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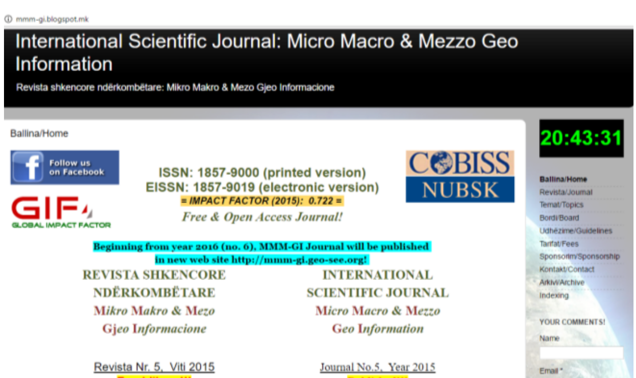

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SULPHUR PRESENCE IN PALEOKARST INFILLINGS AND BITUMEN SIGNS IN UPPER CRETACEOUS CARBONATES FROM THE KRUJA ZONE (ALBANIA)

Ana FOCIRO[1], Gjergji FOTO, Antea LINATOPI

UDC: 553.611.08:546.22(496.5)

SUMMARY

Kruja zone represents mainly shallow-water carbonate deposits (Cr_2-Pg_2). They consist of dolomites, limestones with rudists also rich in miliolides and textularides with frequent hiatus, emersions, discontinuity surfaces and even bauxitic horizons. This paper aid to provide some explanations about the origin of blue clays within paleokarst infillings, caverns and the presence of bitumen and their impact in the surrounding rocks in the region of Burizana in Makareshi anticline structure, Kruja zone. This area was previously known for oil exploration and several exploration wells were drilled, in the South-East, as Makareshi-1 well, while in the West, Ishem, a series of wells, all with the object of oil exploration in carbonate section from the surrounding structures. Also, in this region, the presence of Miocene transgression is present. The presence of terrigenous rocks in the highest hypsometric position, the intrusion of blue-grey clays between carbonate formation, the smell of sulphur in the blue clay formation and the bitumen signs in the cavities of the carbonate rocks are part of the present study.

Key words: Kruja zone, blue clays, sulphur, bitumen.

INTRODUCTION

In literature, paleokarst is defined as karst that has been buried by younger rocks. It is a common component of successions in which limestones are present and serves as a clear indicator of terrestrial environments and, to some extent, duration of emergence. Interpretation of paleokarst may be complicated by two factors; firstly, it is usually visible only in two, rather than three dimensions, and secondly, burial by younger rocks does not prevent modification or even destruction of the paleokarst by subsurface dissolution (Simms, 2014). Most paleokarst exposures are usually level with or are negative features in the landscape. If the materials filling ancient caves

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or dolines are strong enough, paleokarst features can be preserved as positive features protruding above the general level of the land surface (Osborne 2013). After the construction of the new road, a new outcrop in the western part of the Makareshi structure was discovered. In the study area, the carbonate rocks suffered from syngenetic karstification and early-diagenetic near-surface karstification. The phenomenon of paleokarst was encountered throughout the entire section (Qorri, 2014). The infilling materials represent different types of terrigenous facies. In some cases, the blue clay (argillaceous) karstic infillings smell of sulphur. This paper concerns the terrigenous occurrence which was studied in this shallow marine carbonate successions exposed in Makareshi structure. This paper aims to better understand the presence of terrigenous rocks in the highest hypsometric position of the section, intrusion of blue-gray clays between terrigenous and carbonate formations, the origin of sulphur smell in the blue clay formation and the signs of bitumen in the cavities and cracks of the carbonate rocks.

GEOLOGICAL SETTING

The passive margin of the Apulian Plate during the Mesozoic and Palaeogene was bordered by extensive carbonate platforms, known in Albania as the Kruja zone or Kruja platform. The Kruja zone extends northward into the Adriatic Dinaric platform (Montenegro, Croatia) and southward into the Gavrovo platform (northern Greece). Based on different studies in Albania only upper Mesozoic - Palaeogene deposits are exposed. The Makareshi anticline structure is situated in the Kruja zone, part of external Albanides (Figure 1a). In the Borizana section, a section of the Makareshi structure, recently studied by Qorri (2016), the Campanian - Maastrichtian includes deposits of restricted and open platform interior limestones and dolomitic limestones intercalated by dolomites and terrigenous paleokarst infillings (Figure 1b). The Upper Cretaceous is marked by a major hiatus spanning the late Maastrichtian and continued to the early Eocene. Above this gap, the series continues with the middle Eocene bioclastic limestones, deposited in an open shallow subtidal environment. Above the limestones, the horizon of the upper Eocene “passing marl” marks the transition to the 1500 m thick succession of the Oligocene flysch (Heba and Prichonnet, 2006).

MATERIAL AND METHODS

Our study focuses on the Campanian – Maastcrichtian succession cropping out at the southwest of Kruja city and to the east of the Burizana village. The samples were collected from different outcrops along the section. The section consists of thick to medium bedded wackestones to packstones, commonly laminated, rudists biostromes, rudist floatstones/rudstone, solution collapse limestone breccias, dolomitized limestones, dedolomites and terrigenous formation (Figure 1b). The study was focused on the macroscopic description of the samples representing lithified and semi lithified sandstone and XRF analysis for blues clay formation, in order to obtain an overview regarding their chemical composition (Figure 2).

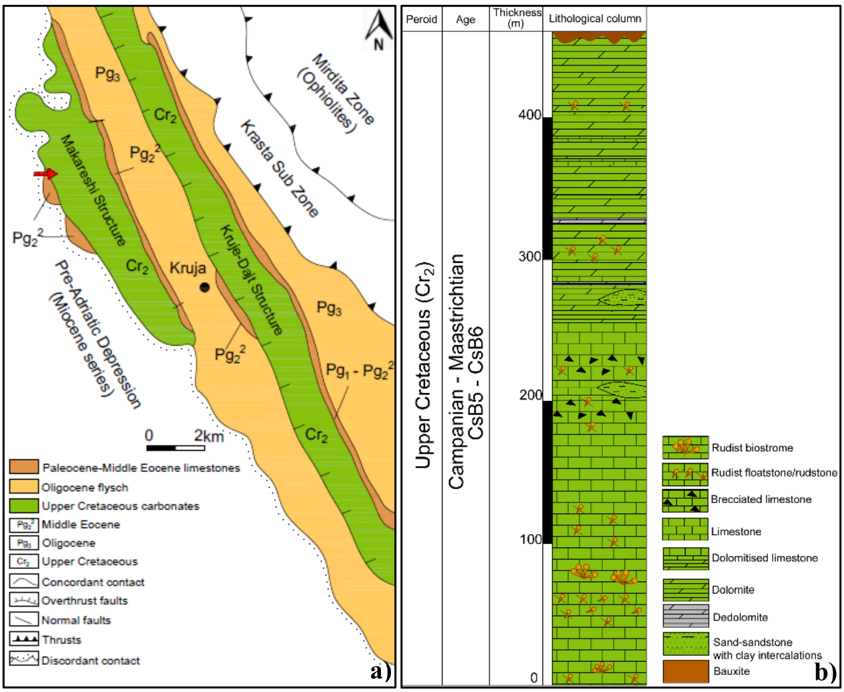

Figure 1: a) Simplified tectonic map showing locations of the Kruja zone, La Route section (after I.S.P.GJ and I.GJ.N., 1983). b) Lithologic column of Upper Cretaceous deposits from Burizana section (Qorri, 2016).

RESULTS AND DISCUSSIONS

From the field geological surveys conducted in the study area and from previous geological studies conducted in the region for oil and gas exploration, but also based on the geological map of the territory on a scale of 1: 200.000. We can state that some of the terrigenous rocks (not those associated with blue clays) are part of the transgressive series of Peri-Adriatic molasses. According to previous studies, they belong to the "Helmesi" formation on the north bank of the Droja River. The Pliocene formation overlies the Upper Cretaceous limestones.

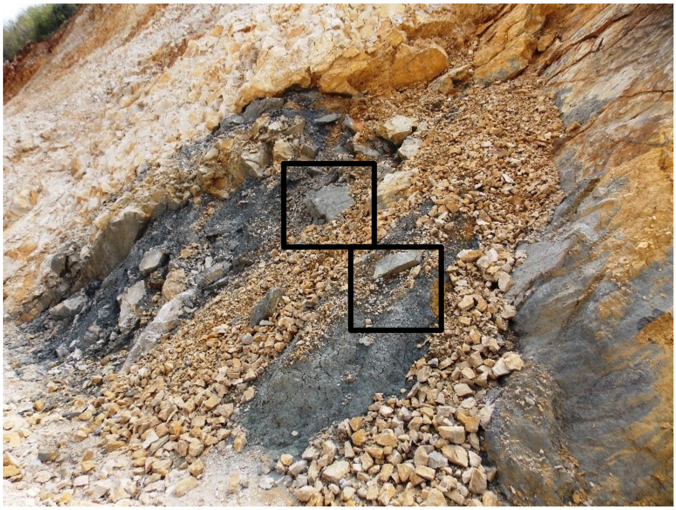

Figure 2: Blue clay infilling and sandstone blocks within this level (black rectangles).

Figure 3: Bitumen signs in limestone cracks.

From the bottom up, the base of the transgression is quite clear, which is often represented by large-grained quartz sandstones, pebbles with different mineralogical compositions, blocks and boulders of limestone. Determining the presence of terrigenous rocks, in this part of the Makaresh structure, is a new finding in the geology of this area and that moves toward the east the boundaries of the Miocene transgression drawn on the geological map of the scale 1: 200.000. The sandstones of the “Helmesi” formation are generally yellow to reddish. In this mixture of granulometry, carbonate blocks of various sizes and shapes are distinguished, and almost all lithological types are found in the fresh carbonate section, including carbonate blocks containing grey to blue organic matter. Limestones blocks, near or inside diluvium have a reddish colour due to the contact with soils rich in iron oxides. The intrusions of blue clays in Upper Cretaceous carbonate rocks and terrigenous formation don’t show any special morphology, but they look like leakage over carbonate surface. Macroscopic observations in fresh outcrops besides their characteristic colour show soft touch, high moisture and smell of sulphur. Based on the geological observations, blue clays within the carbonate section have to do with shapes that are compatible with the surrounding rocks, i.e., they do not appear to have formed in sedimentation conditions simultaneously with the carbonate rocks, i.e., are not of the same age. They fill paleokarst surfaces and other characteristic cavities formed in pure carbonate rocks (Figure 2). From the location, it seems to come from the younger upper levels. For the geological history this carbonate section, this mechanism is acceptable. Their entry paths within the carbonate section appear to be interconnected with cracks, fissures, caverns and cavities. To clarify the relation of the position of the blue clays with the entry paths in the carbonate section, as evidenced by the observations in the outcrops, below the bauxite level, the presence of cavities and caverns of considerable size is noticed, but also in lower parts of the section. On both sides of the road, there are formed two great sinkholes. It seems that the sinkholes have infill and distribute within the carbonate section those types of clays during frequent emersion of the shallow-water carbonates. The limestone presence with clear indicators of mud eating organism activity is one of the evidence of the shallowness of this carbonate substrate and the possibility of supplying the sinkholes with such clays. Also, according to Serjani (2014) the presence of blue clays in samples from well 5-13, with a depth of 83.5-99.5 m has been previously described. From the chemical analyses performed before, they result in high content of sulphur trioxide, reaching up to 12% SO_3. According to the literature from previous works, the blue clays are also found inside the molasses formations. The clearest presence of these compact blue rocks, within the terrigenous rocks, is evidenced in some channels in this territory. In the channels cross to the extension, starting from the deepest part, the base of transgression on the Cretaceous carbonates is identified, which is represented by sandstones. Irregularly distributed blue clays overlain the sandstones and above them, overlain the Quaternary diluvium. Their total thickness is about 20-25 meters. It is known that their origins are from the continent and are the result of the feldspars weathering supplied by the eastern tectonic zones. According to the literature (Bentor, YK and M. Kastner, 1965; Buckley, et al.1978), these clays, claystone and marls with blue or grey-blue colour, are layered silicates such as glauconite. As it appears from the comparisons between cases 1 and 2 of the literature, in the case of Burizana clays, the water content is missing, which would normally reach about 10%, which also completes the total content (Referring to the above-mentioned authors, in the two wells DH/14 and DH/ 13 it is also noticed that at the bottom of these blue clays and rocks, there are strong cavities and caverns, the preferred place of placement of these formations. Changes in the values of sulphur trioxide content are observed towards the increase, depending on their location whether they are on perforated surfaces or at open or uncovered depths (in wells). There is also a change in the reduction of sulphur trioxide content from soft and wet surface clays (formed at relatively younger ages) to rocky clay-carbonate mixtures (formed earlier and compacted), therefore, vary depending on the time of formation. Also, changes in the values of trioxide content in the same samples were determined from the analytical analysis. After the initial determination of SO_3 content, it comes down. The explanation for these low values of the molasses may come from the fact that they are in contact with sandstones with sufficient porosity and permeability to retain sulphur trioxide but also to carry it to the surface and unlike depth clay bodies within the carbonate section which have no contact with the surface or are completely blocked except cavities, cracks, tectonic faults which can cause degassing.

