THE VARIABILITY OF THE TEMPERATURE AND THE WIND DIRECTION AT SZEGED IN VARIOUS LARGE SCALE PATTERN

by

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A hőmérséklet és a szélirány változékonysága Szegeden különböző makroszinoptikus helyzetekben. A szerzők Szeged 20 évi adatsorát (1961-1980) felhasználva megvizsgálták a napi hőmérsékleti anomáliák és a napi maximális széllökések irányának eloszlását a *Péczely-féle*, valamint az *Ambrózy-Bartholy-Gulyás-féle (ABG)* makroszinoptikus típusok szerint rendezett részhalmazokban. Meghatározták a napi hőmérsékleti anomáliák *szórását* és *Shannon-entrópiáját* a *teljes populációra, továbbá az említett típusok részhalmazaira.* A napi maximális széllökések irányainak Shannon-entrópiáját hasonló módon kiszámították. Valamennyi feldolgozást a négy évszakra külön végezték el; a kapott statisztikai eredményeket az *I-VIII. táblázatok* foglalják össze. Az ABG-típusok szerint rendezett relatív gyakoriságokat az 1-8. ábrák mutatják be. Az eredmények szerint a típusok többségében mindkét osztályozás csökkenti a napi adatok szórását ill. entrópiáját. Az entrópia csökkenése a Péczely-típusok esetén valamivel kifejezettebb.

The authors investigated the frequency distributions of the daily temerature anomalies and of the direction of the daily maximum gust in the subsets arranged according to the large-scale circulation types classified by *Péczely*, as well as *Ambrózy-Bartholy and Gulyás (ABG)* using a 20-year data series (1961-1980) of Szeged. The standard deviations and *Shannon entropies* of the daily temperature anomalies were calculated for the total population and for the subsets of the above mentioned large scale types. The Shannon entropies of the directions of the daily maximum gusts were determined in the same way. All calculations for the four seasons were made separately, and the results obtained are aummarized in Tables I-VIII. The relative frequencies of the temperature and the wind directions in different ABG types are shown in Figs. 1-8. It was found that in the majority of the types both classifications deminish the standarddeviations, as well as Shannon entropies of the daily data. The decrease of entropy is a little more expressed in the case of Péczely types.

Introduction

Attempts at classing circulation processes among types of a finite number have been made in a number of countries. These classings have been realised for diverse space scales, from the synoptic scale to the hemispheric scale. *H.H.LAMB* has taken for this basis the current and pressure conditions predominating above the British Isles *(GIRS* and *KONDRATOVICH*, 1978,p. 294*)*. *P. HESS* and *H. BREZOWSKY*'s (1953) circulation classification is orientated to Central Europe. *B.L. DZERDZEJEWSKY* has classified hemispheric circulation on the basis of the Arctic cold outbreaks *(GIRS* and *KONDRATOVICH*, 1878, pp. 66-67*)*. Especially known has become *G.Y. VANGENHEIM*'s classification, which has classed the circulation of the whole hemisphere among nine main types *(GIRS*, 1974; *GIRS* and *KONDRATOVICH*, 1978, 99. 67-81*)*.

Though these classifications defined the individual patterns as types of finite number, the classifications have been realised on the basis of subjective decisions. For that very reason, a number of researches have striven to characterize circulation, producing an infinity of transitions, by numerical parameters. The various circulation indexes proved to be means suitable for this. *J. NAMIAS* (1947) defined indexes for characterizing the zonal circulation of the Northern Hemisphere, namely for 3 zones of latitude separately, on the basis of the pressure data measured on sea level and at an altitude of 3 km. It is also for measuring the intensity of zonal circulation that *E.N. BLINOVA* has worked out an index *(GIRS* and *KONDRATOVICH*, 1978, pp. 87-88*)*, while it is *A.L. KATS* who has combined the indexes of meridional and zonal circulations *(KOPPANY*, 1986. p.113*)*.

A classification orientated to Hungary was done by *G. PECZELY* (1956, 1957a, 1957b), and 13 types were differentiated by him. He extended the catalogue of the types established for the individual days to the years 1881-1983 (*PECZELY*, 1983). As in the cases of similar classifications usually, the claim of the objective, that is numerical definition has come up in relation to Péczely types, too. By the help of cluster analysis *P. AMBROZY, J. BARTHOLY* and *O. GULYAS* (1984) have worked out a classification depending on the season. For the individual seasons they have defined types of different numbers: for winter 17, for spring 19, for summer 8, and for autumn 15 types. While sea level pressure distribution that *PECZELY*'s classification takes for its basis, and it is a smaller area (about 35-65° N, 10°W-40°E) that he takes into consideration, the ABG classification uses the field of the 500 mb level in a larger area (30-65°N, 40°W-50°E), which spreads over a part of the Atlantic Ocean, too.

