GEOGRAPHICAL CENTER OF BOSNIA AND HERZEGOVINA

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Bosnia and Herzegovina has a central geographic position of the western part of the region of Southeast Europe. Therefore, in its territory there are defined two geographic centers; the first time, when Bosnia and Herzegovina was part of the former Socialist Federal Republic of Yugoslavia, and other times when it became an independent state and an independent member of the United Nations. There is a difference between the positions of the geographical centers, which is understandable, because there were two different geographical territories.

When it comes to the analysis of the geographic centers of the former Socialist Federal Republic of Yugoslavia, which are located on the territory of Bosnia and Herzego-vina, there are differences of its geographic coordinates, as a result of the application of different methods.

Position of the geographical center of Bosnia and Herzegovina, determined in 1996., has proven with modern scientific methods, which were used in this study, of which particular is integral method with the help of reading digital maps and using of software package ArcView 10, from company ESRI.

Key words: *geographical center, Bosnia and Herzegovina, methods of determination of geographical center, digital maps, software package ArcView 10*

INTRODUCTION

Fig. 1. Geographical centers of continents, regions or countries are marked with different kind of monuments. Upper left – geographical centar of 27 members of EU; upper right – geographical center of Asia in China; lower left – geographical center of Ukraine; lower right – geographical center of Slovenia

Different symbolic features are recognizable symbols of statehood countries, most notably: anthem, the coat of arms and flag. Some features from area of science, art, culture, institutions, government organization, and so on., Even though they do not have such importance, however, are classified as elements of statehood.

In symbolic elements of statehood, in recent times, one of the characteristic geographic center of the state territory and is consistent in this regard, the Association of geography in Bosnia and Herzegovina - GEO BIH, launched an initiative to define geo-station center of Bosnia and Herzegovina by analyzing existing and by checking the modern methodology.

In the world there are many of geographic centers of different territorial area such as: continental, regional, state, district, city, etc. So in 1996. designated center of North America, located in the village of Rugby in North Dakota, state of the United States. Center of the Asian continent is determined by 1990.. in Ksingjanga in R. China. The central point of Australia, determined in 1988. Lambert represents the center of gravity.

Centre of the European continent was defined in 1989. at about 25 kilometers north of Vilnius, capital of Lithuania. French National Geographic Institute (IGN) is 2007. determine the center of the European Union, which is located on the periphery the small town of Gelnhausen in Hessen - Germany, about 40 kilometers east of Frankfurt am Main. Expansion of the European Union, with the entry of the Republic of Croatian in its composition, entailed the need to find a new geographical center of the member states of this organization. So, from 1 July 2013, the geographic center of the European Union located in northwestern Bavaria, Westerngrund on the river Šulcengrudbah.

Each of these centers is marked by special monumentum (see pic.1.). By specifying the geographical center of a territory, deals with the scientific discipline called scintigrafija. First centrigrafska studies date back to the 70s of the 19th century. and are linked to the name of American Geographers JE Hilgard. Based on his research US Census Bureau, "Bureau of the Census" is the world's first published data on the geographical center of the United States, which is also a worldwide sensation. The famous Russian scientist and chemist DI Mendeleev 1906.god. is in statistical Yearbook of Russia, published the first data on the center of the national territory and the population of Russia.

OBJECT AND METHODS

Geographical shape of Bosnia and Herzegovina and its importance for determination of geographical center

The geographical location of Bosnia and Herzegovina coincides with direktrisa morphostructural whole, administrative dissected river valleys. They had a decisive influence on the formation of geographical borders of Bosnia and Herzegovina towards its neighbors. Its territory bounded by geographical borders gives it character isosceles triangle whose hypotenuse paralelna Dinaric system and the Adriatic basin, and its cathetus are hydrographic boundaries, Sava in the north, the Republic of Croatia and the Drina River in the east, the Republic of Serbia. The total length of the borders of our country according to official statistical indicators is 1538 km, with a length of river border 751 km and 774 km Konen. The sea border has a length of coastline about 22 km, of which 13 km continental shelf.

Bosnia and Herzegovina within the former Socialist Federal Republic of Yugoslavia had a central geographic position, and is in its territory and was defined geographic center. Taking into account the different methods for determining the geographical center of the former SFR Yugoslavia has given two different places. First determine the geographical center conducted by the final border points, 1957., Was determined by the geographic center of the former SFR Yugoslavia 8 km northwest of Ilidza, in the village Košelj near the village of Rakovica, whose du geographic coordinates: $\varphi = 43 ° 51'56$ "N and $\lambda = 18 ° 12'15$ "E (Lj. Sretenović, 1957).

