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INDEX OF MORPHOHYDROGRAPHIC BASIN COMPLETION BY PERIMETRES AND AREAS. CASE STUDY IN ROMANIA

ABSTRACT: GRECU F., *Index of morphohydrographic basin completion by perimetres and areas. Case study in Romania*. (IT ISSN 1724-4757, 2008).

The present paper is aimed at highlighting the index of basin completion for parameters and areas which is relevant for the main morphometric variables depicting the dynamics of the basin as a complex system. The basins discussed herein are situated in the morphogenetic environment characteristic of temperate zones, the approach being sustained by the statistical analysis of a representative number of cases, and by data obtained for topographic charts on the scale of 1:25000, and field observation. Looking at drainage basin dynamics starts from the hierarchy of streams on the Horton - Strahler scale.

The higher the order of magnitude, the better balanced a basin is, and reversely, the smaller the order of magnitude the greater its imbalance. It appears that 4 th- and 5 th -order basins are best suited for a dynamic geomorphic analysis. Drainage basin dynamics synthetic coefficient I_c (I_c - completion index) stands for number of stream segments, as well as for other variables, eg. length, areas and perimeter of hydrographic basins, and is given by the progression ratio. I_c = 1 (100%) equilibrium; I_c< 1 subsized; I_c > 1 oversized.

The analysis focussed on 21 drainage basins situated in mountain zones on crystalline or Mesozoic-Paleogene schists, and 19 basins located in hills and tablelands on Mio-Pliocene sediments.

The completion indexes of mountain basin areas and parameters come closer to unity, which suggests a tendency for basins to reach a state of dynamic equilibrium compared both to drainage model indexes and hill and tableland basins. Disparities between mountain basins and their hill and tableland counterparts do exist, particularly in terms of completion level.

KEY WORDS: Morphohydrographic basin, Completion index, Area, Perimeter, Romania.

REZUMAT: GRECU F., *Indicele de realizare a suprafeţelor şi perimetrelor bazinelor morfohidrografice. Studii de caz din România*. (IT ISSN 1724-4757, 2008).

Lucrarea de faţă are ca obiect indicele de realizare al suprafeţelor şi perimetrelor bazinelor hidrografice, parametrii morfometrici importanţi relevanţi pentru dinamica bazinului hidrografic ca sistem geomorfologic complex. Bazinele analizate sunt situate în unităţi morfogenetice caracteristice zonelor temperate, lucrarea fiind susţinută de analiza statistică a unui număr reprezentativ de cazuri, datele fiind obţinute de pe harta topografică scara 1:25.000 şi din observaţii de teren. Dinamica bazinului de drenaj porneşte de la ierarhizarea în sistem Horton-Strahler.

Cel mai mare ordin de mărine arată un bazin în echilibru, invers un ordin de mărime mai mic arată un bazin în dezechilibru. În acest context bazinele de ordin 4 şi 5 sunt cele mai potrivite pentru analiza dinamicii geomorfologice a bazinului. Indicele de realizare a bazinului ca indice sintetic (I_C)porneşte de la numărul de segemente de râu şi alte variabile (lungime, perimetre şi suprafaţa bazinului hidrografic) şi sunt date de raţia progresiei. I_c = 1 (100%) indica o stare de echilibru, I_c<1 arata o stare de subrealizare, I_c<1 stare de suprarealizare pentru ordinul de marime sau pentru perimetre, pentru suprafete.

Analiza urmăreşte 21 de bazine hidrografice situate în zona mantană cristalină sau în roci Mezozoice şi Paleogene sedimentare şi 19 bazine situate în dealuri şi podişuri în sedimentar Mio-Pliocen.

Indicele de realizare al perimetrelor şi suprafeţelor pentru bazinele din zona montană sunt apropiate de unitate şi sugerează tendinţa bazinelor de a ajunge la o stare de echilibru dinamic comparabil cu indicele de realizare al bazinelor din regiunile de deal şi podiş. Există diferenţe între indicele de realizare pentru bazinele montane şi ceel din deal şi podiş.

CUVINTE CHELE: Bazin morfohidrografic, Indice de realizare, Perimetre, România.

CONCEPT AND METHOD

The study of morphohydrographic basins as complex territorial units was boosted in mid 20th century by the results of fundamental and applied research, mainly the general systems theory, Horton-Strahler's hierarchy of the hydrographic network (Horton, 1945; Strahler, 1957) and the modern morphological theories (theory of fractals) (Dubois & Chaline, 2006).

Drainage basin is a notion defined at least by three major spatial elements: basin area (slope system); drainage network (river channels-channel system) and water divide (basin perimeter). It is from these elements that unidimensional (lengths) and bidimensional or area (plus tridimensional) parameters are obtained. The combination of these elements yields parameters either of lengths and surfaces or of level difference and lengths or areas (average altitudes, slope, etc.).

In Romania, the mathematical relations referred to certain morphometrical variables were applied to representative basins in terms of their position, lithology, landform and relationships with the other environmental components. A history of the results obtained (Grecu, & Zăvoianu,

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1994) shows water specialists to have been interested first in morphometry, elaborating new laws, or verifying those by Horton-Strahler and applying a Horton-Strahler's hierarchisation system (Zavoianu, 1978, 1985), and geomorphologists to analyse and interpret the findings from a morphogenetic and morphodynamic viewpoint (Grecu, 1980, 1981, 1983, 2004; Sandu 1980, Bojoi & *alii*, 1998 and numerous Ph.D. theses, & *alii*), imposed the notion of morphohydrographic basin (Chorley, 1962, cited by Posea, 1977; Grecu, 1992, 2003; Comanescu, 2004, etc.).