Table 1). According to L. Montanari, these clays that are often called blue, in addition to Italy, are also found in Malta and are aged from the upper Langhian to the lower Tortonian (L. Montanari, 1987). So, the origin of these formations, such as those within the carbonates but also in the molasses section, we would say that during the formation of carbonate sediments, there was a connection of the Cretaceous Sea with the continent through areas with the limited temporary or partial circulation with the sea and consequently to the basin. Glauconitic clays have intruded, which, as has been proved, come from the destruction of the feldspar rocks of the eastern zones. These clay muds, formed during all geological times, occupy karst cavities and caverns, undergo to lithogenesis and chemical-physical diagenetic processes, forming a mixture of carbonate and clay material. This supply process has continued even in the later Pliocene times while the carbonate formation has undergone erosion and weathering by reshaping cavities and karsts that are filled with the same clay mud but in this case, they have not reached the stage of lithogenesis and have remained unconsolidated appearing as soft crumbly and hygroscopic rocks. The blue clay rock blocks, already within the section, may have a two-way source either originating from the continuous weathering of Cretaceous carbonate rocks or directly from the eastern part of the continent supplying the crumbly and clayey material. According to mineralogical-petrographic studies carried out in this territory, it results that even in recent times, after the formation of the carbonate formation, the flysch formation of the Lower Oligocene (Pg_3^1) overlain them. These deposits belong to the upper part of the quartz-quarzitic zone and the lower part of the glauconite-phosphate zone (Meçaj 1992). As presented above, their distribution and quantity in both carbonate and molasses sections cannot be predicted by general geological works. The peculiarity of blue clays, as we mentioned, is the strong smell of sulphur and the presence of sulphur trioxide (SO_3) confirmed through chemical analysis. Sulphur trioxide is a chemical component. In gaseous form, this substance is a pollutant, as it is the primary substance of acid rain. It is an anhydride that produces mostly H_2SO_4 (sulphuric acid) through the following reaction:

$$SO_3 \text{ (gas)} + H_2O \text{ (liquid)} \rightarrow H_2SO_4 \text{ (acid)} \ (\Delta H_f = -88 \text{ kJ mol}^{-1})$$

The reaction occurs quickly and with extra energy from outside, but can also hardly be produced in quantity. At temperatures above 340 °C, sulphuric acid, sulphur trioxide and water are found in equilibrium concentrations. In our study area, in the carbonate section of the Upper Cretaceous, even according to macroscopic observations the bituminous limestone horizons are distinguished. They are easily distinguishable by the dark grey concerning the colour of the surrounding rocks. In closer view the presence of fresh or even dry bitumen that saturates the cracks of the rocks are visible (Figure 3). Geochemical studies have also identified this fact (Çurri et al., 1990). The conditions of their formation are known. Generally, they require the accumulation of organic matter mixing with carbonate material mainly of the mudstone type, which creates the possibility of its protection from the destructive action of oxygen or bacteria. These conditions are met in a reducing environment. The immersion of this potential layer is to be oil-formed, at depths where the temperature reaches the stage of catagenesis. At this stage, diagenesis gas is formed, and subsequently, oil formation. The amount of oil formed in this way will depend on the residence time of this potential layer in the oil window. The maximum immersion and reaching the required temperatures occurred during the Lower Oligocene period, where the basin, together with the territory in question, underwent the greatest possible immersion. According to the data and studies performed, folding of this area occurred after the Lower Oligocene and in this case, the cooking conditions of the organic matter were stopped (Çurri et al., 1990, Prifti et al., 2013). The carbonate succession, more or less, has been and is under the direct influence of hydrocarbons with the highest molecular weight. There are mostly asphaltene and resins and practically oxides of heavy metals such as vanadium, nickel, nitrogen, sulphur, carbon dioxide, etc. According to the same geochemical study (Prifti et al., 2013) the oils of Upper Cretaceous limestones and Miocene sandstones of the “Tirana-Ishëm” Depression, which are found at some shallow depths, are heavy and biodegraded oils. There is a close association between the bituminous limestones and all the other rocks within the Upper Cretaceous carbonate section in the study area, but also between this section and the terrigenous formations that overlay the carbonates. The whole carbonate section has undergone a strong peneplanation, the effect of strong movements during folding after the Lower Oligocene, then shifts from East to West, overthrusts of the eastern part of the structure over its western part, until its complete covering up. Folding during and especially after the Pliocene have made its gradual immersion to the West thus being included by an influx of the sea from North-West to South-East, through a transgressive series expressed by the unconformity of Tortonian formations and then, the most powerful immersion during the Pliocene, whose boundaries extend as far as the area in question. The active geologic history has made the connection of the whole section through cracks, faults with relatively small amplitude, through intensive karst development, etc., made this section disperse its contents, including bitumen. It is precisely this contact of limestone horizons with bitumen that supplies hydrocarbons and their content to all kinds of clays including glauconite clays. In general, clays are molecular structures with many free molecular radicals that absorb and retain almost two times their volume in water, or as the case may be, with other chemical elements that feed on bituminous sections, including sulphur. In addition, the gradual immersion of the Makareshi limestone toward the West, in addition to direct contact with seawater, has led to the formation waters, accompanied by bituminous horizons, rich in hydrocarbon elements and especially sulphur (Bilaj) (Frashëri et al., 2010), which may have been here as well, have brought the sulphur content in the glauconite clays. Regarding the higher SO_3 content, in addition to the relation with lithology and bitumen content, the same relation is observed with the content of Al_2O_3 and Fe_2O_3, over (0.2-0.6) %, which exceeds almost 10 times the general background not exceeding 0.07%. In three cases the high content of TiO_2 up to 22 % is distinguished and that is directly related to bituminous limestones, while in some cases it reaches 32 % and is associated with marl limestones. Within the carbonate section, as we have explained above, there are two types of rocks, grey and blue. One type is associated with grey-blue clays, quite wet and with a strong sulphur smell that has leaked down and the second type, shapeless intrusions; unspecified extensions within compact carbonate rocks. They have not been analysed for chemical and mineralogical composition but based on the above relations; they result in high SO_3 content that reaches maximum values of up to 7%. According to Foto et al., (2015) the samples taken and studied for the mineralogical and chemical composition of the rocks in the wells, show that these phenomena observed on the surface exist in-depth as well. Thus, in two of them (DH 5/14 and DH.5/ 13), are found the clays with the blue colour (blue-clays) in separate intervals but also horizontal continuity up to ten linear meters (Serjani 2014). Referring to the above-mentioned authors, in the two wells DH/14 and DH/ 13 it is also noticed that at the bottom of these blue clays and rocks, there are strong cavities and caverns, the preferred place of placement of these formations. Changes in the values of sulphur trioxide content are observed towards the increase, depending on their location whether they are on perforated surfaces or at open or uncovered depths (in wells). There is also a change in the reduction of sulphur trioxide content from soft and wet surface clays (formed at relatively younger ages) to rocky clay-carbonate mixtures (formed earlier and compacted), therefore, vary depending on the time of formation. Also, changes in the values of trioxide content in the same samples were determined from the analytical analysis. After the initial determination of SO_3 content, it comes down. The explanation for these low values of the molasses may come from the fact that they are in contact with sandstones with sufficient porosity and permeability to retain sulphur trioxide but also to carry it to the surface and unlike depth clay bodies within the carbonate section which have no contact with the surface or are completely blocked except cavities, cracks, tectonic faults which can cause degassing.

Table 1: Chemical composition of glauconite.

Chemical composition	Whare Flat, Otago, New Zealand	Makhtesh Ramon, Israel	Well 5-14, Burizanë
SiO_2	49.29	46.52	61.48
TiO_2	0.12	-	1.08
Al_2O_3	3.17	4.61	15.10
Fe_2O_3	21.72	24.76	7.03
FeO	3.19	2.02	-

MgO	3.85	4.65	1,13
CaO	0.74	0.51	2
Na_2O	0.12	0.19	0.22
K_2O	6.02	7.65	2.01
H_2O^+	7.21	5.83	-
H_2O^-	4.60	3.20	-
P_2O_5	0.32	0.08	0,135
SO_3	-	-	1.5
Total	**100.35**	**100.02**	**90.875**

CONCLUSIONS

Regarding the origin and the occurrence of terrigenous formations (sandstones, blue-clays, carbonate blocks and reddish soils) it is clear that these formations are remnants of the transgressive molasses nappe that lies in the West and Northwest of the Burizana region, part of Tirana-Ishëm Depression. The blue clays and the gray-blue rocks, in the two rock formations, those within the carbonate succession and molasses, we would say are glauconitic clays, which as it has been proven, come from the weathering of the eastern zones. These clay muds occupy karst cavities, pits and undergo lithogenesis and chemical-physical diagenetic processes, forming a mixture of carbonate and clay material. This sediment supply process has continued even in the later Pliocene while the carbonate formation has undergone erosion and weathering forming new cavities and karsts surfaces that are filled with the same clay mud but in this case, they have not reached the stage of lithogenesis and have remained unconsolidated appearing as soft and hygroscopic rocks. Authigenic minerals present in clayey sediments are calcite and dolomite, pyrite, kaolinite, opal and chalcedony, glauconite, sericite and illite. According to mineralogical-petrographic studies carried out in this territory, it results that even in recent times, after the formation of the carbonate formation, is overlain by the Lower Oligocene flysch formation. These deposits belong to the upper part of the quartz-quartzite zone and the lower part of the glauconite-phosphate zone. The major problem associated with the presence of blue clays is the high content of sulphur trioxide, SO_3. We can say that the sources of sulfide content are first of all related to the high content of organic matter present in the carbonate section which at certain moments has passed to the stage of diagenesis and catagenesis from which the respective bitumens were formed. The sources have also stimulated the formation and the removal of fluids that have accompanied the formation of bitumen in the upper part of the section, towards lower pressures, thus being captured by glauconitic clays, ready to fill free radicals or to replace water connections with SO_2 sulphur gases. The second possible source is the continuous movement of groundwater accompanying the organic matter, and possibly also the high-temperature thermal waters found in the springs of Mamurras and Ishem (Ishmi 1/b well). Bacterial action is also a possible source. Regardless of the source, this chemical element is already present in the section, whether carbonate or molasses and predictable for SO_3 content.

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MULTIBAND RASTER DATASETS IN ORDER TO USE GLOBAL GRAVIMETRIC MODELS FOR THE TERRITORY OF THE REPUBLIC OF KOSOVA

Fitore BAJRAMI-LUBISHTANI[1]

UDC: 528.21(497.115)

SUMMARY

Due to current situation in Kosova with the national geoid, which is still under development, utilization of global EGM's is more than necessary. In this research, multiband raster datasets with 1km spatial resolution of existing EGM 2008, 1996, and 1984 have been developed. Maximal and minimal differences between the models, range of extreme values of geoid heights in three geoid models, mean heights and other data calculations, are given in this paper.
Calculation have been performed with online geoid calculator GeoidEval, in grid of 10893 points. Based on developed multiband raster model dataset and calculated differences between the models, three maps for the territory of Kosova were compiled. Main purpose of performed research analyses and developed GIS datasets for geoid heights, is free and open for usage by the geo community in Kosova, till the establishing of state gravimetrical network and model.

Key words: EGM, geoid, multiband raster, geoid undulation, earth gravitation, geoid height, Kosova.

INTRODUCTION

A precise local geoid model constitutes one of the most challenging research subjects of geodesy, particularly since 1980s. Geoid modelling deal with the determination of geoid undulations between the geodetic heights obtained from the Global Navigation Satellite Systems (GNSS) techniques and the orthometric heights, or levels, relative to the Mean Sea Level (MSL). Thus, geoid models are crucial for the utilization of GNSS (particularly the Global Positioning System: GPS) in civil engineering projects (Al-Krargy etAll

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2015). Recent advances in GNSS techniques make it possible to measure ellipsoidal heights with an accuracy of a few centimeters. Therefore, if a well-established geoid model is available, orthometric heights can be derived precisely by GNSS positioning, and accordingly a reference height system can be established via the geoid model (Matsuo and Kuroishi 2020).
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 (Bajrami Lubishtani and Idrizi 2020). In geodesy three basic surfaces are encountered: the physical surface of the earth, the geoid and the reference ellipsoid. In relation to these three surfaces another three entities are defined: the orthometric height (h), the ellipsoidal height (H) and the geoidal separation/undulation (N) (Das etAll, 2017). All geodetic measured quantities from the physical surface of the Earth are reduced to the geoid and to the surface of adopted reference ellipsoid through applying corrections on the measured values, as well as into the map projection (Idrizi et All 2018). There are a number of mathematical models to relate the geoidal separation N with corresponding locations in order to define the geoid surface. Such models include simple polynomials, radial basis functions, multilayer perception neural network methods etc (Cakir and Yilmaz, 2014). Though classical geoid determination is restricted to regional computations using the astro-geodetic techniques (Drews and Adam 2019), by grace of the enhancement of space geodesy techniques, are mainly used to determine the figure of the geoid globally and regionally as well in recent decades. The true geoid is not directly observable and estimating it may vary as current knowledge improves. Hence, there may be many models of the geoid surface and, consequently, many geoid height models (Roman et All 2010). The new gravity satellite missions provide new global solutions that allow modeling the long and medium wavelengths of the Earth's gravitational field (Soycan 2014). There are global geoid models such as EGM 84, EGM 96 and EGM 08 which supports the conversion of ellipsoidal heights to orthometric heights with accuracies varying between few centimeters to even a meter.
After establishment of the Kosovo geodetic datum in 2001, the 1st order network has been exaggerated with additional 450 points covering whole territory of Kosovo with an approximate distance of 10 to 15km between neighbor points (Kohli 2003). Currently, these points are serving as height reference surface, however their deviation in some areas exceed ±50 cm and need to be considered (Ameti, Jaeger 2016). Until now, there is no official state geoid model for the area of the Republic of Kosova developed by the Kosova Cadastral Agency as national responsible institution. A model developed for the Kosova area was calculated by Ameti and Jaeger in year 2016 at the Karlsruhe University in Germany, which unfortunately still is not

in official use by the state institutions in Kosova. Aimed to offer three alternative models for the area of the Republic of Kosova, three national models based on three global models (EGM 84, 96 and 08) have been developed within research study performed by this paper authors in collaboration between three institutions: Geo-SEE Institute from Skopje (based on the previous experience for developing three models for North Macedonian territory in year 2013 (Idrizi 2013)), geodesy department of the University of Prishtina (where first and second authors are employed) and geodesy department of the Polytechnic University of Tirana (where the first author is finalizing her PhD thesis on developing of Albanian geoid model). This database in national level has to be developed, and it has to be open and free for usage by geo community (Idrizi 2014). Part of calculations for geoid heights based on EGM for the territory of Kosova have been performed on year 2018 within the research study of length differences from topography to map projection within the state coordinate systems for some countries on the Balkan Peninsula (Idrizi etAll 2018).

EARTH GRAVITATIONAL MODELS (EGM)

The Earth Gravitational Models (EGMs) are geopotential models of the Earth consisting of spherical harmonic coefficients, developed and published by the Office of Geomatics at National Geospatial-Intelligence Agency (NGA) [2], as responsible for collecting, processing, and evaluating gravity data (free-air and Bouguer gravity anomalies) as well as computing gravimetric quantities such as mean gravity anomalies, geoid heights, deflections of the vertical, and gravity disturbances [1]. EGM96 from 1996 is used as the geoid reference of the World Geodetic System [2]. Three versions of EGM are published: EGM84 with n=m=180, EGM96 with n=m=360, and EGM2008 with n=m=2160. “n” and “m” are the degree and orders of harmonic coefficients; the higher they are, the more parameters the models have, and the more precise they are. EGM2008 also contains expansions to n=2190 [1]. Developmental versions of EGMs are referred to as PGMs, Preliminary Gravitational Models (Pavlis etAll 2012).
EGM84 geoid (code 5203) is a vertical datum first defined in 1984, with its geoid origin in WGS 84 ellipsoid. EGM84 geoid is a vertical datum for Geodesy, defined by information from US National Geospatial-Intelligence Agency [4]. Data of EGM84 today have historical importance, without practical utilization (Idrizi 2013). Differences between geoid heights of EGM 84 with two newest models EGM 96 and EGM08 are used in our research just for comparing with two newest models of years 1996 and 2008, and not as a model that can be used at the present time.

