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

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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)

$$K = G\frac{m_1 m_2}{l2} \qquad \ldots(1.1)$$

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):

$$a = G\frac{m}{r^2} \qquad \ldots(1.2)$$

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):

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

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

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

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.).

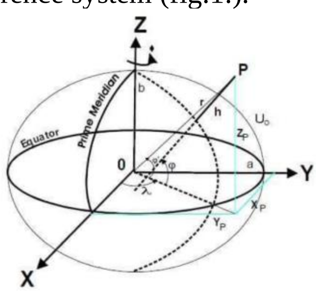

Fig. 1. Geocentric and ellipsoidal coordinates

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

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.

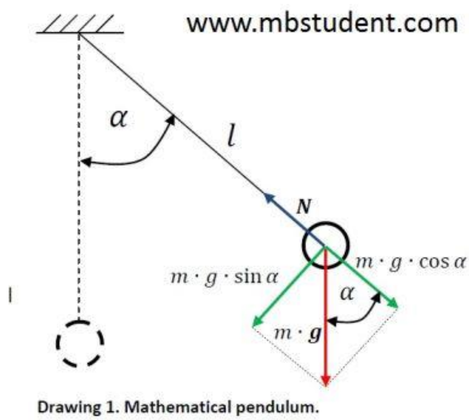

Fig. 2. Mathematical pendulum

The oscillation period unit is given based on the formula:

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

which can also be expressed as:

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

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

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

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:

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

or, after a simple transformation, the gravity difference:

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

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).

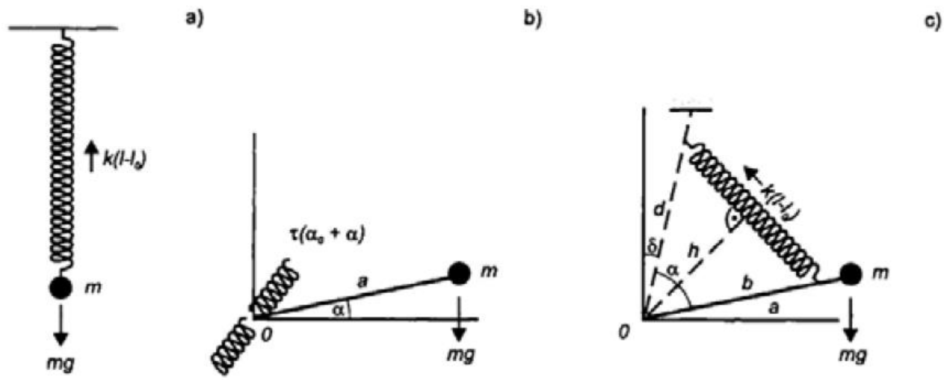

Fig. 3. Elastic spring gravimeter principle: a) vertical spring balance, b) lever torsion spring balance, c) general lever spring balance (Torge, 2001).

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.

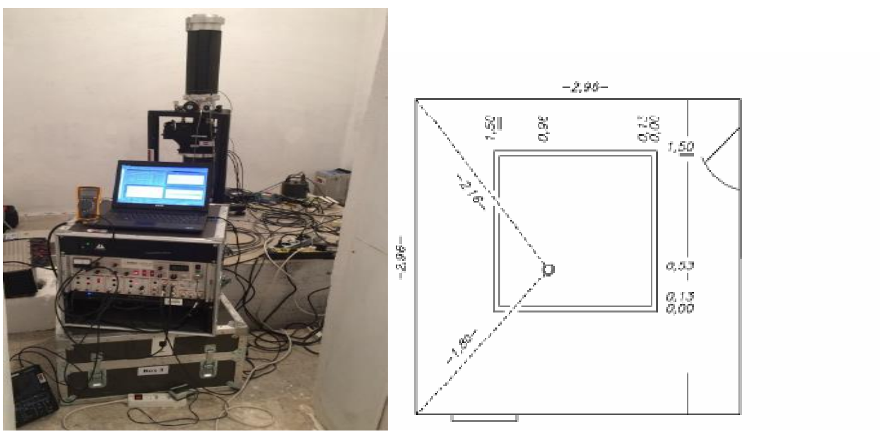

Fig. 4. Point at Shkodra station (Absolute Gravity Measurements Albania-Kosovo-Montenegro 2015; LIN12014 / 15/24 - Absolute Gravimetric Measurements).