One of the practical purposes of classifying circulation types is creating the basis of the conditional climatological investigations, for it is to be expected that the standard deviations of the subsets of weather elements according to types decrease as compared to the standard deviation of the total climatic population. The decrease of standard deviation generally goes with the decrease of uncertainty, which we can measure by the calculation of Shannon entropy. The aim of our investigation is to reveal, by the use of the measured data of Szeged in Southern Hungary, the decrease of the standard deviations and entropies of the data, relating to the subsets of two different classifications, Péczely and ABG types.

Data Base and Method

For the processing with 20-year length period (1961-1980) of the daily measurements of the Szeged meteorological station were used, namely the daily mean values of the temperature, and the directions of the maximum gusts. The latter departs, on the one hand, from an earlier processing of *PECZELY*'s (1957b), in which he had taken into consideration the wind directions measured at 0600 GMT; on the other hand, from *K. TAR*'s (1985) investigation, in which the author had used the hourly anemometries. As *J. SZALMA* (1977) has revealed, 90 % of the hourly wind speeds occurs in the range 0-5 ms^{-1}, and only 10 % of them exceeds the of 5 ms^{-1} force. Weak air motions, in turn, are more influenced by local factors, and in them the baric situation of synoptic scale is less reflected. Stronger wind data, on the contrary, conform to the large-scale pressure conditions somewhat better. Therefore, it seems more expedient to sort the directions of the maximum wind gusts according to the macrosynoptic types.

The catalogue of the ABG classification for the years 1949-1980 (*AMBROZY, BARTHOLY* and *GULYAS*, 1983), and the Péczely catalogue for the years 1881-1983 are available. In Szeged, instrumental observations, with repeated transfers of the weather station, have been going on since 1871 (*SINDELY*, 1985). The station has been functioning on its present spot since 1961; therefore, for our investigation have been chosen the 20 years between 1961-1980.

While processing the daily mean values of temperature, first we determined the daily normal values concerning the period of the years 1961-1980, then the deviations from these, that is the daily anomalies. We determined the standard deviations of the daily temperature anomalies, and the relative frequencies of the latter ones calculated for classes of a breadth of 1°C, and with the help of the relative frequencies we determined the Shannon entropy, on the one hand, for the whole population, and, on the other hand, for the subsets arranged according to the Péczely and ABG-types, as well as we also determined the averages of the temperature anomalies for the individual subsets. The above calculations were done for the four seasons separately. The decreases in the standard deviation and the Shannon entropies signify the becoming arranged of the data within the macrosynoptic situations.

While processing the directions of the daily maximum wind gusts, we determined their relative frequencies; furthermore, we calculated the Shannon entropy, for the whole population (E_T), and for the subsets of the individual types (E_i).

The Shannon entropy, serves for the measuring of uncertainty, and for its determination we used the following, generally accepted formula:

$$E = \sum_i p_i \log_2 1/p_i \qquad \text{[bit]}$$

Here p_i is the relative frequency of the i-th event.

In the case of the temperature we used one-degree spaces between the values, and we classed the directions of the maximum gusts among 16 categories.

We compared the order of the data in the subsets of the Peczely and the ABG types season by season by means of a computer.

Results

In the course of the investigation we were looking for answers to the following questions:

1. Do the standard deviation and the entropy of the daily temperature anomalies decrease in the partial populations of the individual macrosynoptic situations in comparison with the total population; and if so, with which types is this decrease the greatest? 2. Does the entropy of the directions of the maximum wind gusts decrease in the partial populations in comparison with the entropy of the totel population? 3. With which classification does the entropies'average weighted according to frequencies of the types, decrease more strongly, that is to say which of the two typifyings gives a greater information gain?

In their two previous papers the authors had examined the first two questions in detail (*KOPPANY* and *KISS*, 1985, 1987). In these two papers of theirs, they had limited their investigations to the Péczely types only. They had found that the entropies of the temperature and wind direction data classified according to the Péczely types decreased in comparison with that of the total population. In the case of the temperature, the decrease of entropy is the greatest in the situations of northern and western direction, and in the central cyclonal situation; the arrangement of the temperature data according to the Péczely types is the strongest in winter and summer, and the weakest in spring. In the case of the wind directions, the entropy mainly decreases in types *mCc*, *AB*, *CMc*, *Ae*, *Aw*, *AF* and *C*, in the central anticyclonal situation (*A*), however, it increases in comparison with the total population. Of the seasons, it is in winter and autumn that the entropy decreases the most strongly.