EGM96 (code 5773) is a geopotential model of the Earth consisting of spherical harmonic coefficients complete to degree and order 360. It is a composite solution, consisting of a combination solution to degree and order 70, a block diagonal solution from degree 71 to 359, and the quadrature solution at degree 360. It is a result of collaboration between the National Imagery and Mapping Agency (NIMA), the NASA Goddard Space Flight Center (GSFC), and Ohio State University [3]. This gravitational model is complete to spherical harmonic degree and order 2159, and contains additional coefficients extending to degree 2190 and order 2159.
EGM2008 (code 3859) is complete to spherical harmonic degree and order 2159, and contains additional coefficients extending to degree 2190 and order 2159. Computing the geoid undulation values are realized with respect to WGS 84 ellipsoid [1]. Over areas covered with high quality gravity data, the discrepancy between EGM 2008 geoid undulations and independent GPS/levelling data is of the order of ±5 to ±10 cm (Nikolaos et al., 2012). The EGM2008 model gives stable result for the root-mean-square-error (RMSE) of the residuals in terms of relative geoid heights accuracy (Kim, Yun and Choi 2020).
The International Center for Global Earth Models (ICGEM) continuously analyzes the performance of every new released GGM model over several GPS/Levelling check points worldwide. Table 1 presents the statistics of evaluation of the selected seven GGM models in terms of the Root Mean Square error (RMS) of the undulation differences. It can be seen that the overall accuracy of EGM2008 over the entire 12036 check points indicates that it is the most precise GGM (Al-Krargy etAll 2015).

Table 1. RMS of Differences of GGM-Based Geoid Undulations over GPS/Levelling Check Points (m)

Test area	**USA**	**Canada**	**Europe**	**Australia**	**Japan**	**Brazil**	**All**
No. of check points	6169	2691	1047	201	816	1112	12036
EGM08	0.248	0.128	0.125	0.217	0.083	0.460	0.240
EGM96	0.379	0.353	0.493	0.298	0.364	0.730	0.427

Source: http://icgem.gfz-potsdam.de/ICGEM/ICGEM.html

Three global gravitational models are open for download and utilization through the official web page of NGA [1], as well as from many other web pages. One of the WEB GIS based free product via internet is the geoportal of surveying.org web page, where can be found very wide range of special spatial data, such as weather, NGS (national geodetic survey), USGS maps, geoid heights, magnetic declination, state plan systems, UTM zones etc (Idrizi 2013).

SOURCE DATA AND BASIC TEST MODEL

Since the possibility for usage of official data by responsible institution for geospatial information is very limited, as source data have been used test model developed for analyses of length differences between topography and geoid as well as between geoid and referent ellipsoid, with 10893 points with Cartesian/geographic coordinates in the state coordinate system in ground resolution of 1km shown in figure 1 (Idrizi etAll 2018), while for elevation dataset the ASTER global DEM [6] with 30m spatial resolution have been used.

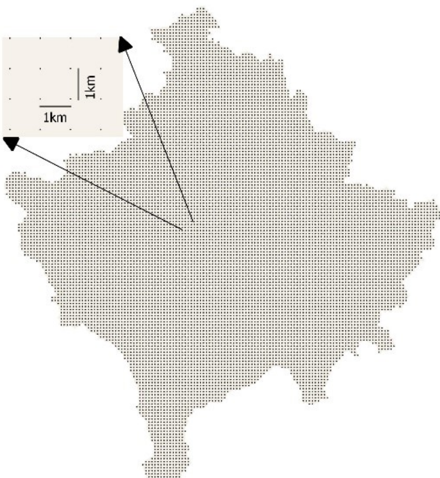


Figure 1. Dataset for test model with 10893 points

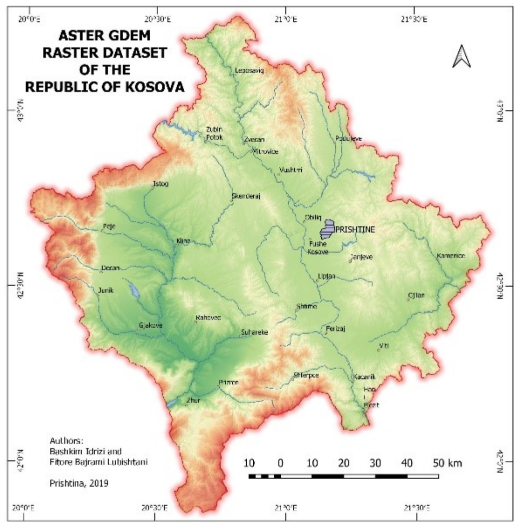


Figure 2. Relief of Kosova based on ASTER GDEM

Aimed to calculate empirical values for three geoid models and differences between them (steps 9, figure 3), as output for each of 10893 points should be calculated:

- Maximal values,
- Minimal values,
- Differences between maximal and minimal values,
- Mean values, and
- Standard deviations.

DEVELOPING EGM MODELS 2008, 1996 AND 1984 FOR THE KOSOVA's TERRITORY

Three EGM models (2008, 1996 and 1984) for the national area of the Republic of Kosova are developed as separate point vector datasets with 1km ground resolution (Idrizi etAll 2018), while later converted to raster datasets, and finally merged into multiband raster dataset based on obtained elevation values, obtained geoid heights for three models, and calculated values between geoid heights and with elevations. Schema for whole process is given in next figure 3.

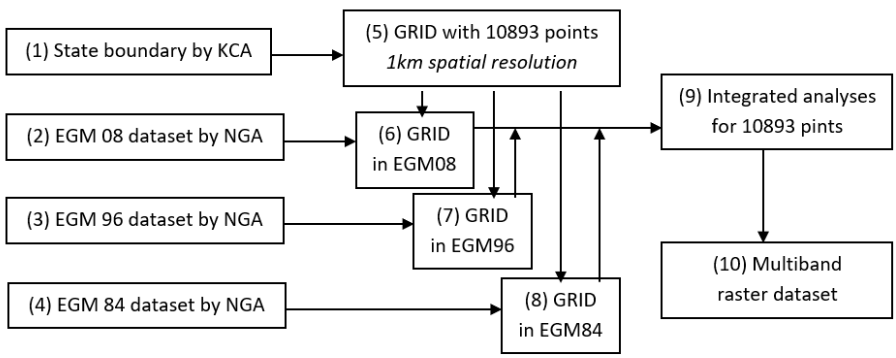


Figure 3. Scheme of developing multiband raster dataset of EGM 08, 96 and 84 for the Republic of Kosova

Test model used from previous research of Idrizi etAll 2018 (steps 1 and 5) contain cartesian/geographical coordinates and ASTER elevation [6] data for each of 10893 points. Data for steps from (2) to (4) were extracted directly from official web page of NGA [1], which then have been used for calculation of geoid heights [5] for all test model points (steps 6 to 8).

Three grids of 10893 points (6, 7 and 8) with values for coordinates, elevations, and geoid heights for three EGM models, at final step of calculation, before developing multiband raster dataset, have been used for calculation of differences between geoid heights of three models and ellipsoidal heights based on difference between the elevations and geoid heights of three models (step 9). With this, input grid of 10893 points with coordinates and elevations (5) is extended with nine new columns for geoid heights of three EGMs, difference between them and ellipsoidal heights based on each EGMs (9).

Final output database of test points with three obtained values for coordinates and elevations (step 5), as well nine calculated values (steps 6 to 9), as final product has been converted to single multiband raster dataset with ten bands and 10893 cells of 1km spatial resolution. Meaning of bands are given in bellow table with description:

Table 2. Description of bands in developed multiband raster dataset

BAND	DATA	BAND	DATA
1	ASTER elevation	6	Difference between geoid heights of EGM 08-96
2	Geoid height (EGM 84)	7	Difference between geoid heights of EGM 08-96
3	Geoid height (EGM 96)	8	Ellipsoidal heights based on EGM 84 and ASTER
4	Geoid height (EGM 2008)	9	Ellipsoidal heights based on EGM 96 and ASTER
5	Difference between geoid heights of EGM 08-96	10	Ellipsoidal heights based on EGM 2008 and ASTER

EGM 2008 FOR THE NATIONAL AREA OF KOSOVA

In step 6 of above given schema, the geoid heights for all points have been calculated for the entire area of Kosova. Calculation of geoid heights have been realized with precision of 4 decimals after meter (0.1mm), and 1mm RMS of interpolation of geoid heights in points of test model. From the calculated results, maximum value of geoid heights within EGM08 is 46.433m, while the minimum is 43.9215m. The difference between extreme values within the territory of Kosova of EGM08 geoid heights is 2.5115m, while the mean geoid height is 45.5391m, shown in table 3. In figure 4 [9], compiled map of geoid heights based on EGM2008 for the national area of Kosova is given.

EGM 1996 FOR THE NATIONAL AREA OF KOSOVA

The identical procedure as in a case of using EGM 08 for the territory of Kosova, have been implemented for EGM96 also (step 7), by calculation of geoid heights with precision of 4 decimals after meter (0.1mm), and 1mm RMS of interpolated geoid heights of points of test model. The largest value of geoid heights within EGM96 is 45.8281m, the lowest one is 43.1571m, mean height is 43.9581m, and the difference between extreme values is 2.671m, given in table 3. With the same methodology as in a previous case of EGM2008, the GIS raster dataset with 1km spatial resolution of EGM96 for Kosova is compiled, which is shown in bellow figure 5 [10].

EGM 1984 FOR THE NATIONAL AREA OF KOSOVA

Procedure and methodology for calculation of EGM84 geoid heights for the territory of Kosova (step 8) and their representing in a compiled map (figure 6) [11], were same as in a cases for EGM08 and EGM96. Greatest value of geoid heights within EGM84 is 47.198m, the smallest one is 43.9867m, the mean height is 45.5669m, while the difference between extreme values within the EGM84 geoid heights is 3.2113m, given in table 3.

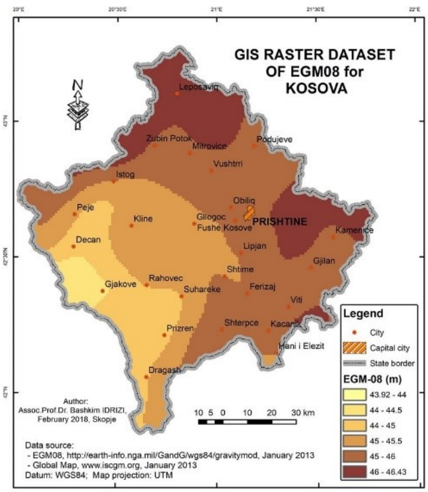


Figure 4. GIS raster dataset with 1km spatial resolution of EGM2008for Kosova

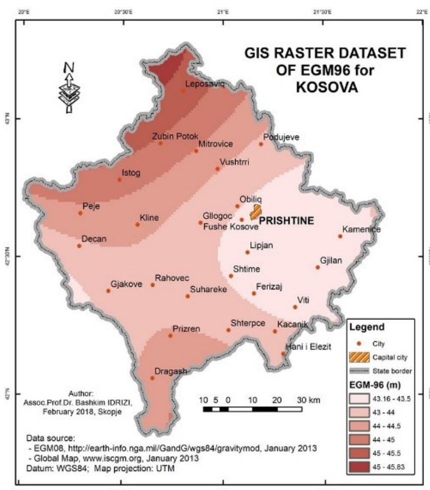


Figure 5. GIS raster dataset with 1km spatial resolution of EGM96 for Kosova

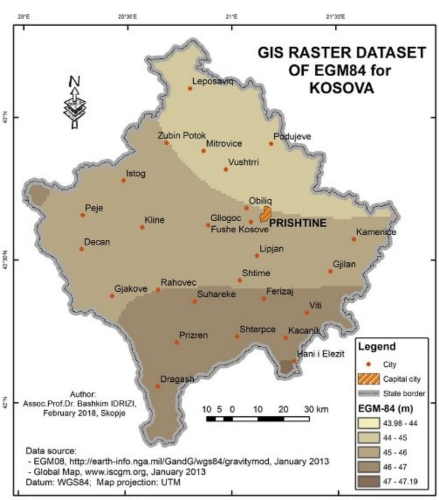


Fig. 6. Gis raster dataset with 1 km spatial resolution of EGM84 for Kosova

Table 3. Geoid heights and differences between EGM 08, 96 & 84 in the territory of Kosova

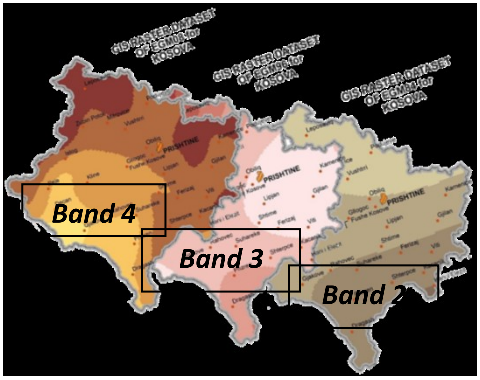
	Geoid heights (m)			Difference between two geoid heights (m)		
	EGM84	EGM96	EGM2008	EGM 08-96	EGM 96-84	EGM 08-84
Max value (m)	47.198	45.8281	46.433	2.9344	1.1018	2.1423
Min value (m)	43.9867	43.1571	43.9215	0.2611	-3.259	-2.0307
Diffe Max-Min (m)	3.2113	2.671	2.5115	2.6733	4.3608	4.173
Mean value (m)	45.56692	43.95809	45.53911	1.581024	-1.608835	-0.027811
Stand.Dev. (m)	0.690377	0.572147	0.493465	0.6974836	1.003411	1.04026

MULTIBAND RASTER DATASET FOR GEOID HEIGHTS FOR THE NATIONAL AREA OF KOSOVA

In the last step 10 (figure 3), according to ASTER elevation data and calculated values for all 10.893 points, as are presented in table 2, in GIS software multiband raster dataset with 10 bands was established. Each cell of raster image contains 10 values, per one in each band, which means that multiband raster image with 10.893 cells contain 108.930 values/calculations. Developing multiband raster image instead developing separate raster images for each calculated value, i.e. one instead ten raster images, is intended for multipurpose usage and creating suitable environment for further analyzes in this subject for the area of the Republic of Kosova. In bellow figure 7, three bands (EGM 08, 96 and 84 geoid heights) out of ten are shown as example/extract from developed multiband raster dataset, followed by the short description of each band.

