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SOME CONSIDERATIONS CONCERNING MORPHOCLIMATIC CONDITIONS OF THE ROMANIAN CARPATHIANS

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Néhány meggondolás Román Kárpátok morfoklimatikus viszonyairól

A cikk a figyelem középpontjába helyezi azt a módot, ahogyan a Román Kárpátok sajátos éghajlati viszonyai – amelyekre időszakos (évszakos, hónapos), ill. térbeli (magassági, szélességi) változékonyság jellemző – befolyásolják a domborzatalakító folyamatok lefolyását. A megismerő és megmagyarázó eljárás a Peltier diagrammok használatát veszi igénybe a domborzatalakító folyamatok típusának és intenzitásának megállapításához (felaprózódás, szétmállás, periglaciális jelenségek, folyóvízi folyamatok), még karakterisztikus hónapok esetében is (január, július, április, október). A morfoklimatikus viszonyok összképét a karakterisztikus hőmérsékleti intervallumok és a jellemző napok (nyári, téli, csapadékos, havazásos, hóréteges, fagyos, derűs, alacsony hőmérsékletű napok) egészítik ki minden egyes állomás esetében. A figyelembe vett 13 meteorológiai állomás a következő geoökológiai övekben található: félniviális (2250–2300 m felett), alpesi (2000 és 2250–2300 m között), szubalpin (1750–1800 és 2000 m között) és erdő (1750–1800 m alatt).

The article brings in attention the way on which the specific climatic conditions of the Romanian Carpatians – characterized by temporal variability (seasonal and monthly) and spatial variability (according to the altitude and the latitude) – influence the unfurling of geomorphological processes. The cognitive and explanatory approach benefits by the utilisation of the Peltier diagrams which emphasize the type and intensity of geomorphological processes (mechanical and chemical weathering, periglacial processes, fluvial action), including those for the characteristic months (January, July, April, October). The board of the morphoclimatic conditions is completed by the thermic characteristic intervals and by the characteristic days (summer, winter, serene, frost, freezing, precipitation days, days with snow, days with snow layer) for each meteorological stations. The 13 stations taken into consideration correspond to the next geoecological domains: seminival belt (above 2250–2300 m), alpine belt (between 2000 and 2250–2300 m), subalpine belt (between 1750–1800 and 2000 m) and forest belt (below 1750–1800 m).

Key-words: morphological conditions, goecological belts, Carpathians

The climatic conditioning of morphogenesis is primordial: it is realized in different ways and it controls directly the distribution and the intensity of certain processes. The theorists of climatic geomorphology (e.g. *Tricart and Cailleux*, 1965) consider that, among the elements that define the climate, temperature and precipitation are the most important.

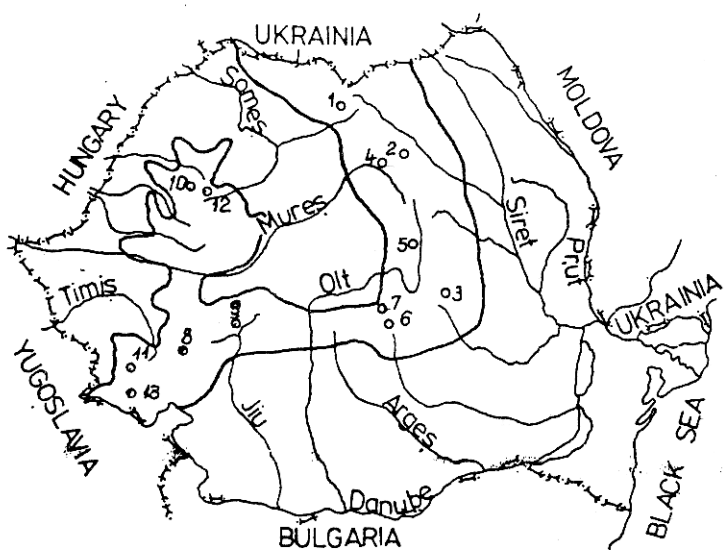


Fig. 1 Location map of meteorological stations

It is generally known how these two climatic elements vary in the Romanian Carpathians depending on latitude, longitude, circulation of air masses, exposure, altitude, etc.

Therefore, in order to outline the morphoclimatic conditions specific to this mountaineous area, we considered necessary to have in view data from meteorological stations having different positions in the mountain range (*Fig. 1, Table 1*).

We have used the geoecological belts established by Kotarba for the Tatra Mountains (*Kotarba*, 1987). The Romanian Carpathians have similar conditions. Therefore we have adapted the sane vertical division into zones of geoecoligical features, based not only on altitude, but also on temperature:

- seminival belt, above 2250–2300 m;
- alpine belt, between 2000 m and 2250–3000 m;
- subalpine belt, between 1750–1800 m and 2000 m;
- forest belt, below 1750–1800 m.

The climatic geomorphology is not interested only in the independent evolution of temperature or of precipitation, but also in the correlation which determines direcly the type and the rapidity of morphogenetic processes.