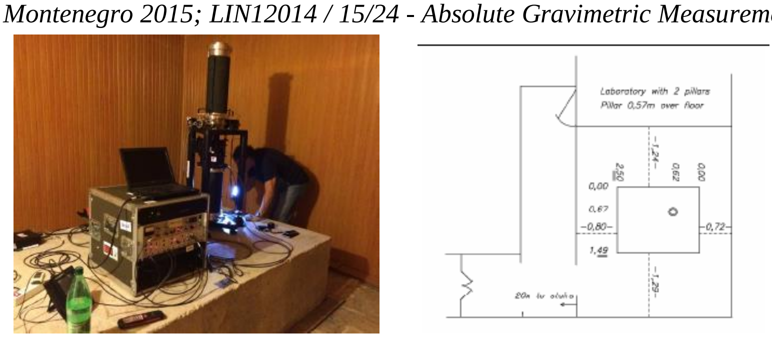

Fig. 5. Point at Tirana station (Absolute Gravity Measurements Albania-Kosovo-Montenegro 2015; LIN12014/15/24 - Absolute gravimetric measurements).

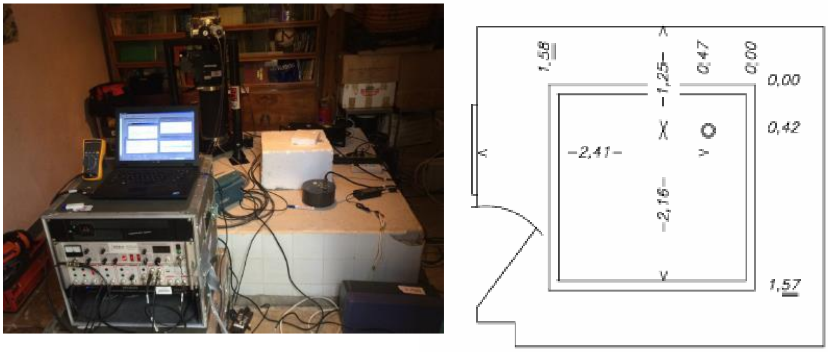

Fig. 6. Point at Saranda station (Absolute Gravity Measurements Albania-Kosovo-Montenegro 2015; LIN12014/15/24 - Absolute gravimetric measurements).