It is open for further improvement by adding additional bands with geoid heights data developed by other researchers. A new band with official geoid model of the Republic of Kosova after its development by the responsible national mapping institution (Kosova Cadastral Agency), will be added by our side, in order to put into one place many geoid models for multipurpose usage, for everyday professional up to research purposes. If the national digital elevation model will be available free of charge by the KCA, it will be added to this multiband raster dataset, and some data as ellipsoidal heights (bands 8, 9 and 10) will be recalculated and updated.

Main objective of developed multiband raster is to fill current gap in this field in the Republic of Kosova, as well as to establish platform that will be used for performing multipurpose research analyses in a period post developing of official national geoid model.



Band 1	ASTER elevation
Band 2	Geoid height (EGM 84)
Band 3	Geoid height (EGM 96)
Band 4	Geoid height (EGM 2008)
Band 5	Difference between geoid heights of EGM 08-96
Band 6	Difference between geoid heights of EGM 08-96
Band 7	Difference between geoid heights of EGM 08-96
Band 8	Ellipsoidal heights based on EGM 84 and ASTER
Band 9	Ellipsoidal heights based on EGM 96 and ASTER
Band 10	Ellipsoidal heights based on EGM 2008 and ASTER

Figure 7. Multiband raster dataset for EGM 08, 96 and 84 geoid heights for Kosova

CONCLUSIONS

Model for utilization of existing global Earth Gravitational Models (EGM) for entire area of the Republic of Kosova through developing GIS dataset is given in this paper. Due to current situation in Kosova with the national geoid, which is still under development process by the Kosova Cadastral Agency [7], usage of global EGM's for issues related to geoinformation is more than necessary. Three existing global models EGM 2008, EGM 96 and EGM 84 [1] have been used for performing this research study. Comparing of the results between three models, were calculated based on joint GRID model with 10893 points which covers all national area with 1km ground resolution. Maximal and minimal differences between the models, maximal and minimal geoid heights (height of geoid above/bellow the WGS84 ellipsoid) in three geoid models, mean differences, standard deviation, ellipsoidal heights and other data-calculations, followed by developing of multiband raster dataset, are main outputs of performed research in this study.
Based on three developed models and differences between the models, nine maps for the territory of the Republic of Kosova were compiled. For map background, such as data for cities and boundaries, open and free Kosova Global Map data has been utilized, as official data developed by the national mapping authority of Kosova [7], while for the elevation data the ASTER global Digital Elevation Model (DEM) with 30m spatial resolution [6] has

been used. Within the paper, only three maps EG models with geoid heights as layouts of three bands are shown.

Calculation with online geoid calculator GeoidEval [5], gave us feedback and insure for calculated geoid heights for three models. Control points were selected by criteria to cover entire national area of Kosova. Based on the calculated values, the differences between calculated geoid heights with online geoid calculators and those exported from models in GIS platform have been evaluated, which resulted with very low differences.

Main purpose of analyses and developed GIS dataset for geoid heights and other data, is their open usage by geo community in Kosova, mainly for direct obtaining of elevations during field measurements and further research projects, till the establishing and formalization of national gravimetrical network and national geoid model.

Multiband raster image with ten bands in 1km spatial resolution, which contain 108.930 values stored in 10.893 cells, is the main output of this research study. It is open and extendable raster dataset, that is intended for multipurpose usage and update its content, as well inclusion of new band with the official national geoid model of the Republic of Kosova as soon as it is developed by the Kosova Cadastral Agency. Until the official national geoid, this model will fill the current gap in geo sector in the Republic of Kosova as contribute of academic community for professional and research usage of global geoid models for national purposes.

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THE IMPACT OF EMIGRATION IN THE AGING OF THE POPULATION OF ALBANIA AFTER 1990

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UDC: 314.117:314.15(496.5)

SUMMARY

The paper evaluates the indicators of aging of the population of Albania (percentage of elderly, ratio of elderly dependence, aging index, median age, average age and average life expectancy) for the period 1990 - 2060. These indicators are calculated in terms of existence of migration (Albania is a typical case), where the net migration rate is taken into account, as well as in the assumed conditions of lack of migration.
In addition to declining fertility and mortality, the population structure of Albania after the 1990s has been strongly influenced by the constituent processes of continuous emigration. The paper estimates that the indicators of population aging would have been up to 4% - 5% lower, if the emigration process had been limited and controlled.
From the analysis of statistical indicators, it is noticed that, during the whole period from 2001 until the projection of 2060, the average annual population growth is estimated negative (-0.7%), while the annual population growth over the age of 65 (65+) is estimated positive (+ 0.5%).
In order to slow down the phenomenon of aging of the population of Albania and mitigate the negative consequences of this aging, it is recommended to design and elaborate rigorous and continuous immigration and family policies.

Key words: Emigration, Albania, Population, Aging.

INTRODUCTION - Population aging and migration

Population aging, also known as demographic aging (non-demographic aging; population aging, etc.), is a summary term for shifts or displacements in the age distribution (in the age group structure) of the population towards older ages. The level and pace of population aging vary greatly between regions and within geographic regions (Samuel H., Himes and Eggers, 1989), as well as between socio-economic categories. But almost all Nations are currently experiencing an increase in the number of their elderly

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inhabitants. As a direct consequence of the continuing global fertility transition (decline) and declining mortality in older ages , population aging is progressing rapidly in many developed (industrialized and postindustrialized) and developing countries. This pattern is expected to continue over the next few decades, affecting the entire world (Samuel H., Heuveline, and Guillot. 2001).

According to current forecasts, the aging of the population in the first half of this century (XXI), should exceed elderly population of the second half of the twentieth century. For the world as a whole, the number of older people relative to the total population will increase from 6.9% in 2000 to a projected value of 19.3% in 2050. All regions are expected to see an increase, even why softer in some of them, like Africa, where the projected growth is from 3.3% in 2000 to 6.9% in 2050, etc. But in Latin America and the Caribbean, the number of older people is projected to reach 16.9% in 2050 (higher than the current European average) from 5.4% in 2000. The increase is projected to be even more worrying in China: from 6.9% in 2000 to 22.7% in 2050 (Wolfgang, Sanderson and Scherbow, 2001).

Population aging has important socio-economic and health consequences. It poses challenges to public health (concerns about the possible overload and bankruptcy of medicine and related programs), as well as to economic development (shrinkage and aging of the workforce, possible overload and bankruptcy of social security systems, etc.). With the aging of nations, the prevalence of disability, weakness and chronic diseases (Alzheimer's disease, cancer, cardiovascular disease, etc.) is expected to increase dramatically. Some experts raise the concern that humanity could become a "global nursing home" (Eberstadt, 1997).

The rate of population aging can also be modeled on migration. The effects of migration on population aging are usually more pronounced in smaller populations, due to the higher relative weight (percentage) of migrants in such populations.

Emigration has accelerated the phenomenon of population aging in Albania, because immigrants have been young and with many children. On the other hand, the emigration of working-age adults has also accelerated the aging of the population. The aging of the population in Albania has been accelerated by the return of elderly pensioners from other countries and the return of former emigrants who are above the average age of the population.

Emigration will play a more important role in population aging and age group imbalances in the future, in addition to low fertility, mortality and declining population.

STATISTICAL INDICATORS OF THE AGING POPULATION OF ALBANIA AND THEIR ASSESSMENT

Theoretical considerations

The study of population aging is also economically motivated by concerns about the aggravation of pension systems. From this point of view, the aging of the population is often measured by the increase in the percentage of elderly retirees and individuals of retirement age as well as by the increase of the dependency index. The retirement age may be different for different countries, but the most typical one is 65 years old. Nowadays a society is considered relatively old, when the number of elderly people aged 65+ exceeds 10% (8-10%) of the total population. By this standard, American society (US) is considered relatively old, as since 2000 the percentage of older people was 12.6% (Kevin and Velkoff. 2001).
An indicator related to the aging of the population is the ratio of dependence of the elderly - "the number of elderlies over 65 years in relation to the number of population in the working age group". For convenience, and laws of working, depends on the countries, the working age can be assumed to start at 15-16, despite the growing number of people pursuing their studies even after this age who remain, meanwhile, financially dependent, either on the state, or increasingly, by their parents or bank managers. The ratio of the elderly population to the economically active (employed) population is also known as the old age dependency ratio, the age dependency ratio, or the burden of aging dependency and is used to assess generational transfers, tax policies, and behavior. to savings.
Another indicator of age structure is the aging index (once referred to as the ratio of the number of elderly to the number of children), defined as the number of older people over 65 per 100 young people under 15 years old. According to research organizations and authors in the field, by 2030 the aging index is projected to exceed 100 in all developed countries and in some European countries and Japan is expected to exceed 200. To date, the aging index is much higher lower in developing countries than in the developed world, but the proportional increase in the aging index in developing countries is expected to be greater than in developed countries.
These indicators of population aging are simply counting ratios, which mean that they simply relate to the number of individuals in the older age categories. These indicators fail to take into account the age distribution within these categories, in particular within the older category. When fertility and mortality trends, responsible for population aging, are fairly regular over time, population growth is positively correlated with age (i.e.,

older age groups are growing faster). This means that if the percentage of the population aged 65+ is increasing, then within this population, the percentage of the subgroups of the population aged 65+ is also increasing significantly. For example, we say that the number of elderly people aged 80+ is also increasing. Just as health, financial status, and consumption patterns vary greatly between 65-year-olds and 80-year-olds, simple relationships hide significant heterogeneity in the elderly population. Attention is increasingly being paid to "older age" (typically 80+ years old). Curiously, the number of centenarians is growing even faster. Estimated at 180,000 worldwide in 2000, it could reach 1 million by 2030 (United Nations, 2001). The number of centenarians is growing even faster. Estimated at 180,000 worldwide in 2000, it could reach 1 million by 2030 (United Nations, 2001). The number of centenarians is growing even faster. Estimated at 180,000 worldwide in 2000, it could reach 1 million by 2030 (United Nations, 2001).

To consider the age distribution within the categories, the second class of population aging indicators or, alternatively, the set of statistical location measures (median, mean and modal age of the population) is used. Median age , the age at which, exactly, half of the population is older and half is younger, is probably the most widely used indicator. To study the dynamics of population aging the most preferred is the average age of the population.

Since population aging refers to correlated changes throughout the age distribution, every single indicator is insufficient to measure it. Also, the age distribution of the population is often very irregular and reflects the signs of past events; therefore, this distribution can not be described by a single number / indicator without significant loss of information.

Thus, the most appropriate approach to study population aging is to examine age distribution through:

(a) the percentage of older people over 65;

(b) the dependency ratio of the elderly - the ratio of the number of elderly people over 65 to the number of economically active (working) population;

(c) aging index - the number of older people over 65 per 100 young people under 15;

(d) Median age;

(e) Average age;

Calculation of aging and correlation of their indicators with migration

The following data were used for the calculation and analysis of the indicators of Albania aging population:

(a) Number of population by age groups in different years until the forecast of 2060 (tab. 2.2.1);

Tab. 2.2.1. Population of Albania by age groups (in - thousand inhabitants) (1990 - 2060). For the period 2015 - 2060, the forecasts are calculated according to the middle scenario

Years	**1990**	**1995**	**2000**	**2005**	**2010**	**2015**	**2020**
0 - 14 years old	1 073	1 014	945	812	657	538	534
15 - 64	2 028	1 892	1 956	1944	1 948	2,000	1 981
65+	181	200	220	263	314	359	421
Total	3 282	3106	3121	3019	2919	2 897	2 935

Years	**2025**	**2030**	**2035**	**2040**	**2045**	**2050**	**2055**	**2060**
0 - 14 years old	568	552	501	442	404	390	386	374
15 - 64	1 891	1 823	1 788	1 765	1 740	1 679	1 562	1 416
65+	501	579	626	648	641	642	687	763
Total	2 960	2 954	2 915	2 855	2 785	2 710	2635	2 554

Data Source: United Nations, Population Division, Department of Economic and Social Affairs. INSTAT, 2014

(a) Net migration rate (per 1000 inhabitants) in different years until the forecast of 2060 (tab. 2.2.2)

Tab. 2.2.2. Net migration rate (per 1000 inhabitants). For the period 2015 - 2060, the forecast is given according to the middle scenario

variant	1990-1995	1995-2000	2000-2005	2005-2010	2010-2015	2015-2020	2020-2025
Average	-27.8	-11.5	-11.3	-16.9	-6.3	-3.4	-3.4

variant	2025-2030	2030-2035	2035-2040	2040-2045	2045-2050	2050-2055	2055-2060
Average	-3.4	-3.4	-3.5	-3.5	-3.6	-3.6	-3.5

Data Source: United Nations, Population Division, Department of Economic and Social Affairs.

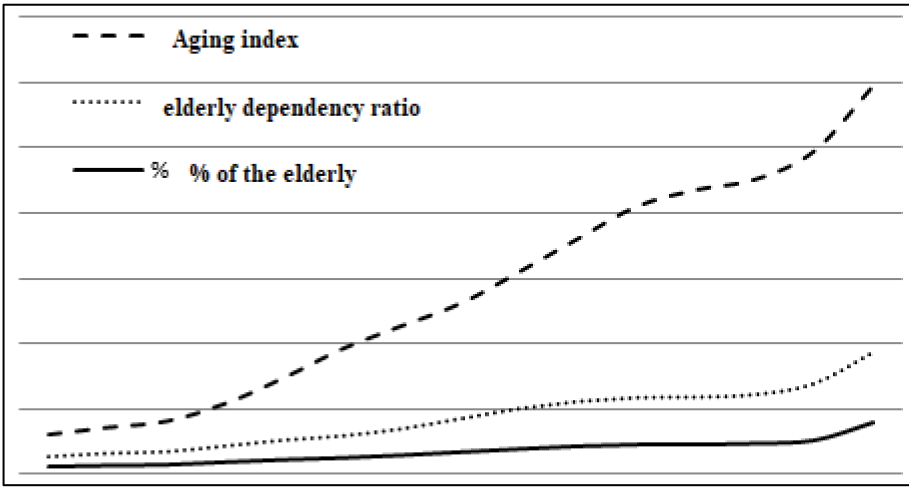
From the data processing of tables 2.2.1 and 2.2.2 are calculated the numerical indicators of population aging[1] (tab. 2.2.3), which are also given in the figures / graphs 2.2.1:

Tab. 2.2.3. Indicators of population aging (1990 - 2060)

Years	% of the elderly	Elderly dependency ratio (%)	Aging index	Median age		the average age	Average life expectancy
1	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1990	5.5	8.9	16.9	24.1	No migration	26	71.96
1995	6.4	10.6	19.7	24.7			72.24
2000	7.0	11.2	23.3	27.1		30.1	74.27
2005	9.1	13.5	32.4	29.3			76.09
2010	10.9	16.1	47.8	33.1		34.8	77.04
2015	12.4	17.9	66.7	34.3	34.3	37.2	77.90
2020	14.4	21.2	78.8	35.2	34.9	38	78.89
2025	16.9	26.5	88.2	37	36.5	40	79.82
2030	19.3	31.8	104.9	39	38.4	42.5	80.72
2035	21.5	35.0	124.9	41.5	40.6	45	81.61
2040	22.7	36.7	146.6	43.9	42.7	47	82.49
2045	23	36.8	158.7	46.2	44.6	49	83.31
2050	23.6	38.2	164.6	47.6	45.5	50.5	84.07
2055	26.1	44.0	178	48.1	45.3	51	84.79
2060	39.9	53.9	204	48.2	45.9	51.5	85.42

Processed based on data from the United Nations, Population Division, Department of Economic and Social Affairs.

