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The Double Correlative Statistical Relation through the Horizontal and Vertical Tearing of the Watershed in the Albanian Alps

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Abstract:

The study that we are giving has as an aim to show the general characteristics and the regional morphometry in the territory of the basins in the Albanian Alps. In general, the Geographical phenomena and specially the shape of the relief are products of a group of factors that forms the relief, especially the inner forces, and to the outer factors, which in conflict and unity with each other have led and are leading in continuity the pattern of the relief in general. The characterization of the natural phenomena of the geomorphometry through observations, measurements and of the exact calculation of the values taken directly on the spot (some of them) and especially through the topographic maps which are of a great scale (1: 25.000), it is the starting point of our study, while the analysis and the evaluation of these phenomena in particular and especially in co-operation with each-other through the double correlation have led to important practical and scientific conclusions. In this study it is tried (probably for the first time in field of geographic studies and especially in) that the natural geomorphometry phenomena being calculated and analyzed through statistic methods and concretely with the theory of Correlation, in the double correlative evaluation.

Key words: Albanian Alps, statistical methods, double correlation, horizontal tearing, vertical tearing.

1. INTRODUCTION

We know that there exist natural and social phenomena (natural phenomena in our case) which are connected and overlapped with each other. Where the development and transformation of one phenomenon leads to the development and transformation of the geomorphometry and other phenomena at the same direction or even in the different directions.

In the Albanian Alps, the main geomorphometry phenomena are overlapped with each other, with the changing of one phenomenon (ex. With tectonic elevation or lowering) it will lead in changing and developing of the other phenomena (ex. The altitude, declivity etc) in the same direction or in the different directions.

In this study are taken in consideration the main geomorphometry indicators of the Albanian Alps such as the horizontal and vertical tearing. It is made an effort that these indicators to be shown in quantitative values (through measurements and calculations), to be valued and analyzed from the mathematical statistics, concretely through the theory of double correlation giving the mass and the direction of the relation, finalizing in compiling the maps of the izopleth of the double correlative dependence (map 2.1)

Stressing that in this case are made hundreds and thousands map metric measurements and calculations on the topographic maps on scales 1:25000 of the double correlation. They results are taken and reflected in the isopleth maps of the double correlative dependence. (Map 2.1).

Giving the fact that the territory of the watershed in the Albanian Alps has an enormous surface S=2627km^2, measurements and the calculations of map metric are made separately for every single quadrate in the kilometric line, thus for every 1km^2, that is for the horizontal and vertical tearing.

The double correlative tables of the morphometry quantities of the horizontal and vertical tearing are calculated for every four quadrate of the kilometric line, thus for every 4km², we have got 656 correlative tables.

The probability theory in general and especially the theory of the mathematical statistics today are widely applied and interpreted in many fields. The theories of the statistical evaluation are one of the more important problems of the mathematical statistics. These theories occupies with the processing of the measurements, the observations in quality and quantity of the different social and natural phenomena.

In this paper we have this argument:

> ***H_0*** *: There is a strong correlative relation through the horizontal and vertical tearing that influenced the shape of the watershed in the Albanian Alps.*

2. THE DOUBLE CORRELATIVE STATISTICAL RELATION THROUGH THE HORIZONTAL AND VERTICAL TEARING OF THE WATERSHED IN THE ALBANIAN ALPS

In the watershed of the Albanians Alps geomorphometry phenomena of the horizontal and vertical tearing are related between them in a statistical and correlative matter, because of that in the territories with the same horizontal tearing do not have the same values of the vertical tearing, because that their quantity values are related even with the other physical-geographical factors, such as: lithification, climate, average altitude etc. These relations and overlapping among them we will interpret through the mathematical statistics starting with the simplest ones, such as the arithmetical simple mean (x,ȳ), and up to the correlation coefficient (r). To define the quantity values of these indicators (geomorphometry) of the watershed in the Albanian Alps are used the topographic maps of a scale 1:25000.