The present paper is aimed at highlighting the index of basin completion for parameters and areas which is relevant for the main morphometric variables depicting the dynamics of the basin as a complex system. The basins discussed herein are situated in the morphogenetic environment characteristic of temperate zones, the approach being sustained by the statistical analysis of a representative number of cases, and by data obtained for topographic charts on the scale of 1:25000, and field observation.

In the light of this hierarchisation system our drainage network analysis considers 1st-order streams the junction of two 1st-order streams to form a 2nd-order stream, etc. This type of ordering enables one to assess the relathionships between stream frequency, channel length and drainage surface, surface perimeter, etc. Besides, it allows comparing some elements of morphohydrographic basin dynamics in terms of size and morphogenetic conditions.

The significance of 1st-order stream analysis targets both formal elements, like the extraction of a network from topographic charts (scale 1:25.000) and its confrontation with the reality on the ground, and elements of substance, their geomorphological role being comparable with that of «the cell in a biological tissue» (Baulig, 1959).

The geomorphometric elements of drainage basins can be grouped into: unidimensional (linear), bidimensional (areas) and tridimensional. Their combination yields elements including either dimensions of lengths and surfaces or level differences and lengths or surfaces (Grecu, 1981).

The present analysis covers 21 drainage basins located in the mountain zone with a crystalline schists or Mesozoic-Paleogene sedimentary substrate, and 19 hill or tableland basins overlying a Mio-Pliocene sediment (tables 1, 2), fig. 1. A, B.

The following variables have been statistically processed:

The elements of perimeters:

- ratio summed perimeters R_P (Horton, 1945; Strahler, 1952); completion index I_P
- ratio of average perimeters R_P (Horton, 1945; Strahler, 1952); completion index I_p

The elements of areas:

- ratio summed areas R_A (Horton, 1945; Strahler, 1952); completion index I_A
- ratio of average areas R_a (Horton, 1945; Strahler, 1952); completion index I_a

The basin order of magnitude and the elements of lengths were presented in a previous study (Grecu, 2004).

TABLE 1 - The completion index for summed and average perimeters and the completion index for summed and average areas for drainage basins in Carpathian Mountains

Drainage basins	Location	Ord. of magnitude	R_P	R_p	Completion index % I_P	I_p	R_A	R_a	Completion index % I_A	I_a
Săraţii	Făgăraş Mts.	5	0.58	1.92	68	111	1.13	3.63	99	160
Valea Schitului	Ceahlău Mts.	5	1.30	1.60	94	114	1.68	1.43	59	59
Zamora	Baiu Mts.	4	2.20	1.80	24	46	2.1	1.80	40	17.1
Podragu	Făgăraş Mts.	4	1.09	2.38	100	100	0.55	0.15	100	100
Valea lui Stan	Căpăţânii Mts.	5	1.71	2.14	78	95	0.9	4.07	84	102
Azuga	Baiu Mts.	5	1.64	2.90	73	174	0.73	6.57	126	244
Valea Morarului	Bucegi Mts.	4	1.48	2.93	69	151	0.75	5.78	78	170
Lotrioara	Lotru Mts.	5	1.89	2.77	108	81	0.82	6.34	99	56
Limpedea	Făgăraş Mts.	5	1.78	2.25	60	120	0.8	50	89	178
Cumpăna	Făgăraş Mts.	4	1.68	2.17	106	129	0.79	4.62	101	130
Izvorul Dorului	Bucegi Mts.	5	2.15	2.71	237	82	0.94	6.20	39	202
Capra	Făgăraş Mts.	5	1.62	2.36	114	146	0.84	4.56	117	151
Mălăeşti	Bucegi Mts.	4	2.34	2.56	27	83	1.63	4.37	51	145
Ţigăneşti	Bucegi Mts.	4	0.94	2.13	125	126	1.38	6.03	114	248
Telejenel	Ciucaş Mts.	5	1.98	2.36	53	50	0.81	5.76	123	27
P. Alb	Ciucaş Mts.	4	1.24	1.62	89	89	0.76	2.76	148	114
Valea Stânii	Ciucaş Mts.	4	1.44	2.65	77	99	0.72	2.81	83	54
P. Şipote	Ciucaş Mts.	4	0.99	2.39	103	24	0.61	4.24	83	154
P. Chiojd	Ciucaş Mts.	4	0.74	3.66	97	131	0.74	3.66	97	131
Pintic	Ceahlău Mts.	5	1.61	2.15	68	116	0.74	4.70	89	147
Bătrâna	Iezer Mts.	5	1.63	2.2	83	147	0.81	4.44	103	183

ORDER OF MAGNITUDE AND COMPLETION INDEX OF DRAINAGE BASINS

The basin order of magnitude is given by the order of the lower segment at the mouth of the mainstream. The basins studied herein are of the 4th and 5th orders, assumed to be best indicated for comparative and dynamic studies. The higher the order of magnitude the better balanced the basin is; as a rule, lower-order basins (1-3) are torrential, and intermittently unbalanced. In other words, balance and unbalance are extremely frequent cyclic states.