[1]For the period 2015 - 2060, the indicators of population aging are calculated based on the forecasts according to the middle scenario (columns 2, 3, 4, 5, 7, 8 of tab. 2.2.3). The median age was also calculated in terms of the absence of migration (column 6 of tab. 2.2.3).



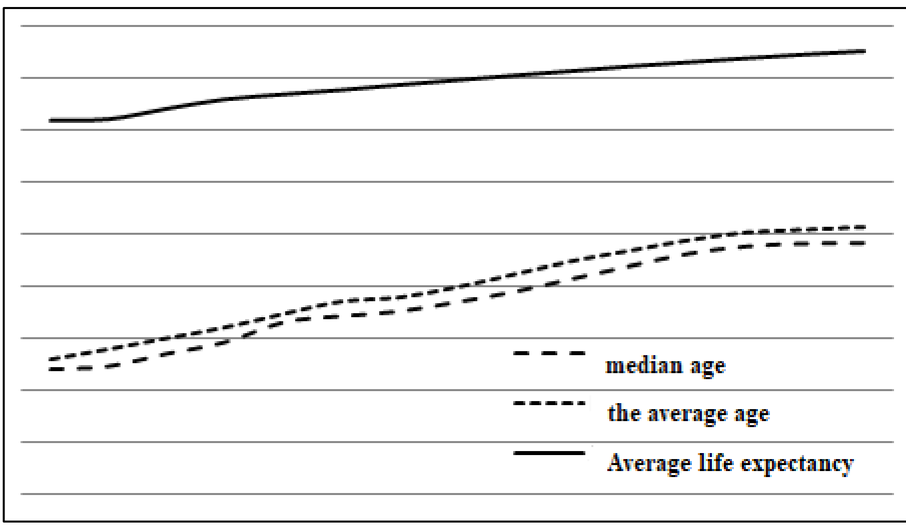


Fig. 2.2.1. Graphic dependence of indicators of aging population of Albania (1990 - 2060)

To see the impact of migration on indicators of population aging (1990 - 2060) the correlation coefficient was calculated[2] (r) and the error of this coefficient (m_r) between each indicator and the net migration rate (NMN) with the formulas:

---

[2] The correlation coefficient represents the degree and intensity of connections between phenomena.

$$r = \frac{n\sum_{i=1}^{n} x_i y_i - \sum_{i=1}^{n} x_i \sum_{i=1}^{n} y_i}{\sqrt{[n\sum_{i=1}^{n} x_i^{\ 2} - (\sum_{i=1}^{n} x_i)^2][n\sum_{i=1}^{n} y_i^{\ 2} - (\sum_{i=1}^{n} y_i)^2]}}$$

$$m_r = \frac{1 - r^2}{\sqrt{\text{n}}}$$

Where: x_i - values of indicators of population aging,
y_i - Net Migration Rate (NMN) values,
n - number of pairs examined

The results of the calculations are given in table 2.2.4.

Tab. 2.2.4.

Indicators of aging (1990 - 2060)	NMN (1990 - 2060)	Correlation coefficient (r)	Error m_r
Percentage of older people	NMN (per 1000 inhabitants	0.73	0.12
Elderly addiction report	NMN (per 1000 inhabitants	0.74	0.11
Aging index	NMN (per 1000 inhabitants	0.77	0.10
Median age	NMN (per 1000 inhabitants	0.79	0.09
the average age	NMN (per 1000 inhabitants	0.81	0.08
Average life expectancy	NMN (per 1000 inhabitants	0.68	0.13

ANALYSIS OF CORRELATION INDICATORS: SOME CONCLUSIONS AND RECOMMENDATIONS

Population aging is a worrying phenomenon in most parts of the world, especially in developed countries with low fertility.

The declining fertility rate below the replacement level (2.3 children per mother) has raised fears that many countries will not have enough employees to support an increasing number of older people.

The values of the correlation coefficients (tab. 2.2.3) indicate a direct and strong positive link between migration and the aging of the population in Albania. Since, in all cases, the link between the indicators of aging and the rate of emigration is stable.

However, the increase in the indicators of aging of the population of Albania has occurred for several main reasons:

- Drastic reduction of fertility, as a global trend in the last stages of demographic transition, including Albania. In 2015, the birth rate was 1.67 children / woman. This indicator is below the replacement rate (2.1 children / woman). In 1960, this indicator had a max value (7 children / woman); in 1970, 5 children / wife; in 2001, 2.3 children / women; in 2012, 1.72 children / woman. With these rates of declining fertility, Albania is the third country in the world with the fastest aging population, after Korea and Russia. In France, it took 2 centuries for fertility to fall from 5 children / woman to below the population replacement rate. In Albania this happened in only 34 years.
- Immigration plays an important role in the aging process of the population, as most of the emigrants are young (average); migratory outflows, affect the population aged 20 - 40 years (0-14 years, ≈ 14.34% of emigrants, 15 - 64 years, ≈ 80.66% and 65+ years, ≈ 5%); our population has been reduced due to this phenomenon. Emigration accelerates the aging of the population.
- Increased life expectancy çon in the aging population.

If the forecast of the dynamics of the main age group of the population for the period 2001 - 2020 is calculated, taking into account the census data of 2001 and assuming Low Mortality[3] (VU), Low Fertility[4] (LU) and lack of Migration[5] (PaM) (tab. 3.1), we will have the following indicators of population aging in% (in terms of the existence of migration taking into account the number of population measured by INSTAT, and the lack of migration taking into account consider the population number from tab. 3.1) (tab. 3.2):

Tab. 3.1. Assumed (projected) population by age groups in the absence of migration, calculated on the basis of the 2001 census

Age group	2001 (Starting population)	2005	2010	2015	2020
0-14	905131	847881	774334	723235	683349
15-64	1930755	2084410	2253343	2389864	2469018
64+	227432	266186	316308	352700	402330
Total population	3063318	3198477	3343985	3465799	3554697

Source: INSTAT

Tab. 3.2. Indicators of population aging in terms of the existence of migration (measured data) and the absence of migration (projected population values).

INDICATORS	conditions	2005	2010	2015	2020
Percentage of older people	**With emigration**	9.1	10.9	12.5	14.4

[3]The lower hypothesis assumes the following annual mortality rate in women: 7% for infants, 5% for children aged 1 to 4 years, 4.3% for ages 5 to 59, and 1% for older age groups. Thus, infant and child mortality will be halved during each of the periods 2011-2021 and 2021-2031, resulting in a final mortality by a quarter of the 2011 level.

[4] The low fertility hypothesis is based on the long-term trend and suggests a continuous convergence towards the European model.

[5]Given the previous two decades of large-scale emigration, widespread throughout Albania, all hypotheses assume a generally declining trend for the next twenty years. Given the emigration levels for both sexes over the last decade, similar future trends are assumed for both men and women.

	No emigration	8.3	9.4	10.2	11.3
Elderly addiction report	**With emigration**	13.5	16.1	18.3	21.0
	No emigration	12.8	14.1	14.8	16.3
Aging index	**With emigration**	32.4	47.7	72.2	85
	No emigration	31.4	40.8	48.8	58.9

Refer to the analysis of the table 3.2., can be seen that as a result of the mass emigration of Albanians, the statistical indicators of population aging have increased:

- Percentage of older people, up to 3%
- Elderly dependency ratio, up to 4%
- Aging index, up to 20%

Population aging is inevitable in the future, but increasing the fertility rate and reducing net migration through regulatory policies would significantly slow it down. Therefore, measures should be taken to improve immigration and family policies.

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RASTER LAYERS OF ALBANIAN GLOBAL MAP DATASET

Milot LUBISHTANI[1]

UDC: 528.93.06(496.5)

SUMMARY

One of the main aims of the infrastructural organization of geospatial data is to provide users to be capable to acquire complete, exact and updated dataset at the right time. This is necessary for providing of an ideal environment, where all stakeholders can work collaboratively in an effective way, in order to solve environmental issues and to fulfill their target goals.

The necessity of infrastructural organization of geospatial data in global level, by including official geospatial datasets developed by the national mapping organizations, for environmental monitoring, protection, and early warning management in international level, are the main findings of this research study.

Data standardization of Global Map as contributor of GSDI and GEOSS have been analyzed through developed Albanian GM dataset. As main components that were taken into consideration for performing research analyses are data and metadata, technology, institutional framework, policies, interoperability, network services, search opportunities, and data sharing within GSDI.

Key words: GM raster data , Albania, Global Map, , land use, land cover, elevation, vegetation.

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1. INTRODUCTION

The main purpose of Global Mapping (GM) project is global data collection of geospatial data from all states and interested organizations to develop and to have easy access to digital geographic information at global level of scale 1:1.000.000, aimed to be used to equip the implementation of international/global agreements and conventions for environment protection, supervision of major phenomena of the environment and encourage economic growth. GM also intend to contribute in development of spatial data in global level (GSDI-Global Spatial Data Infrastructure, www.gsdi.org).

Existing topographic maps in scale 1:25.000, high resolution orthophoto images, as well as the official data from governmental institutions has been utilized as source data for Albanian GM datasets. In this paper in details will be presented whole process of data preparing, quality and outputs of Albania's GM data, with focus on raster data DEM, land cover, land use and vegetation with 100m spatial resolution.

The Republic of Albania within the project for the compilation of the global map is represented by the State Authority for Geospatial Information (ASIG), as the responsible institution for Albania's cartography at the national level. Preparation of Albania's GM data has been proceeded in academic level within the PhD study research in geodesy department of the Polytechnic University of Tirana, with aim to support, help and improve young cartography in Albania. It was published officially on July 14th 2016 (Lubishtani, Idrizi 2016).

2. GLOBAL MAP

Global Map is a set of digital maps that accurately cover the whole globe to express the status of global environment. It is developed through the cooperation of National Geospatial Information Authorities (NGIAs) in the world. An initiative to develop Global Map under international cooperation, the Global Mapping Project, was advocated in 1992 by Ministry of Construction, Japan (Idrizi 2005).

Due to negative experiences of international world map with a scale of 1: 1,000,000 dating from 1891, the development of technology and the need for recognition of global geospatial data and these data are as update, in 1992 in

RioDeZhaniero in Brazil was proposal creation world global digital mapping in scale 1: 1,000,000 (Idrizi 2005).

The main purpose of this project is global data collection of geospatial data from all states and interested organizations to develop and to have easy access to digital geographic information at global level of scale 1:1.000.000. It is aimed to be used to equip the implementation of international/global agreements and conventions for environment protection, for supervision of major phenomena of the environment and encourage economic growth (Nagayama 2016). GM also needs to contribute in development of spatial data (GSDI-Global Spatial Data Infrastructure, and GEOSS-Global Earth Observation System of Systems).

Since the world as a whole is divided into different continents and countries that follows the various institutions which produce geospatial data with the same or different standarts, it is thought that these geospatial data to have same standarts, so they can be used, to be exchanged to reach the analysis of a problem more easily and with low cost. The primary objective of Global Map project is to contribute to the sustainable development through the provision of base framework geographic dataset, which is necessary to understand the current situation and changes of environment of the world (Sasagawa etAll 2017).

Global Map is fundamental digital geospatial information being developed to cover the whole land of the globe. It is an effort central to the Global Mapping Project. The purpose of the Global Map is to accurately describe the present status of the global environment in international cooperation of respective National Mapping Organizations (NMOs) of the world, aimed for (Idrizi 2006):

- Monitoring and early warning systems for natural disasters;
- Developing ecosystem, drainage basins framework for environmental assessment;
- Monitoring and management of natural resources;
- Quantifying trans boundary issues;
- Assessment of the trends of environment changes;
- Rapid response capability/early warning;
- Local, national and multinational physical development planning;
- Environmental priority setting, analytical studies over large areas and
- Informed decision-making of policy makers with a strategic database.

The benefits of participation in Global Mapping include: Joining the world community of surveying and mapping organizations will facilitate the acquisition of the latest information and knowledge of digital geographic data development and service (Idrizi 2018); it would also facilitate to raise the status of the organization by active participation in international activities and the contribution to sustainable development which is the final goal of Global Map.

There are two series of Global Map. One is National and Regional version which each participating NMOs are basically in charge of development of their own Global Map. The other is Global Version which is developed by using satellite imagery with cooperation between participating NMOs and supporting stakeholders. Global version covers only in vegetation layer and land cover layer (Lubishtani 2018).

GM national and regional version database contains four vector layers (population centers, transportations, drainage and boundaries) and raster layers (land cover, land use, vegetation and elevation) at scale 1:1.000.000 for vector and with spatial resolution of 30" (arc seconds of longitude and latitude) for raster layers (Lubishtani, Idrizi 2016).