2.1. The definition of the territory horizontal tearing values

The horizontal tearing of territory (C_h) is the breaking of the relief in the horizontal outline or the intensity of the permanent and temporary of the hydrographic line of a territory or the quantity superficial erosions of the territory.

For this geomorphometry indicator it is used the method of cartogram in defining the values of the horizontal tearing for each quadrant of the kilometric line of the topographic map (1km² in terrain). For that, each quadrant of the kilometric line of the territory (basins of the Albanian Alps), so 2627 km² the all that have this territory are defined through direct measurements in the topographic maps of a big scale 1:25000, of the permanent and temporary hydrographic line with the help of mechanical and electronic curbmetre.

The horizontal tearing (C_{hl}) for each quadrant of the kilometric line it is defined with the help of the formula (1.1)

$$C_{h1} = \frac{\sum_i^n l}{S} \quad (km/km^2) \qquad \textbf{(1.1)}$$

Where **C_{hl}-** the value of the horizontal tearing for a quadrate (1km²)
l- the longitude of the permanent and temporary hydrographic line for one quadrate of the kilometric line measured with the electronic curbmeter.
S- The surface of a quadrate of the kilometric line (1km²)

With the help of this formula (1.1) are defined the values of the 2627 other quadrates of the kilometric line that are located in the territory in study.

Applying the formula (1.1) for the first quadrate, we will have:

$$C_{h1} = \frac{1.3\ km}{1km^2} = 1.3(km/km^2) \qquad \textbf{(1.1.1)}$$

At the same time have been made the measurements with the mechanical and electronic curbmeter in the topographic maps and then are made calculations of the horizontal tearing even for the 2627 quadrates of the kilometric line of the territory in study and their values are shown in the correlative statistical tables.

2.2. The defining of the values of the vertical tearing of the territory

With the vertical tearing (the energy of the relief), we comprehend the breaking of the relief in the vertical outline or the difference in the quota of the highest altitude with smallest altitude of a given territory in the surface unit. For this geomorphometry indicator (vertical tearing) it is used the cartograme method in the defining of the values of the vertical tearing (C_{vl}), for each quadrate of the kilometric line ($1km^2$).

For that, each quadrate of the kilometric line (2627 quadrates), are defined through the main isohypse, intercessory, complementary and of the normal equidistance among isohypse, the maximal and the minimal quota (h_{lmax} – h_{lmin}).

The vertical tearing (C_{vl}), for each quadrate of the kilometric line it is defined with the help of the formula (1.2)

$$C_{v1} = \frac{h_{1max} - h_{1min}}{S} \, (m/km^2)) \quad \textbf{(1.2)}$$

C_{vl}- the value of the vertical tearing for a quadrate ($1km^2$).

h_{lmax}- the maximal altitude within the first quadrate of the kilometric line that is defined through the main and intercessory isohypse in the maps.

h_{lmin}- the minimal altitude within the first quadrate of the kilometric line that is defined through the main and intercessory isohypse in the maps.

S- The surface of a quadrate of a kilometric line ($1km^2$).

With the help of this formula (1.2), are defined even the 2627 other quadrates of the kilometric line of the territory in study.
Applying the formula (1.2) only for the first quadrate we will have:

$$C_{v1} = \frac{2146.6 - 1868.5}{1\ km^2} = 278.1(m/km^2) \quad \textbf{(1.2.1)}$$

With the same manner are made the measurements in the topographic maps and are calculated the values of the vertical tearing even for the 2627 quadrates of the kilometric line of the territory in study and their values are shown in the correlative statistical tables.

2.2 The calculation by the mathematical statistical manner

Looking the factual values of the measurements and the calculations of the two geomorphometry indicators (horizontal and vertical tearing) for the whole territory of the watershed that are located in the Albanian Alps, we notice that the same factual values of the horizontal tearing of different territories correspond with different values of the vertical tearing.

The factual values of the two geomorphometry measured and calculated through the formula (1.1) and (1.2) are grouped in every four quadrates of the kilometric line, thus, $4km^2$ in terrain and in a consecutive manner, it is made possible the calculation of the statistical indicators starting with the simplest which is the arithmetical simple mean and ending to the correlation coefficient.