The confluence ratio (Hirsch, 1962, Zavoianu, 1978, Grecu, 1980) or the ratio of bifurcations (Horton, 1945; Schumm, 1956, Strahler, 1957, Avena & *alii*, 1967), the ratio of parameters and the ratio of areas indicate that basins tend towards a state of dynamic equilibrium. The confluence ratio is obtained starting from lower-to-higher orders, it representing the arithmetical mean of individual ratios

TABLE 2 - The completion index for summed and average perimeters and the completion index for summed and average areas for drainage basins in hilly regions

Drainage basins	Location	Ord. of magnitude	R_P	R_p	Completion index % I_P	I_p	R_A	R_a	Completion index % I_A	I_a
Bisoca	Subcarpathians	4	1.45	3.04	31	19	3.19	1.6	42	30
Arva	Subcarpathians	4	1.73	2.4	99	122	0.81	5.13	98	121
Crasna	Subcarpathians	5	2.21	2.03	25	49	0.95	5.04	58	137
Bud	Barlad Tableland	4	2.23	1.34	88	100	2.23	1.34	120	180
Văsui	Subcarpathians	6	1.5	2.5	111.4	105	0.83	5.2	118	128
Câmpiniţa	Subcarpathians	4	1.39	2.72	61	115	1.42	2.6	97	18
Slănicel	Subcarpathians	5	1.49	2.39	25	29	1.68	2.12	111	47
Belia	Subcarpathians	5	0.86	6.8	151	442	0.55	2.3	66	41
Valea Satului	Subcarpathians	5	1.1	3.24	32	57	2.15	3.71	73	122
Mislea	Subcarpathians	5	1.4	2.78	72	140	0.65	6	74	145
Mălina	Covurlui Tableland	4	1.4	2.4	123.4	138	1.5	5.7	132	167
Sărăţel	Subcarpathians	4	1.92	2.82	85	178	0.95	5.25	108	28
Valea Seacă	Casimcea Plateau	4	1.12	3.09	99.6	110	1.38	1.70	93	104
Casimcea	Casimcea Plateau	5	2.87	2.18	35	106	1.19	5.28	88	199
Zăvoi	Transylvanian Tableland	5	1.97	2.32	165	109	0.70	6.54	114	174
Harta	Transylvanian Tableland	5	1.83	2.07	66	84	0.84	4.50	90	114
Zlagna	Transylvanian Tableland	5	1.77	2.09	68	84	0.85	4.32	87	108
Albac	Transylvanian Tableland	5	1.77	3.10	64	172	0.68	8.01	111	280
Carpinis	Subcarpathians	5	1.79	2.29	95	102	0.86	4.79	100	120

and can be calculated by several relations (Haggett and Chorley, 1969 cited by Zavoianu, 1978, 1985).

For example, higher R_c values for hilly regions are a convincing proof that basin dynamics is higher than in mountainous regions where lower R_c values are recorded, the confluence ratio being under 3 in certain cases (Grecu, 2004).

The index of basin completion is illustrative of drainage basin order in terms of the total number of river segments (Grecu, 2004) and also of the real and calculated values of areas and parameters (for each basin order).

The completion index is calculated by the ratio between the values of the last term of calculated progression and the last term of measured progression (fig. 1.B, table 3). The last term of calculated progression can be obtained by referring the last-but-one term to the progression ratio. The simplified completion index calculation formula reads as follows:

$I_n = (N_n\text{-}1/R_c)/1$ for basin size

and

I_x = (calculated value/measured value)x100 for perimeters and areas;

for ex.: $Ip = 24.38 / 23.80 \times 100 = 102$

$I_x = 1(100\%)$ balanced $I_x < 1$ undersized $I_x > 1$ oversized

(where $N_n - 1$ = value of the last-but-one term of progression; R_c = confluence ratio).