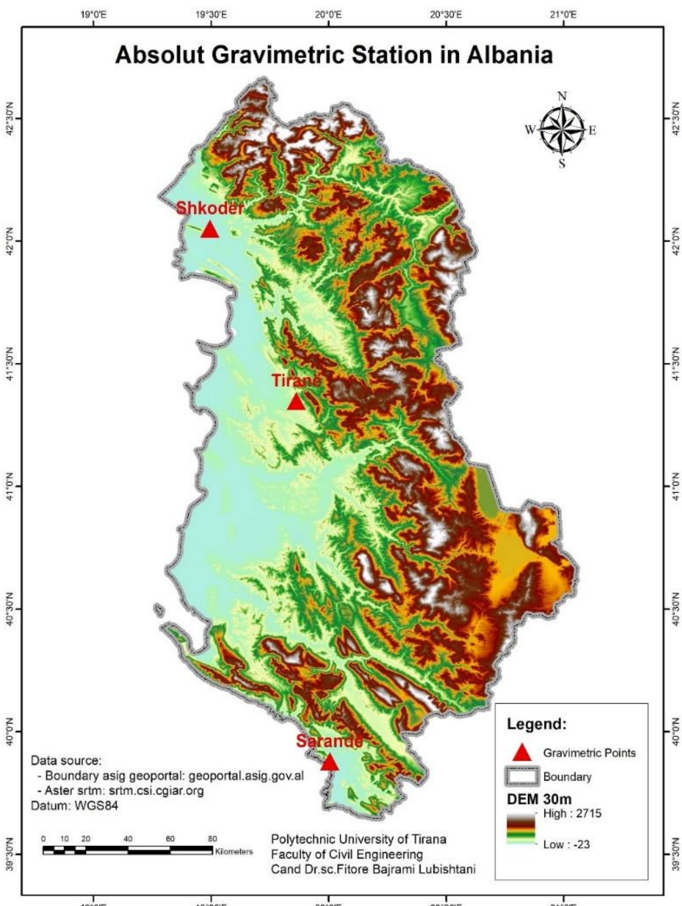

Fig. 7. Graphical representation of gravimetric stations

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.