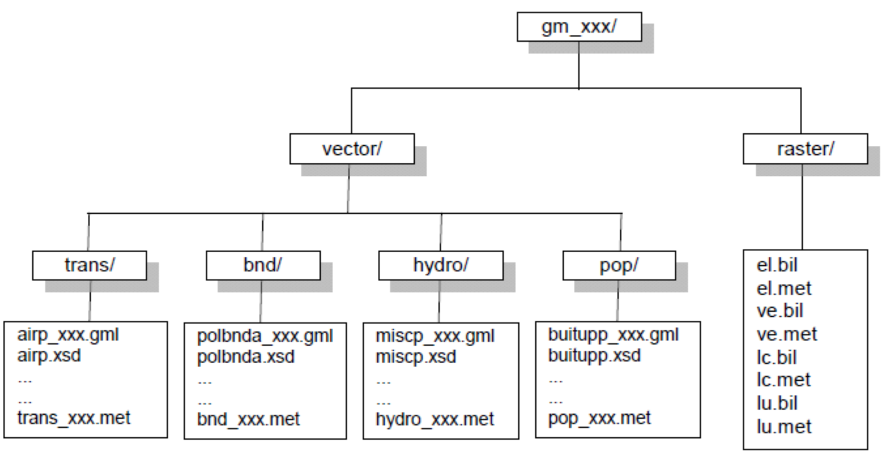

Figure 1. Directory Structure (Global Map Specifications Version 2.2)

GM data structure is defined on Global Map specification documents 1.1, 1.2, 1.3, 2., 2.1 and 2.2, based on ISO/TC 211 international standards. i.e. ISO19136 for GML format, ISO 3166 for nation codes, ISO 19115 standard of metadata of V2 by using ISO 19139 for encoding, ISO 15046 standard of metadata of V1, ISO639 for language code, and ISO8601 for date code (Idrizi etAll 2011). In next figure scheme of GM standards is given:

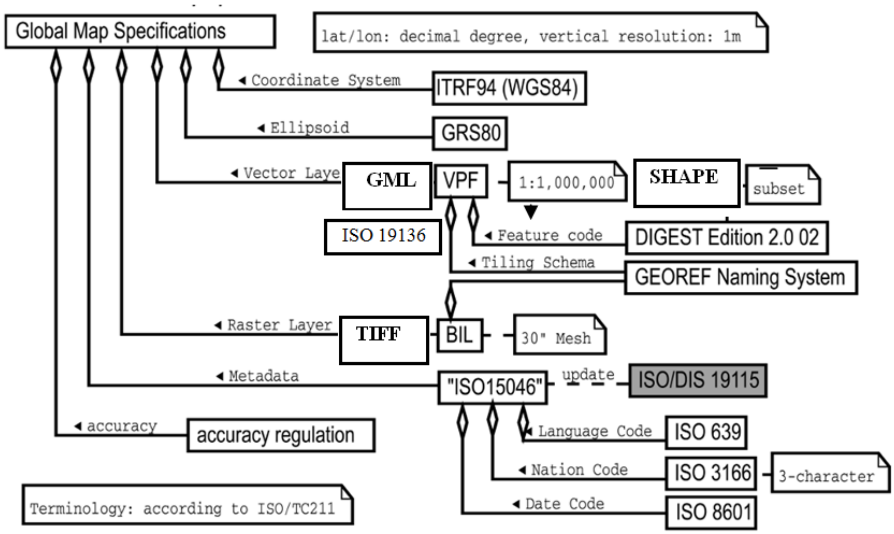

Figure 2. Scheme of GM standards (Idrizi etAll, 2011)

Despite the maps prepared in local/national standards, Global Map dataset enable (Idrizi, 2006):

- All data of Earth to be in one place;
- With the same attributes;
- In the same format;
- In the same coordinate system;
- In the same scale and
- With similar accuracy.

Increasing demand and the need to be qualified data geospatial and their use for achieving a result set and necessary and cost as little as possible, many European countries and the Balkans have handed over the data as geospatial on the global map with a scale of 1 1.000.000 and as such as Macedonia in 2006, Romania in 2009, Bulgaria in 2009, Kosovo in 2010 and Albania in 2016. All European countries have joined the GM through EuroGlobalMap (www.eurogeographics.org), unless countries like Montenegro, Belarus and Bosnia and Herzegovina are not joined GM (Lubishtani etAll 2018). Currently, 168 countries/16 regions participate in the Project. Among them, data of 114 countries/8 regions have been released. Version 2 data are for 90 countries/4 regions (GM newsletter, no.81, 2016).
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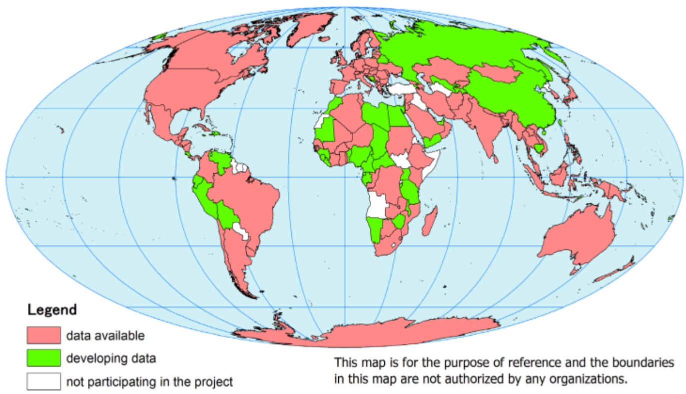
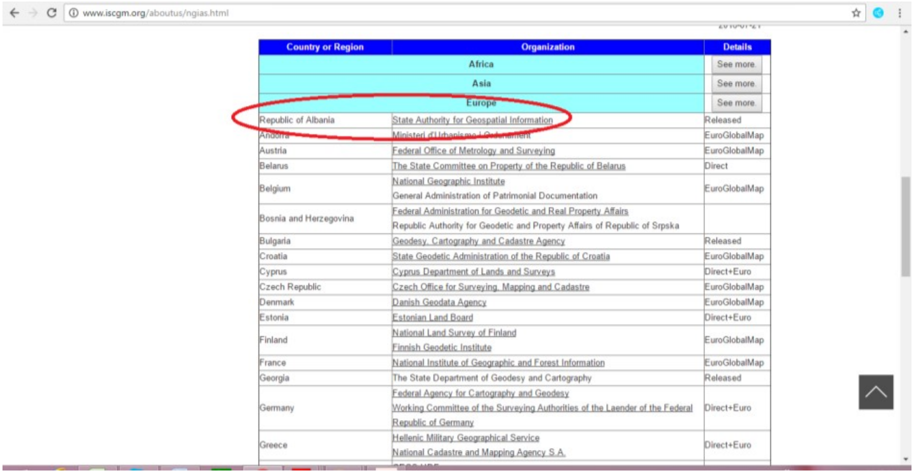


Figure 3. Coverage of countries with Global Map datasets (GM newsletter, no.81, 2016)

3. GLOBAL MAP DATASET OF ALBANIA

The Republic of Albania participate in global mapping project since 30.06.2016 in Level B (*Level B* mean that institution will prepare the data set of own country), represented by the State Authority for Geospatial Information (ASIG), as the responsible institution for Albania's cartography at the national level. Preparation of Albania's GM data has been proceed in academic level within the geodesy department of the Polytechnic University of Tirana, with aim to support, help and improve young cartography in Albania. Existing topographic maps 1:25.000, high spatial resolution orthophoto images, as well as the official data from governmental institutions has been utilized as source data (Lubishtani, Idrizi 2016).



Country or Region	Organization	Details
Africa		See more
Asia		See more
Europe		See more
Republic of Albania	State Authority for Geospatial Information	Released
Andorra	Ministeri d'Urbanisme i Ordenament	EuroGlobalMap
Austria	Federal Office of Metrology and Surveying	EuroGlobalMap
Belarus	The State Committee on Property of the Republic of Belarus	Direct
Belgium	National Geographic Institute General Administration of Patrimonial Documentation	EuroGlobalMap
Bosnia and Herzegovina	Federal Administration for Geodetic and Real Property Affairs Republic Authority for Geodetic and Property Affairs of Republic of Srpska	
Bulgaria	Geodesy, Cartography and Cadastre Agency	Released
Croatia	State Geodetic Administration of the Republic of Croatia	EuroGlobalMap
Cyprus	Cyprus Department of Lands and Surveys	Direct+Euro
Czech Republic	Czech Office for Surveying, Mapping and Cadastre	EuroGlobalMap
Denmark	Danish Geodata Agency	EuroGlobalMap
Estonia	Estonian Land Board	Direct+Euro
Finland	National Land Survey of Finland Finnish Geodetic Institute	EuroGlobalMap
France	National Institute of Geographic and Forest Information	EuroGlobalMap
Georgia	The State Department of Geodesy and Cartography	Released
Germany	Federal Agency for Cartography and Geodesy Working Committee of the Surveying Authorities of the Laender of the Federal Republic of Germany	Direct+Euro
Greece	Hellenic Military Geographical Service National Cadastre and Mapping Agency S.A.	Direct+Euro

Figure 4. Part of list of participants in GM project (www.iscgm.org, 30.06.2016)

Albania is one of the last European countries that has published database at Global Map, exactly on 14th July 2016 has published the vector and raster database according to technical specification V2.2. Official source data that have been used for developing Albanian GM dataset were supplied by official governemantal institutions: State Authority for Geospatial Information (ASIG), Institute of transportation, Albanian Institute of Statistics (INSTAT), Military Geographical Institute of Albania, and Ministry of Urban Development (Lubishtani, Idrizi 2016).

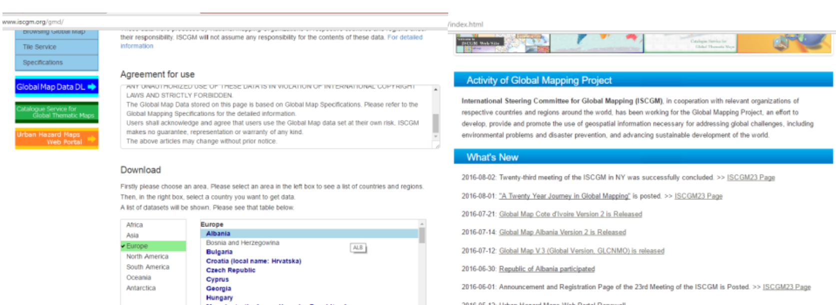


Figure 5. Albanian GM data (www.iscgm.org/gmd, 30.08.2016)

4. GLOBAL MAP RASTER DATASET OF ALBANIA

Global Map raster data is in simple binary raster format without the embedded header – BIL (Band Interleaved by Line) format, pixel information stores band by band for each line, or row, of the image. Vegetation, Land Cover and Land Use are in 8 bit unsigned data and the elevation data in 16 bit signed in Motorola (big-endian) byte order. On October 10th 2008 the existing GM raster data (national/regional version) has been published in TIFF format also, which is more simple and user-friendly format (Idrizi etAll 2010).

All layers are identified with two letters, which explain the name of layer (el – elevation, ve – vegetation, lc – land cover, lu – land use). The file names have the form ww_xxx.zzz where:

- ww identifies the theme,
- xxx identifies the country code which is defined at ISO 3166 Nation Code, and
- zzz is the extension identifying the data (bil or tiff) or the header (hdr).

Raster grid cells are arrayed on a horizontal coordinate system in degrees of latitude and longitude referenced to ITRF94 and GRS80, with 30" spatial resolution, and tiling dividing system by second pair with 1° by 1° standard GEOREF division (Idrizi etAll 2011). The following groups of features are stored as raster layers:

ELEVATION: The vertical distance between the surface of the earth and the standard sea level that the nation has defined. Vertical units represent elevation in meters above Mean Sea Level (MSL). The elevation layer is in a Band Interleaved Line (BIL) format with 16-bit elevation value and 30" horizontal grid spacing. The values of elevation are represented in meters, in which the codes -9999 are areas masked with the sea.

VEGETATION: Percent tree cover data by an integer value from 0 to 100 will are as vegetation layer. For Vegetation layer, a modified water legend with 20 classes is adopted.

LAND COVER: GLCNMO global legend are used for land cover layer. Land cover is the observed (bio) physical cover on the earth's surface (Di Gregorio and Jansen, 1998). In Global Map specification the codes of Land Cover Characteristics of GM V1/V2 national/regional version is adopted for International Geosphere-Biosphere Programme (IGBP). IGBP has 17 Land Cover classes. The global land cover layer is product of a collaboration between USGS and the University of Maryland, Department of Geographical Sciences.

LAND USE: Codes developed for the Global Map are adopted. Land Use is a series of operations on land, carried out by humans, with the intention of obtaining products and/or benefits through using land resources (de Bie 2000).

Classification of land cover data was made in two ways: one was global classification and the other was national/regional classification. Land cover global version dataset contain 20 land cover classes, and another additional class with code 255 which represent the areas without data. In table 7 are represented the comparison between the Land cover classes in national/regional with 17 and global version with 20 classes (Idrizi etAll 2010).

Table 1. Types of raster data of GM V1/V2 national and regional version (Idrizi etAll 2010)

Land Cover		Land Use		Vegetation	
Description	***Code***	***Description***	***Code***	***Description***	***Code***
Evergreen Needleleaf Forest	1	Forest	10	Tropical rainforest	10
Evergreen Broadleaf Forest	2	Mixture	20	Hydrotropic forest	20
Deciduous Needleleaf Forest	3	Grassland/shrub	30	Grassland in tropical or sub-tropical zone	30
Deciduous Broadleaf Forest	4	Agricultural area	40	Semi desert in tropical or sub-tropical zone	40
Mixed Forest	5	Wetland	50	Desert in tropical or sub-tropical zone	50
Closed Shrublands	6	Barren area	60	Evergreen thick-leaved forest	60
Open Shrublands	7	Built-up area	70	Evergreen broad-leaved forest	70
Woody Savannas	8	Drainage/water	80	Deciduous broad-leaved forest	80
Savannas	9	Ocean	90	Grassland in temperate zone	90
Grasslands	10			Semi-desert in temperate zone	100
Permanent Wetlands	11			Desert in temperate zone	110
Croplands	12			Northern coniferous forest	120
Urban and Built-Up	13			Tundra	130
Cropland/Natural Vegetation Mosaic	14			Water body	140
Snow and Ice	15			Ice and snow	150
Barren or Sparsely Vegetated	16			Wetland	210
Water Bodies	17			Mixed forest	220
				Mixed land	230
				Non natural	240
				Unclassified	250

Table 2. Comparison between classes of Land Cover global and national/regional versions (Tateishi 2005)

Land cover global version	Land cover – national and regional version
1. Broadleaf Evergreen Forest	2. Evergreen Broadleaf Forests
2. Broadleaf Deciduous Forest	4. Deciduous Broadleaf Forests
3. Needleleaf Evergreen Forest	1. Evergreen Needleleaf Forests
4. Needleleaf Deciduous Forest	3. Deciduous Needleleaf Forests
5. Mixed Forest	5. Mixed Forests
6. Tree Open	8. Woody Savannas 9. Savanna
7. Shrub	6. Closed Shrublands 7. Open Shrublands
8. Herbaceous, single layer 9. Herbaceous with Sparse and Tree/Shrub	10. Grasslands
10. Sparse Herbaceous/Shrub	16. Barren
11. Cropland (herbaceous crops except rice) 12. Rice, paddy	12. Croplands
13. Cropland/Natural Vegetation Mosaic	14. Cropland/Natural Vegetation Mosaics
14. Tree-Water (Brackish to Saline) 15. Wetland	11. Permanent Wetlands
16. Bare area, consolidated (gravel, rock) 17. Bare area, unconsolidated (sand)	16. Barren
18. Urban	13. Urban and Built-up
19. Snow/Ice	15. Snow and Ice
20. Water Bodies	17. Water Bodies

According to point 3.2.2 (data structure) of GM specification V2.2, the raster data with higher resolution can be developed, such as 3 or 15 arc seconds, in order to unable resampling procedure with 30 arc-second data. In a case of Albanian raster dataset of GM data, we used the highest option of spatial resolution, and four raster layers have been developed with spatial resolution of 3 arc-seconds, which is equal to about 100m spatial resolution.