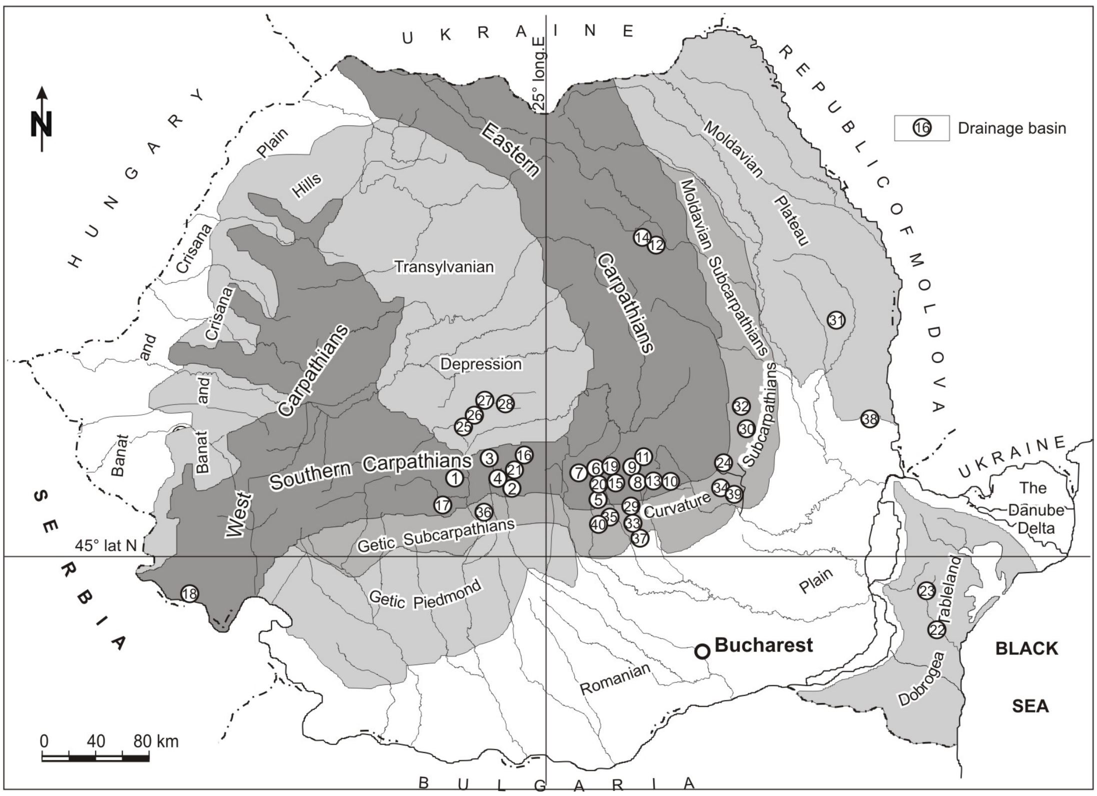

FIG. 1 A - Romania. The geographic position of the drainage basins - Drainage basin: 1. Lotrioara; 2. Limpedea; 3. Saratii; 4. Cumpãna; 5. Izvorul Dorului; 6. Mãlãesti; 7. Tigãnesti; 8. Valea Stânii; 9. Pârâul Alb; 10. Pârâul Chiojd; 11. Pârâul Sipote; 12. Valea Schitului; 13. Telejenel; 14. Pintic; 15. Zamora; 16. Podragu; 17. Valea lui Stan; 18. Bãtrâna; 19. Azuga; 20.Morarului; 21. Capra; 22. Valea Seacã; 23. Casimcea; 24. Bisoca; 25. Zãvoi; 26. Hârta; 27. Zlagna; 28. Albac; 29. Crasna; 30. Arva; 31. Bud; 32. Vasui; 33. Campinita; 34. Slanicel; 35. Belia; 36. Valea satului; 37. Mislea; 38. Malina; 39. Saratel; 40. Carpinis.

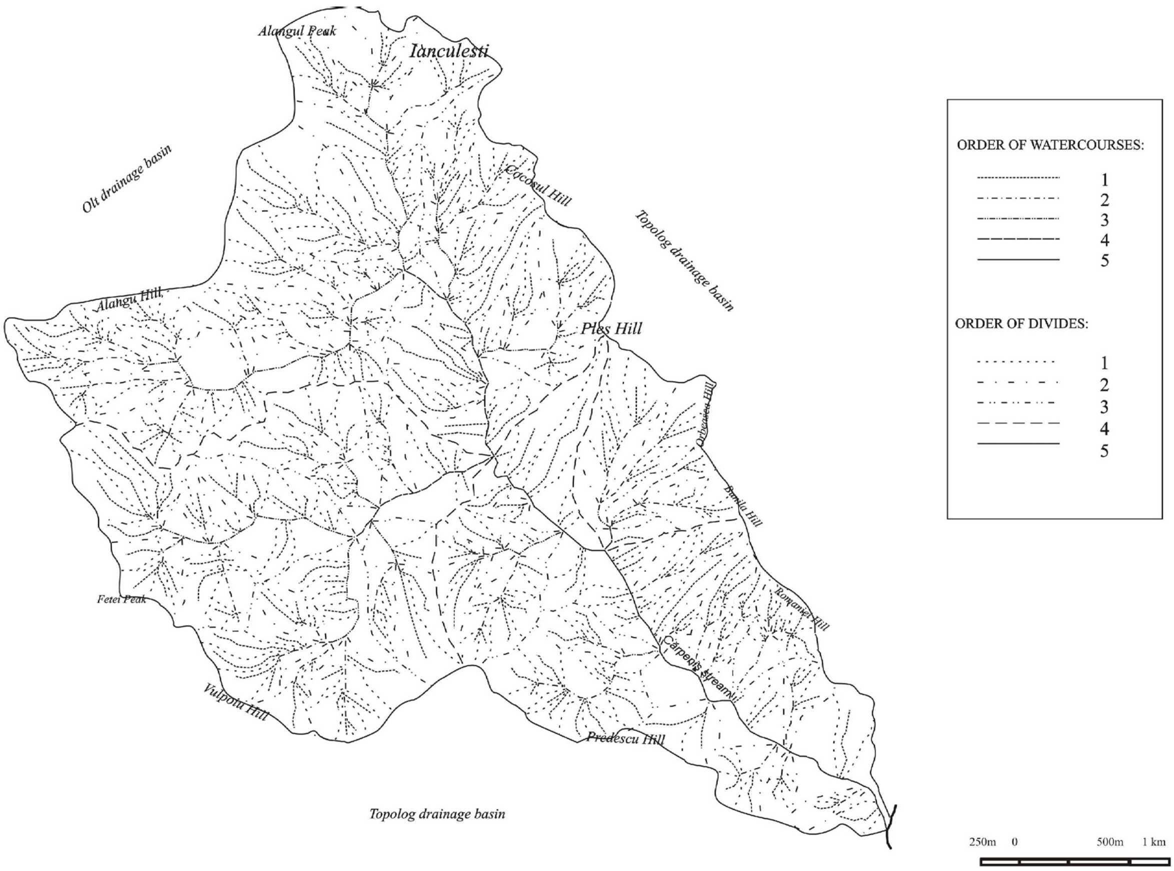

FIG. 1 B - Cărpeniş Catchment. Hierarchization of the river network.