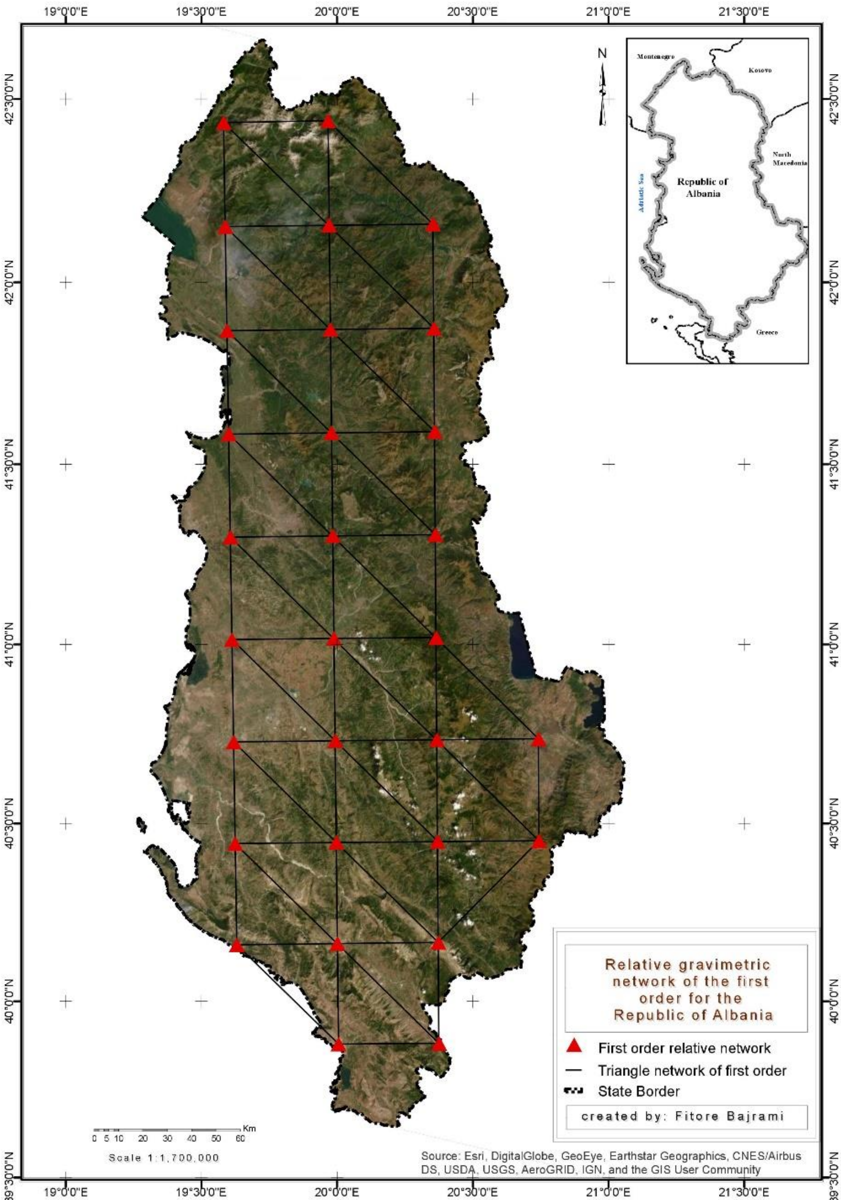

Fig. 8. Planned first order relative gravimetric network

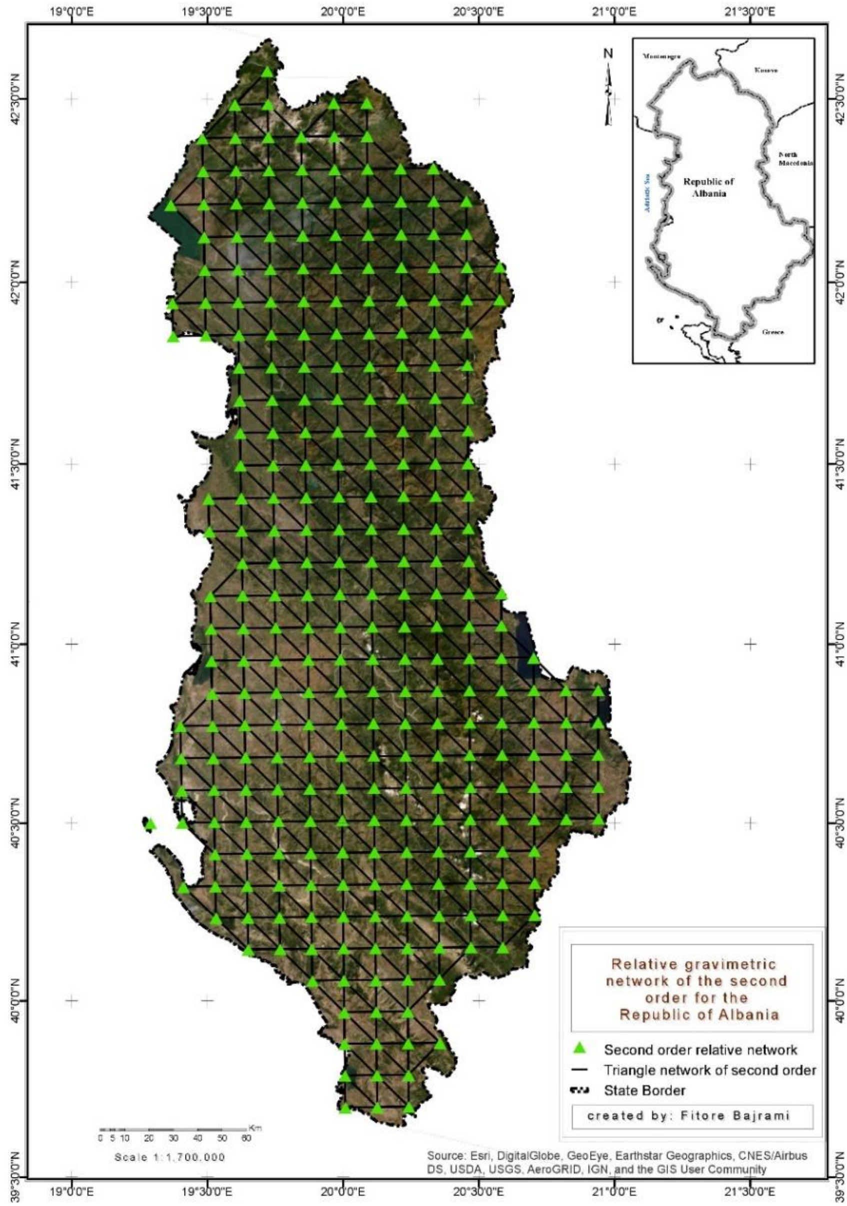

Fig. 9. Planned second order relative gravimetric network

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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):

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

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:

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

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):

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

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:

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

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.

