map, which is found in NLA, is the one entitled "Albania [cartographic material], Roma, 1937, with statistics from 1936-1937 for the main agricultural and livestock products and for the registration of working animals of the prefectures: Kosovo, Shkoder, Durres, Dibër, Tirana, Elbasan, Berat, Korçë, Vlore and Gjirokastër
"Economic map of Albania - for schools", (wall map with color and size 87 x 48 cm), compiled by prof.dr. Vasil Kristo, former lecturer in the Department of Geography at the University of Tirana and published in 1963, is the first general economic map of the Republic of Albania.

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Key words: Cartography, Albania

INTRODUCTION

It has already been proven that cartographic representations have been used since primitive society, before the written language (Shehu and Nikolli, 2001). Cartographic literature defines that thematic cartography developed after the seventeenth century AD, when the exact maps that served as the basis for the creation of thematic maps were created. Thus, according to this literature, one of the earliest thematic maps is that of 1607, created by Jodocus Hondius, part of his Little Atlas. The map showed the distribution of major religions (Van der Dussen, Jan and Kevin Wilson, 1995). This map was subsequently followed by a thematic globe with the same theme (1614) .

An early contributor to thematic cartography in England was also the English astronomer, Edmond Halley (1656-1742). In year 1686 he created a star sketch map and published the first meteorological sketch map using basic maps. He had placed this map as part of an article he wrote about the winds of trade (Thrower, 2008).

According to the above descriptions, cartographic literature defines the seventeenth century AD as the time when the process of thematic mapping began. But on the other hand, the chinese maps of the 4th century BC, painted in black on wooden blocks and representing places where different types of wood could be collected along with the respective distances, can be considered as the oldest economic maps in the world, as they precede the maps economic of Strabo (Hsu, Mei-ling, 1993). Meanwhile, the literature defines that the "New Map of Europe" compiled by August Friedrich Wilhelm in year 1872 is considered the earliest economic map (Robinson, 1982). On this map were marked, by means of cartographic signs special products and the most important commercial regions of all European countries.

From the above we can say that since economic maps are thematic maps, we must consider the century IV BC as the time when the first thematic maps and the first economic maps were created and not respectively, the century XVII (for thematic maps) and century XIX (year 1872) (for economic maps). However, this is a topic that should be widely discussed by cartographers and ICA to finally decide when the first thematic and economic maps were created.

DEVELOPMENT OF THEMATIC CARTOGRAPHY IN ALBANIA

Thematic maps of Albania were created after 1820. Initially, geological maps were compiled by foreign authors, then ethnographic, economic maps etc., were compiled. Economic maps have been published by Bianconi (1886), Riedels (1906), etc. Political maps published by K. Peucker in 1902 and by G. Freytags in 1913 are like Kiepert maps (Shehu and Nikolli, 2001). There are about 180 thematic maps of Albania in the National Library of Albania, of which about 38 are economic maps.

Geological maps

The first geological maps of Albania, which are considered the first thematic maps of Albania, were created in the years 1828 - 1879 by the naturalist A. Boue and the geologist A. Vuquesnel (Nikolli, 2011). But, at the Albanian Geological Service archive there are also 6 geological maps in manuscript of this period in the scales 1: 2000000 - 1: 200000, which include the whole territory of Albania . Geological maps have also been published by Viquesnell (1841,1844), Toula (1882), Nopcsa (1905,1911), Veters (1906) etc., (Shehu and Nikolli, 2001).

In the years 1903 - 1912, A. Marteli created a geological map of Vlora in the scale 1: 200000, which he published in Rome in 1912. F. Nopsca, after several years of study, published in Budapest (1916) the geological map of Northern Albania in the scale 1: 200000. Also, geological maps of different regions of Albania were processed and published by various geologists, such as: Weters, Hammer, Roth, Telegt, Goebel etc., (Shehu and Nikolli, 2001; Shehu and Nikolli, 2005). We also mention here the map in the scale 1: 200000 entitled "Geological map of Southeast Albania", published in Paris in 1921 by J. Bourcart. For the first time, a geological map of the whole Albanian territory was published in Salzburg in 1929 by Novak . In 1943, S. Zuberi prepared in manuscript the geological map of Albania in the scale 1: 200000. In 1950, E.A. Stankjev and Z.A. Mishunina and E.A. Ivanova prepared the geological map of Albania along with explanatory notes, in the scale 1: 200000, for use in the oil industry. This map was published in 1957 in Leningrad with a limited number of copies .

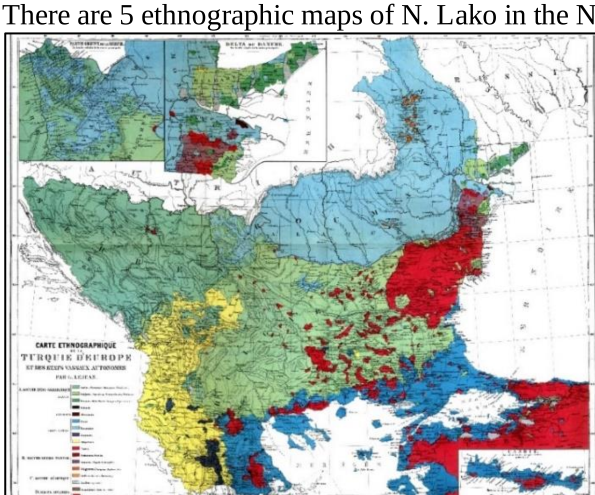
A group of Albanian geologists (T. Biçoku et al.), compiled (1967) and published in Tirana, in Albanian and in French, the geological map of Albania in the scale 1: 200000 together with the explanatory texts (1970, 1971) .

In 1990, the third geological map was published, entitled "Geological Map of the Socialist People's Republic of Albania" in the scale 1: 200000, compiled by a group of geologists (R. Shehu, etc.). In 2000, under the chairmanship of

A. Xhomos, etc., was compiled the geological map of Albania at the scale of 1: 200000, which was published in 2002 and was named "Geological Map of Albania".
In addition to the geological maps in the scale 1: 200000, maps of various scales have been compiled, which have remained unpublished and are in the Albanian Geological Service archive and that of the Institute of Geological Research. From 1997, the publication of the series of geological maps in the scale 1: 25000 based on topographic maps began.
The publication of geological maps is continuing to this day in order, all the information gathered, to make known to the scientific world and the public. In addition, work is underway to digitize these maps, creating multi-purpose digital interactive maps that can be used electronically via GIS. Hydrogeological, metallogenetic, geophysical maps in the scale 1: 200000 etc., have also been published .

Ethnographic maps

As a result of numerous historical events during the century XIX (such as the declaration of independence of some Balkan states and their desires to take from our lands considerable territories, etc.), we have important cartographic publications and especially publications of ethnographic maps. The latter have played an important role, as documents that have influenced in the protection of the remaining Albanian territories. We mention here the ethnographic maps published by Lejean (1861) (map 2.2.1), Saks (1877), Kiepert (1876, 1882), etc., but especially the ethnographic maps published by Albanian authors such as: N. Lako (map 2.2. 2), A. Gashi, N. Kosturi, etc. ., which are distinguished for indisputable truth (Shehu and Nikolli, 2001; Shehu and Nikolli, 2005). There are 5 ethnographic maps of N. Lako in the National Library of Albania.



Map 1. Guillaume Lejean's Ethnic map of European Turkey and its vassal states. 1861

Map 2. N. Lako. "Ethnographic Map of Albania" was published in 1913 in Paris.

During the XIX-XX centuries, F.W. Putzger has published many historical and ethnographic maps and atlases, in which the Albanian lands are presented in a large scale. We mention here the atlas entitled "Historischer Weltatlas", the content of whose maps is also found in other historical atlases (mainly in black and white) (Shehu and Nikolli, 2001).
In addition to the maps mentioned above by foreign authors, there are many other maps published in various parts of the world. During the time interval 1847-1913 alone, 17 ethnographic maps were published (Shehu and Nikolli, 2001).

Thematic maps of Albania after the Second World War

If topographic maps have covered the entire territory of the Republic of Albania, even in large scale (while in many developed countries of the world this requirement was not met), thematic maps have been missing in the required amount, especially in meeting the requirements of schools and many scientific institutions of Albania.
After World War II, thematic cartography in Albania was developed mainly by the former Enterprise of Teaching, Cultural and Sports Tools «Hamid Shijaku», Tirana; the former Center for Geographical Studies of the Academy of Sciences of Albania and private units (after the 1990s) (Shehu and Nikolli, 2001).
In the period 1954 - 1958, the former Enterprise of Teaching, Cultural and Sports Tools "Hamid Shijaku", Tirana, has published about 20 wall maps, including the physical map of Albania in the scale 1: 300000 and the atlases of Albania for primary schools. After 1963, many teaching maps and other cartographic products were published, such as: "Economic Albania", "Atlas of Albania" (for primary schools), "Geographical Atlas" for 8-year schools, etc. (Shehu and Nikolli, 2001).
In the ’70 years of century XX are published many physical maps, political-administrative maps and other topics, as well as school geographical atlases. Whereas, in the 80' years of this century, three-dimensional maps, relief models (in plastic-opaque measures) and thematic atlases were published, such as: map of animals and birds, geological map, tectonic map, hydrogeological map, forest and pasture map, physical map, political-administrative map, seismic map, etc., all of these for Albania and in scale 1: 200000. A work of great importance is the Climate Atlas of Albania, published by the former Enterprise of Teaching Tools, compiled by the former Hydrometeorological Institute and which is the most dignified capital work in the field of Albanian thematic cartography (Shehu and Nikolli, 2001). The former Enterprise of Teaching Tools also functioned in the '90 of century XX,

by publishing new maps and republishing old maps, in function of the messages that state and private institutions have had. Currently, this enterprise is no longer functioning.

Since 1986, when it was established, the former Center for Geographical Studies of the Albania's Sciences Academy has published a series of thematic maps and three-dimensional models of Albania. We mention here the political-administrative map of Albania in the scale 1: 200000 and 14 geographical atlases of the tourist potential of the Albanian coastal area and of some mountainous areas of Albania (Shehu and Nikolli, 2001).

One of the most successful achievements of the former Center for Geographical Studies is the creation for the first time, of a land cover map, in the scale 1: 100000, for the entire territory of Albania, according to the CORINE program. The creation of this map, utilizing (for the first time) satellite images, corrected and transformed to the scale 1: 100000, was completed in 1999 (Shehu and Nikolli, 2007). Currently, the Center for Geographical Studies no longer functions.

Thematic maps and other thematic cartographic products are published today by various private units, which are numerous. Already, the private sector is present in Albania's major cities.

However, in the cartographic products of these private units, many inaccuracies and errors are noticed (Nikolli, 2011), the elimination of which requires a close cooperation between cartographers and geographers and GIS specialists.

Economic maps

Economic maps have a special place in the cartographic fund of the National Library of Albania. Thus, we mention: Albania [cartographic material], Rome, 1937, with statistics from 1936-1937 for the main agricultural and livestock products and for the registration of work animals of the prefectures of Kosovo, Shkodra, Durres, Dibra, Tirana, Elbasan, Berat, Korça, Vlora and Gjirokastra; Economic Map of the Republic of Albania, Albania [cartographic material], in the scale 1: 500000 published in 1960 and 1978 by the former Enterprise of Teaching, Cultural and Sports Tools "Hamid Shijaku", Tirana (which reflects the situation in 1938), etc.

Later, in continuation, many other maps with economic content were published, such as: sheep - goats [cartographic material], in the scale 1: 420000, Tirana 1976; Electrification of Albania [cartographic material], Tirana 1970; light industry - economic map in the scale 1: 420000, Tirana 1972 and a series of other thematic maps that representing the chemical industry, construction materials industry, glass and ceramics industry, mineral industry, food industry, agriculture, livestock, etc., all these products of the former Enterprise of Teaching, Cultural and Sports Tools "Hamid Shijaku", Tirana. When it ended the electrification of Albania, on October 25, 1970, the former Enterprise of Teaching, Cultural and Sports Tools "Hamid Shijaku" published the map of electrification of Albania in the scale 1: 200000 (Shehu and Nikolli, 2001).

In the cartographic fund of NLA there are about 180 thematic maps, of which 38 are economic maps. To date, hundreds of economic maps of Albania have been published by state institutions and private enterprises. Of importance is the economic map of Albania that is currently in the Library of Congress, compiled by prof.dr. Vasil Kristo. It is a complete map and deserves special attention for all the values it carries.

“ECONOMIC MAP OF ALBANIA” (FOR SCHOOLS) IN THE SCALE 1: 400000, COMPILED BY PROF.DR. VASIL KRISTO AND PUBLISHED IN 1963

Economic map of Albania - for schools, (wall map, with color and dimensions 87 x 48 cm), was compiled in 1963 by prof.dr. Vasil Kristo, former lecturer in the Department of Geography at the University of Tirana and was published in late 1963 by the former Enterprise of Teaching and Sports Tools "Hamid Shijaku", Tirana (map 3.1.).