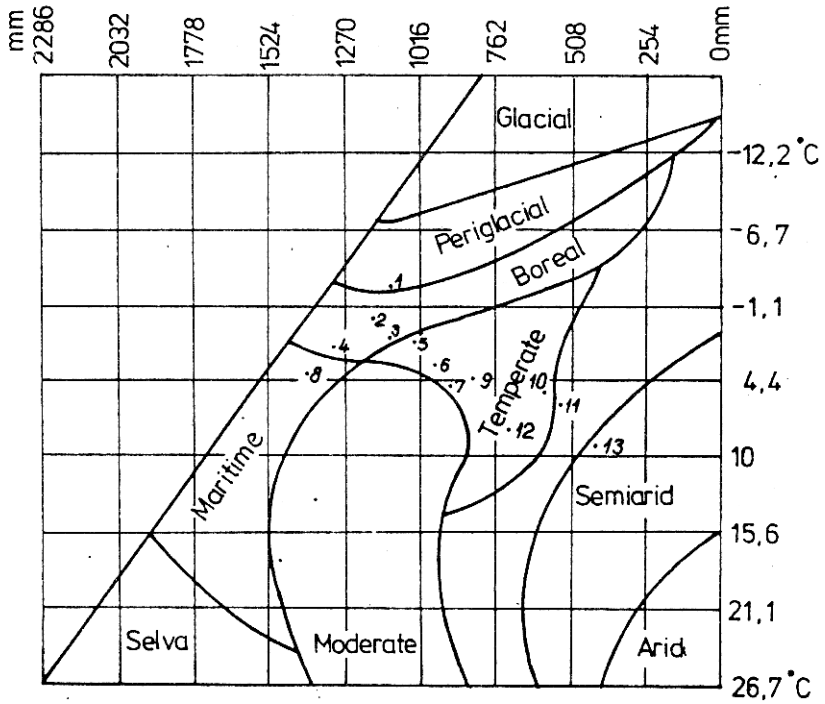
Table 1
Selected Romanian Carpathians meteorological stations

Station	Location	Altitude	Geoecological belt
		m.a.s.l.	
1. Iezer	Eastern Carpathians	1785	subalpine
2. Ceahlau	Eastern Carpathians	1897	subalpine
3. Lacaut	Eastern Carpathians	1777	subalpine
4. Toplita	Eastern Carpathians	687	forest (corridor)
5. Miecurea Ciuc	E.Carpathians	720	forest (depression)
6. Omu	Southern Carpathians	2505	seminival
7. Predeal	Southern Carpathians	1093	forest
8. Tarcu	Southern Carpathians	2180	alpine
9. Petrosani	S. Carpathians	581	forest (depression)
10. Vladeasa	Apuseni Mountains	1836	subalpine
11. Semenic	Banat Mountains	1440	forest
12. Baisoara	Apuseni Mountains	1385	forest
13. Bozovici	Banat Mountains	260	forest (depression)

In order to discover some mathematical relations of this correlation geomorphologists succeeded into establishing some morphoclimatic systems and even into defining them in terms of temperature and precipitations. Thea also named the predominant processes for each system (*Peltier*, 1950; *Pégui*, 1961).

Peltier diagrams illustrate:

- the affiliation to the morphoclimatic regions;
- the intensity of mechanical weathering and of chemical alteration;
- the intensity of fluvial action.



1 - Vf. Omu ; 2 - Tarcu ; 3 - Vlădeasa ; 4 - Iezer ; 5 - Lăcăuți ;
6 - Parâng ; 7 - Predeal ; 8 - Semenic ; 9 - Băișoara ;
10 - Toplița ; 11 - Miercurea - Ciuc ; 12 - Petroșani ; 13 - Bozovici

Fig. 2 The affiliation of the stations to the morphoclimatic systems in a Peltier diagram

Applied to the meteorological data from the Romanian Carpathians, these diagrams point out:

(i) the morphoclimatic systems to which are affiliated the selected stations are (*Fig. 2*): periglacial system (with physical dominate) – Omu; boreal system (here appears the biological dominate, too) – Iezer, Tarcu, Vladeasa; temperate system (the rivers are the main agents of the „normal erosion" (sense *Macar*, 1946); thanks to the submediteranian influences, the Semenic stations is situated at the limit ot the temperate system and maritime system.

(ii) the fluvial action is (*Fig. 3*): maximum in the subalpine and forest belts and medium (moderate) in the seminival and alpine belts.

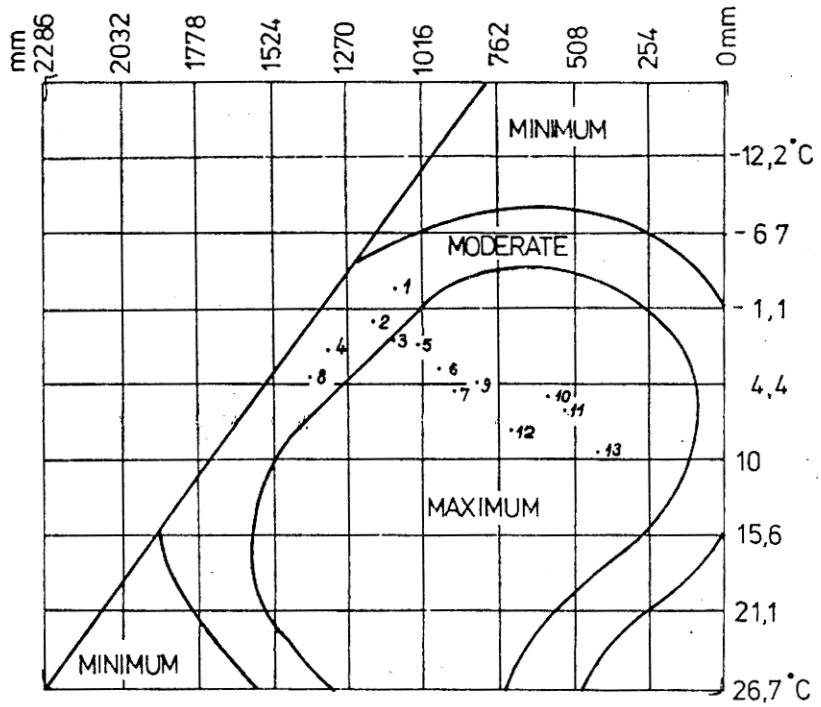


Fig. 3 The intensity of fluvial action after a Peltier diagram

(iii) the main morphogenetic processes in the studied area (*Fig. 4*): a slight mechanical weathering in seminival belt – Omu, situated upper than the maximum level of the precipitations, the low values of precipitations and temperatures make the chemical alteratio to be minimum; a moderate chemical alteration and freezing for rest of the stations.