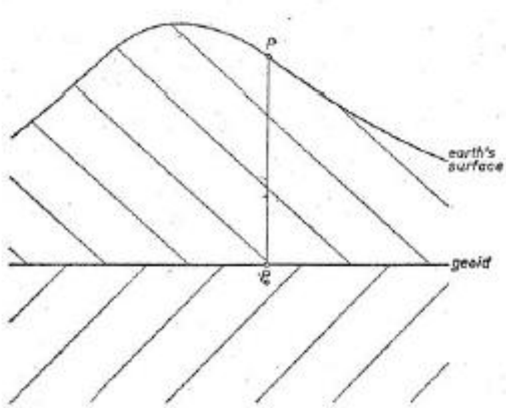

Fig. 10. Gravity reduction (Heiskanen & Moritz, 1967)

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

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

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.

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

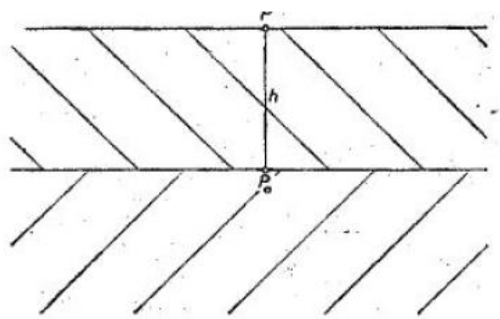

Fig. 11. Bouguer plate (Heiskanen and Moritz, 1967)

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).

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

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:

$$g_B = g - A_B + F \qquad \text{…(1.23)}$$

With the assumed numerical values:

$$g_B = g + 0.1967h \qquad \text{...(1.24)}$$

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).

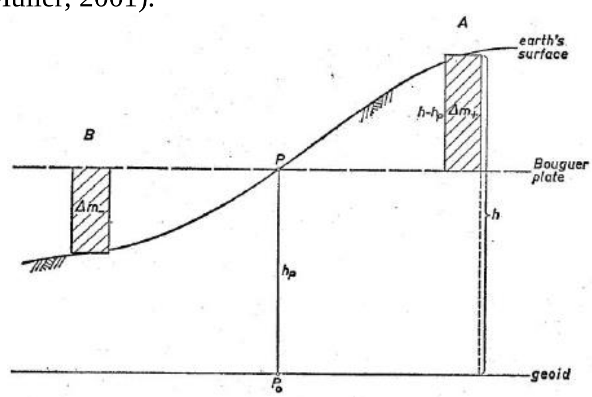

Fig. 12. Terrain correction (Heiskanen and Moritz, 1967)

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

$$\Delta g_B = g_{\boldsymbol{B}} - \gamma_0 \qquad \text{… (1.25)}$$

They are called Bouguer anomalies.