TABLE 3 - The Cărpeniş Catchment. Data on the Morphometrical Model of Perimeters and Areas

Parameter		Order 1	2	3	4	5	Ratio	Index compl. %
No. river segments (N)	M	270	64	13	3	1	Confl. ratio	$I_N = 92$
	C	263.68	64	15.53	3.77	0.92	$R_c = 4.12$	
Summated perimeters (P, km)	M		129.65	58.67	33.51	23.8	$R_P = 1.79$	$I_P = 95$
	C	72.43	129.65	72.43	40.46	22.61		
Mean perimeter (p, km)	M		2.03	4.51	11.17	23.80	$R_p = 2.29$	$I_p = 102$
	C	0.89	2.03	4.65	10.65	24.38		
Summated areas (A)	M		12.53	14.31	18.12	19.6	$R_A = 0.86$	$I_A = 100$
	C	10.78	12.53	14.57	16.94	19.70		
Mean areas (a)	M		0.20	1.10	6.04	19.6	$R_a = 4.79$	$I_a = 112$
	C	0.04	0.2	0.96	4.59	21.98		

M - measured; C - calculated

INDEX OF PERIMETER COMPLETION

In order to determine the ratio of summed perimeters and the ratio of average perimeters of drainage basins for each order of magnitude, a first step is to draw the basin divide line by direct measurement on the map. The data, centralised by order of magnitude, yield a progression embodied in the following law: the summed perimeters of drainage basins of successively increasing orders tend to form a decreasing geometric series in which the first term is the summed perimeters of first-order basins (P_1) and the ratio (R_p) is the ratio of the summed perimeters (Zăvoianu, 1978; Grecu, 1981).

Once the sum of the perimeters and the number of basins of each order is known, the average perimeter can be calculated. The series of values thus obtained, also representable on semilogarithmic scales, shows that the average perimeter of successively increasing basins forms an increasing geometric series in which the first term is the average perimeter of first- order basins (P_1) and the ratio (R_p) is the ratio of these perimeters. The ratio can also be calculated from the R_c/R_p relation.

The ratio of the sum of perimeters and the ratio of average perimeters are concordant with the ratio of lengths, the perimeters being that variable which is most relevant for the relationships among the length elements within a drainage basin, and the connection to basin area. These elements are useful in identifying some drainage basin catchments (Grecu, 1980, 1992).

It is significant that values of R_x= 2-3 (for the sum of perimeters and for average perimeters) prevail in mountain basins, while values of R_x= 1-2 (for the sum of perimeters) are characteristic of hill basins; R_x= 2-3 and over 3 (for the mean value of parameters) being specific to small drainage basins (tables 4, 5).

TABLE 4 - Frequency of the ratio of the sum of perimeters R_P

Value classes R_P	Absolute frequency Mountain	Absolute frequency Hill and tableland	Relative frequency % Mountain	Relative frequency % Hill and tableland
0-1	4	1	19.04	5.26
1-2	3	15	14.28	78.94
2-3	14	3	66.66	15.78

TABLE 5 - Frequency of the ratio of average perimeters R_p

Value classes R_P	Absolute frequency Mountain	Absolute frequency Hill and tableland	Relative frequency % Mountain	Relative frequency % Hill and tableland
0-1	–	–	–	–
1-2	3	1	14.28	5.26
2-3	16	13	76.19	68.42
>3	2	5	9.52	26.31

In the case of perimeters, the drainage basin completion index shows a high frequency (ca. 40-50%) of class *Ip* = 80-120 mountain basins, which proves the basins tendency to attaining a state of equilibrium in respect of the summed mean value of perimeters.

As regards the sum of perimeters in mountain and hill basins, the two value classes (*Ip* = 41-48 and 81-120) show a slight tendency to undersizing, while with area averages, a slight tendency to over-sizing is nevertheless visible in mountain basin only (if value class *Ip* = over 120, which has a high frequency, is taken into account).

The index of drainage basin completion in terms of perimeters (summed and averages) shows mountain basins in the class of 80-120 to have the highest frequency, which proves that they are better balanced than basins in the hills. However, compared to average perimeters, hill basins appear to have definitely a better completion index for the dynamic equilibrium class (fig. 2, 4).

INDEX OF AREA COMPLETION

The ratio of the sum of drainage basin areas and the ratio of their average areas can also be calculated by the direct measurement of each basin area, the data obtained being centralised by order of magnitude.

In this case, too, the values of areas summed by order of magnitude follow the law according to which areas of drainage basins summed by successively increasing orders tend to form a geometric series in which the first term is the summed area of first-order basins A_1 and ratio R_A is the ratio of summed areas (Zăvoianu, 1978; Grecu, 1981).

By referring the summed area to the number of basins of the respective order, an important parameter, namely average basin area, is obtained. These values form an increasing geometric series in which the first term is the average area of first-order basins (A_1) and ratio R_A is the ratio of areas. Like in the case of average lengths this ratio can be deduced by dividing the ratios of the analysed series (R_C/R_A).