Applied to the characteristic months, January and July, but also to the „trasitional" months, April and October, the Peltier diagrams emphasize the annual evolution of the intensity processes, depending on the morphoclimatic conditions. Thus, in January:

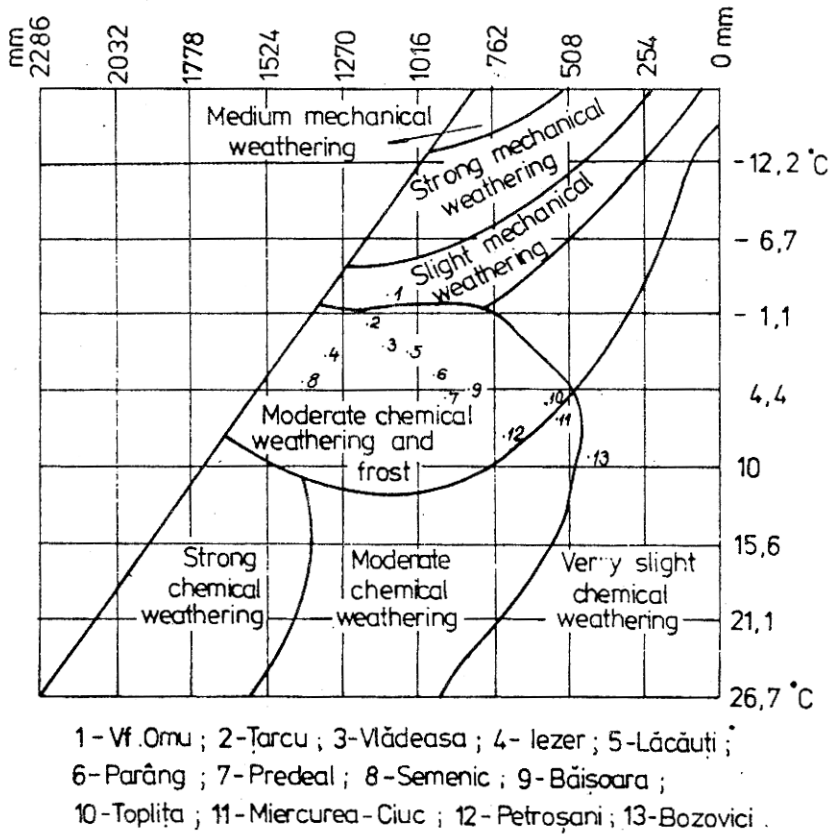


Fig. 4 The type and the intensity of the predominant processes after a Peltier diagram

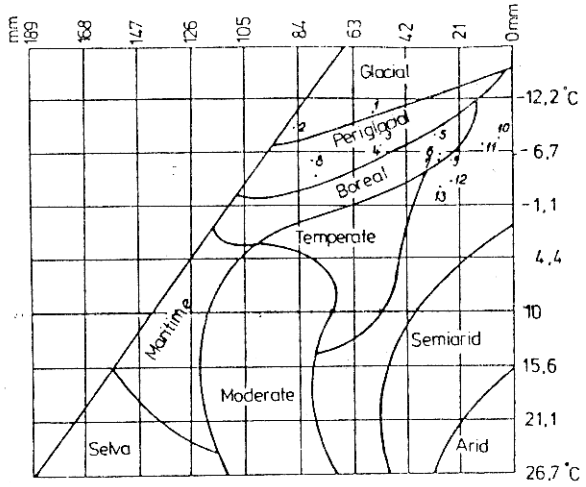
(i) the morphoclimatic conditions define the glacial system at Omu and Tarcu, the periglacial system at Vladeasa, Iezer and Semenic, and the boreal system in the rest (*Fig. 5a*):

(ii) the fluvial action is minimun in the seminival and alpine belt, and moderate and maximum in the other belts (*Fig. 6a*);

(iii) the main morphogenetic processes is the mechanical desintegrations is minimum and, „transitional" in seminival, alpine and subalpine belts (*Fig. 7a*).

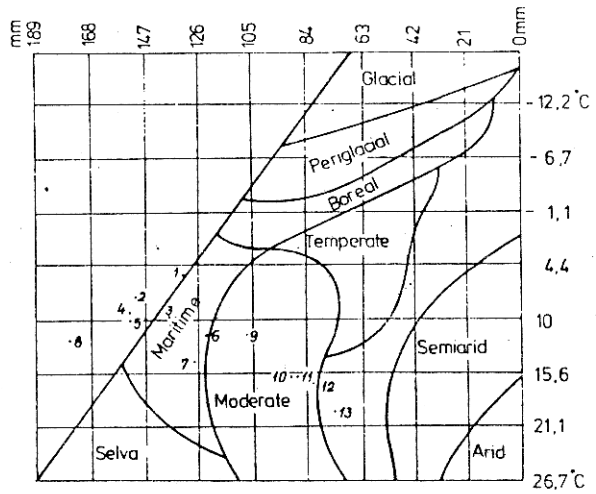
In July, with higher temperatures and precipitations:

(i) the morphoclimatic conditions define the temperate, moderate and maritime systems (*Fig. 5b*);



(a)