4.1. Land cover dataset of Albanian GM

IRS, SPOT, Landsat and RapidEye satellite images, dual coverage, orthophotos, and topographic maps 1:25000 are used for developing Land Cover dataset for Global Map of Albania. The classes which are included for Albanian land cover dataset are: 2,3,5,6,7,8,9,10,11,13,15,16,17,18,20, and 255, while not included classes are: 1,4,12,14, and 19. In bellow table are given counted areas of Albanian national area with land cover classes according to GM specification 2.2.

Table 3. Coverage of Albanian national area with Land Cover classes according to GM Specification 2.2

Value	Count	Area [km2]	Value	Count	Area [km2]	Value	Count	Area [km2]
2	967749	6332	8	521750	3414	15	12537	82
3	139143	910	9	427294	2496	16	27441	180
5	65632	429	10	228933	1498	17	32167	210
6	91671	600	11	722383	4727	18	113523	743
7	556290	3640	13	432418	2830	20	54343	356
255	61	1						

4.2. Land use dataset of Albanian GM

For creating of land use of Albania, high resolution orthophoto images, Landsat, CORINE, and topographic maps 1:25000 were used. The classes which are included for land cover are: 10, 30, 40, 50, 60, 70, 80, and 255, while 20 and 90 classes have not been included. In bellow table are given counted areas of Albanian national area with land use classes according to GM specification 2.2.

Table 4. Coverage of Albanian national area with Land Use classes according to GM Specification 2.2

Value	Count	Area [km2]	Value	Count	Area [km2]
10	1264195	8272	60	59608	390
30	1734267	11348	70	113523	743
40	1154801	7556	80	54343	356
50	12537	82	255	61	1

4.3. Vegetation dataset of Albanian GM

Based on results derived from analyses and processing vegetation of Albania's GM, the vegetation dataset of Albania have been developed based on high resolution orthophoto images, Landsat TM/NDVI and topographic maps 1:25000. In next table are given counted areas of Albanian national area with vegetation classes according to GM specification 2.2.

Table 5. Coverage of Albanian national area with Vegetation classes according to GM Specification 2.2

Value	Count	Area [km2]	Value	Count	Area [km2]	Value	Count	Area [km2]
1	710	5	34	4988	33	67	45926	301
2	1471	10	35	6234	41	68	44559	292
3	2268	15	36	8731	57	69	43663	286
4	964	6	37	11475	75	70	38053	249
5	587	4	38	10125	66	71	30884	202
6	3143	21	39	9156	60	72	37892	248
7	2030	13	40	9143	60	73	53247	348
8	1416	9	41	9373	61	74	50257	329
9	3559	23	42	11509	75	75	53798	352
10	3840	25	43	14314	94	76	47448	310
11	2782	18	44	14078	92	77	47513	311
12	1904	12	45	10292	67	78	34341	225
13	1314	9	46	8254	54	79	31759	208
14	1426	9	47	10925	71	80	47174	309
15	2974	19	48	12504	82	81	54030	354
16	2901	19	49	15347	100	82	45190	296
17	2711	18	50	18690	122	83	38140	250
18	1759	12	51	18973	124	84	38006	249
19	1475	10	52	22143	145	85	35801	234
20	2045	13	53	18120	119	86	29234	191
21	3027	20	54	15236	100	87	32376	212
22	4651	30	55	19454	127	88	32163	210
23	7761	51	56	17943	117	89	28933	189
24	6606	43	57	15282	100	90	34453	225
25	6999	46	58	14508	95	91	53468	350
26	5057	33	59	18467	121	92	47557	311
27	3012	20	60	25519	167	93	40501	265
28	2317	15	61	22452	147	94	31879	209
29	2635	17	62	17767	116	95	19630	128
30	3209	21	63	24617	161	96	17510	115
31	3851	25	64	34639	227	97	22347	146
32	4571	30	65	42349	277	98	24926	163
33	5995	39	66	45375	297	99	14493	95
						100	1976	13

4.4. Elevation dataset of Albanian GM

For creating of elevation of Albania, SRTM with 90m spatial resolution have been used as basic data, which later have been adjusted with 1d transformation based on list of official ground control points of Albanian geodetic network. In bellow table are given counted areas of Albanian national area with graduated classes in every 100m altitude.

Table 6. Albanian national areas divided with 100m altitude graduated areas

Elevation [m]	Count	Area [km2]	Elevation [m]	Count	Area [km2]	Elevation [m]	Count	Area [km2]
0-100	730235	4778	901-1000	247577	1620	1801-1900	50835	333
101-200	312268	2043	1001-1100	226168	1480	1901-2000	37290	244
201-300	180074	1178	1101-1200	211187	1382	2001-2100	25254	165
301-400	299275	1958	1201-1300	188625	1234	2101-2200	16063	105
401-500	282245	1847	1301-1400	164729	1078	2201-2300	9075	59
501-600	260960	1708	1401-1500	135296	885	2301-2400	4533	30
601-700	248671	1627	1501-1600	109197	715	2401-2500	1877	12
701-800	230532	1508	1601-1700	86368	565	2501-2600	570	4
801-900	266031	1741	1701-1800	68050	445	2601-2700	165	1
						2701-2749	16	1

Results derived from analyses and processing of land cover, land use, vegetation and elevation layers of Albania's GM, are shown in four maps figures 6 to 9 (Lubishtani etAll 2018).

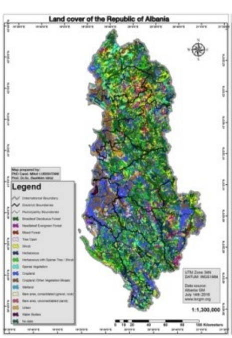


Figure 6. Land Cover layer

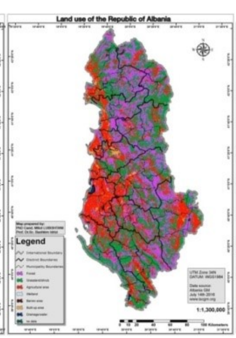


Figure 7 Land Use layer

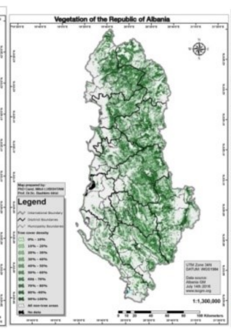


Figure 8 Vegetation layer

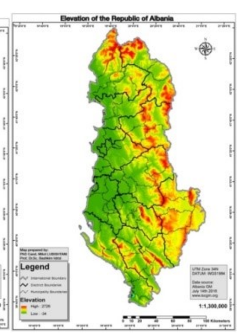


Figure 9 Elevation layer

5. CONCLUSIONS

Modern trends in the world such as globalization, across all aspects of human life and the management of all possible techniques in the world, and in geodesy as a science, has ordered to create a single map of the world where all countries of the world will be presented with several sets data and substrates and homogeneous standards.

Characteristic of the GM is that all the data on the Earth are in one place, with the same structure, in the same format, on the same coordinate system, the same volume and with similar accuracy.

The GM data covers the entire land area with a spatial resolution of 1 km for raster data and scale 1:1,000,000 for vector data, and are in line with the specifications of the International Steering Committee for Global Mapping. Global mapping is an international collaborative initiative through voluntary participation of national mapping organizations of the world, aiming to develop globally homogeneous geographic data set, and to establish concrete partnership among governments, private sectors, data providers and users to share information and knowledge for sound decision-making.

Climate change is a process by which facing the world in these days, and automatically create a need that we geospatial data global of which can manage a various emergency situations such as natural disasters, floods, earthquakes, mudslides, volcanoes etc. With the Global Map dataset being in digital form, it lends itself to various data manipulation and for modeling real life situations.

Global Map dataset may have limited uses at national and local scales. However, Global Map dataset is needed to address global, regional, trans-boundary and in many cases national concerns.

Albanian GM dataset as case study of the research aimed for performing analyses of infrastructural organization of geospatial data in global-intercontinental level, have been developed within PhD research study of Milot Lubishtani (Lubishtani etAll 2020), first author of this paper, under the supervision of prof Bashkim Idrizi, second author of this paper, at the Polytechnic University of Tirana, in cooperation with the Agency for Geospatial Authority of Albania (ASIG), in year 2016 (www.asig.gov.al).

Involvement by an organization in the project in generally is categorized in three levels, i.e. as Level A, B and C. Level A means that institution will prepare the data set of own country and other countries, the Level B mean that institution will prepare the data set of own country, and the Level C mean that institution will give all necessary data, preparation will be done by ISCGM (Idrizi etAll 2010). The Republic of Albania participate in global mapping project since 30.06.2016 in Level B, through State Authority for Geospatial Information (ASIG). State Authority for Geospatial Information (ASIG) and geodesy department of the Polytechnic University of Tirana as represent from PhD Candidate developed vector and raster data for GM version 2 for Albania and the data was published in www.iscgm.org. The Republic of Albania within the project for the compilation of the global map is represented by the State Authority for Geospatial Information (ASIG), as the responsible institution for Albania's cartography at the national level. Preparation of Albania's GM data has been proceed in academic level within the geodesy department of the Polytechnic University of Tirana, with aim to support, help and improve young cartography in Albania. Existing topographic maps in scale 1:25.000, high resolution orthophoto images, as well as the official data from governmental institutions has been utilized as source data. Albania is one of the last European countries that has published database at ISCGM, exactly on 14th July 2016 has been published the vector and raster data base according to technical specification V2.2.

Global Map data is now downloadable from the web site of UNGIS (http://ggim.un.org/IGIF/overview), mostly intended for non commercial use. If someone tries to use these data for commercial purposes must obtain permission from the relevant institution that has developed the data, otherwise, each unauthorized use for commercial purposes is in conflict with the law on copyright and related rights which is prohibited and punishable by (Idrizi etAll 2010).

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THE EFFECT OF CEMENT AND FLY ASH ON THE UNDRAINED SHEAR STRENGTH OF CLAYS

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UDC: 553.611:551.31.053]:666.943-027.252

SUMMARY

The study takes into consideration the effect of chemical agents in stabilizing soils considered to be of weak properties. The methodology is based on the procedure of mixing the soil with chemical agents in various proportions, namely, cement as 1%, 3% and 5% of the dry mass of soil, as well as its combination with fly ash in the following proportions: 1.5C-8FA, 3.5C-8FA, 5.5C-8FA, 3.5C-6FA and 3.5C-10FA. The clay material used for this purpose was collected in the area of Currila, Durrës, and the tests determined the effect of these chemical agents in changing the undrained shear strength of the soil.

Key words: chemical agents, weak soils, undrained shear strength.

INTRODUCTION

In analyzing the problem encountered with Pliocene clays in Currila hill in Durrës, Albania, a significant role is identified in the undrained shear strength parameter for increasing the stability of the slope. The location chosen lies along the western coast of Albania and it is affected by periodical landslides occurring along the slope as a result of a weathering process of the clay material, followed by the development of a system of crevices that over time accumulate water, thus lowering the mechanical strength parameters of the clay. One of the methods employed for the treatment of clayey soils is mixing them with various percentages of chemical agents, such as cement and fly ash. This procedure was computed last year with significant results.

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In this study, the effect of such agents is considered in changing the undrained shear strength parameter of the soil, thus influencing the stability of the slope. The calculations of this parameter were made possible by taking into account the results obtained from the fall cone test, as well as from parameters that were derived from this test, such as the Liquid Limit and Liquidity Index of the clay.

METHODOLOGY

The undrained shear strength parameter is usually determined via the unconfined compressive strength (UCS) test and triaxial test, but also using a number of empirical formulas from literature that relate the fall cone test with this parameter (Strozyk & Tankiewicz, 2013; Nagaraj et al., 2012; Tanaka et al., 2012). The fall cone test procedure, according to BS EN ISO 17892-6:2017, determines the liquid limit of the soil through the penetration of a standard cone dropped for 5 seconds from a position where the tip is in contact with the soil surface. The penetration of the cone for 20 mm inside the soil that fills a cylindrical vessel of standard dimensions corresponds to the liquid limit of the soil. Hansbo (1957) suggests a relation between the undrained shear strength of the soil and cone penetration given in Equation 1:

$$c_u = K\frac{mg}{d^2} \qquad \text{(Eq.1)}$$

where: c_u – undrained shear strength (kPa); K – constant (no units); m – mass of the cone (g); g – ground acceleration (m/s^2); d – cone penetration (mm).