The average values of the ratio of summed areas reveal the latter to be lower in mountain basins (0.91) than in hill basins (1.2) because the harder rocks of mountain zones require a larger area for the organisation of the drainage network (tables 1, 2, 12). If four basins from the Transylvanian tableland (with high relief energy and milder slopes than in the Subcarpathians) were omitted from calculation, then the average value of the ratio of the sum of areas would be even higher (1.35) (tables 2, 7, 12) Insofar as the

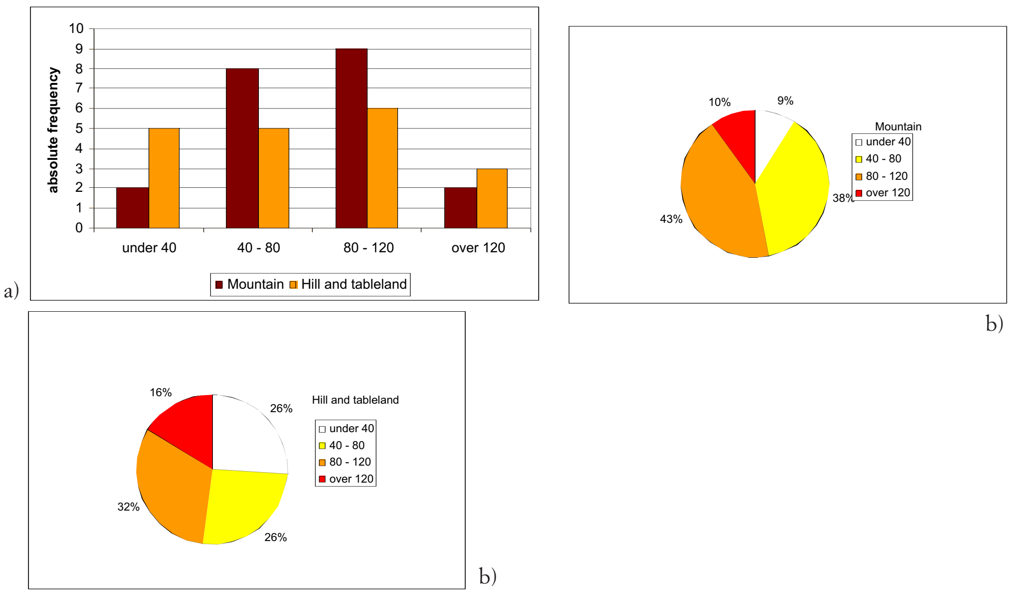

FIG. 2 - Completion index of the sum of perimeters I_P: a) absolute frequency; b) relative frequency (table 6).

TABLE 6 - Frequency of completion index of the sum of perimeters I_P

Value classes I_P	Absolute frequency Mountain	Absolute frequency Hill and tableland	Relative frequency % Mountain	Relative frequency % Hill and tableland
under 40	2	5	9.52	26.32
40-80	8	5	38.09	26.32
80-120	9	6	42.85	31.58
Over 120	2	3	9.52	15.78

TABLE 7 - Frequency of completion index of average perimeters I_p

Value classes I_P	Absolute frequency Mountain	Absolute frequency Hill and tableland	Relative frequency % Mountain	Relative frequency % Hill and tableland
under 40	1	2	4.76	10.52
40-80	2	2	9.52	10.52
80-120	10	9	47.61	47.38
Over 120	8	6	38.09	31.58

ratio of average areas is concerned, there is a significant increase in R_A = *4-5* in the mountains and R_A = *5-6* in the hills, the arithmetical mean being approximately the same (4.23 and 4.27, respectively) which indicates the basins' tendency in the two major units, namely, mountain and hill (most of which lie in the Carpathians and Curvature Subcarpathians) to enlargen their area (table 8, 9, 12).

The most frequently occurring value classes for the ratio of average areas (R_A = 4-5 in the mountain and R_A = 5-6 in the hilly zones) are characteristic of small basins with a greater dynamic (table 9).

The index of basin area completion indicates a state of equilibrium (for sums) and mild overcompletion (for averages), with both categories of basins. Thus, the changes that may occur inside the systems in respect of number of stream segments and length of drainage network do not modify the basin area (fig. 3, 5, table 10, 11).

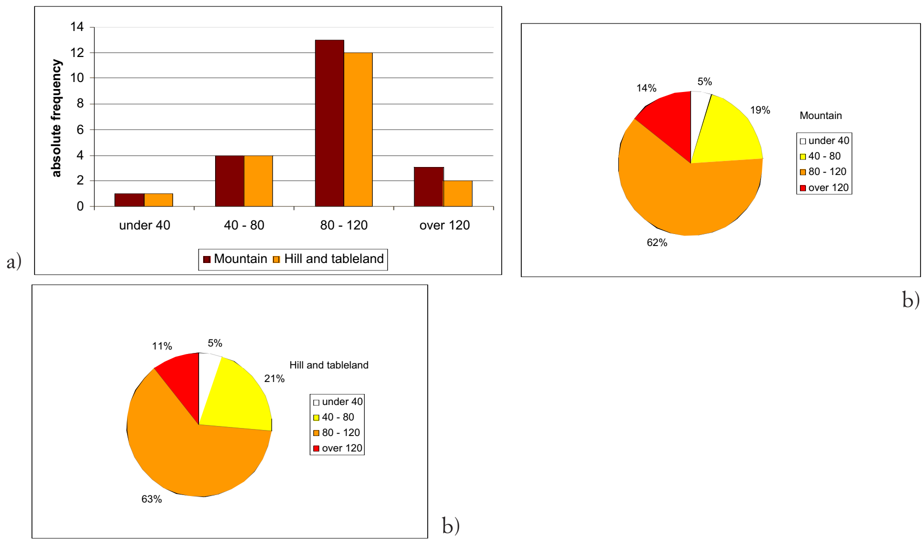

FIG. 3 - Completion index of the sum of areas I_A: a) absolute frequency; b) relative frequency (table 10).