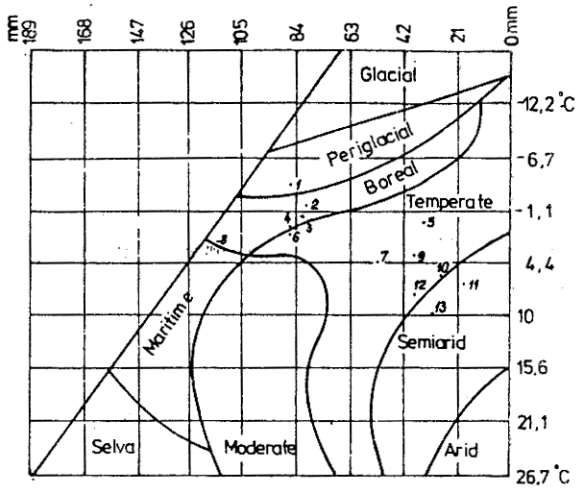
1- Vf. Omu ; 2- Ţarcu , 3- Vlădeasa ; 4- Iezer; 5- Lăcăuti,
6- Parâng ; 7- Predeal ; 8- Semenic ; 9- Băisoara ;
10- Toplita ; 11- Miercurea- Ciuc ; 12- Petroşani ; 13- Bozovici



(b)

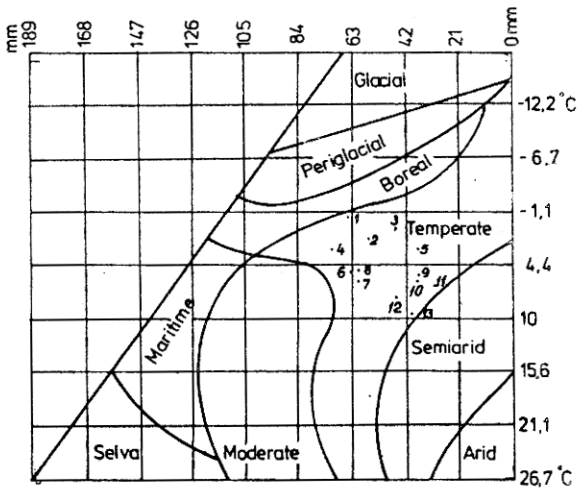
1 - Vf. Omu ; 2 - Ţarcu ; 3 - Vlădeasa ; 4 - Iezer ; 5 - Lăcăuti ;
6 - Parâng ; 7 - Predeal ; 8 - Semenic , 9 - Băisoara ;
10 - Toplita ; 11 - Miercurea - Ciuc ; 12 - Petroşani ; 13 - Bozovici

Fig. 5 The affiliation of the stations to the morphoclimatic systems in a Peltier diagram, for the months January (a), July (b), April (c) and October (d)



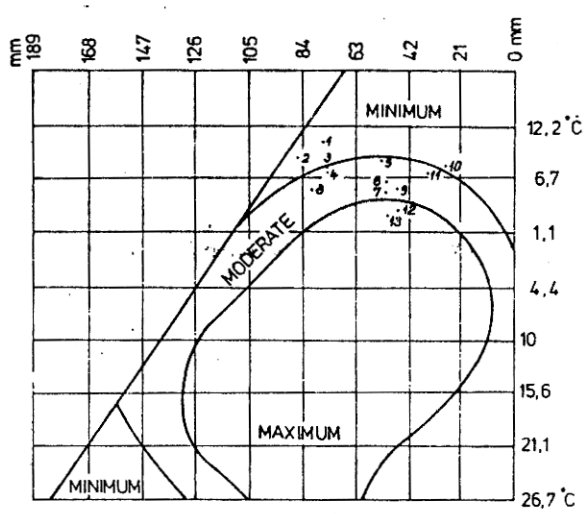
1 - Vf. Omu ; 2 - Țarcu ; 3 - Vlădeasa ; 4 - Iezer ; 5 - Lăcăuți ;
6 - Parâng ; 7 - Predeal ; 8 - Semenic ; 9 - Băișoara ;
10 - Toplița ; 11 - Miercurea - Ciuc ; 12 - Petroșani ; 13 - Bozovici .

(c)



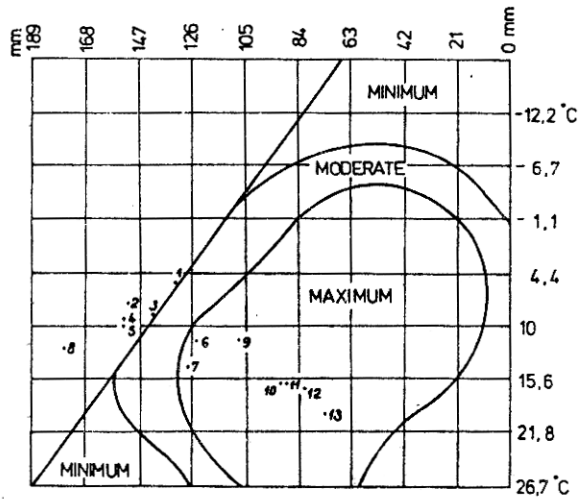
1 - Vf. Omu ; 2 - Țarcu ; 3 - Vlădeasa ; 4 - Iezer ; 5 - Lăcăuți ;
6 - Parâng ; 7 - Predeal ; 8 - Semenic ; 9 - Băișoara ;
10 - Toplița ; 11 - Miercurea - Ciuc ; 12 - Petroșani ; 13 - Bozovici .