This is a general economic (statistical map) which represents all the main branches of the economy and it is the first complete general economic map of Albania. It contains mathematical, geographical and editorial elements. To compile this map, the author has collected a lot of data, analyzed and grouped them and presented them graphically. He has studied the content of special economic maps, previously published, and based on cartographic principles and criteria has correctly presented all the main indicators that characterized the economy of Albania at the time of compiling the map.

The author has paid special attention to detailing the objects of the economy and presenting those economic elements that are important and related to the predetermination of the map (for schools). The map shows the industrial centers, industry (in scalable graphics), agriculture and livestock, trees and forests, mineral resources, power plants, seaports, forests, etc.

This map shows detailed hydrography, road network, forests and borders. Less detailed are the inhabited centers, other elements of vegetation and relief. The road network is just as complete as on topographic maps in the same scale because it plays a special role in the development of the economy. The map contains a very detailed and simple legend to be understood by school students.

The author has classified industrial centers into 4 groups and then successfully used the methodology of the diagrams where circles with different radii represent the industry as a whole, while the sectors with which the circles are divided, represent special branches of industry such as metal processing industry, chemical industry, construction materials industry, glass and ceramics industry, wood and wood processing industry, light industry, food industry, polygraphic industry, oil processing industry and other different industries. The ordering of the various branches of industry, within geometric figures, has been done in a studied manner, starting from a certain direction for all figures. At first, the branches of heavy industry were placed in circles, then those of light industry, according to the importance they occupy in the country's economy, etc. The size of industry objects is shown by relative values.

Zones that provide the raw material (e.g., cotton planting areas, sugar beets, etc.) and those where the finished product goes, are given on the map by means of the areas. The geographical position of the mineral deposits is shown on the map by the method of symbols (for objects) and by the method of the areas (for mineral-bearing areas). We emphasize that in school maps, the cartographic signs of the mineral deposits are almost standard. Qualitative changes of mineral resources have been shown using different colors and shapes of symbols and areas. For fuel have been used dark colors, for the metallic minerals – red color, for the chemical industry – purple color, for building materials – orange color and for others – blue color. The hydropower plants have been shown by a star with sky color, inside of which is a broken, white arrow. The same signs are used for power plants, but the color is red, etc.

Agricultural crops such as cotton, sugar beets, olives, etc., are presented on the map by means of special cartographic signs compiled by the author himself. Natural signs have been used successfully, the size of which has been calculated in proportion to the statistical indicators of agricultural crops.

This map is the first of its kind compiled by an Albanian author in Albania. The map satisfies the scientific and methodological requirements of cartography for easy use by pre-university school students and university students. It is important to remember that at the time when this map is compiled, digital techniques were completely lacking and all calculations and graphic constructions are done manually. Therefore, for the technical and technological conditions of the time when it was created, this map is a great achievement.

Map 3.1. Albania's economic map: for schools. Compiled in 1963 by prof.dr. Vasil Kristo.

CONCLUSIONS

We think that a discussion should be opened about the time when the first thematic maps and the first economic maps were created. By the analysis of cartographic literature, it turns out that we must consider the 4th century BC as the time when the first thematic maps and the first economic maps were created and not respectively the century XVII (for thematic maps) and century XIX (1872) (for economic maps).

The first geological maps of Albania, which are considered the first thematic maps of Albania, were created in the years 1828 - 1879 by the naturalist A. Boue and the geologist A. Vuquesnel.

But, for the first time, a geological map for the entire territory of Albania was published in Salzburg in 1929 by Novak. In the following years, the geological maps of Albania were continuously published in the scale 1: 200000. The last geological map was published in 2002.

In addition to geological maps, ethnographic and economic maps, etc., have also been published. Ethnographic maps have been published by foreign authors such as: Lejean (1861), Saks (1877), Kiepert (1876, 1882), etc., but also by Albanian authors such as: N. Lako, A. Gashi, N. Kosturi, etc. During the period 1847-1913, about 17 ethnographic maps were published.

In the National Library of Albania there are about 180 maps with different themes in a large scale, such as: physical map, map of animals and birds, tectonic map, hydrogeological map, map of forests and pastures, map of land cover, political-administrative maps, seismic map, etc., and atlases such as: climate atlas, etc., all for Albania.

Economic maps have a special place in the cartographic fund of the National Library of Albania (about 38 economic maps in the large-scale).

“Economic map of Albania: for schools”, (wall map, with color and size 87 x 48 cm), compiled by prof.dr. Vasil Kristo (former lecturer in the Department of Geography at the University of Tirana) and published in 1963, is the first and most accurate general economic map of the Republic of Albania. It was compiled at a time when digital techniques were completely lacking, and all calculations and graphic constructions were done manually. Therefore, for the technical and technological conditions of the time when it was created, this map is a great achievement.

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ISSN: 1857-9000, EISSN: 1857-9019

CONTEMPORARY ARCHITECTURE IN SEISMIC ZONES, CONCEPTS AND REALIZATIONS

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UDC: 72.036:550.349

SUMMARY

With the rapid development of society and the demand for a better and more modern life, there is a need for the development of civil engineering in general, and of earthquakes. Recently, we are witnessed by many natural disasters occurring in the world, leaving huge footprints, taking a large toll on human lives and causing extensive material damage.
The main problems remain without clear and precise answers now. Which arise during the impacts of dynamic loads, and the origin of those loads can be from: earthquakes, winds, explosions, working with cars, etc.
Earthquakes are still one of the greatest nature threats which is causing to mankind. Although earthquakes cannot be prevented, modern science and engineering have provided the means and tools that if they will be used properly can significantly reduce the impact of powerful earthquakes.

Key words: *earthquake, seismic architecture, objects, seismic zones*

1. INTRODUCTION

The earthquake was and remains one of the most terrifying natural occurrences for mankind. During this occurrence, "man made" buildings collapse, major material damage is caused and, unfortunately, we have a large number of human casualties.
Earthquakes are associated with the creasing and tearing of the Earth's crust, respectively, with the physical activities that occur deep inside the Earth's

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interior. The interior of the Earth is still in a gaseous state where tectonic movements occur. The earthquake is due to the sudden movement of the tiles from which the Earth's crust is formed, during which earthquakes are created. The Earth's crust is formed by so called plates that are touched with each other in long cracks, i.e., cracks in the Earth. The thickness of the tectonic plates goes up to 70 km, under the seas, and twice as much under the ground.

In this paper, I will not deal with earthquake concepts and the causes of earthquakes. Areas where earthquakes occur, forces of action, calculations on earthquakes and so on.

But like architects, designers of construction sites in the regions where we operate, they are still limited in design and modeling due to seismic impacts. But in the world, it is quite different.

The analysis in the paper will be elaborated by questions and answers

2. QUESTIONS

2.1 QUESTION (1)

Does contemporary architecture in seismic zones differ from that in "calm" zones?

or:

How much does the earthquake affect the architectural shaping of objects?.

2.2 QUESTION (2)

Do basic seismic rules, such as:

- the necessary horizontal and vertical symmetry of objects,
- uniform distribution of stiffness and rigidity, etc.,

so that contemporary architecture in seismic zones is less interesting and attractive?

2.3 QUESTION (3)

Do standardized rules on the construction of buildings in seismic zones affect the quality of architectural expression?

3. ANSWERS TO THE QUESTIONS ASKED

- Architecture today represents a phenomenon that lies between art, fashion, and structure. It contains the characteristics of different disciplines, and above all it is diverse. The very dynamic development of science, as well as the constant technological transformation, have largely opened the door to new / non-Euclidean forms that are met today, as often as in the past, to domes or other regular forms.

- We are witnessing the redefinition of the phenomenon of beauty and its relation to the function of the object, which has produced "no structure" architecture, which reminds us more in scenery, design or sculpture, and less in true architecture, which should be at the service of its users. This complexity of architectural forms and expression requires complex analysis of construction.
- In addition to these trends in architecture, design norms and standards in seismic zones are 'moving in place' and consistently point out that simple forms respond better to seismic, so their performance during earthquakes can be predicted.
- The primary seismic requirement is horizontal stiffness for the two orthogonal directions of the object. Stiffness to the torsion is also a necessary condition. Symmetry and uniformity in the distribution of impediments are one of the basic conditions for a "sound project".
- There should be a certain hierarchy in the bearing system, namely, the vertical bearing elements need to be more rigid and rigid than the horizontal ones, which is a minor difference compared to the constraints in seismically inactive areas.
- There are also a large number of other secondary requirements, which in one way or another affect the configuration of the structure - object.
- The question arises: to what extent do these principles and rules restrict architects working in seismic zones?
- So far no study has been published comparing the architecture-urbanism of cities with different levels of seismicity, to identify the seismic factors that have influenced architecture, namely urbanism.
- Many factors influence the shape, size, and configuration of objects, making it impossible to identify the impact of seismic factors.
- Cities like Tokyo, Los Angeles, San Francisco, and Mexico City are just some of the metropolises that have been historically hit by powerful earthquakes.
- However, these cities are full of objects that with their shapes, dimensions and expressiveness do not speak of any restrictions on architecture.
- Irregularities in the composition are, for example, very pronounced in Los Angeles buildings.
- Escalations and "jumps" along with object height, curved walls, asymmetric retention systems, are almost everyday phenomena.

Good examples are the works of Californian architect Eric Owen Moss (Stealth building, Art Tower I Glass House) and Frank O. Gehry (Walt Disney Concert Hall - Fig. 4).

- On the other hand, Mexico City, a city with unfavorable geo-seismic conditions, which in 1985 experienced a truly devastating earthquake, is on the cutting edge of new architectural trends. After the earthquake, the construction of objects higher than 4 floors was not allowed. Today, the fear of the earthquake has been overcome.
Multi-story buildings, (Torre Bicentinarrio-350m, Torre Mayor 300m and those with complex geometries (Tayoma Museum Fig. 5,6,7)), can be found everywhere in the city.
- Japanese architecture is quite "rich" with asymmetrical structures at the base and height, with large consoles as well as sculptural forms. In general, Japanese objects are "heavier" and there are many examples where elements, asymmetric devices, are visible and important parts of the object's architecture (visible facades, etc.). On the one hand, there is frequent use of seismic insulation * and damper **, but on the other hand, there is no evidence that seismic parameters and factors are restrictive to Japanese architects.
Despite the island's regular seismic activity, Japanese architects have always been carriers and pioneers of interesting architectural solutions..
*) concept of seismic base isolation - the support of the object on several seismic isolators which with its flexibility amortize the effects of the earthquake. The object gains reduced seismic force.
**) Passive energy dissipators are special elements designed to absorb earthquake energy 3

3.1 TOKYO

- A good example is the TOD "s object, authored by Toyo Ito (Fig. 1, 2, 3).
- The design is inspired by the natural structure of the simple tree-trunk, where the "trunk" itself is the main driving force to the foundations, while the "branches" are thinner, respectively less loaded.
- This concept is reflected in the facade of the building, the facade which is also a retaining system, which consists of a series of "trees". No particular algorithm was used to determine their dimensions, but they were largely conditioned by aesthetic conditions.
- The facade, in addition to being the main retaining system, it also provides space without pillars on seven floors. This space, without pillars, implies the construction of a 50cm thick midrange, which in no small measure increases the seismic force, that is, the displacement of the object as a whole. To minimize horizontal displacements the object is seismically insulated at base*).

Figure 1 & 2: Inovative Structurec -Tod's Omotesando building-Toyo Ito-Tokyo

Figure 3: Inovative Facade- Tod's Omotesando construction

- Indeed, often extravagant forms can only be achieved by irregular facade construction, while the holding structure may be quite regular. Accounting and analysis are done the same as for simple objects, including the facade in the account only as a load on the primary structure.
- The situation is quite different when the non-symmetry and "irregularities" in the architecture of the building are achieved with the retaining design itself.
- The typical and extreme cases are the works of the famous architect Frank O. Gehry who with their complexity have confused and are constantly confusing many engineers

3.2 LOS ANGELES

- The orthogonal organization and positioning of the retaining elements in Gehry can rarely be met. Its objects must be viewed - analyzed only as three-dimensional, and the position of the key holding elements can very often only be described through X, Y and Z coordinates.

- Although 3D models enable detailed analysis both static and dynamic, in these cases engineers are almost completely dependent on software outputs and cannot predict object response.
- Modeling of the Walt Disney Concert Hall facility (Fig. 4), is implemented in CATIA software mainly used in the aviation and auto industries. At present, it is the only software that has the capacity for these types of modeling. For the same account, the same model has been exported to commercial SAP2000 software.
- The heavy dependence on software leaves engineers in the dark because standard formulas for accounting and dimensioning cannot be used in highly non-standard constructions. Due to a large number of approximations, it has not been possible to perform the test in a reduced model, so the software account remains the only way of analysis.