The second research, conducted by more gravity was determined center SFR Yugoslavia at about 10 km southeast of Kladanj, apropos 1 km north of the village Žeravica

with geographical coordinates from: φ = 44 ° and λ = 09,4'N 18 ° 46.7 'E (NE Radosevic, 1977).

After acquiring the constitutional status of Bosnia and Herzegovina, to our knowledge, determined its center only in 1996.., Using the method of multiple gravity. On the basis of such research is defined, the center of Bosnia and Herzegovina in the Vitez, in the cadastre municipality Preočica, in Krčevine, which belongs to the as cadastral plot no. 4602. (T. Krzyk, 1996).

Concept of the geographical center and methods of determination

The concept center which instructs of the central place longer, the geometric figure or body and is defined by their focus. Short and most common definition of the geographical center of a certain territory signals the point, which is, on average, closest to other points of units (J. Ilic, S. Stankovic, 2007). It is in fact, the geographic center of the center of gravity that makes the geometric figure you include borders treated territory.

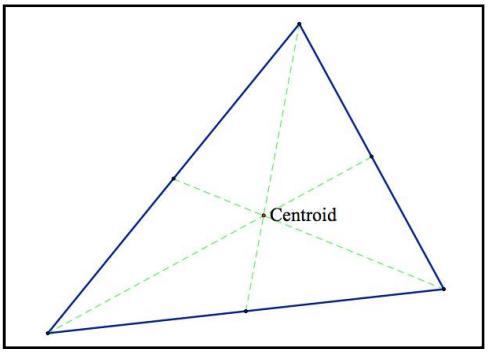

Fig. 2. Centroid, center of mass, center of gravity and geographic center is a point where is contained all the weight of the body.

The focus of the material body, in its simplest form is the point at which as it includes the entire weight of the body. Although it can not be regarded as a precise formal definition, this description of reveals the meaning of the concept of gravity, which usually refers to of static balance. Possible cases are generally known from everyday use: the material body suspended above the center of gravity is in stable equilibrium, which returns to primarily condition after his physical movements. It can be defined and hanging or supported with the body below, or above or below the center of gravity, located in unstable balance.

In addition to the concept of center of gravity, which in mentioned case synonymous with the geographic center of the geometric figure you includes the boundaries of the territory, in technical projects, which deal with this problem, the use of the terms center, mass and centroid. In these geographical studies centroid is the center of a two-dimensional form of the earth's surface, forming a geometric figure, radially projected at the level of the sea surface, or geoid. Therefore it is necessary to note that the geographic center, the focus, the center of mass and centroid synonymous with the same meaning.

There are several methods for determining the geographical center of a certain territory. The most popular methods commonly include: linear focus determined to end border points, determining the center of gravity, izofrontire, translation, combined method izofrontire and translation, network integration points and center of gravity.

Method of boundary points is one of the simplest methods in determining the geographical center a specific territory. It is a mean of length with latitude and longitude certain geographic coordinates in the territory which is defined center. Form to calculate these values is the following:

$$\square c = \frac{\phi n + \phi s}{2} \text{ i } \lambda c = \frac{\lambda e + \lambda w}{2}$$

Method of gravity**,** belongs to the group of simple methods for identifying the geographical center. The essence of this method is reduced to the search center point of a territory bounded by borders, presented in map form and the cut on the cardboard paper. Center of gravity, and the geographic center, in this case, represents the point at which the card horizontally in unstable balance reached its peak at the needle tip.

Method of iso frontiers involves drawing lines on a map parallel to the boundary of the territory for which it determines the geographic center. All points on one line are equally distant from the border line. The interval between iso frontiers are usually taken over a length of 5 km. By entering iso frontiers on the map, the territory is gradually reduced until it reaches the end of iso frontiers. Last iso frontiers covers relatively small geographical area, for which is very easy to determine the center of gravity.

Method of translation refers to the cartographic drawing and measurement line along longitude and latitude, in a way that the surface of a given area, for that determines the center, first divided into two parts. In this way is determined by half the surface of said area. Determination environment defined territory carried out a ruler of the South (abscise) parallel to the north and from the west (ordinate) to the east. The intersection of the first and second divisional lines obtained location geographical center.