(d)



(a)

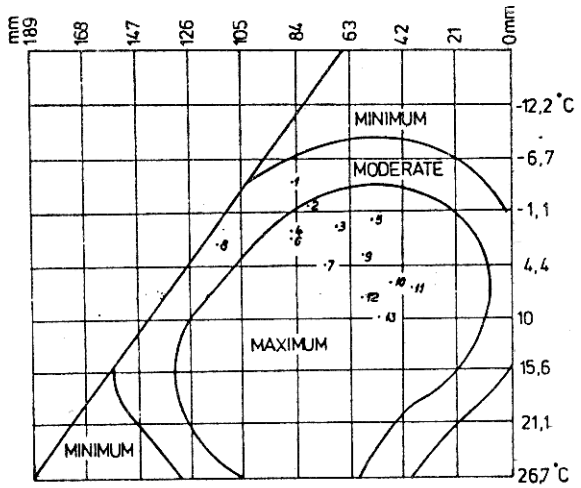
1 - Vf. Omu ; 2 - Tarcu ; 3 - Vlădeasa ; 4 - Iezer ; 5 - Lăcăuți ;
6 - Parâng ; 7 - Predeal ; 8 - Semenic ; 9 - Băișoara ;
10 - Toplița ; 11 - Miercurea - Ciuc ; 12 - Petroșani ; 13 - Bozovici.



(b)

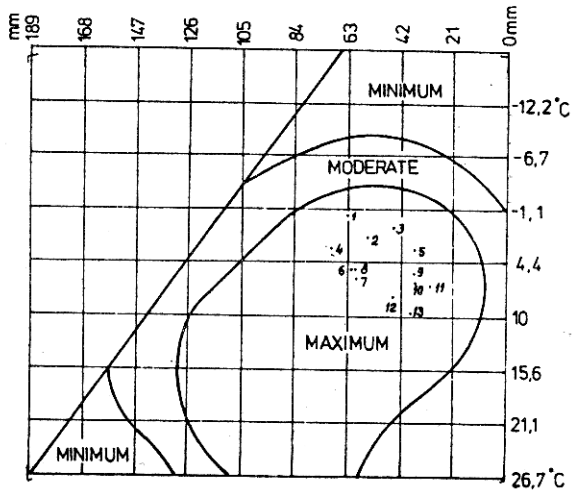
1 - Vf. Omu ; 2 - Tarcu ; 3 - Vlădeasa ; 4 - Iezer ; 5 - Lăcăuți ;
6 - Parâng ; 7 - Predeal ; 8 - Semenic ; 9 - Băișoara ;
10 - Toplița ; 11 - Miercurea - Ciuc ; 12 - Petroșani ; 13 - Bozovici.

Fig. 6 The intensity of fluvial action after a Peltier diagram, for the months January (a), July (b), April (c) and October (d)



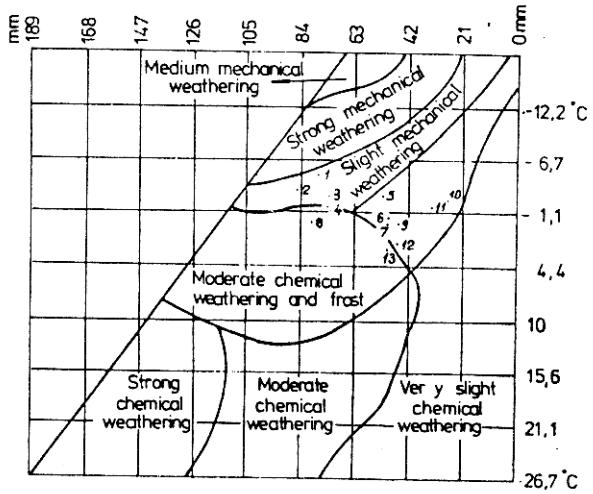
1 - Vf. Omu ; 2 - Țarcu ; 3 - Vlădeasa ; 4 - Iezer ; 5 - Lăcăuți ;
6 - Parâng ; 7 - Predeal ; 8 - Semenic ; 9 - Băișoara ;
10 - Toplița ; 11 - Miercurea - Ciuc ; 12 - Petroșani ; 13 - Bozovici .

(c)



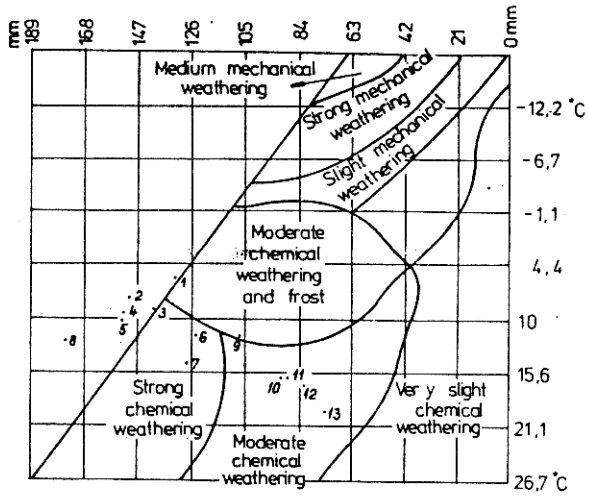
1 - Vf. Omu ; 2 - Țarcu ; 3 - Vlădeasa ; 4 - Iezer ; 5 - Lăcăuți ;
6 - Parâng ; 7 - Predeal ; 8 - Semenic ; 9 - Băișoara ;
10 - Toplița ; 11 - Miercurea - Ciuc ; 12 - Petroșani ; 13 - Bozovici .

(d)



1 - Vf. Omu ; 2 - Ţarcu ; 3 - Vlădeasa ; 4 - Iezer ; 5 - Lăcăuţi ;
6 - Parâng ; 7 - Predeal ; 8 - Semenic ; 9 - Băişoara ;
10 - Toplita ; 11 - Miercurea - Ciuc ; 12 - Petroşani ; 13 - Bozovici .