In the present investigation, the authors partly sum up a few of their more important results got for the Péczely types, partly complete them with their recent researches carried out for the ABG types. For it is doubtless that the comparison of the synoptic climatological valuations of the two kinds of typifying can command interest.

Tables I to IV sum up for the four seasons the statistical results got for the order of the daily temperature anomalies. In spring, of the

Péczely types, it is only in the situation *An* that the entropy does not decrease, and it is in the situations *An* and *A* that the standard deviation increases in a small degree.

In spring the entropy decreases in a larger or smaller degree in each of the 19 ABG types; the standard deviation, however, increases somewhat with six types (*Table I*).

In summer the entropy decreases in each of the Péczely types; the standard deviation, with the exception of the situation *As*, also decreases in all situations. In summer the number of the ABG types is only 8; with 4 types of these the standard deviation of the temperature does not decrease, the decrease of the entropy is slight (*Table II*).

In autumn it is in three of the Péczely types that the standard deviation does not decrease; the entropy, however, with the exception of *CMw*, decreases with all types. With 5 of the 15 ABG types the standard deviation increases a little; with 3 of these, the entropy also increases (*Table III*).

In winter it is in only one Péczely and four ABG types that the standard deviation of the temperature does not decrease; the entropy, however, decreases in all types (*Table IV*).

It deserves attention that *in spring and winter*, when the number of the ABG types is the greatest (19 and 17 respectively), the **weighted average** of the entropy decrease is the greatest: **0.209** and **0.297** bits respectively; while *in summer*, when the number of the ABG types is only 8, the weighted average of the entropy decrease is the smallest: **0.12** bit. The number of the Péczely types is 13 in each season, the entropy decrease changes less from one season to another: it oscillates between **0.261** and **0.338** bits.

The relative frequencies of the daily temperature anomalies classified according to the ABG types are illustrated by *Figs. 1–4*.

The entropies of the *directions of the maximum wind gusts* calculated for the macrosynoptic types and the whole population, are summed up for the four seasons by *Tables V to VIII*.

In spring, of the Péczely types, only in the situations *A* does the entropy not decrease, and of the 19 ABG types, in only one is there no entropy decrease (*Table V*).

In summer, of the Péczely types, again only in the situation *A* does the entropy not decrease, and ones of the 8 ABG types, in two (*Table VI*).

In autumn there is a larger or smaller entropy decrease in each of the 15 ABG types; of the Péczely types, there is none in the situation *A* (*Table VII*). As the authors had pointed out in their previous papers, the air current is weaker than the average in Péczely's situation *A*; therefore, it is understandable that the wind directions do not become arranged in the central anticyclonal situation.

In winter the entropy decreases in all Péczely and ABG types (*Table VIII*).

The weighted average of the entropy decrease is, in the case of the ABG types, the greatest *in winter and autumn*: **0.254** and **0.228** bits respectively, and the smallest *in summer* (**0.075** bits), when the number of the types is also the smallest. In the case of the Péczely types, the entropies of the wind directions decrease the most considerably *in winter and autumn*: by **0.426** and **0.416** bits respectively, while *in spring and summer* by only **0.291** and **0.311** bits respectively. The seasonal differences in the decreases of the entropies of the wind directions, similarly to those of the temperature, are considerably greater with the ABG types than with the Péczely types.

The relative frequencies of the directions of the maximum wind gusts in the whole populations and in the populations arranged according to the ABG types are illustrated, relating to the four seasons, in *Figs 5–8*. Of the 19 spring types, the types *1*, *6*, *8*, *13* and *16* which, with a remarkable frequency of the wind directions *SE* and *S*, deserve attention; then, again, types *3*, *5*, *11*, *14* and *17*, with the accumulation of the wind directions *NW* and *N* (*Fig* 5).

In summer it is the frequency of the wind directions *NW* and *N* that are characteristic of types *1*, *2*, *3*, *5*, *6* and *8* of the 8 ABG types: the high frequency of the wind directions contrary to these, however, does not occur in any of the types (*Fig. 6*).

In autumn, of the 15 ABG types, nos. *2*, *5*, *13* and *14* can be characterized by the prevalence of the wind directions *NW* and *N*, while types *3*, *4*, *6*, *12* and *15* by that of the wind directions *SE* and *SSE* (*Fig.* 7).

In winter, of the 17 types, nos. *1*, *5*, *6*, *8*, *9* and *17* excel by the high frequency of the wind directions *SSE* and *SE*, types *2*, *7*, *11*, *12* and *13* by that of the wind directions *NW* and *N* (*Fig.* 8).