For this reason, designers have, in certain cases, pre-dimensioned some of the key retaining elements.

Figure 4: Walt Disney Concert Hall-Frank O Gehry

3.3 MEXICO CITY

- The 1985 Mexico City earthquake has left trauma and fear unspeakable to citizens. However, this fear has recently disappeared. Thus, the controversial Torre Bicentinarrio (Rem Koolhaas) project has not been halted due to its atypical configuration and high altitude (350m) but has been halted for other reasons, such as economic and property.

The Tayoma Museum building (Fig. 5,6,7) located on one of Mexico City's outskirts has been completed (May 2009). The main parts of the facility are consoles over 25 meters in length. The entire console design relies on the narrow concrete core, which is also the main carrier of seismic loads.

- The object generally represents a highly cumbersome seismic configuration.
- The account is made with SAP2000 and ETABS commercial software

Figure 5. Tayoma Museum Rojkind Arquitects & BIG (Mexico City)

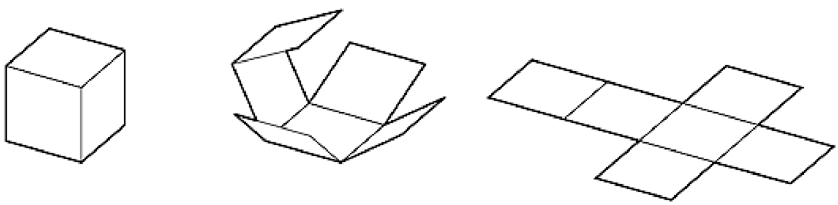

Figure 6. Initial concept of the museum

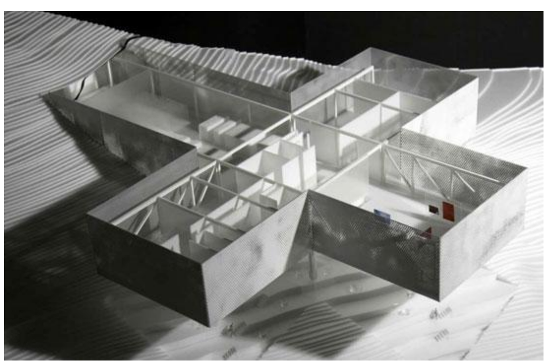

Figure 7. Model of Tayoma Museum

3.4 PEKINI (BEIJING)

- The Chinese National Television Building, CCTV, in Beijing (Fig. 8.9) designed by Rem Koolhaas, represents one of the boldest projects of today.

The size, shape, unstable configuration and seismicity of the site has produced an extremely complex static and dynamic analysis.

- The concept of holding is extremely inventive. Thus, the facade of the object also represents the main conductor of all lateral loads, thus creating a continuum holding tube. The largest shake table test to date has been carried out in China, the 1: 30 model, while the characteristic facade nodes have been tested in the 1: 5 model. Complex linear and nonlinear analysis was performed on over ten powerful software (Oasys LS-DYNA. GSA, GSRaft, CSI SAP 200, X-tract, MSC / Nastran, X steel).

- Seismic analysis is based on performance-based design - taking into account the 2500 year earthquake return period.

Figure 7. & 9. No stability illusion – CCTV- Rem Koolhaas

The elaboration of this paper is somewhat different from that of the researchers but the principle of what is a model and design philosophy in modeling structures. It presents a conceptual approach to the design of buildings today, especially multi-story structures. Today's architecture does not support a certain set of architectural philosophies and therefore deciphering the symbolism is highly subjective. Symbols are undefined today, it happens that architecture justifies the symbolism. This approach to architecture enables creators greater freedom, often inspiration is metaphorically and symbolically derived from the earthquakes themselves.

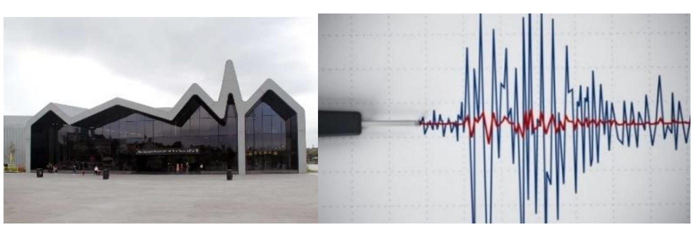

Figure 10. The Museum of Transport in Glasgow

Figure 11. De Beers Ginza Building Tokyo Japan

CONCLUSIONS

Resume (1)

- From these, but also many other examples, it can be seen that today's architecture is largely independent of seismic factors. Seismic factors do not prevent it from being diverse, asymmetric, irregular, fluid, extraordinary and at first glance contrary to basic asymmetric principles.
- A new approach to computation, analysis, fair and unreserved use of software, modeling, use of new materials and modern asymmetric equipment have made a major contribution to making modern architecture possible.

Resume (2)

- This situation is a bit different in our country. Although architects complain that seismic limits static spaces, increases the dimensions of retaining elements, limits console sizes, seismic factors play a secondary role in the architectural shaping of objects.
- Architecture in our country is more a product of meeting the requirements of functionality and economics, and there are rare instances where we can notice a "part" of the good contemporary world experience.

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THE GROWTH OF RUBBER IN THE PERSPECTIVE OF GEOMORPHOLOGY AND SOIL CHARACTERISTICS IN JEMBER INDONESIA

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UDC: 633.912.11-14(594)

ABSTRACT

This study aimed to analyze the suitability of land that can be covered with rubber trees and other vegetation in Jember in the persective of geomorphology and soil characteristics in Jember Indonesia. The research method used was survey and laboratory testing on soil samples taken from the study area. Five samples taken at different points. The analysis technique used in the form of descriptive analysis. The results showed dominated by clay soil texture, soil moisture worth 9-10 that indicates the soil is very moist. The old volcano as geomorphological factor has significant impact for high prduction of rubber in jember. Soil pH range 6-7 slightly acid to neutral. Soil organic matter content is very high and produce a lot of foam when reacted with H2O2 identified from soil dark brownish black.

Key words: Land Suitability, Rubber, Jember

INTRODUCTION

Results plantations in Indonesia is one sector that is relied upon to increase state revenues. This plantation is still promising given fairly extensive land throughout Indonesia. Both public and private companies widely established in Indonesia as PTP Nusantara. Indonesian soil and climatic conditions are suitable for plantation trigger optimization efforts plantation products in Indonesia.

One plantation crops grown in Indonesia is rubber. The rubber plant is a plant that has a high economic value. Not long to grow these plants only need 5 years already tapping sap. Rubber plantations in Indonesia, including the largest rubber plantations in Southeast Asia with an area of 3.5 million hectares. The existence of the above facts it is necessary to well manage. The

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characteristics of each area of course vary, therefore the assessment of the condition of the land needs to be done before planting. Adjustment of soil conditions, good cultivation techniques necessary so that productivity can reach a maximum target.

Have recently experienced problems of agricultural rubber crucial for disease. Reported Bisnis.com (Newswire, July 31, 2018), agricultural diseases such rubber leaf fall disease (Fusicoccum) attacked rubber plantation in seven provinces in Indonesia. Authority Gede, Bogor Rubber Research Center Director stated that the autumn leaves was first detected in 2016 in North Sumatra. After a few years later, in 2018 there were approximately seven provinces (North Sumatra, South Sumatra, South Kalimantan, Southeast Sulawesi, Central Java, East Java, and Lampung) who contract the disease this autumn leaves. According to Gede Authority is one of the causes of climatic factors and the lack of durability of rubber Indonesia. Of the seven provinces, about 22,000 hectares of land are affected by the disease fall leaves, The raw data obtained from company reports in seven provinces as of February 2018. As a result of this incident latex production has decreased. Banyuasin Sumbawa rubber plantation, which was supposed to produce 180 tons of harvest season in July-August, but only 90 tons with total area of 905 hectares. It is known that rubber production decreased 40-50% in 2018.

Achmad and Aji (2016) explained that the soil factors have an important role for the growth of rubber plants. Some indicators of soil must be met for the rubber trees can grow well which have a pH ranging from 6 to 6.42. The texture of the soil affects the soil structure, macro and micro activity in the soil. Besides the above, the efforts made in managing the rubber plant also has an important role, such as manure, the use of clones, mulch. Although rubber is not included plants that are difficult to grow, if the handling is not appropriate rubber will not grow optimally, because many existing crop pests. Today, many evolving techniques of rubber cultivation. Not only the look of natural factors as well that soil and climate conditions, but taking another way to make rubber plants grow well. One is diversification. This technique is a crop diversification efforts that exist around rubber plants. Was found a lot of rubber plantations interspersed with other crops such as sugar cane. The benefits of this perselingan can keep rubber plants from pests and land use. Noorcahyati, et al (2016) explain that action perselingan rubber plantations with other crops can protect plants from plant species penggangu rubber. However, please note diversion planted crops must correspond primarily to rubber plantation. Based on the above problems, hence the author examines the problem of land suitability for rubber plant growth, and takes the title "Suitability of Soil Against Rubber Plants and Other Vegetation in PTP NUSANTARA Rubber Plantation XII Glantang".

METHOD

The method used for surveying the field and laboratory testing. The field survey was conducted to determine the condition of the rubber plantation Glantangan PTP Nusantara XII, as well as soil sampling which will then be carried out laboratory tests. Soil sampling using ground ring. Besides measurement of humidity and pH using Moist Soil PH Detector Analyzer. Determination of soil color using Munsell Soil Color. Laboratory tests conducted to measure the concentration of organic matter in the soil using a chemical solution of 50% H2O2. Determination of soil texture conducted qualitatively by the sense of touch. The analysis technique used is descriptive analysis. In conducting the required analysis of several indicators, among others:

Table 1.Indicators Research

No.	Measurement indicators
1.	Coordinate
2.	Elevation
3.	Humidity
4.	Ph
5.	Organic ingredients
6.	Texture
7.	Color
8.	Geomorphology

Table 2. Point Location Research

Name Location	Coordinate
A	S = 08019'143.82 "E = 113041'15.61"
B	S = 08019'31.25 "E = 113041'00.61"
C	S = 08019'148.79 "E = 113042'30.31"
D	S = 08020'11.77 "E = 113042'17.88"
E	S = 08018'23.63 "E = 113041'47.39"

RESULTS AND DISCUSSION

Results

The results of measurements performed at five points PTP Nusantara XII Glantangan research Jember include measurement of elevation, soil texture, soil moisture, soil pH, organic matter, soil color and vegetation companion rubber plants. Pengkuruan The results can be seen in the table below:

Table 3. Results of Measurement Some Properties of Soil

locations	elevation	Soil texture
A	76 m	Smooth (a dusty clay)
B	81 m	Somewhat Smooth (clayey loam)
C	75 m	Medium (clay dusty)
D	73 m	Rather coarse (fine sandy loam)
E	84 m	Smooth (a dusty clay Clays)

Source: Data Measurement and Test Laboratotium 2019 Soil Sample

The texture of the soil in the study area is divided into five classes: dusty clay, clayey loam, dusty loam, sandy loam, clay loam dusty (Table 3). Soil structure in penentunnya influenced by the comparison between the particles of clay, sand, and dust. The main content in the soil that affect the structure of Rubber Plantation Glantangan is the structure of clay and sand. Different textures of each study site occurs due to differences in soil-forming factors, such as climate, parent material, topography, time, and vegetation. A study soil in a land that has a dusty clay structure, so that when it is done using the thumb touching land obtained results indicate the location A has a smooth texture. Land at the location B has a clayey loam structure and produce rather fine particle structure. Land at the location C has a dusty clay structure and indicate medium texture. Ground level in the D has the structure of fine sandy loam, showed slightly rough texture. Land at the location E has a dusty clay loam soil structure show rather smooth texture.

Table 4. Results of Soil Moisture Measurement

locations	Humidity	Information
A	10	very Moist
B	10	very Moist
C	10	very Moist
D	10	very Moist
E	9.5	Moist

Source: Data Glantangan 2019 Plantation Field Measurements

Based on the data in Table 4, the average soil moisture worth 10. Soil moisture indicates the number of water content contained in the soil. Humidity can be used to measure the degree of dryness of a land. The higher the number, the smaller the moisture level of dryness of a land. It can be concluded that the observation locations have an average water content much so that a small degree of dryness. Humidity research areas that have a value between 9-10 at a depth of ± 20 cm.