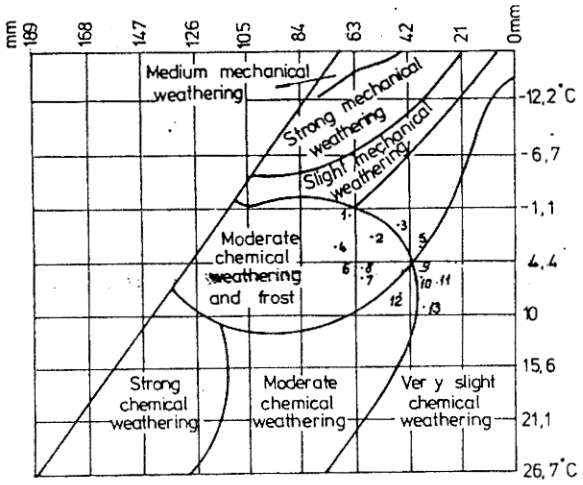
(a)



1 - Vf. Omu ; 2 - Ţarcu ; 3 - Vlădeasa ; 4 - Iezer ; 5 - Lăcăuţi ;
6 - Parâng ; 7 - Predeal ; 8 - Semenic ; 9 - Băişoara ;
10 - Toplita ; 11 - Miercurea - Ciuc ; 12 - Petroşani ; 13 - Bozovici .

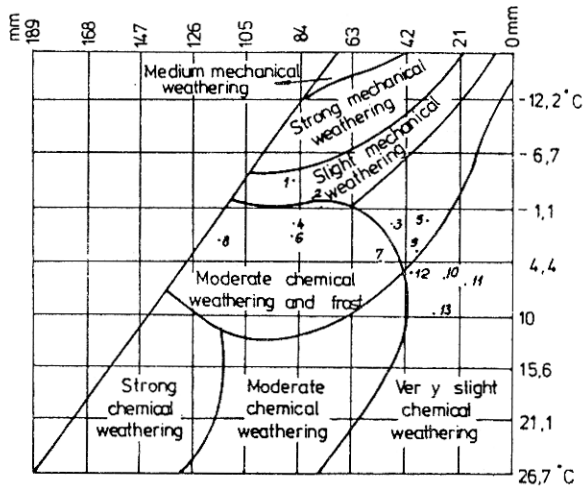
(b)

Fig. 7 The type and the intensity of the predominant processes, after a Peltier diagram, for the months January (a), July (b), April (c) and October (d)



1 - Vf. Omu ; 2 - Ţarcu ; 3 - Vlădeasa ; 4 - Iezer ; 5 - Lăcăuţi ;
6 - Parâng ; 7 - Predeal ; 8 - Semenic ; 9 - Băişoara ;
10 - Toplita ; 11 - Miercurea - Ciuc ; 12 - Petroşani ; 13 - Bozovici.

(c)



1 - Vf. Omu ; 2 - Ţarcu ; 3 - Vlădeasa ; 4 - Iezer ; 5 - Lăcăuţi ;
6 - Parâng ; 7 - Predeal ; 8 - Semenic ; 9 - Băişoara ;
10 - Toplita ; 11 - Miercurea - Ciuc ; 12 - Petroşani ; 13 - Bozovici.

(d)

(ii) the fluvial action is maximum in the forest belt and moderate in the other belts (*Fig. 6b*);

(iii) the predominant processes is the chemical alteration which is strong (Parang, Predeal) and moderate for the rest (*Fig. 7b*).

In April, the increase of the temperatures and the precipitations in liquid state create conditions specific to:

(i) the morphoclimatic conditions define the periglacial system at Omu, the boreal system at Tarcu and Iezer, the semiarid system in depression (Bozovici, Miercurea Ciuc) and the temperate system in the rest (*Fig. 5c*);

(ii) the fluvial action is moderate at Omu, situated upper than the level of maximum precipitations and snow layer is still present, and Semenic, with losses through evaporation, and maximum at the rest of stations, because of the liquid precipitations added to the melt of the snow (*Fig. 6c*);

(iii) the morphogenetic processes are: the chemical alteration which is moderate in the alpine, subalpine and forest belts, minimum in depression and corridor and the minimum mechanical weathering in the seminival belt (*Fig. 7c*).

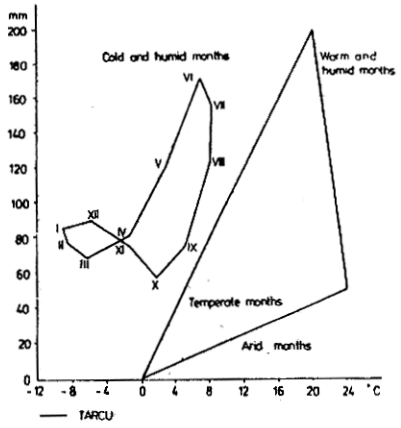
In October temperatures and precipitations define the temperate system (*Fig. 5d*), the fluival action is maximum (*Fig. 6d*), and the chemical alteration is the predominant process and it is minimum in the depressiom (Bozovici, Miercurea Ciuc) and moderate in the upper belts (*Fig. 7d*).

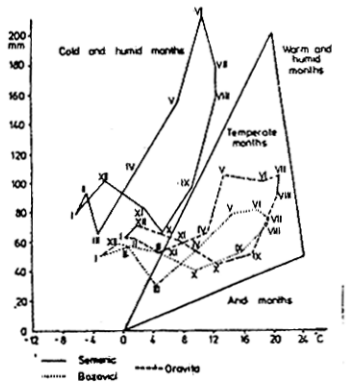
Based on the mathematical correlation of temperature and precipitations, the Pégui diagrams classify the months in cold and humid, temperate and arid, warm and humid (*Pégui*, 1961).

Thus, at Omu and Tarcu stations, all the months are „cold and humid" and this justifies their affiliation to the periglacial morphoclimatic system. At other stations (e.g. Predeal, Parang, Petrosani, Baisoara) more months are „temperate" and the higher values of temperature make the chemical alterations more intensive (*Fig. 8*).