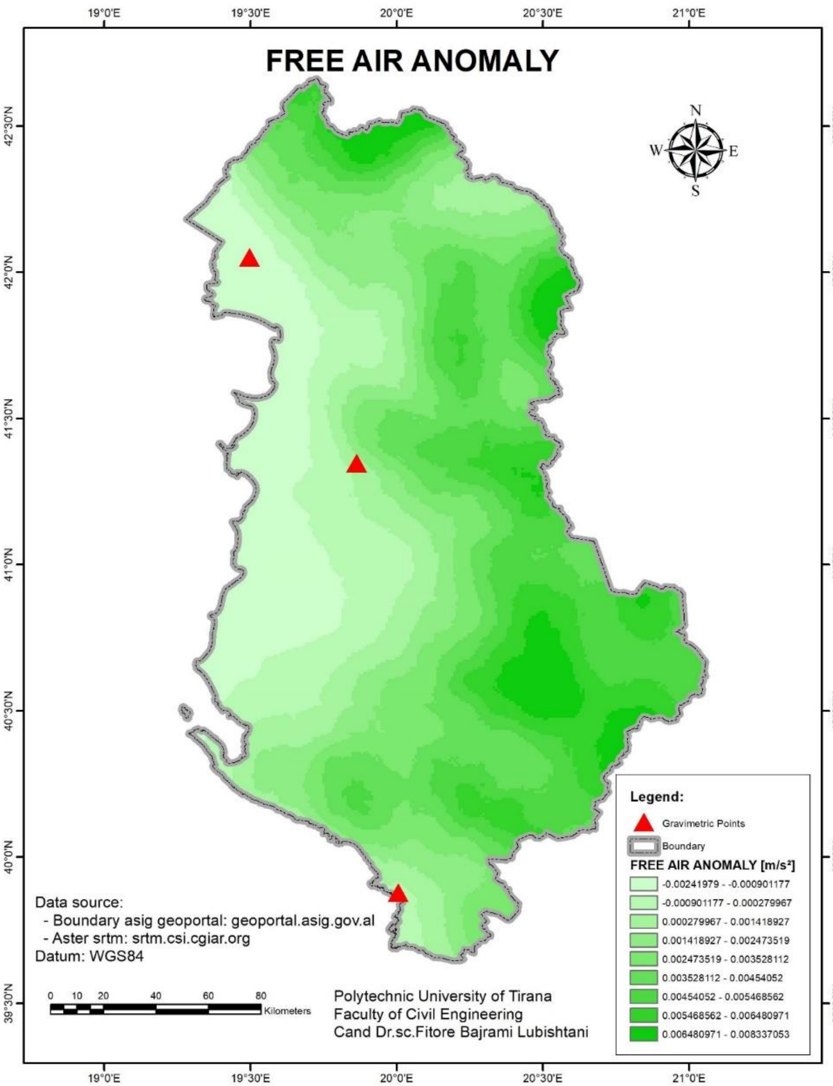

Fig. 13. Free air anomaly for first and second order gravimetric relative

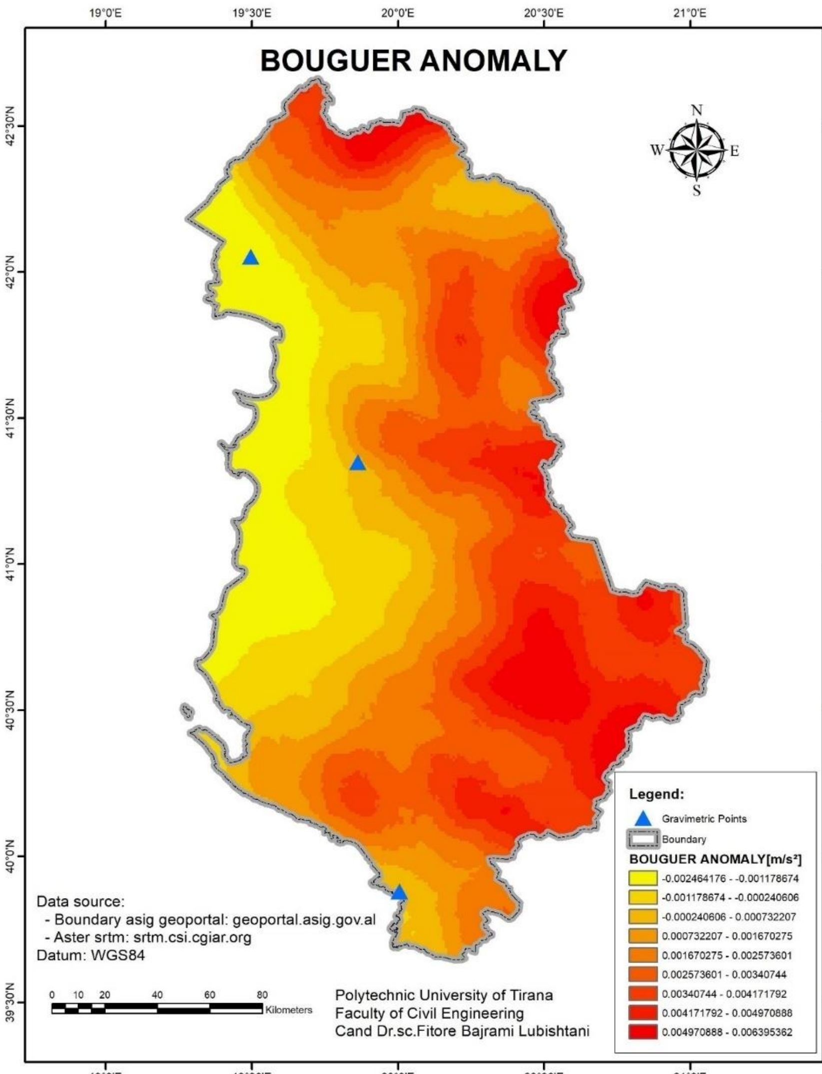

Fig. 14. Bouguer anomaly for first and second order gravimetric relative