2.2.1 The simple arithmetical mean

The simple arithmetical mean it is the indicatory that defines in the approximate way the situation and the development of a geomorphometry phenomenon and concretely the values of the horizontal and vertical values for four quadrates of the kilometric line and it is calculated with the formula (2.1.1) and (2.1.2)

$$\bar{X} = \frac{\sum_1^n x_i}{n} = 2.25(km/km^2)$$
$$\bar{Y} = \frac{\sum_1^n y_i}{n} = 431.4(m/km^2) \quad \textbf{(2.1.1), (2.1.2)}$$

Where: **X and Y** are the arithmetical simple mean of the geomorphometry of the horizontal and vertical tearing.
X_i and Y_i- are the measured and calculated values of the horizontal and vertical tearing for four quadrates of the kilometric line.
n- is the number of measurements taken into analyze, in our case are taken four quadrates of the kilometric line ($4km^2$).

At the same way are made the calculations even for the 656 other quadrates of the $4km^2$ in the terrain, thus it is covered the whole territory in study.

2.2.2 Dispersion

The dispersion (σ^2) tells how are dispersed the quantitative values of the different quantities from the values of the calculated arithmetical mean and shows the nature of the dispersions of factual values, inclination and the direction of its development in space.

The dispersion (σ^2) it is calculated with the formula (2.2.1) and (2.2.2)

$$\sigma_x^2 = \frac{\sum_1^n (x_i - \bar{x})^2}{n} = 0.37 \quad \textbf{(2.2.1)}$$
$$\sigma_y^2 = \frac{\sum_1^n (y_i - \bar{y})^2}{n} = 11445.4 \quad \textbf{(2.2.2)}$$

Where **σ 2** -it is the dispersion for the values of the horizontal tearing.
Where **σ 2**- it is the dispersion for the values of the vertical tearing.
x_i and y_i – are the measured and the calculated values of the horizontal and the vertical tearing.
X and Y – are the simple arithmetical mean of the horizontal and vertical tearing.

n- it is the number of the quadrates in our case $4km^2$.

The values of the dispersion (**σ^2_x and σ^2_y**) are calculated even for 656 quadrates in $4km^2$ in terrain and their results are shown in the tables.

2.2.3 The quadratic mean deviation σ_x and σ_y

The mean quadratic avoidance (deviation) σ_x and σ_y and tells the linear displacement of the calculable values towards the quadratic mean and it is calculated with the formula (2.3.1) and (2.3.2)

$$\sigma_x = \sqrt{\sigma_x^2} = 0.61 \quad \textbf{(2.3.1)}$$

$$\sigma_y = \sqrt{\sigma_y^2} = 107 \quad \textbf{(2.3.2)}$$

The calculated values of the quadratic mean of deviation (**σ_x and σ_y**) are calculated even for the 656 quadrates that corresponds $4km^2$ in terrain and the results are shown in the tables.

2.2.4 The standard error (ε_x and ε_y)

The standard error (ε) for the completely statistical series it is calculated with the formula (2.4.1) and (2.4.2)

$$\varepsilon_x = \frac{\sigma_x}{\sqrt{n}} = 0.305 \quad \textbf{(2.4.1)}$$

$$\varepsilon_y = \frac{\sigma_y}{\sqrt{n}} = 53.5 \quad \textbf{(2.4.2)}$$

Where: ε_x - is the standard error for the horizontal tearing

ε_y – it is the standard error for the vertical tearing

n – it is the number of the quadrates in our case for $4km^2$

The all calculated values of the standard error (ε_x and ε_y) are calculated even for the 656 quadrates of $4km^2$ in terrain and the results are shown in the tables.