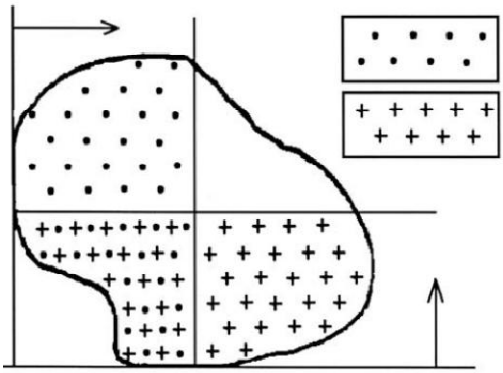

Fig. 3. Determination of the geographical center with the method of translation

Iso frontier - translations method**,** as its name suggests, is a combination of iso-frontier and translational methods. Mainly used for determining the geographic center of the state with extremely irregular shape, in which the center of gravity falls outside their borders, as is the case with R. Croatia or Somalia. Use of this method involves drawing iso-frontire and central longer primary pathway of the territory, as the medial iso frontiers. Then the other translational moves along, translational mediala, perpendicular to the medial iso-frontier along the border of the division of the territory into two equal parts. The intersection of these two medial longer represents the geographic center of the territory.

Network of points is more complicated, precise and more sophisticated method that takes into account the final border points. This method avoids errors that may occur as a result of brokenness or irregularities boundaries between the end: east, west, north and south border points. Thus, the border points with the same latitude, ie the same longitude joined together. In this way, form a network line. What is more dense network of lines, it is the accuracy with which determines the geographic center of the greater. For each center line, the center of gravity method, to determine the values of latitude or longitude. Latitude geographical center represents the arithmetic mean of all high value-latitude grid lines. By repeating the procedure for the lines that connect places with the same longitude, you get the value of longitude geographic center. Geographical coordinates of the geographic center of the territory for which it determines the geographical center is obtained by the formula.

$$\square c = \frac{\square\square n(1,i) + \square s(1,i)}{i} \qquad \lambda c = \frac{\square\lambda w(1,i) + \lambda e(1,i)}{i}$$

Integral method is one of the most accurate to determine the geographical center and is a combination of methods of extreme border points and the method of grid. It is a mathematical procedure that uses a function integral. The geographical center determined by this method is a center of weight distribution, which is obtained by construction of grid. The geographical center of a coordinate value represented by the average values of the coordinates of the center of gravity of elementary surfaces.

DISCUSSION

Determination of the center of the method of extreme border points used Lj. Sretenović (1957) in defining the geographical center of SFR Yugoslavia. If this methodology is applied in the search for the center of Bosnia and Herzegovina to the geographic coordinates of limit values (see Table 1). Gets are geographic center whose geographical coordinates: φ = 43 ° 54'45 " n λ = 17 ° 40'51 ".

Horizon orientation	**Place and Municipalities**	**Φ**	**λ**
Ultimate Northern (N) point in BiH	Gradina Donja B. Dubica	45°16' 30“	16°55'56“
Ultimate Southern (S) point in BiH	Podštirovnik Trebinje	42°33'00"	18°32'24"
In the easternmost (E) point in BiH	Žlijebac Bratunac	44°00'03"	19°37'41"
The ultimate western (W) point BiH	Bugar Bihać	44°49'30"	15°44'00"

Source: Federal Bureau of Statistics

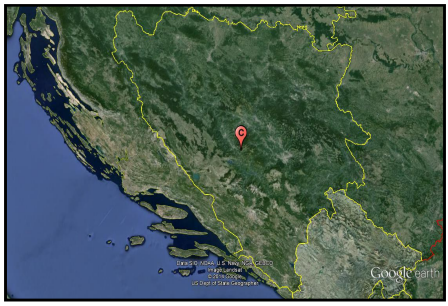

Fig. 4. The geographical center of Bosnia and Herzegovina defined by the method of extreme boundary point is located on Vranica mountain, municipality of Gornji Vakuf / Uskoplje, about 2.5 km northeast of the village Seoci

Application of endpoints is applicative only for those territories that have approxi-mately the proper form. The curvature of the territory of Bosnia and Herzegovina makes it practically unfit neuporte-mentioned methods. This is calculated cents postponed more than 29 km to the southeast of the actual geographical center. Calculating the geographical center by means of endpoints is unusable in countries with extremely irregular shape, as is the case for R. Croatia. If in this way determined the center of R. Croatia would be located in the northwestern part of Bosnia and Herzegovina.

Determination of the geographical center of the method of extreme border points were used N. E. Radošević (1977), in determining the

center of the SFRY Yugoslavia, and T. Krzyk (1996), in defining the geographical center of Bosnia and Herzegovina. Although this method is very simple, in our case, has proved very useful for determining the geographical center of Bosnia and Herzegovina. Deviations of the data from those our research has shown slight, at approximately 300 meters in the north-east.