Table 5. Results of Soil pH Measurement

Locations	Soil pH	Information
A	7	Neutral
B	6	sourish
C	6	sourish
D	6	sourish
E	6	sourish

Source: Data Glantangan 2019 Plantation Field Measurements

Based on the above data, the average pH of the research area is pH 6. This shows the level of acidity. Sour-base reactions in the soil can affect the rate of decomposition of mineral and organic matter, forming clay minerals, the activity of microorganisms, the availability of nutrients for plants and directly or indirectly affect plant growth. zoom the soil pH at 1-14. pH was at five points in PTP Nusantara XII Glantangan has a soil pH that is different. A point of rubber land has a pH of 7, while at points A, B, C, D has a pH of 6. The pH soils showed 6-7 can be interpreted react somewhat sour-neutral.

Table 7. Results of Measurement of Soil Organic Matter and Color

locations	Organic ingredients	Soil color
A	A lot of froth, high organic matter	2.5 YR 3/3 Dark Reddish Brown
B	A little froth, low organic matter	5/4 10 YR Brown
C	A lot of froth, high organic matter	5/6 10 YR Yellow Wish Brown
D	A lot of froth, high organic matter	Brown 7.5 YR 5/4
E	Foamy medium, organic materials are being	4/6 10 YR Yellow Wish Dark Brown

Source: Data Measurement and Testing Laboratory Field Plantation Glantangan 2019

Based on research that has been done on average organic matter content has a lot of trials using the organic with 50% H2O2 reaction produces a lot of froth. This indicates that a lot of froth high organic matter content. A location that the soil found in standard colors on Munsel book soil color chart has 2.5 YR 3/3 Dark Reddish Brown. The land has a value of 2.5 YR hue value 3 and Chroma 3 and generate a lot of froth. This indicates that the content of organic matter contained in the soil is high. On the ground measurements with location B Brown 5/4 results obtained results indicate memliiki brown color and high organic matter content. On site measurement C has the result 5/6 10 YR Yellow Wish Brown. The land has a brown color. Location D result 7 5/4, 5 YR Brown obtained brown. E research location has 10 YR 4/6 result wish brown or dark yellow overall had a brown color.

Table 6 distribution of the region of Jember based on geomorphological factor and its relation to rubber growth *(Research finding, 2019)*

Region	Volcano Type	Impact on the rubber growth
Argopuro	quarter	low
Arjasa	Quarter	low
Bangsalsari	Mixed (quarter-tertairy)	low
Tanggul	Mixed (quarter-tertiary)	ow
Mayang	Tertiary volcanic	high
Silo	Tertiary volcanic	high
South Jember	Tertiary volcanic	high

The table above explains the influence between the types of volcanic mountains and the growth of coffee. The growth of coffee in a tertiary volcano is very good. This is caused by a combination of groundwater aquifer systems with air temperature and elevation.

Discussion

Soil texture

The soil texture indicates the relative ratio between the fraction of sand, silt, and clay (clay). Soil texture of a piece of land will affect the level of aeration, fertilizing the soil and easily whether the processing of land. Based on the results of measurements that have been done, the average land area of research fifth point has the texture of clay.In the triangle classification according to the USDA soil texture clay fraction has a very high surface area. clay fraction affects the availability of plant nutrients. Land in Rubber Plantation teksur Glantangan dominated by clay. According to the Rubber Cultivation Technical books issued by the Directorate General of Plantation (2009), the right soil to plant rubber textured sandy loam and sandy clay. This indicates that the texture of the land area suitable for planting rubber research. Clay-textured soils can absorb nutrients properly. Siregar (2018) describes the textured clay soil has a larger surface of the sand so that the ability to hold water and nutrients mempuyai high.The texture of the clay can be made where runoff also reduces the durability of the ground (Kurnianto, 2018). Rubber also will not grow if waterlogged excessive, but the area of research that has tekstru clay, rubber plants also continue to grow, Besides iu supported by the findings of clay-textured soils derived from basic rocks clay has the ability litifikasi long as part of the alluvial plain (Kurnianto, 2019), so it will play a role in retaining water that affect the nutrients and aeration. The results also showed that soil texture varies greatly not only alone but clay dusty loam, clayey loam, dusty loam, sandy loam, clay loam can dusty overgrown rubber plantations.

Soil moisture

Soil moisture depends on soil texture. Fraction of the soil in the ground showing grain texture / pores of the soil. The texture of sandy soil will have the ability to store water is low. Sandy soil texture will spend water supply quickly because the water storing capacity is very low, so that dry faster than plants growing in clay. High and low soil water-holding will mmpengaruhi size of soil moisture. The findings Karamina (2017), soil moisture depends on climatic factors such as temperature and humidity. Relation to atmospheric humidity, excessive evaporation will occur in areas with low air humidity and heat, ground water and consequently rises capillary into the soil profile. The situation is causing land Humidity level is low. As mentioned above, soil moisture depends on climatic conditions. Climate is a soil forming factors. When managing land using organic materials which one it will result in the increase of heavy metals and is absorbed by plants. Salinity will increase thereby affecting the process of soil formation. Total soil organic influenced by the nature of organic materials that are returned, the level of soil aeration, temperature, soil moisture, nutrient supply of properties. Measurement of soil moisture is needed to determine whether the soil is dry during the dry season and wet in the rainy season. By knowing the level of soil moisture can help optimization tillage and increase land productivity. Weather conditions in the study area that are still included in the transitional season between the rainy and dry seasons, rainfall in the study area is also quite high, resulting in high soil moisture, which ranges from 9-10.

Soil pH

pH was good with plants suitable conditions will allow farmers to cultivate the maintenance of the park so it is not too much. Rubber plants must have the proper acidity level that does not affect the growth processes in plants rubber itself. The rubber plant is a plant that is often grown on plantations. pH study area that shows the depth of 0-20 cm 6-7 with a pH suitable for growing rubber. Nurmegawati, et al (2014) pH corresponding to the rubber plant is 4-6. According to the General Guidelines for rubber cultivation by the Directorate General of Plantation (2009), a good ground for the cultivation of rubber has a pH of 4.3 to 5. This is not consistent with the findings in the field. Rubber plants can grow well despite having a pH of 6-7. Plant growth is influenced by soil reaction. Ground reaction is the level of acidity and alkalinity of the soil pH is expressed through the numbers. Availability of plant nutrients in the form of N, S, P, K affected by pH. Generally all the nutrients will be available when the pH of the soil in normal / neutral. According to the diagram of the effect of pH and availability of the chemical elements in the soil by Forth (1990), Nitrogen, Phosphorus, Sulfur is available in neutral pH. Iron and Manganese are available in an acidic pH. The pH value is also influenced by crop fertilization. Karamina, et al (2017) explain that the acidic pH arising from the use of fertilizers and continuous long-term. Inorganic fertilizers such as ZA will produce excess acid, the water will be hydrolyzed into H + ions. The acidity of the soil pH can be maintained using a buffering soil.

Rubber plant that has a normal pH will not need compost or other fertilizers to be done because ph fertilization or fertility of the rubber plant is appropriate (Firman, 2013). New discoveries in the study area itself does Glantangan plantation of rubber trees that flourish in spite of having pH 6 and 7. The factors of disease to be controlled in this rubber plant and must have the right balance of plants such as pH balance. Factors temperature, pH, and moisture is the biggest factor for controlling the rubber trees that are in the area of plantation (Diamond, 2013). Having a good soil fertility rubber then growth will increase, so that it can be concluded that the soil pH ranged PTPN XII Glantangan 6-7 still viable for planting rubber.

Soil Organic Matter and Color

Soil fertility can be seen from the color of the soil, organic matter content, pH of the soil, and vegetation growing on the land. Soil color can be used as an indicator measuring soil parent material, climatic conditions found in the area, and the latter can be used as indicators of soil fertility. Measurement of soil color is based according to a standard color on Puku Munsel soil color chart which, in the book there are three indicators namely hue (color spectrum is dominant in accordance with the wavelength), value (darker lightness in accordance with the reflected light), and Chroma (degree differentiator discoloration of gray or neutral white). According Saptaningsih (2016) of organic matter in the soil affects the properties that exist on the ground covering properties of biological, chemical fiisk and high organic tanah.bahan can be used as an indicator of soil fertility. In addition to organic matter, there is also the color of the land used as an indicator of soil fertility.

From the results of these measurements can be concluded that the soil contained in the Rubber Plantation Glantangan has fertile soil. Organic materials help provide substances for the plants to the formation of soil aggregates, help control runoff and erosion, improve water binding capacity and pass water. Soil organic matter affects soil properties such as color, structure, aggregate stability, pH, cation exchange capacity. According Margolang et al (2015) soils with high organic matter that can be said better soil and the soil has a dark color. Humus has a high organic matter content, which contribute color pigmentation colloidal humus black soil. Soil that has high organic matter usually has a darker color value and chroma value ≤ 3 (Sartohadi, 2016). As in the A site that has a value and chroma value of 3 and generate a lot of foam when reacted with H2O2 50%. Based on the research results, obtained new discoveries if Glantangan Rubber Plantation has a variety of colors at points B, C, D, E. Mostly of the four locations consisting of a dark brown, yellowish, until brown. If the previous researchers say that the dark color soil has a high organic matter of the present invention is that even dark colors do not land still has a high organic matter content. Organic matter content is influenced by soil depth and drainage. According Nurmegawati (2014), organic material at a depth of 0-20 is higher than the layer below it. Suharta (2017) To suggest that the productivity of the land is not determined on the basis of soil fertility naturally however, is determined by soil and plant responses to the application of the technology used in land management. In this case, researchers found that not only the land that has a black color (high fertility) however, suitable land will be able to make the tumbuhpasdatanah plants that have high productivity. Plants rubber plantations grow on land glantangan average has brown and yellowish brown brass. From these facts indicate that soil fertility levels are not too high can result in maximum productivity.

Accompanying vegetation Rubber Plant

Based on the survey results in PTP Nusantara XII Glantangan, besides the plant arch which became another major commodity crops are also planted around the rubber tree. Plants grown very varied including cocoa, sugar cane. Tropical areas situated around the equator in this area, especially adjacent to the ocean much rain. The influence of the evaporation of sea water during the day, the type of plants that grow varies, so in this area often encountered heterogeneous forests, plants that were found are from plantation and agriculture (Fachan, 2013). Soil in the study area is the land latosol. Latosol is a land that has progressed or differentiation occurs horizon. Latosol have ranges of properties in the solum, plate texture, crumb structure to blocky, friable consistency until firm, brown, red to yellow.

Vegetation in this Glantangan rubber plantation that was planted with rubber trees with an area of 1414.3 hectares, beberepa types of wood with an area of 390, 66 hectares for breeding 15.18 hectares and a small part planted by cocoa, sugar cane and beans (PTPN XII Region II Glantangan, 2012). The area is suitable as plantation because has fertile soil of this area has soils derived from tuff host rock originating from letuasan Mount Argopuro. Robby (2018) explain that the use of plantation land will have an impact on environmental degradation and the decreasing availability of the function of a neighborhood. One effort made is perselingan partly used as a cover crop land. Nuts are suitable for use as a soil cover because the plants that grow vines well as a small plant roots will not interfere with the main plant. Controversies crops such as sugar cane and cocoa done because of the step diversification, but it also prevents the plant perselingan rubber plants exposed to pests.

Vitello (2013), land is a state of the landscape influenced by the physical environment, climate, topography or relief, hydrology and vegetation that enveloped it and then it will affect the use of the land. Rubber Plantation Glantangan predominantly planted rubber trees has a climate and warm temperatures while the rubber plantations are common in low temperature. Topography or relief was also flat while the rubber plantations usually synonymous with mountainous terrain. Rubber plantation in Glantangan affected by the depression and tuff and breccia bedrock of Mount Argopuro so despite being in a low-lying area is still suitable for planting rubber trees. Latuamury (2012), challenging vegetation in fertility soils due to the abundant activity of vegetation organisms in rubber plantations Solid challenges with complications of rubber plants, sugar cane, cocoa, and a few sengon gardens. The groundwater aquifer system in Jember will have an infiltration effect that is not the same in one year. This is supported by elevations above 50 meters from sea surface. This is supported by Kurnianto (2018) the research results showed that several regions in North Jember and South Jember. Mid Jember is an older volcanic depression compared to the surrounding region. South Jember is a karst zone that is very vulnerable to losing the ability to store a ground water.

CONCLUSIONS

Land suitability study PTP Nusantara XII overall Glantangan according to plant rubber. The soil texture dominated by clayey and sandy loam is in accordance with a rubber plant. Moist soil moisture helps keep the rubber plants from drought. suitable soil pH so it does not need to be done on the ground pengkapuran this rubber plantation. Organic matter that provides nutrients that either assisted with land cover and perselingan the plant to avoid the erosion of rubber plants and plant pests.

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THE PLANNING OF THE FIRST AND SECOND ORDER RELATIVE GRAVIMETRIC NETWORKS FOR THE TERRITORY OF THE REPUBLIC OF ALBANIA

Fitore BAJRAMI LUBISHTANI[1] and **Bashkim IDRIZI**[2]

UDC: 528.27(496.5)

SUMMARY

This paper presents the first and second order gravimetric relative network planning for the territory of the Republic of Albania, as well as the calculation of free-air anomalies, Bouguer anomalies, and Bouguer gravity.