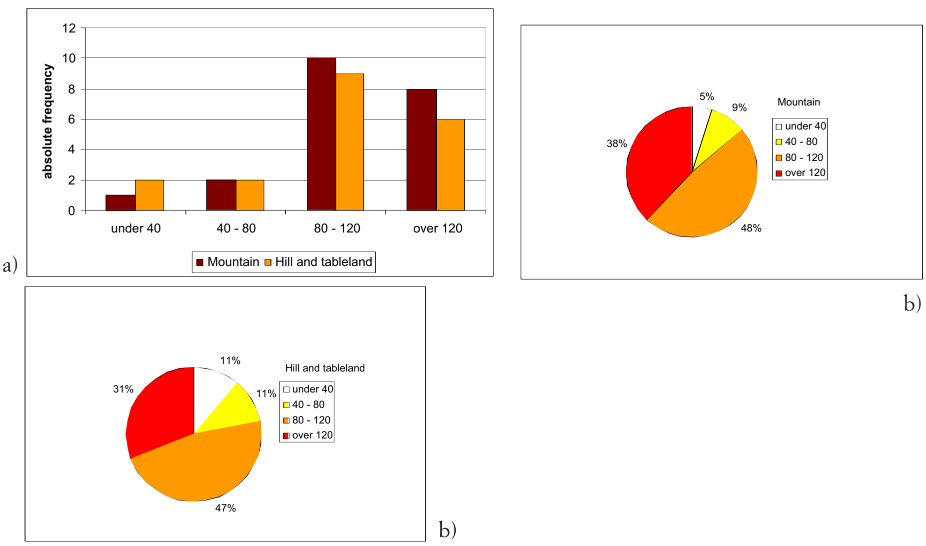

FIG. 4 - Completion index of average of perimeters I_p: a) absolute frequency; b) relative frequency (table 7).

FIG. 5 - Completion index of the average of areas I_a: a) absolute frequency; b) relative frequency (table 11).

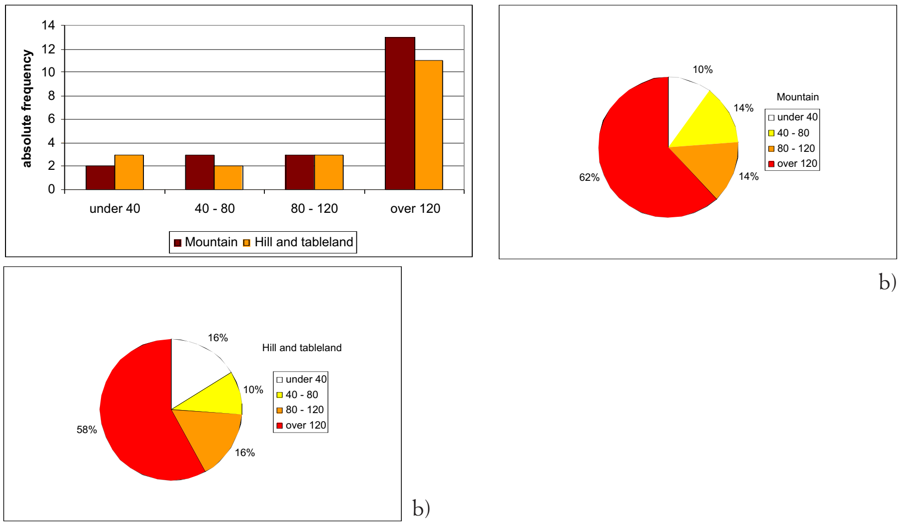

TABLE 8 - Frequency of the ratio of summed areas R_A

Value classes	Absolute frequency		Relative frequency %	
R_A	Mountain	Hill and tableland	Mountain	Hill and tableland
0-1	16	11	76.19	57.89
1-2	4	5	19.04	26.31
2-3	1	2	4.76	10.52
>3	–	1	–	5.26

TABLE 9 - Frequency of the ratio of average areas R_a

Value classes	Absolute frequency		Relative frequency %	
R_A	Mountain	Hill and tableland	Mountain	Hill and tableland
0-1	1	–	4.76	–
1-2	2	3	9.52	15.78
2-3	2	3	9.52	15.78
3-4	2	1	9.52	5.26
4-5	7	3	33.33	15.78
5-6	3	6	14.28	31.57
>6	4	3	19.04	15.78

TABLE 10 - Frequency of completion index of summed areas I_A

Value classes	Absolute frequency		Relative frequency %	
I_A	Mountain	Hill and tableland	Mountain	Hill and tableland
under 40	1	1	4.76	5.26
40-80	4	4	19.05	21.07
80-120	13	12	61.91	63.15
Over 120	3	2	14.28	10.52

TABLE 11 - Frequency of completion index of average areas I_a

Value classes	Absolute frequency		Relative frequency %	
I_a	Mountain	Hill and tableland	Mountain	Hill and tableland
under 40	2	3	10.52	15.78
40-80	3	2	14.28	10.52
80-120	3	3	14.28	15.78
Over 120	13	11	61.90	57.89

TABLE 12 - Statistical analysis of morphometric variables

Statistical data	R_P mountain	R_P hill	R_p mountain	R_p hill	R_A mountain	R_A hill	R_a mountain	R_a hill
Amplitude	1.26	2.01	2.05	5.46	1.49	2.64	5.14	6.67
Arithmetical mean	1.60	1.67	2.36	2.71	0.96	1.23	4.46	4.27
Median line	1.62	1.61	2.36	2.4	0.82	0.85	4.44	4.79
Module	1.6	2.03	2.7	2.00	0.5	0.6	3.7	4.0
Statistical data	I_P		I_p		I_A		I_a	
Amplitude	98	140	150	423	108	90	230.9	262
Arithmetical mean	88.23	78.02	105.48	119.29	91.16	94.05	132.01	119.43
Median line	89	72	90	107	97	97	145	122
Module	116	60	80	120	102	74	124	100

DATA SYNTHESIS AND CONCLUSIONS

The present approach has proceeded from Horton-Strahler's drainage network hierarchy with focus an the 4th- and- 5th order basins (table 1, 2, 12). The completion index for number of segments usually shows that basins are undersized, the other parameters indicating a statistically homogeneous population.