2.2.5 The variation coefficient (k_x and k_y)

The variation coefficient (k_x and k_y) characterize for these two quantities the scale of variability of the quadratic mean of deviation in comparison with the values of the arithmetical simple mean of the phenomena in study and it is calculated through the formula (2.5.1) and (2.5.2) for the both quantities.

$$k_x = \frac{\sigma_x}{\bar{x}} * 100\% = 27.1 \quad \textbf{(2.5.1)}$$

$$k_y = \frac{\sigma_y}{\bar{y}} * 100\% = 24.8 \quad \textbf{(2.5.2)}$$

Where (k_x and k_y) are the values of the variation coefficient for the both quantities in study.
Where (σ_x and σ_y) are the values of the quadratic mean of deviation of the both quantities in study.
X and Y – are the arithmetical simple mean of the horizontal and vertical tearing.

The values of the variation coefficient (k_x and k_y) are calculated even for the 656 quadrates of 4km^2 and the results are shown in the correlative tables.

2.2.6 Co variation ($cov_{x,y}$)

The co variation ($cov_{x,y}$) tells the direction of the regress line or to the regress equation and it is calculated with the formula (2.6)

$$cov_{x,y} = \frac{\sum_1^n (x_i - \bar{x}) * (y_i - \bar{y})}{n} = 44.7 \quad \textbf{(2.6)}$$

Where ($cov_{x,y}$) – it is the co variation of the geomorphometry quantities of the horizontal and vertical tearing.
Where (x_i and y_i), are the values measured and calculated of the horizontal and vertical tearing.
Where (X and Y), are the arithmetical simple mean of the horizontal and vertical tearing.

Where n- it is the number of the quadrates, in our case four quadrates of the kilometric line ($4km^2$).

All the values of the co variation ($cov_{x,y}$) are calculated even for the 656 quadrates of $4km^2$ in terrain and the results are shown in the correlative tables.

2.2.7 The correlation coefficient (r)

The correlation coefficient (r), makes the proper mathematical valuation of the correlative relation among two or more geomorphometry phenomena (horizontal and vertical tearing) and tells that in what quantity they are related among them the geomorphometry phenomena that we are dealing with, how strong and secure are these relations giving us the rule of their development.

The correlation coefficient it is calculated with the formula (2.7)

$$r = \frac{\sum_1^n (x_i - \bar{x}) * (y_i - \bar{y})}{\sqrt{\sum_1^n (x_i - \bar{x})^2 * \sum_1^n (y_i - \bar{y})}} \quad \textbf{(2.7)}$$

$$r = \frac{cov_{xy}}{\sigma_x * \sigma_y} = \frac{44.7}{64.2} = 0.7$$

Where r- it is the correlation coefficient of the two quantities in study (horizontal and vertical tearing)

Where cov_{xy}- it is the co variation of the two quantities in study(horizontal and vertical tearing).

Where (σ_x and σ_y) are the values of the quadratic mean of deviation for the quantities of the horizontal and vertical tearing.

The values of the correlation coefficient (r) are calculated even for the 656 quadrates of $4km^2$ in terrain and their results are shown in the correlative tables.

2.2.8 The quadratic mean error of the correlation coefficient (m_r)

The quadratic mean error of the correlation coefficient (m_r) it is calculated with the formula (2.8)

$$m_r = \frac{1-r^2}{\sqrt{n}} \quad \textbf{(2.8)}$$

Where (m_r)- it is the quadratic mean error of the correlation coefficient.
Where (r) – it is the correlation coefficient
Where n – it is the number of the quadrates taken into analysis.

Applying the formula (2.8) only for the first coefficient of correlation we will have:

$$m_r = \frac{1-r^2}{\sqrt{n}} = \frac{1-0.72^2}{\sqrt{4}} = 0.240 \quad \textbf{(2.8.1)}$$

In the analog manner are calculated even the other 656 quadrates of the $4km^2$ in terrain.