By applying the method of iso-frontiersin determining the geographical center of Bosnia and Herzegovina, although a lot of practical, limiting the Mali and Veliki školj in the Adriatic Sea, and belonging to Bosnia and Herzegovina. Method of iso-frontiers is far more suitable for determining the geographical center of the country and the region, which does not consist of continental and island area.

Use of the integrnal method in determining the coordinates of the geographical center involves the use of huge amounts of data. In the specific case for the determination of the geographical center of Bosnia and Herzegovina used digital map R = 1: 100 000, with which the computer can determine the coordinates of points on the border each 1 cm. Given the length of the border, the teritoriji Bosnia and Herzegovina, it is possible to withdraw 10,390,000 focal points line. Without the use of modern computer software, practically it would be impossible to use this huge amount of data from which are quite distinct geographic coordinates geographic center of Bosnia and Herzegovina.

Fig. 5. Construction of the rectangular network in order of determination of the elemental surface

Determining the geographic coordinates of the geographical center of Bosnia and Herzegovina was carried out with digital topographic maps scale R = 1: 100 000, constructed in ekvivalentno projection, which is gradually keyed borders of Bosnia and Herzegovina. All procedures related to the calculation of geographic coordinates, drawing boundaries, reading digital maps and the like. was done using the software package ArcView 10, the company ESRI. This computation is implied use of integrated methods of determining geographic coordinates, contained in this programming software. In this manufacturer ESRI states that the centroid represents the geometric center of the tool. For a line or polygon to the center of mass, centroid, focus or geographic center. For broken lines or polygon boundaries composed of multiple parts, calculated weighted mean value of the geographical coordinates of all elementary surfaces.

In other words, the use of modern computer technology and software package ArcView, using the integral method, calculated with great precision, the geographic coordinates of the geographical center of Bosnia and Herzegovina. The obtained values of geographic coordinates, with the necessary conversion, have been transferred to the satellite images, Google Earth, to roughly acquired images of the actual position geographical center of Bosnia and Herzegovina. Please check back later, using modern GPS devices, directly on the field is determined by the position and the geographic coordinates of the center of our country. The geographical center of Bosnia and Herzegovina are located in the in the village Krčevine, Vitez. The center is located at about 1.5 km north-northeast of the city center

Vitez. Geographical coordinates of the geographical center of Bosnia and Herzegovina have the following geographical coordinates:

Geographical latitude φ = 44 ° 9'55.41 "N;
Geographical longitude λ = 17 ° 47'30.40 "E;
Meters above sea level H = 413 m.

Fig.6. Topographic position of geographic center of Bosnia and Herzegovina

Topographic position of geographical center of Bosnia and Herzegovina is on the right side of main road Sarajevo - Travnik at the entrance of the trade center Vitez. Belongs to the settlement Krčevine in the meadow behind the department store "Buba".

The geographical center of Bosnia and Herzegovina is extremely important and interesting tourist point, which should be marked appropriately. In many countries, the geographical centers are marked with special monuments that have been registered geographical coordinates and altitude points. We sincerely hope that this work represents

The geographical center of Bosnia and Herzegovina is extremely important and interesting tourist point, which should be marked appropriately. In many countries, the geographical centers are marked with special monuments that have been registered geographical coordinates and altitude points. We sincerely hope that this work represents a modest contribution, to the competent institutions launched a process for adequately marking the geographical center, symbols of statehood of Bosnia and Herzegovina.

CONCLUSION

The geographical center of Bosnia and Herzegovina is defined by equivalent geographic projections, which retains the equality of the surface, as in the case of defining the center of gravity was crucial. The center of gravity has been verified integral method of applying digital topographic maps scale R = 1: 100 000, constructed in equivalent projection, which is gradually keyed border line of Bosnia and Herzegovina.

All procedures related to the calculation of geographic coordinates, drawing boundaries, reading digital maps and the like. was done using the software package ArcView 10, the company ESRI. These procedures were corrected, previously calculated center of gravity (T. Krzyk (1996) for about 300 m. The obtained values of geographic coordinates, with the necessary conversion, have been transferred to the satellite images (Google Earth) that the framework glass image of the actual position of the geographical center of Bosnia and Herzegovina. Please check back later, using modern GPS devices, directly on the field is determined by the position and geographical coordinates of the center of our country, as follows: φ = 44°09' 55.41 "N and λ = 17°47'30.40" E and H = 413 m .

The geographical center of Bosnia and Herzegovina are located in the in settlement Krčevine, Vitez. The center is located at about 1.5 kilometers north-sjveroistočno from the

town of Vitez. Topographic binds to the immediate right, at about 25 m, main road Sarajevo - Travnik in Vitez shopping center, directly on the lawn behind the department store "Buba".

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