While the basin completion index shows no differences in the progression ratio of basins located in the mountain, hill or tableland, yet there are variables (order of magnitude parameter and area), which show some disparities which warranting the necessity for a dynamic analysis of drainage basin to take into account this index as well.

The completion indexes of mountain basin areas and parameters come closer to unity, which suggests a tendency for basins to reach a state of dynamic equilibrium compared both to drainage model indexes and hill and tableland basins.

Disparities between mountain basins and their hill and tableland counterparts do exist, particularly in terms of completion level.

A correlation between the completion index of perimeters and the completion index of areas reveals that the linear correlation is the optimum one, the correlation coefficents of 0.70 and 0.85, respectively surpassing the critical value of the chosen level of signification (Fischer and Student tests) (figg. 6-9).

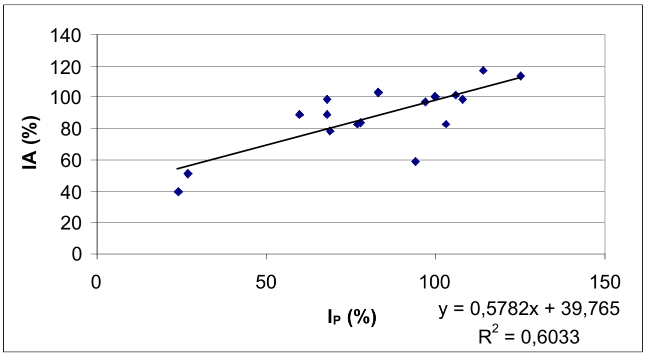

FIG. 6 - The corelation between the completion index of suumed perimeters and completion index of summed areas in mountain regions.

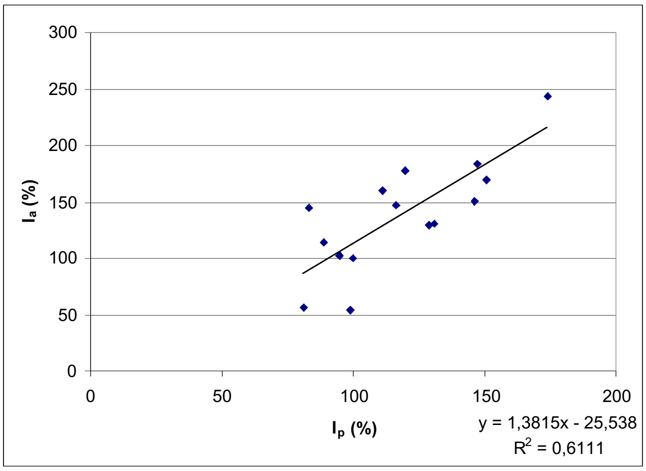

FIG. 7 - The corelation between the completion index of average perimeters and completion index of average areas in mountain regions.

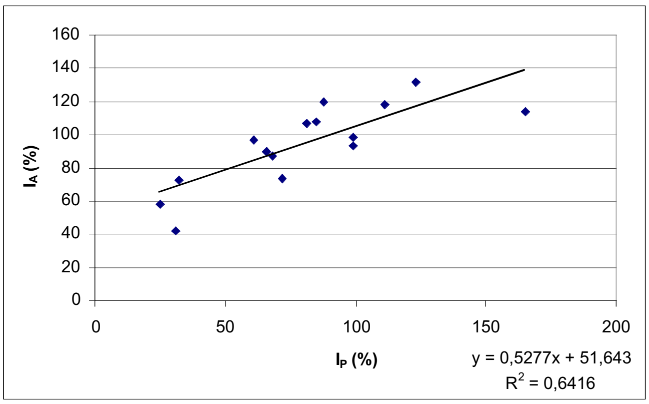

FIG. 8 - The corelation between the completion index of summed perimeters and completion index of summed areas in hilly regions.

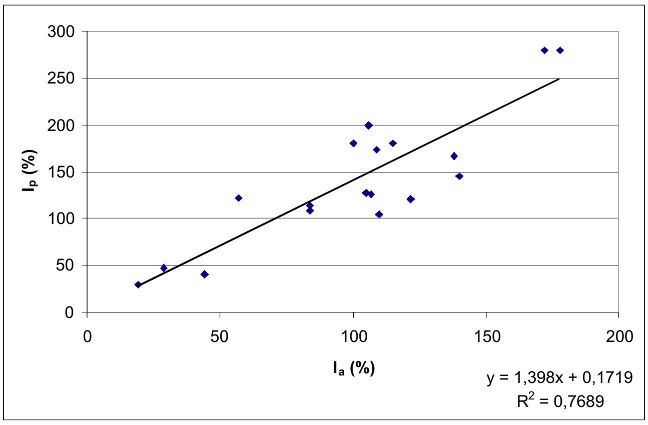

FIG. 9 - The corelation between the completion index of average perimeters and completion index of average areas in hilly regions.

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