The planning of the first and second order relative gravimetric network is done for the whole territory of the Republic of Albania, based on the three absolute gravimetric points. The planning of the first order network is done using the 1 point/1000km2 surface criteria, while the second order network planning is done again using the 1 point/100km2 surface criteria.

The ArcGis software tested the best dot coverage of the network of triangles based on two criteria set out as above. The tests done on all three gravimetric absolute points shows that the best coverage of the whole territory, with first and second order points has absolute gravimetric points at Saranda station. So, taking this fact into consideration, a grid network has been built in ArcGis software based on regular triangles. As a result, 30 first-order relative and 289 second order relative points were obtained, for which the calculations of free-air anomalies, Bouger anomalies and Bouguer gravity using WGS84 parameters were performed in Excel.

To enable the calculation of free-air anomalies, Bouguer anomalies, and Bouguer gravity, first must be calculated the normal ellipsoid gravity, then the gravity of height and finally the reduction of free-air. Based on the measured gravity (which in our case was obtained the measured gravity point at the Saranda station) by adding free-air reduction and then removing the normal gravity value, the free-air anomalies were calculated.

Bouguer anomaly calculation first must be reduced to topography with the Bouguer plate, and then we remove the gravity of height at the gravity point P_0. Bouguer gravity is calculated from the measured gravity (which in our case is taken the measured gravity point at the Saranda station) by removing the Bouguer plate and adding free-

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air reduction. The calculations were performed in Microsoft excel software, where based on the values obtained from ArcGis software 10.2.2. maps were constructed for free-air anomaly, Bouguer anomaly, and Bouguer gravity for both planned ranks, which are presented within this paper.

Key words: Gravity, gravimetric networks, anomaly, first relative gravity network, second relative gravity network, Republic of Albania.

INTRODUCTION

Building a coordinate base of height is just as important as building a geodesic base plan. Gravimetric works in the territory of the Republic of Albania date since the liberation of the country, but these gravimetric works have been only for mining and geophysical research. The only gravimetric works for geodetic purposes have been performed at points of the first order of polygon level in the northern part of Albania, but they have been relative and unrelated to any absolute value.

The absence of absolute gravimetric and relative measurements makes it impossible to calculate ellipsoid – geoids' heights (N).

Only in 2015, with the initiative of the Norwegian authorities Statens Kartverk, it was possible to develop absolute gravimetric measurements for three countries in the region: Albania, Kosovo and Montenegro. In the Republic of Albania absolute gravimetric measurements were done at three points for the whole territory (Shkodra, Tirana and Saranda) taking as a base the station point in Saranda.

As long as, three gravimetric absolute points are not sufficient to calculate the height between the ellipsoid and the geoid, then it is needed to add lower order networks. Based on this fact, we have planned the 1st order relative gravimetric networks and the 2nd order relative gravimetric networks based on these three absolute gravimetric points.

Furthermore, free-air anomaly, Bouguer anomaly, and Bouguer gravity calculations were performed using WGS84 parameters. Based on the calculations made for these two planned orders, the respective maps were also constructed.

THEORY OF GRAVITY - PRINCIPLES OF THEORY OF GRAVITY

Earth's gravity field plays a major role in geodesy. The basis of the theory of gravity field stands in the definition that a body on the Earth's surface experiences Earth's gravitational force as well as centrifugal force due to the

rotation of the Earth, and this is what we call gravity. Gravity field theories have been treated in geodesy and geography textbooks, including: Heiskanen and Moritz (1967), Moritz (1980), Hofman-Wellenhof and Moritz (2005), Jeffreys (1970) and (2009), Lawrie (2007).
Physical geodesy is one of the disciplines of geodesy which deals with defining the shape and size of the Earth in general as well as defining the Earth's gravity field in particular. To determine the Earth's gravity field it is necessary to address some scientific issues such as:

- Potential theory
- Mathematical functions
- Boundary values
- Signal treatment etc.

According to Newton's laws of gravity, the mass of two points m1 and m2 attract each other with gravitational force (traction force) (Torge & Muller, 2011)

$$K = G\frac{m_1 m_2}{l2} \quad \dots(1.1)$$

where:
G represents the gravitational constant with a relative uncertainty of 1 x 10-4 and we present it as follows. (CODATA System of Physical Constants 2006; Mohr et al., 2008)

Equation (2.1) is symmetric: the mass m1 exerts a force over m2 but also m2 exerts a force above m1 of the same magnitude but in the opposite direction. Therefore we set m1 = m, then the attraction of gravity will be (Skuka Q. 2010):

$$a = G\frac{m}{r^2} \quad \dots (1.2)$$

where:
r - distance between the point mass and the point attraction. Gravity attraction has units m / s2. In geodesy the unit Gal is often used (by the name of Galileo), (Skuka Q. 2010):

$$1Gal = 10^{-2} m/s^2 = 1cm/s^2$$

$$1mGal = 10^{-5} m/s^2 \quad (1.3)$$

$$1\mu Gal = 10^{-8} m/s^2$$

THE EARTH'S GRAVITY FIELD

The Earth's gravity field consists of two parts: the first part is caused by Newton's law of attraction, whereas the second part is caused by the Earth's rotation. The ultimate force that is a result of gravity force and centrifugal force is called gravity force. These definitions can be formulated according to the rectangular coordinate system as follows: (Ameti P. 2006).

$$W_P(X,Y,Z)=V_P(X,Y,Z)+\phi_P(X,Y,Z) \qquad ..... (1.4)$$

where: VP - potential gravity is determined by:

$$V_P = \iiint_{Earth} \frac{dM}{l} \qquad ..... (1.5)$$

where:
dM - is the element of mass, l is the distance between the calculated point and the moving point, G is the Earth's gravity constant: G = 6.672x10l-11m 3s -2kg-1.

ϕP - is the centrifugal force potential given by (Heiskanen and Moritz, 1967) (Ameti P. 2006):

$$\phi_P = \frac{1}{2}\omega^2(X_P^2 + Y_P^2) \qquad ..... (1.6)$$

where:
ω-is the average angular velocity of the Earth's rotation,

XP and YP are the geocentric coordinates of the given point *P* within the reference system (fig.1.).

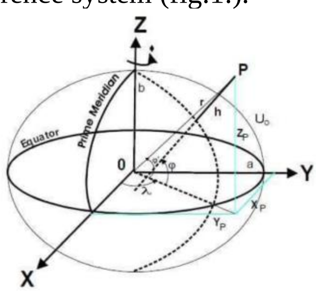

Fig. 1. Geocentric and ellipsoidal coordinates

$$V_P = \frac{GM}{r}\left[1 + \sum_{n=2}^{n-max} \sum_{m=0}^{n} (\frac{a}{r})^n P_{\overline{nm}}(sin\varphi')(\bar{C}nmcosm_x + \overline{S_{nm}}\, sin\lambda')\right] \quad ... (1.7)$$

METHODS OF GRAVIMETRIC MEASURES

Two different types of gravity measurements are done that are apparent: absolute gravity measurements and relative gravity measurements. If the value of the acceleration of gravity can be determined at the point of direct measurement from the data observed at that point, the measurement of gravity is absolute. If only the differences in the value of the acceleration of gravity are measured between two or more points, the measurements are relative.

Absolute Method

This method relies on the theory of free fall bodies, dating back to 1950 (Teddington Laboratory). Long before this method, Galileo used both physical and mathematical pendulum to determine the gravitational attraction of bodies, by which he measured the periods of longitude of mass oscillation pendulum under the influence of gravitational attraction force.

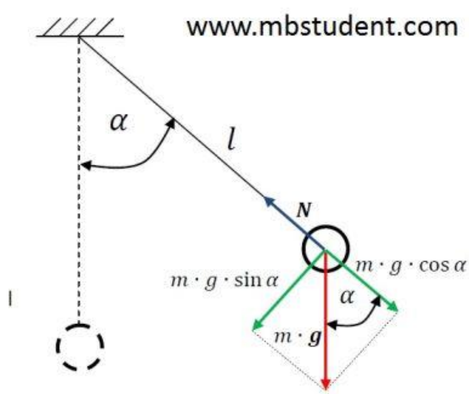

Fig. 2. Mathematical pendulum

The oscillation period unit is given based on the formula:

$$T_0 = 2\pi\sqrt{\frac{l}{g}} \quad \text{... (1.8)}$$

which can also be expressed as:

$$l = \frac{g}{\pi^2} T_0^2 \quad \text{... (1.9)}$$

The theory of free fall is based on the free fall body equation:

$$Q = m * g \quad \text{... (1.10)}$$

where:

m- mass of the body
g- gravitational attraction

Relative Method

Relative gravity measurement represents the solution to some problems of gravimetric geodesy that require knowledge of gravity acceleration of many points divided into a uniform way over the entire surface of the earth. The earliest measurements of relative gravity were made with reversible pendulum. Since the theory of relative pendulum measurements is somehow simpler than that of absolute pendulum measurements, the best accuracy was obtained from the first one (CHAPTER V PHYSICAL GEODESY, ngs.noaa.gov).
"Relative" gravity measurements yield the gravity difference between two stations or the variations of gravity with time, cf. [5.4.6]. Either time or length is measured, keeping the other quantity fixed. As a consequence, relative measurements can be performed more easily than absolute ones.
The pendulum method was still used until 1960 establishing gravimeter calibration lines, exploiting the fact that the pendulum results are given in the unit of acceleration and do not need to be calibrated. The pendulum method was superseded in the 1930s by elastic springs gravimeters.
For the pendulum method, the oscillation periods T_1 and T_2 of the same pendulum are measured at two stations P_1 and P_2 from (5.71) we obtain:

$$\frac{g_1}{g_2} = \frac{T_1^2}{T_2^2} \quad \text{... (1.11)}$$

or, after a simple transformation, the gravity difference:

$$\Delta g_{1,2} = g_2 - g_1 = -2g_1 \frac{T_2 - T_1}{T_2} + g_1 \frac{(T_2 - T_1)^2}{T_2^2} \quad \text{... (1.12)}$$

The relative pendulum method has been widely used since v. Sterneck (1887) developed a transportable device, pendulum length 25 cm, two pendulum

swinging on the same support in opposite phase in order to eliminate floor recoil effects (RECOIL layer effect).
Relative gravity meters use a counterforce to keep a test mass in equilibrium with gravity. Gravity changes in space or time are monitored by corresponding changes of the counterforce, which are transformed to the gravity unit by a calibration function. An elastic counterforce is used at most constructions, but magnetic counter forces are also employed, mainly in instruments operating on moving platforms and in stationary mode.
The elastic spring gravimeter is based on the principle of a spring balance. If gravity changes, the spring length will also change in order to maintain the static equilibrium between gravity and elastic force. According to Hooke's law, the strain is proportional to the stress for small elongations.
We distinguish between translation (rarely used) and rotational systems (Torge, 2001).

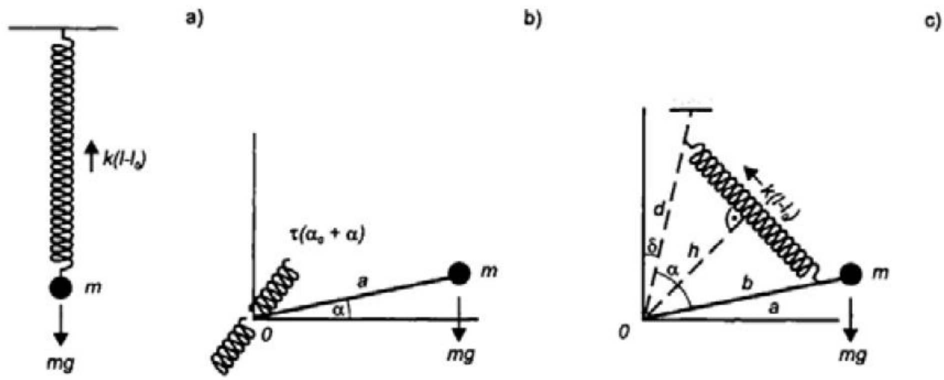

Fig. 3. Elastic spring gravimeter principle: a) vertical spring balance, b) lever torsion spring balance, c) general lever spring balance (Torge, 2001).

Modern relative gravity measurements are made with small, highly portable, easily used instruments known as gravimeters (gravity measurement). By using a gravimeter, relatively accurate measurements can be done at a specific location, known as a gravity station, in half an hour or less. Modern institutions of the gravimeter type were first developed in the 1930s.
Although at least 28 different types of gravimeters have been developed, only two types are widely used. LaCoste-Romberg gravimeter is used for most of the geodetic works today, although the Worden gravimeter has been widely used for such work in the past.
Since relative gravity surveys can only determine changes in gravity from one point to another, every relative gravity study should include measurements at one or more reproducible points where the acceleration of gravity is known.