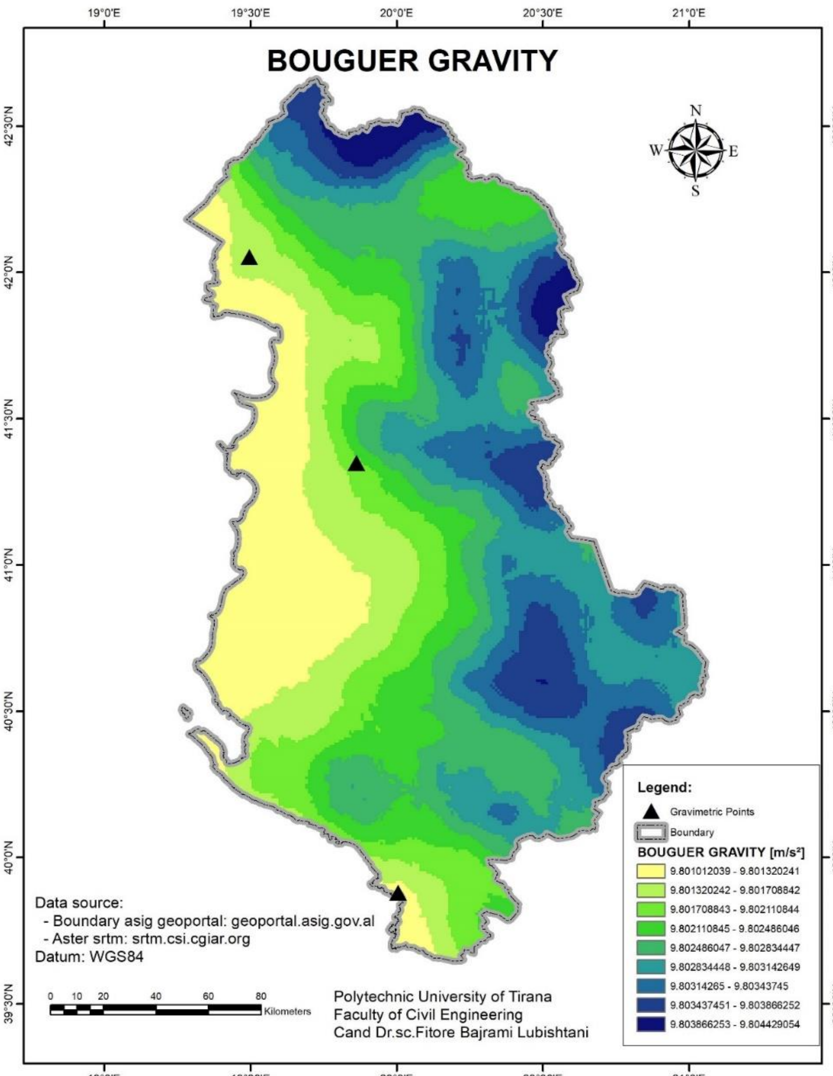

Fig. 15. Normal gravity for first and second order gravimetric relative

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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