In order to evaluate the steadiness of the relation between the two geomorphometry phenomena (values of the horizontal and vertical tearing) in study, it is needed that the correlation coefficient (r) to be:

$$r \geq 3m_f \quad \textbf{(2.9)}$$

$$3m_f = 3 \cdot 0.240 = 0.72 \quad \textbf{(2.10)}$$

In the case of the quadrate taken into analysis according to the data of the correlation tables we will have:

$$r = 0.72 \geq 3m_f = 0.72 \quad \textbf{(2.11)}$$

From the calculations made for the first four quadrates of the kilometric line ($4km^2$) and according, we see that the correlation coefficient (r) it is almost equal with the quadratic mean error of the correlation coefficient r = 0, 72 and m_r = 0, 72 which means that for these four quadrates of the kilometric line

($4km^2$) the relations between these two phenomena are almost steady because of $r = m_f$.

The quadratic mean errors of the correlation coefficient (m_r) are calculated even for the all others quadrates of the kilometric line and concretely of the 656 quadrates of $4km^2$ in terrain.

According to the correlative tables we see that 68% of the territory in study (the watershed of the Albanian Alps), the correlation coefficient (r) between these two geomorphometry phenomena (horizontal and vertical tearing) take the values 0,60 up to 0,98 (taken in absolute value) for the whole territory. According to the values we can conclude that the relations between these two quantities are of a big steadiness, where with the development of one phenomenon it results that is developed the other phenomena at the same direction.

Looking at the same time even the quadratic mean error of the correlation coefficient for all the quadrates of the kilometric line taken into analysis in this study (656 quadrates of $4km^{2}$ in terrain), we reach the conclusion that in 72% of the whole territory the correlation coefficients are bigger than $3m_r$, thus overall the relations are steady.

Only a small percentage of the territory in study, it came from the calculations made to be smaller than the quadratic mean error of the correlation coefficient.

2.3 The designation of the map of the double correlative relation between horizontal and vertical tearing

The all measured and calculated values of the both indicators geomorphometry in correlative and statistical relation finalized with the correlation coefficient for quadrate of $4km^2$ in terrain, are transferred in the map with scale 1:100.000.

With the help of the interpoler method, based on the correlation coefficients values for all the quadrates (656) it is made possible the designation of the map of the correlative relation between two geomorphometry phenomena (the compiling of the isopleth of subjection) with a normal equidistance among isopleth in values 0,3; 0,5; 0,7; 0,9; 1,0; (map 2.1)

To be shown in this study this map it is diminished even more simplifying the more the equidistance among the isopleth (map 2.1)

2.4 The analysis of the map of the double correlative relations between horizontal and vertical tearing.

The double correlative relation between horizontal and vertical tearing have a colorful connection in the territory in study, this is as a cause while consequently these relations are overlapped even from the other geological phenomena (mainly tectonically and of the lithification of the rock compositions), from the relief (average altitude), from the climate (atmospheric precipitations) etc.

In designed map (Map 2.1) we see that the intensity of dispersion of the subjection isopleth (the lines with the same correlative relations between horizontal and vertical tearing), and also their numerical values in all the territory in study, shows in an obvious way the correlative relations between these two geomorphometry phenomena giving us the tendency and the direction of their development.

Looking the designed map (Map 2.1) and the numerical values shown in it, we consist that 56, 3% of whole territory in study, the correlation coefficient between these phenomena have the values from 0,7 – 1,0 taken in an absolute value (table 1).

CONCLUSIONS AND DISCUSIONS

As a conclusion, we can say that in more than half of the territory in study the correlative relations are too strong between these two geomorphometry phenomena, because they are conditioned even from many other inner and outer factors, such as the inner neotectonical forces, particularly of the uplifting, with the high intensity and amplitude in the center of Alps, the uplifting forces with the medium intensity before mountainous areas and also with tectonically descent forces particularly in the field areas as in the OverShkodra lowland and in the Tropoja Hole.

Because of the forces they have made possible the increasing of the erosions forces of the river, small rivers, ravines, etc making possible the increasing of the permanent and temporary hydrographic line in the certain areas of the territory in study, being helped very much even from the lithification compositions of the rocks.