Such points are called base stations. Then all measurements of gravity changes are calculated in relation to the known gravity value at the base station. Therefore, linking a relative gravity survey to a base station creates the gravity data of this study (CHAPTER V PHYSICAL GEODESY, ngs.noaa.gov).

PLANNING OF RELATIVE GRAVIMETRIC NETWORKS OF THE I AND II ORDER

In 2015, with the help of the Norwegian authorities, Statens Kartverk, absolute gravimetric measurements were developed for three countries in the region: Albania, Kosovo and Montenegro. In the Republic of Albania absolute gravimetric measurements were made at three points for the whole territory (Shkodra, Tirana and Saranda), taking into account the point at the Saranda station.

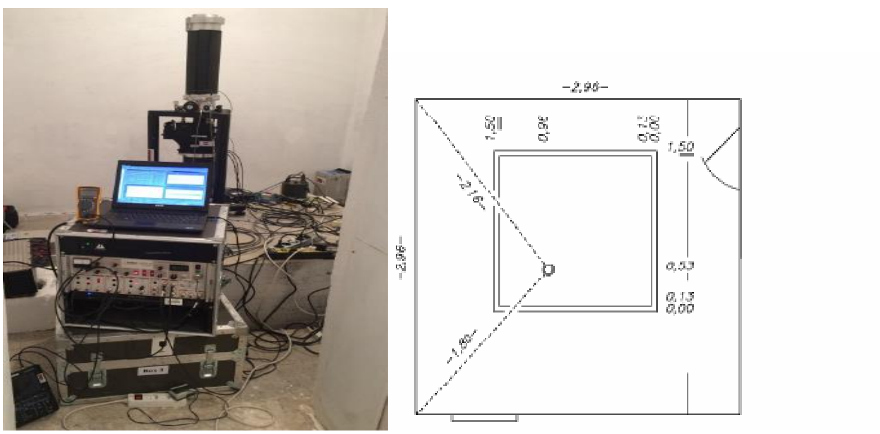

Fig. 4. Point at Shkodra station (Absolute Gravity Measurements Albania-Kosovo-Montenegro 2015; LIN12014 / 15/24 - Absolute Gravimetric Measurements).

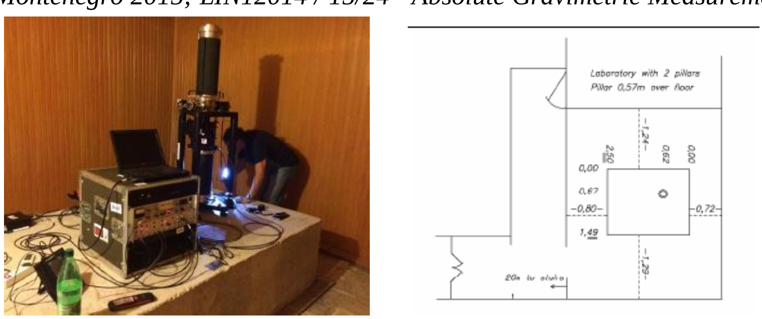

Fig. 5. Point at Tirana station (Absolute Gravity Measurements Albania-Kosovo-Montenegro 2015; LIN12014/15/24 - Absolute gravimetric measurements).

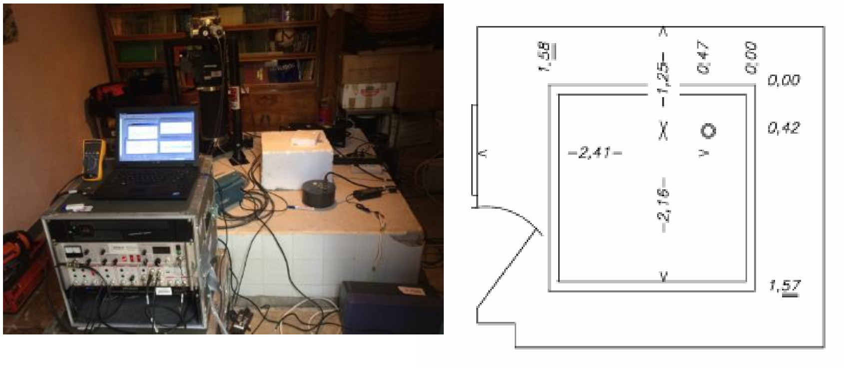

Fig. 6. Point at Saranda station (Absolute Gravity Measurements Albania-Kosovo-Montenegro 2015; LIN12014/15/24 - Absolute gravimetric measurements).

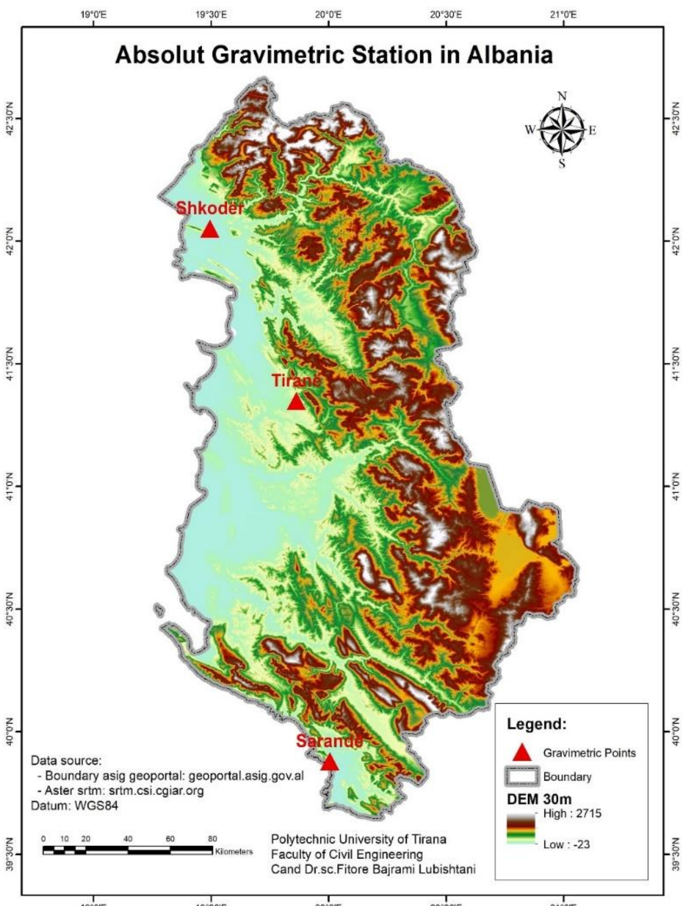

Fig. 7. Graphical representation of gravimetric stations

ISSN: 1857-9000, EISSN: 1857-9019

As a result of these absolute gravimetric measurements made at these three stations, the measured values for the three absolute gravimetric points for the territory of the Republic of Albania have been obtained.

Table 1: Representation of absolute gravimetric points at the three stations (Absolute Gravity Measurements Albania-Kosovo-Montenegro 2015; LIN12014/15/24 - Absolute gravimetric measurements):

Station	**City**	**Latitude**	**Longitude**	**Reference position**	**Height [m]**	**Reference height**
Albania_1	Shkoder	42°03'02.04"	19°29'46.89"	ETRS89	24.63	Sea level
Albania_2	Tirana	41°20'49.98"	19°51'48.17"	ETRS89	197.73	Sea level
Albania_3	Saranda	39°52’41.82"	20°00'19.01"	ETRS89	48.72	Sea level

All absolute gravity values are referenced to 1.22m over the pillar at each station. The measurement uncertainty varies between ± 2.4 and ± 2.7 μGal, which are typical values for observations with FG5 instruments at a good location.

Table 2: presents the measured gravity values for the three absolute gravimetric points (Absolute Gravity Measurements Albania-Kosovo-Montenegro 2015; LIN12014 / 15/24 - Absolute Gravimetric Measurements).

Stacioni	Location	Gradient [μGal/cm]	Gravity [μGal] at reference level 122 cm	Mean set scatter [μGal]	m-unc [μGal]
Albania_1	Shkoder	2,44	980270198,75	1,22	2,6
Albania_1	Shkoder	2,44	980270198,27	0,96	2,5
	Shkoder		**980270198,5**		**2,6**
Albania_2	Tirana	2,22	980159534,88	1,22	2,6
Albania_2	Tirana	2,22	980159535,54	1,16	2,6
Albania_2	Tirana	2,22	980159534,59	0,92	2,5
	Tirana		**980159534,9**		**2,6**
Albania_3	Saranda	2,69	980101429,44	1,17	2,6
Albania_3	Saranda	2,69	980101428,89	1,57	2,8
	Saranda		**980101429,3**		**2,7**

FIRST ORDER RELATIVE GRAVIMETRIC NETWORK

Taking into considering that the territory of the Republic of Albania has an area of 28,748km2 then we decided on the planning of these two networks according to the criteria of the surface network.

In the creation of first order relative gravimetric network, a test for starting the network was done.

Tests show that there is greater coverage of the whole territory, if we start from the point station at Saranda. The criterion we used is 1 point per 1000km2, from this set criterion a total of 38 triangles and 30 points of first order are formed. The longest length in this first order network is 44 719m, the shortest one is 33 1620m, while the average length is 35 986m.

SECOND ORDER RELATIVE GRAVIMETRIC NETWORK

The second order gravimetric network is a density of the first order gravimetric network, whereas the same is done for the construction of the second order relative gravimetric network. Initially testing has been done for the planning of this network. The tests done again show that the best coverage of the entire surface area has the same points as in the first order network. In the first variant is the point which is located at Saranda station. The criterion we used is 1 point per 100km2, from this established criterion a total of 492 triangles and 289 second order points were formed.

The longest length in the second order network is 14 141m, the shortest one is 9 999m, while the average length is 11 380m.