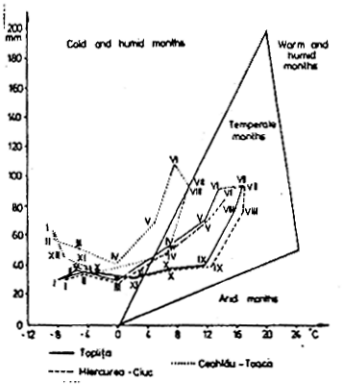
Fig. 8 Pégui climatograms for meteorological stations from Romanian Carpathians

(a)

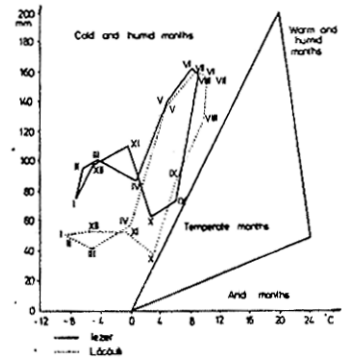



Cold and humid months
Warm and humid months
Temperate months
Arid months
Semenic
Bozovici
Oravita

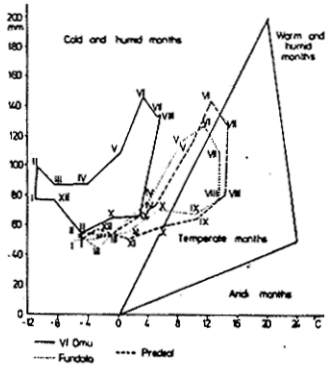
(b)


Cold and humid months
Warm and humid months
Temperate months
Arid months
Topița
Mărcurea - Cluc
Ceahlău - Toaca

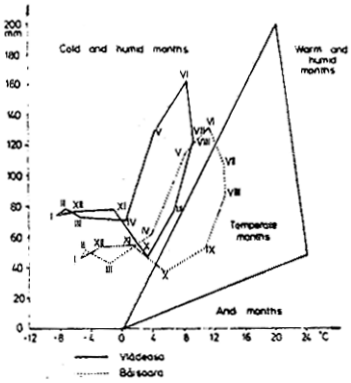
(c)


Cold and humid months
Warm and humid months
Temperate months
Arid months
Iezer
Lăcăuți

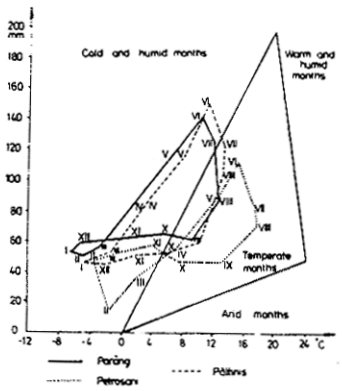
(d)


Cold and humid months
Warm and humid months
Temperate months
Arid months
VI Omu
Fundata
Predeal

(e)


Cold and humid months
Warm and humid months
Temperate months
Arid months
Vlădeasa
Băișoara

(f)


Cold and humid months
Warm and humid months
Temperate months
Arid months
Parâng
Petroșani
Păltiniș

(g)

The graphic representation of the minimum and maximum temperatures outlines the intervals with freezing-thawing cycles and the interval with negative temperatures (*Fig. 9*). We can note that higher is the altitude of the stations, the longer and latter is the interval with freezing-thawing cycles. The intervals with negative temperatures, which indicate very favourable conditions for the maintenance of permafrost (*Urdea*, 1993), have durations directly proprortional to altitude.

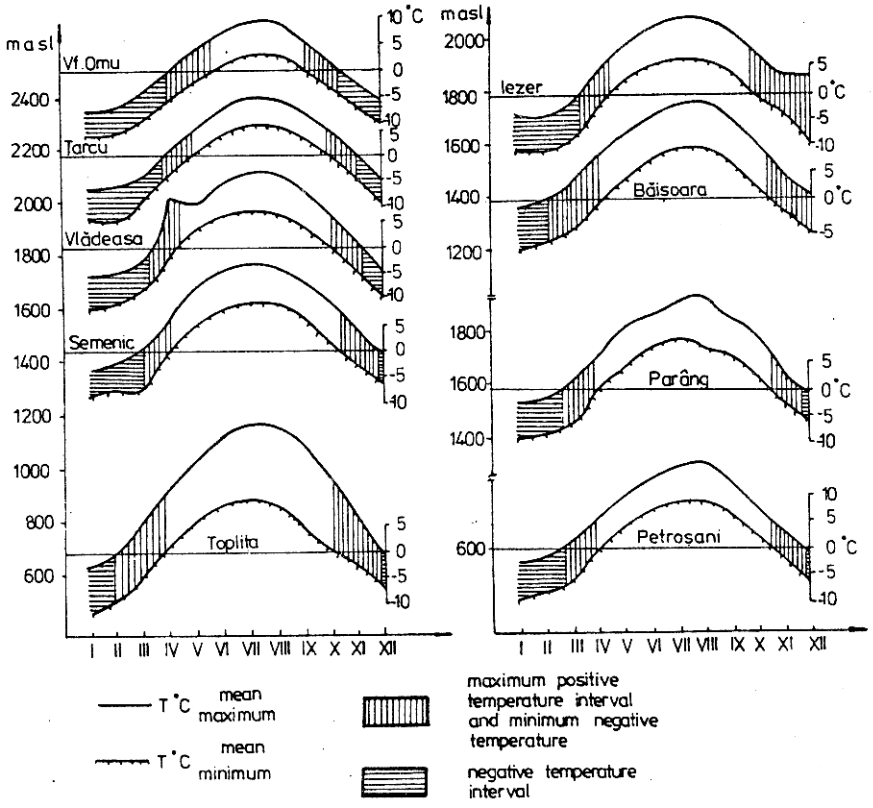


Fig. 9 Mean maximum and minimum air temperatures and characteristic intervals for some meteorological stations from Romanian Carpathians

The box-plot of monthly temperatures at selected meteorological stations from the Romanian Carpathians gives the range in monthly air temperatures during the year, conditions characteristic for most stations from this area (*Fig. 10*).