As a result in these areas the values of the horizontal and vertical tearing are with a big values and as a consequences even the correlative relations are stronger r = 0,9 up to 1,0, where with the increasing of the vertical tearing values are increased even the horizontal tearing values. The territories with the strong correlative relations are noticed in the Lepusha valley, to the mountain ridge of Trojan, in the valley of the Cemi river in Vukel, in the slopes and the ridges from the Jezerca mountain (2692 m), continuing with the Hekurave mountain (2558 m) and going on up to the Merturi mountain (1758 m), along the lateral slopes of the Gashi valley etc. With the very strong correlative relations between these two geomorphometry phenomena they take a considerable surface about 720km^2 or 27,4 % of the whole territory (Map 2.1), (table 1), (where the values are r = 0,9 up to 1,0).

The big relative values of the strong correlative relations (r = 0,9 up to 1,0) lies at the same time even in the western slopes of the Kurila mountain (1848 m), Bishkozi mountain (1866 m), and up to the Maranai mountain (1576 m) and also in the lateral slopes of the Cukali mountain (1721 m).

In this strong correlative relations in these areas, at the same time have influenced even other physical-geographical factors such as the relief, climate, hydrograph, topography, flora etc.

In the territories with strong correlative relations between horizontal and vertical parceling, the relief is properly mountainous with an average altitude higher than 1500m, with high ridges and slopes and with profound valleys that are lies in a radial shape.

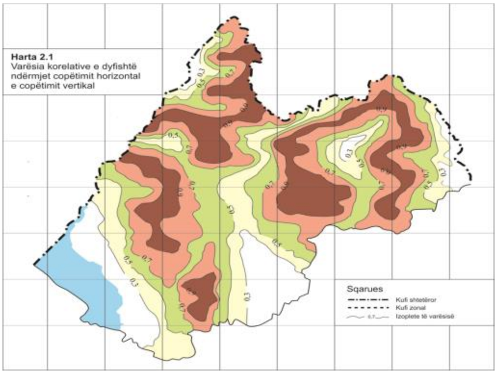
Even the precipitations are in a considerable quantity (2000-2500 mm precipitations per year) in these territories, appreciably influencing in the strong correlative relations between these two geomorphometry phenomena. The territories with small values of the correlative relations between the horizontal and vertical tearing it is noted mainly along the field of over Shkodra, along the valley of the Shala river, along the medium and lower stream of the Valbona valley, in the territory of the Bjeshket e Namuna, in the carstic plateau of Velecik-Bridash, in the eastern part of the Tropoja river etc, where the values of the correlative relations are oscillated from 0,0 – 0,5 (Map 2.1)

Table 1 The table of the double correlative relation between horizontal and vertical tearing:

No	VALUES OF CORRLATIVE COFICIENT	SURFACE (km2)	%
1	0,0 - 0,3	220	8,3
2	0,31 - 0,5	262	9,97
3	0,5 1- 0,7	665	25,31
4	0,71 - 0,9	760	28,93
5	0,9 - 1,0	720	27,4
TOTAL	0,0 - 1,0	2627	100

These lied areas in the territory in study take relatively a small surface 482km^2 or a percentage of 18,34% of the whole territory. This small correlative relation between these two geomorphometry phenomena, it is conditioned even from the other geological factors such as (tectonic, lithification) physical-geographical as for relieves with high and small altitude, precipitations etc.

In these areas, however that have very high and small tectonically values, up and low, abundant precipitations, the superficially flows are relatively small because of it is related tightly with the lithification composition of the rocks with the high percentage with the clean carbonic of the periods Triassic, Jurassic, cretaceous. It is to be mentioned that in general the authentic Albanian Alps that in a high percentage (around 60% of territory) are composed from the carbonic depositions of Triassic , Jurassic and cretaceous, and have relatively developed a tectonic quasi-long and quasi transversal. The correlative relations between these two phenomena are relatively strong. This it is seen in the values in the correlation coefficient from 0, 51 – 1, 0 and take a surface of 2145km^2 and a percentage of 81,6% (Map 2.1) and (Table 1).



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