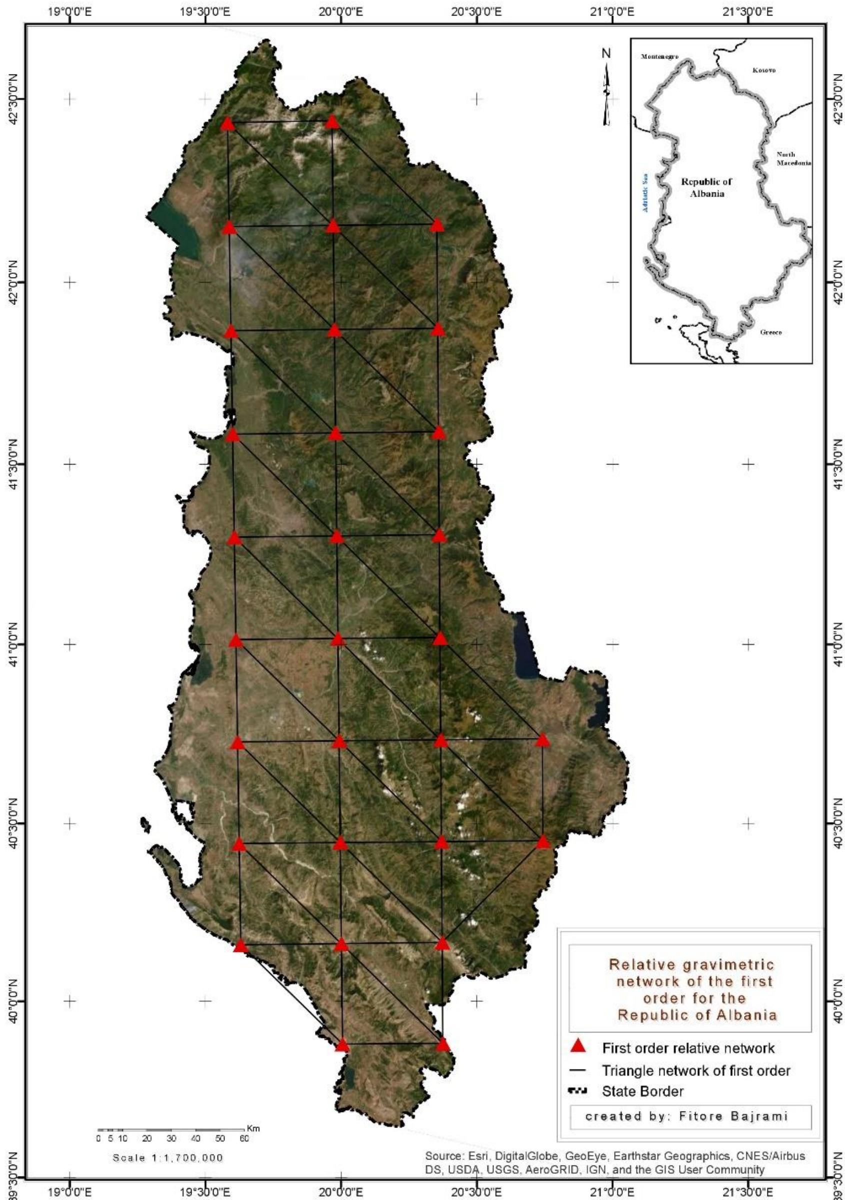

Fig. 8. Planned first order relative gravimetric network

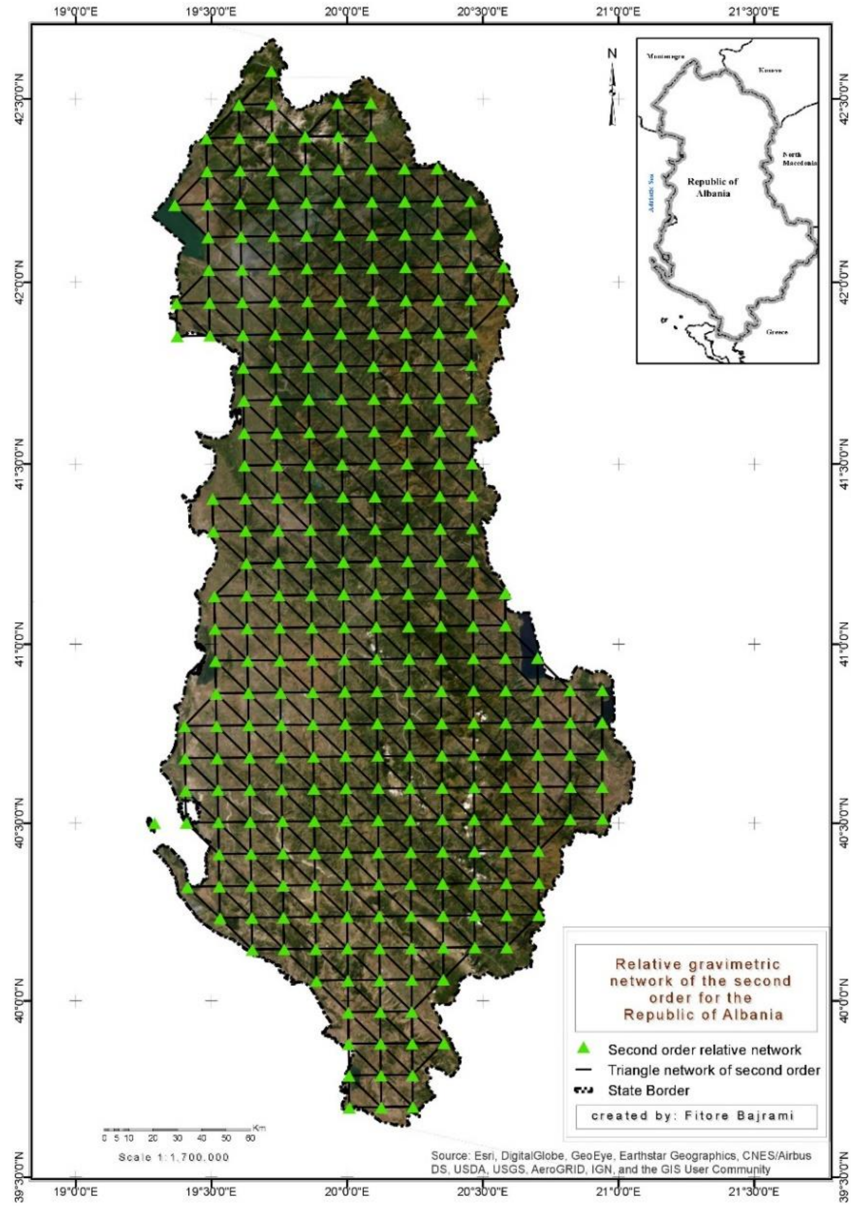

Fig. 9. Planned second order relative gravimetric network

CALCULATION OF FREE-AIR ANOMALIES, BOUGUER ANOMALIES AND BOUGUER GRAVITY

In order to accurately calculate free-air anomalies, Bouguer anomalies and Bouguer gravity, there were taken points even from outside of the territory of Albania. In function of the calculations for the first order and the second order there has been calculated a total of 724 points, while only within the territory of Albania, as planned points of relative gravimetric of the first and second order are 319 points. To enable the calculation of free-air anomalies, Bouguer anomalies and Bouguer gravity, normal ellipsoidal gravity, height gravity and then free air reduction must first be calculated.

Table 3: Presentation of WGS84 parameters (NIMA TR8350.2, January 2000):

Constant	Notation	Value
Second degree Zonal Harmonic	$\overline{C_{2.0}}$	$-0.484166774985 \times 10^{-3}$
Semi-minor Axis	b	6356752.3142 m
First Eccentricity	e	$8.1819190842622 \times 10^{-2}$
First Eccentricity Squared	e^2	$6.69437999014 \times 10^{-3}$
Second Eccentricity	e’	$8.2094437949696 \times 10^{-2}$
Second Eccentricity Squared	e'^2	$6.73949674228 \times 10^{-3}$
Linear Eccentricity	E	$5.2185400842339 \times 10^5$
Polar Radius of Curvature	c	6399593.6258 m
Axis Ratio	b/a	0.996647189335
Mean Radius of Semi-axes	R_1	6371008.7714 m
Radius of Sphere of Equal Area	R_2	6371007.1809 m
Radius of Sphere of Equal Volume	R_3	6371000.7900 m

Table 4: Presentation of derivative physical constants (NIMA TR8350.2, January 2000)

Constant	Notation	Value
Theoretical (Normal) Gravity Potential of the Ellipsoid	U_0	62636851.7146 m^2/s^2
Theoretical (Normal) Gravity at the Equator (on the Ellipsoid)	γ_e	9.7803253359 m^2/s^2
Theoretical (Normal) Gravity at the pole (on the Ellipsoid)	γ_p	9.8321849378m^2/s^2
Mean Value of Theoretical (Normal) Gravity	$\bar{\gamma}$	9.7976432222m^2/s^2
Theoretical (Normal) Gravity Formula Constant	k	0.00193185265241
Mass of the Earth (Includes Atmosphere)	M	5.9733328 x 10^{24} kg
m=w 2 a 2 b/GM	m	0.00344978650684

Based on the measured gravity (which in our case is taken the measured gravity point at the Saranda station), while adding free-air reduction and then removing the value of normal gravity, the calculation of free-air anomalies is done. The calculation of the Bouguer anomaly must first be done by reducing the topography with the Bouguer plate, and then the gravity at a point P_0 is removed from gravity of height. Bouguer gravity is calculated from the measured gravity (which in our case is taken the measured gravity point at the Saranda station) by removing the Bouguer plate and adding free-air reduction. The calculations in this work were done in Microsoft Excel by using WGS84 parameters and the derived physical constants.

In geodesy and geophysics, theoretical gravity or normal gravity is an approximation of true gravity on the Earth's surface by a mathematical model representing (a smooth physics) the Earth.
A more recent theoretical formula for gravity as a function of latitude is International Gravity Formula 1980 (IGF80), also based on the WGS80 ellipsoid but now using the Somigliana equation (Theoretical gravity):

$$g(\Phi) = g_e \left[\frac{1+k\sin^2(\Phi)}{\sqrt{1-e^2\sin^2(\Phi)}}\right] \quad .... (1.13.)$$

Where:
a, b are the equatorial and polar half axes,

$e^2 = \frac{a^2 - b^2}{a^2}$ is the eccentricity of the spheroid squared,

g_e, g_p is gravity at the equator and pole,

$k = \frac{bg_p - ag_e}{ag_e}$ constants

On the basis of these parameters of the world geographic system WGS1984 the following value is obtained:

$$g_p = 9.8321849378 \frac{m}{s^2} \quad \text{.... (1.14)}$$

When the geodetic height (h) is small, the normal gravity on the ellipsoid can be estimated by continuing *g* on the ellipsoid surface using a shortened Taylor series expansion (Nima, 2000):

$$\gamma_h = \gamma + \frac{\partial \gamma}{\partial h} h + \frac{1}{2} \frac{\partial \gamma}{\partial h^2} h^2 \quad \text{.... (1.15)}$$

An extension of the Taylor series often used for normal gravity over the ellipsoid with a positive downward direction along the geodesic normal to the reference ellipsoid is:

$$\gamma_h = \gamma [1 - \frac{2}{a}(1 + f + m - 2f sin^2 \Phi) h + \frac{3}{a^2} h^2] \quad \text{.... (1.16)}$$

where:

$$m = \frac{\omega^2 a^2 b}{GM},$$

f- Plate of ellipse
a- Semi-major axis,
Φ- Geodetic latitude,
γ- Normal gravity on the ellipsoid at geodetic latitude Φ.

FREE- AIR ANOMALY

Free-air anomaly is the gravity anomaly measured after a free-air correction is made to correct the height at which a measurement is made. Free air correction does this by adjusting these measurements of gravity to what would have been measured of a reference level.
For a theoretically correct reduction of gravity to the geoid, we need the vertical gradient of gravity. If g is the observed value at the surface of the earth, then the value *go* at the geoid may be obtained as a Taylor expansion. (Wellenhof & Moritz, 2005):

$$g_0 = g - \frac{\partial g}{\partial H} H \qquad \text{... (1.17)}$$

where H is the height between P, the gravity station above the geoid, and P_0 *the corresponding point on the geoid*. Suppose there are no masses above the geoid and neglecting all terms but the linear one, we have:

$$g_0 = g + F \qquad \text{... (1.18)}$$

where

$$F = -\frac{\partial g}{\partial H} H \qquad \text{... (1.19)}$$

is the "free air" reduction to the geoid.

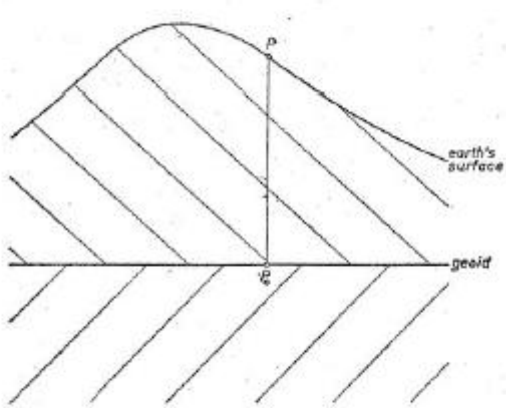

Fig. 10. Gravity reduction (Heiskanen & Moritz, 1967)

If instead of the normal gradient gravity ∂g / ∂H is related to the ellipsoidal height h, we obtain ∂γ / ∂h (Hofmann-Wellenhof & Moritz, 2005):

$$F = -\frac{\partial \gamma}{\partial h} H = +0.3086H \text{mga} \quad \text{... (1.20)}$$

BOUGUER GRAVITY

The objective of the Bouguer reduction of gravity is the complete removal of the topographic masses, that is, the masses outside the geoid (Heiskanen and Moritz, 1967).
According to (Heiskanen & Moritz, 1967) Bouguer plate is presented as follows. Assume the area around the gravity station *P* to be completely flat and horizontal (Fig. 500.500), and let the masses between the geoid and the earth's surface have a constant density p = 2.67g / 〚cm〛 ^ 3.

$$A_B = 2\pi G\rho h \quad \text{... (1.21)}$$

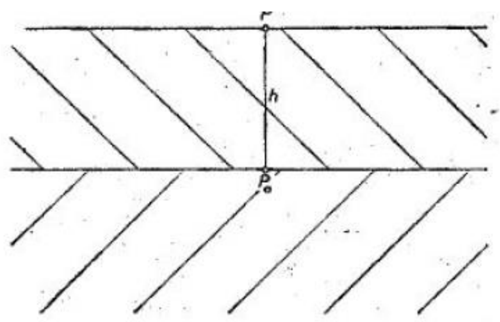

Fig. 11. Bouguer plate (Heiskanen and Moritz, 1967)

By well-known rules of the calculus, we obtain as the attraction of an infinite Bouguer plate, where G represents the gravity constant, ρ is the density of the infinite plate of cliff between h height and sea level, we obtain G from (equation 2.3) and by assuming a constant density, Bouguer's correction is 1.1 x 〚10〛 ^ (- 6) m / s ^ 2 per meter height (Geology.cwu.edu).

$$A_B = 0.1119\text{h mgal} = 0.1119 \text{ mGal } m^{-1} \quad \text{...(1.22)}$$

To complete our gravity reduction, we must decrease the gravity station from *P* geoid, to P_o. This is done by applying the free-air reduction because after

removing the topography, station P is in "free air". This is called complete Bouguer reduction (Heiskanen & Moritz, 1967).
Its result is Bouguer gravity at the geoid:

$$g_B = g - A_B + F \quad \ldots(1.23)$$

With the assumed numerical values:

$$g_B = g + 0.1967h \quad \ldots(1.24)$$

Bouguer anomalies are used for regional and local research as long as they are free from the effect of topography. They mainly reflect density anomalies in the crust and upper mantle and may be related to tectonic structures such as ocean ridges, deep sea canals, new mountains, and upper mantle structures (Torge & Muller, 2001).