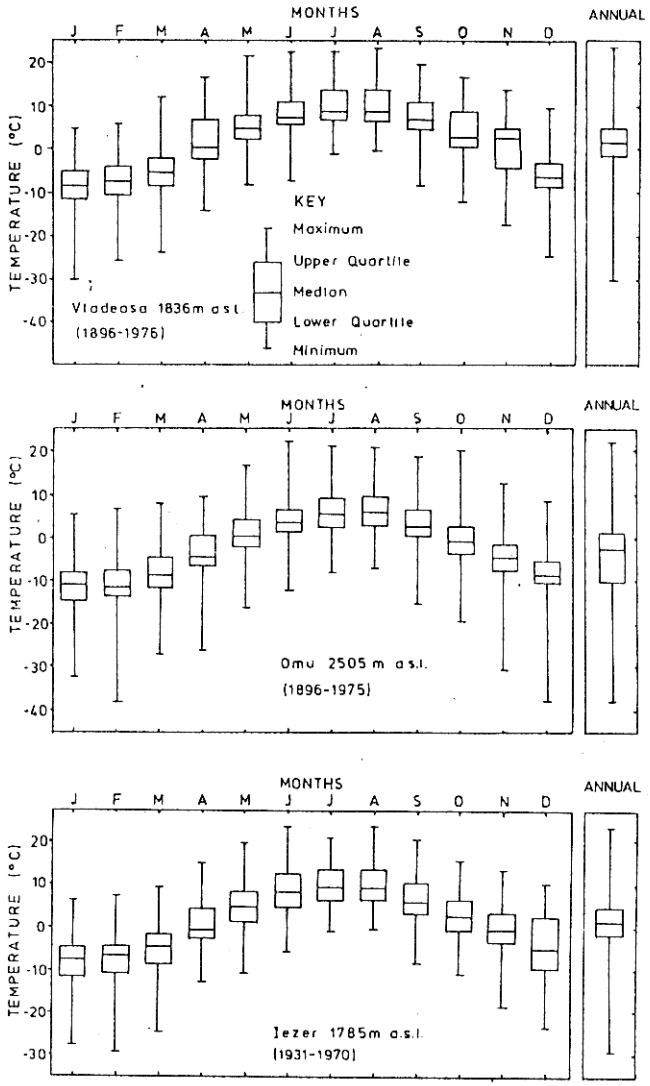


Fig. 10 Box-plots of the distribution in monthly temperatures, at some selected meteorological stations from the Romanian Carpathians

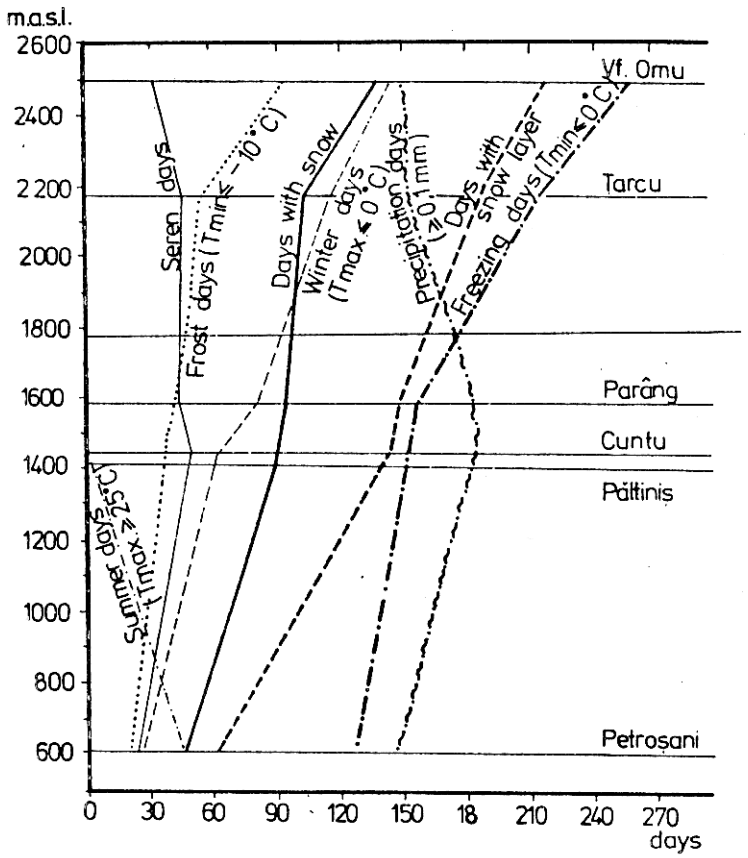


Fig. 11 „Daily characteristics" for some selected stations from Romanian Carpathians

Very useful in the geomorphological research is the study of the „characteristic days" (*Urdea*, 1992) whose names give informations about temperatures – „summer days", „winter days" – precipitations – „days with snow", „precipitation days" – or processes – „freezing days", days with snow layer". Generally, the number of the characteristic days increases with altitude, the exceptions are: the summer days, which disappear upper than 1500 m, and the precipitations days, which decrease upper than the maximum level of precipitations situated at 1500 m (*Fig. 11*).

The morphoclimatical conditions influence, as we have already said, the intensity of processes: but the resultant forms depend, to a great extent, an different local faxtors (rock, degree of wethering, biological component, etc.).

However, we considered that the graphic representations of climatological data lead to relevant conclusions and can be an useful instrument both at the beginning and at the end of a geomorphological research.

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