The dimensions and weight of the cone may vary, but for this study a standard cone of 80 grams and 30 degrees tip angle was used. For such characteristics, the value of K is considered as 0.867 (Vardanega & Haigh, 2014). Taking into account the various cone penetration measurements (in millimeters) obtained from this test for mixtures of clay with 1%, 3% and 5% cement, as well as the combinations of cement-fly ash of 1.5C-8FA, 3.5C-8FA, 5.5C-8FA, 3.5C-6FA and 3.5C-10FA – cured for 24 hours – Table 1 shows the values of undrained shear strength calculated with this formula. For every mixture, four different water content (w) values were considered, thus also calculating the Liquidity Index I_L based on the values for Liquid Limit (LL) and Plastic Limit (PL), shown in Equation 2 according to Atterberg (1911):

$$I_L = \frac{w-PL}{LL-PL} \quad \text{(Eq.2)}$$

The above parameter made possible the comparison of these results calculated according to Hansbo (1957) with the calculations of the undrained shear strength according to the formula proposed by Leroueil et al. (1983), which relates this parameter to the Liquidity Index, given by Equation 3:

$$c_u = \frac{1}{(I_L-0.21)^2} \quad \text{(Eq.3)}$$

Table 1: Cone penetration results for various admixtures cured for 24 hours and undrained shear strength calculated according to Hasbo (1957)

	LL	PL	w	d (mm)	I_L	Cu (kPa)
1%C	55.2%	24.6%	48.2%	14.4	0.77	3.29
			51.4%	16.9	0.88	2.39
			54.1%	18.8	0.96	1.93
			58.4%	22.6	1.10	1.33
3%C	56.5%	27.8%	47.0%	12.3	0.67	4.50
			52.8%	17.4	0.87	2.24
			55.2%	18.9	0.96	1.90
			59.8%	22.7	1.12	1.32
5%C	55.7%	30.3%	49.8%	14.3	0.77	3.32
			52.9%	17.1	0.98	2.32
			56.5%	20.5	1.12	1.62
			59.8%	24.4	1.25	1.14
3.5C/6FA	54.3%	26.6%	50.1%	16.2	0.85	2.59
			52.1%	17.6	0.92	2.20
			56.3%	21.5	1.07	1.47
			58.5%	24.6	1.15	1.13
3.5C/8FA	54.4%	26.8%	50.6%	15.8	0.86	2.71
			53.9%	19.9	0.98	1.71
			56.5%	22.2	1.08	1.38
			60.3%	26.1	1.21	1.00
3.5C/10FA	55.3%	29.2%	50.5%	14.8	0.82	3.10
			55.0%	19.7	0.99	1.75
			57.1%	22.4	1.07	1.36
			59.4%	24.7	1.16	1.11
1.5C/8FA	52.9%	24.3%	48.3%	15.6	0.84	2.78
			52.4%	19.4	0.98	1.81
			53.8%	20.9	1.03	1.56
			57.6%	24.7	1.16	1.12
5.5C/8FA	0.5347	0.285205	47.9%	13.8	0.78	3.55
			51.1%	16.7	0.91	2.43
			56.8%	24.1	1.14	1.18
			58.1%	25.5	1.18	1.05

Another formula proposed by Federico (1983) relates the undrained shear strength parameter to the Liquid Limit and the water content of the mixtures. Just like in the example above, this parameter relates to soil consistency depending on the value of the water content. Federico (1983) relation is given by Equation 4:

$$c_u = e^{[5.25(1.161 - w/_{LL})]} \qquad \text{(Eq.4)}$$

The calculations were based on the values of the Liquid Limit parameter for the admixtures of cement and cement-fly ash cured for 1, 24 and 48 hours.

RESULTS

Figure 1 shows the comparison between the results obtained. The blue line in the graph denotes the relation proposed by Leroueil et al. (1983), whereas the various symbols represent the values of the undrainsed shear strength calculated according to Hasbo (1957), in admixtures cured for 24 hours. The results clearly indicate a significant compatibility between the formulas used by the two authors. The values for undrained shear strength fluctuate from 1 kPa to 4.5 kPa, according to the consistency of the soil.

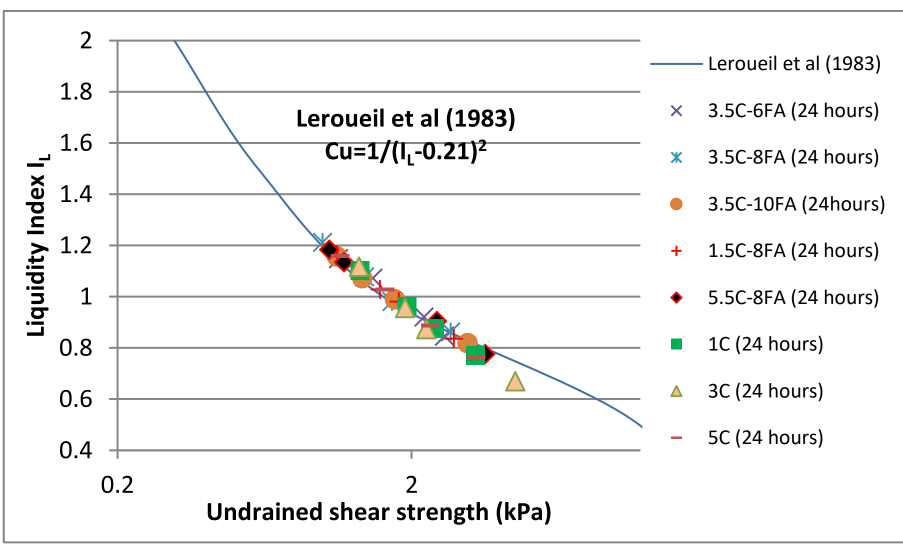

Figure 1: Comparison of undrained shear strength values according to Hansbo (1957) dhe Leroueil (1983)

For the formula proposed by Federico (1983), the reference value considered for the water content parameter was the one corresponding to the liquid state of the clay. This is because site surveys have shown that this is the consistency of the clay when slope failure occurs during the rainy season. The Liquid Limit for the natural soil was determined to be 55%, as shown in Figure 1:

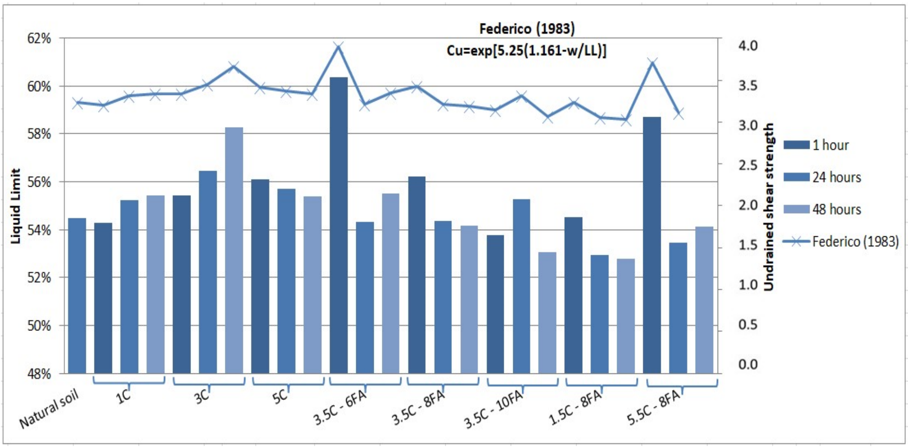

Figure 2: Fluctuation of undrained shear strength values according Federico (1983)

The vertical axis on the left side of the graph shows the values reached by the Liquid Limit parameter (the bars of various shades of blue, according to the curing period), whereas the right side of the graph vertical axis shows the values of the undrained shear strength in kilopascals (relating to the blue line at the top). As it can be observed by the graph, the obtained values for undrained shear strength are similar to those obtained in the previous case.

CONCLUSIONS

From the results obtained by the fall cone test regarding the values of the Liquid Limit of the clay mixed with various chemical agents, the undrained shear strength values were obtained based on correlations from empirical formulas. The results demonstrated a concordance between the formulas proposed by Hansbo (1957) and Leroueil et al. (1983). The values of the undrained shear strength fluctuate from 1 kPa to 4.5 kPa, depending on the consistency of the soil. According to Table 1, the highest consistency was achieved for a mixture with 3% cement after a 24-hour curing period. These values were also compared to an analysis proposed by Federico (1983), thus obtaining similar results, pointing to the fact that the presence of water in the soil accounts for significant fluctuations of the undrained shear strength parameter based on its consistency.

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OVERVIEW ON THE SCIENTIFIC AND ACADEMIC CONTRIBUTION OF PROFESSOR RISTO RIBAROSKI WITH EMPHASIS ON HIS PUBLICATIONS

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Prof. Ribaroski has abundant, versatile and significant opus. While he was one of the few in geodesy professors in Macedonia, teaching many generations of students in geodesy and other subjects in geodetic-civil engineering fields, he was also able to write and publish textbooks in almost all subjects he was teaching. Many of those are the first ever textbooks in Macedonia in the relevant subjects. Prof. Ribaroski was also leading and participating in many scientific projects which were presented at international events. Some biographic data about Prof. Ribaroski are presented below.

Prof. Ribaroski was born in Bucharest (Romania) in 1943, in a family of Macedonian emigrants. He spent his childhood and youth in Ohrid, Skopje and Belgrade – elementary education was completed in Ohrid, Civil engineering high school (geodesy department) in Skopje and University education at the faculty of civil engineering in Belgrade. At 1969, he started working at the Faculty of Civil Engineering in Skopje (St. Cyril and Methodius University) and progressed to be assistant professor in 1979, associate professor in 1984 and regular professor in 1990.

The job description at the Faculty included theoretical and on-field practices with the students of civil engineering and architecture. Also, he lectured geodesy and practical geodesy on part-time basis in the period 1973-75 at the civil engineering high school in Skopje. Mr. Ribaroski spent the summer semester in 1977/78 at the Geodesy institute of the Civil Engineering Faculty

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in Bucharest (Romania), where he got familiar with the latest geodesy achievements at that time and prepared his habitation work - 'Theoretical aspects of preparing stenographic projection of the territory of Republic of Macedonia'.

After being elected as university lecturer assistant professor in 1979, Mr. Ribaroski lectured the following subjects: theory of errors with adjustments, geodetic calculations, basics in high geodesy, and geodesy for the students of first level in geodesy, as well as geodesy for students of civil engineering study programme at all departments of the Faculty of Civil Engineering in Skopje.

After the establishment of the full Geodesy studies in year 2000, prof. Ribaroski lectured the following subjects: theory of errors, high geodesy, combined parametric-correlative adjustments, and management and technology of geodetic works. Between 1995 and 2003, he lectured also the following subjects at the Faculty of Geology and Mining at the Goce Delchev University in Stip: geodesy and surveying in mining to the students from the mining department and subject maps and geomorphology to the students from the geological department.

Upon establishment of the Military Academy in Skopje, prof. Ribaroski lectured applicative geodesy with GIS (Geographical Information System) for three years. Also, he lectured cartography at the post-graduate studies at the Faculty of natural sciences and mathematics in Skopje until his retirement in 2007. And after the retirement, in the period 2010-2017, he lectured geodesy, basics on civil engineering and civil engineering in mining at the University Goce Delchev in Shtip - Faculty of Natural and Technical Sciences.

Prof. Ribaroski started to publish textbooks in 1988, when his first textbook Theory of errors with adjustments was published by the St.Cyril and Methodius University – Skopje. In that textbook, calculating and adjustment of direct, indirect and conditional measurements are presented in clear and explicit way. By providing many examples, those subjects are in fact understandable to all readers.

In 1994, the University of Cyril and Methodius published Prof. Ribaroski's 2nd book – Basics of high geodesy. This is original and specific textbook, since it comprises subjects such as mathematical cartography, geodetical astronomy, precise geodetical measurements, satellite positioning etc. This

textbook presented all modern achievements of the Geodetical science at that time.
After the first edition of the first textbook Theory of errors with adjustments was sold out, the 2nd edition was prepared in 1997. This edition was adjusted to the needs of the upcoming geodesy studies which started in 2000. Apart from the content from the first edition, the 2nd edition was enriched with theory of probability elements in theory of errors.
The next textbook was published in 1999 under the subject Geodetic calculations, as per the program that included this subject in the final semester of the Geodesy studies. This textbook was about practical application of indirect and conditional adjustments to certain geodetic points and smaller networks. The numerous examples presented in explicit way enabled easier understanding of this complex subject which has mathematical backgrounds from Theory of errors with adjustments. With this textbook, Prof. Ribaroski completed his opus for all subjects he was teaching at the first-degree geodesy studies at the Faculty of Civil Engineering in Skopje.

Prof. Ribaroski's next textbook– 'Practical Geodesy' was published in 2003 by the Faculty of Civil Engineering in Skopje. This textbook was adjusted to the program of all departments of civil engineering studies and apart from the usual geodesy content, it contained parts about the modern methodologies at that time. It was therefore considered a modern textbook that presents all the benefits from the modern geodesy practice methodologies to the readers.

As a contribution to the newly-started complete geodesy studies at the Faculty of Civil Engineering in Skopje, Prof. Ribaroski published the textbook High geodesy – Basic geodetic networks in 2005. This textbook contains the three basic parts of High geodesy: existing basic geodetical networks (one and two-dimensional), precise geodetical measurements that are applied during establishment and maintenance of the basic geodetical networks and special (global, three-dimensional) geodetical networks as a new modern, reality. This textbook is original piece in Macedonian language.

During same year, Prof. Ribaroski also published the textbook 'Management and technology of the geodetical works' which is used by the geodesy students at the Faculty of the civil Engineering. The main moto of this textbook is that – 'The economic activity consists of people, products and profit, but the most important element are the people' (Lee Iacocca).

Just before his retirement, in 2007, Prof. Ribaroski published his most complex textbook – Combined parametric – corelative adjustments. Although it is mainly intended to be used for the post-graduate geodesy studies, this texbook can be useful to the geodesy experts for resolving numerous practical theoretical issues during the every-day geodesy practice.

Following the retirement, Prof. Ribaroski published two more handbooks for the students of the Goce Delchev University in Shtip – 'Geodesy' in 2014 and Civil Engineering in Mining in 2017. Both are available in digital format as part of the e-library of the Goce Delchev University in Shtip.

To conclude, Prof. Ribaroski's publishing activity is abundant, versatile and continuous. All his textbooks are using simple expressions, enabling the readers to easily apply the content in their everyday practice. One of the main benefits from Prof. Ribaroski's textbooks is establishing original terminology in Macedonian language for numerous technical expressions and procedures which were non-existing due to the small number of specialized geodesy textbooks published in Macedonian language.

Apart from the educational activities, Prof. Ribaroski also had success in offering expert advices. It is usual for the professors from the faculty of civil engineering to cooperate with different corporate entities and other specialized organizations by offering expert advice and solutions for different types of complex problems. Prof. Ribaroski was included in such activities from the very beginning of his career as assistant professor and to date has participated in about 150 such projects, either as individual or as a team member. Those project activities include geodetic measurements, calculations, adjustments, and above all numerous examinations of the stability of different objects of capital significance for the country. As result of such activities, many studies, projects and audits were produced, most of which under direct supervision of Prof. Ribaroski.

Prof. Ribaroski also had success in the field of Science. He participated in many congresses, seminars and symposiums and was also managing several scientific projects, out of which two are most significant. Under his leadership, the scientific Project – 'Choosing the most suitable cartographic projection for the presentation of the territory of Republic of Macedonia' was completed in 1998. After that, in 2003, the project 'Applying the UTM projection and WGS geodetical system as basic NATO standards in the cartographic projection of Republic of Macedonia' was completed. With these two projects, all problems regarding the compliance of our basic standards with the European and world standards were theoretically resolved.

Looking at Prof. Ribaroski's opus, it can be confirmed that small nations do big things, i.e. there are numerous scientists and educators from less developed countries that have significant achievements during their careers, which leave everlasting mark in their direct and wider surrounding.

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