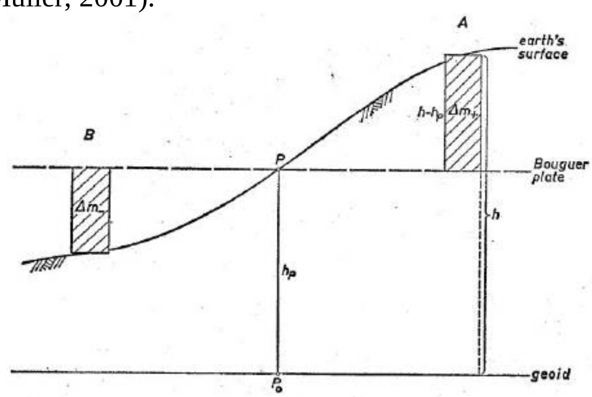

Fig. 12. Terrain correction (Heiskanen and Moritz, 1967)

Since gB now refers to the geoid, we obtain genuine gravity anomalies, by subtracting normal gravity γ referred to the ellipsoid:

$$\Delta g_B = g_{\boldsymbol{B}} - \gamma_0 \quad \ldots (1.25)$$

They are called Bouguer anomalies.

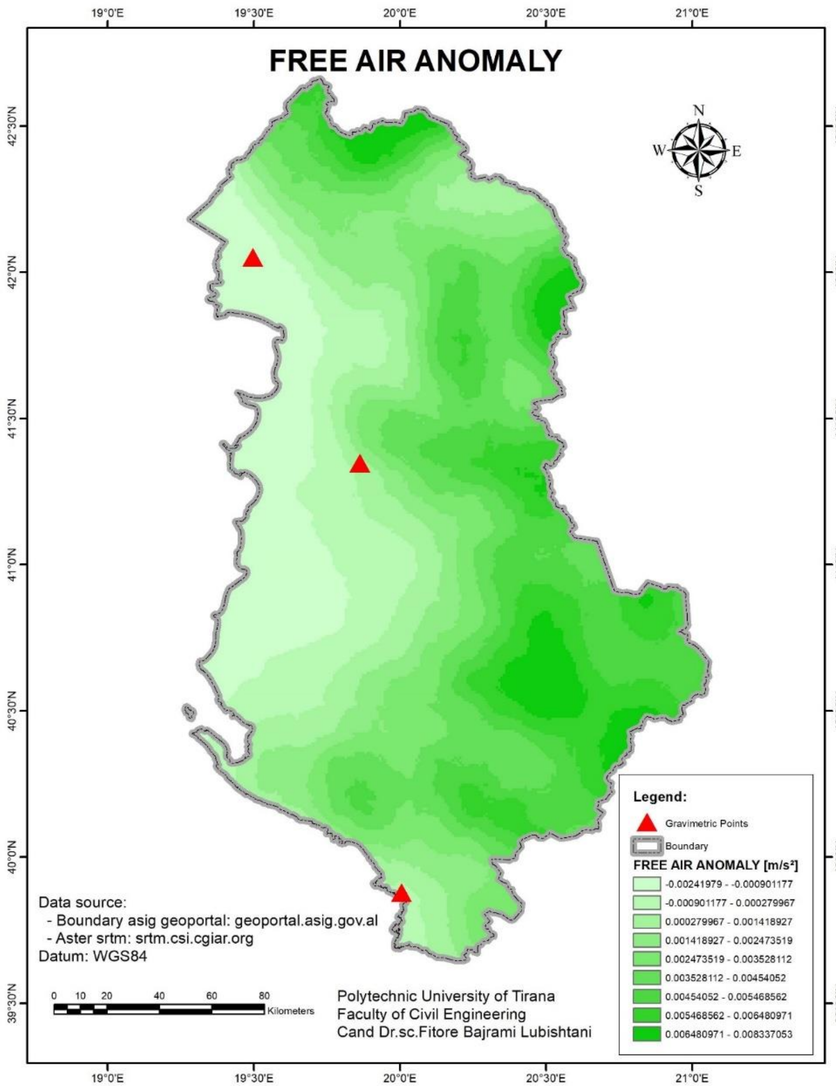

Fig. 13. Free air anomaly for first and second order gravimetric relative

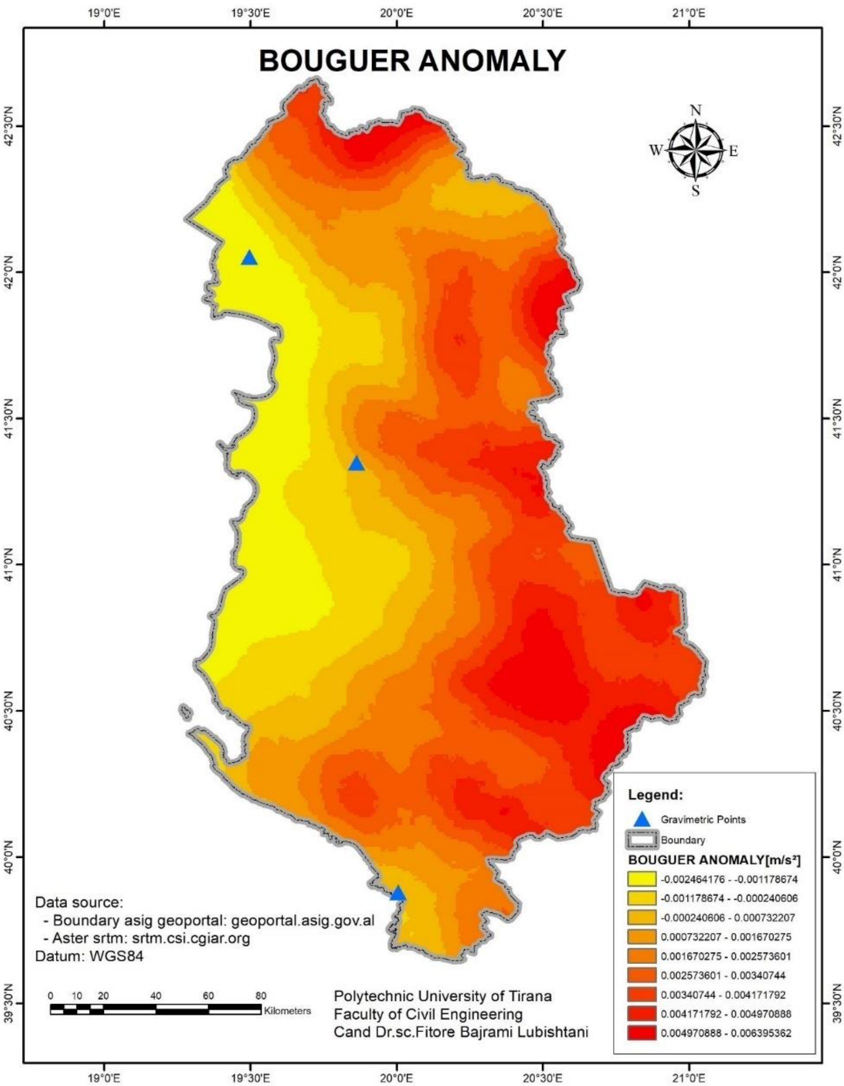

Fig. 14. Bouguer anomaly for first and second order gravimetric relative

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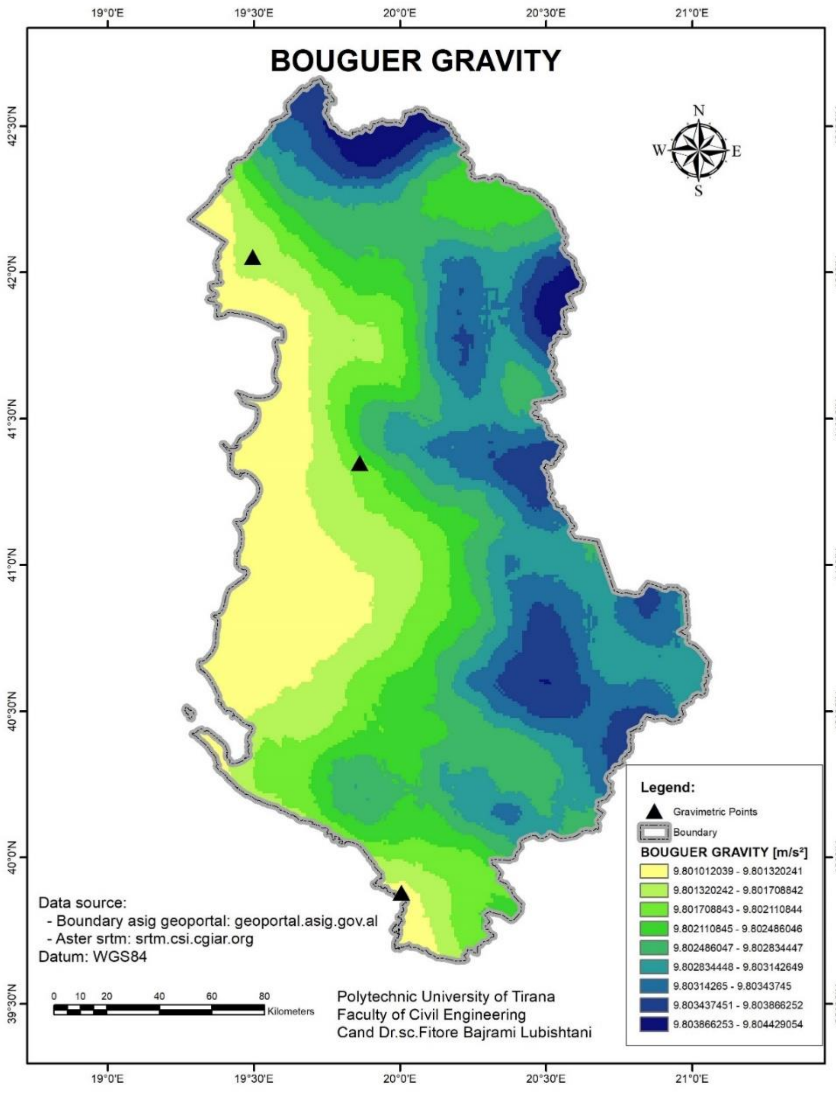

Fig. 15. Normal gravity for first and second order gravimetric relative

CONCLUSIONS

Geodesy aims designation and definition of the shape and physical size of the Earth. The part of Geodesy that deals with determination of the physical form of the earth is called physical Geodesy.
Geophysics - The field of gravity of the earth reflects the internal allocation of inner mass, the determination of which is one of the tasks of geophysics.
The mean sea level approximates the geoid, that special surface of equatorial potential of the Earth's gravity field that should serve as the global reference height surface.
The surface of the geoid is mostly used on the reference surface of the heights for continental description, as well as the topographic surface of the sea (Torge & Muller ed.4 2011). One reference surface is called the geoid, while the other reference surface is the ellipsoid. The use of the ellipsoid as the reference surface for the gravity field is relatively recent.
Nowadays the determination of heights is directly related to gravimetric measurements, whether they are absolute or even relative. Since building the coordinate base at height is just as important as building the geodesic base in the plan. But the lack of gravimetric measurements makes it impossible to calculate ellipsoid-geoid heights (N).
As it is known in Albania there were no absolute gravimetric measurements until 2015, where absolute gravimetric measurements were performed at three points, while relative gravimetric measurements are not performed yet.
The main purpose of this paper was the planning of the first and second order gravimetric realistic network and to calculate the Bouguer anomaly, free-air anomaly and Bouguer gravity for all points of these two planned networks. The projected density points of these two relative gravimetric networks are in accordance with European standards.
As Albania is still in the process of planning such networks, this paper may serve as a basis for further steps in the planning and field realization of relative gravimetric measurements.
Gravity is not uniform. It varies geographically. In geodesy and geophysics, the Bouguer anomaly (named after Pierre Bouguer) is a gravity anomaly, corrected for the height at which it is measured and the traction of terrain. The height correction alone gives a free-air gravity anomaly. A complete-Bouguer anomaly contains a terrain correction that uses a more complete representation of the local topography, which is necessary for accurate gravity values in mountainous areas.

Bouguer anomaly it is believed to indicate both the gravity field/mass and the density variations. The theory of gravity states that gravity field is proportional to the mass distribution irrespective of the density of the sources.

Based on the above mentioned, but also based on the results obtained from the calculation of Bouguer anomalies and base on the maps constructed, it is concluded that the attraction of terrain around the sea surface is in a lower density, while in mountainous areas the attraction of the terrain is higher.

Bouguer anomalies take into account factors such as latitude, longitude, altitude, and the rotation of the earth and are often seen as evidence of local variations in the density of the earth.

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