Although, with the exception of the summer, a considerable part of the ABG types determined for the individual seasons can be divided into two groups; characteristic of the one of which is the prevalence of the wind directions *SE* and *S*, of the other one that of the wind directions *NW* and *N*, in these types, the contours of the 500 mb level, are only in partial accordance with the most frequent wind directions received from the surface anemometries.

Conclusions

The investigation arranged the anomalies of the daily mean temperatures, and the directions of the maximum wind gusts measured at Szeged, for macrosynoptic types determined on the basis of two classifications different from each other. Both classifications have advantages and disadvantages.

The advantages of Péczely's classification are as follows: 1. that it is based on the analysis of the surface pressure field, which is in a closer connection with the weather, and 2. that it is orientated to Hungary. Its disadvantages are the following: 1. the determination of the types is carried out visually, 2. so it is not free from subjective mistakes.

The advantage of the ABG classification is that for determining the types it uses an objective method worked out well mathematically, the cluster analysis.Its disadvantages are as follows: 1. that it is based on the 500 mb surface referring to a larger area, and 2. that thus its types can less be brought into connection with the weather in Hungary. Despite the disadvantages, the majority of the types obtained by the two classifications decrease the entropies of the temperature and wind data measured at Szeged.

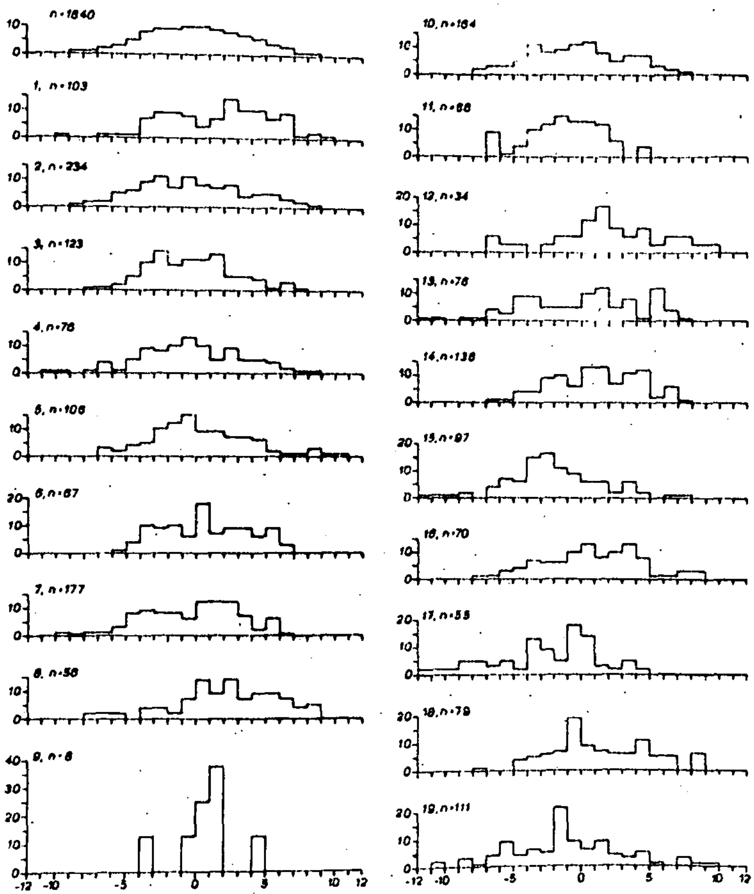

Fig 1 Distribution of relative frequencies of daily temperature anomalies in total population and in ABG-types at Szeged, in spring; n = number of cases

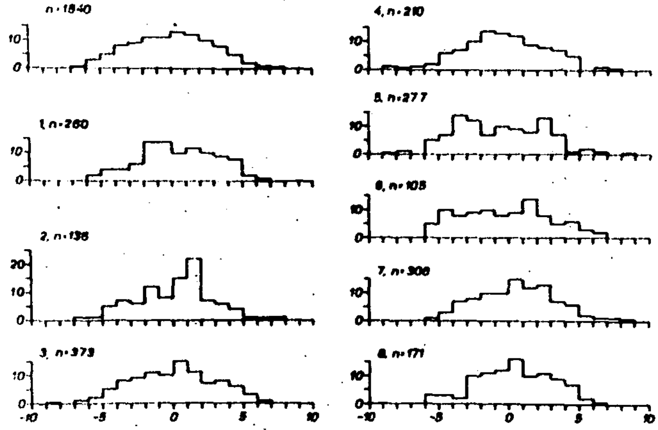

Fig. 2 Distribution of relative frequencies of daily temperature anomalies in total population and in ABG-types at Szeged, in summer; n = number of cases

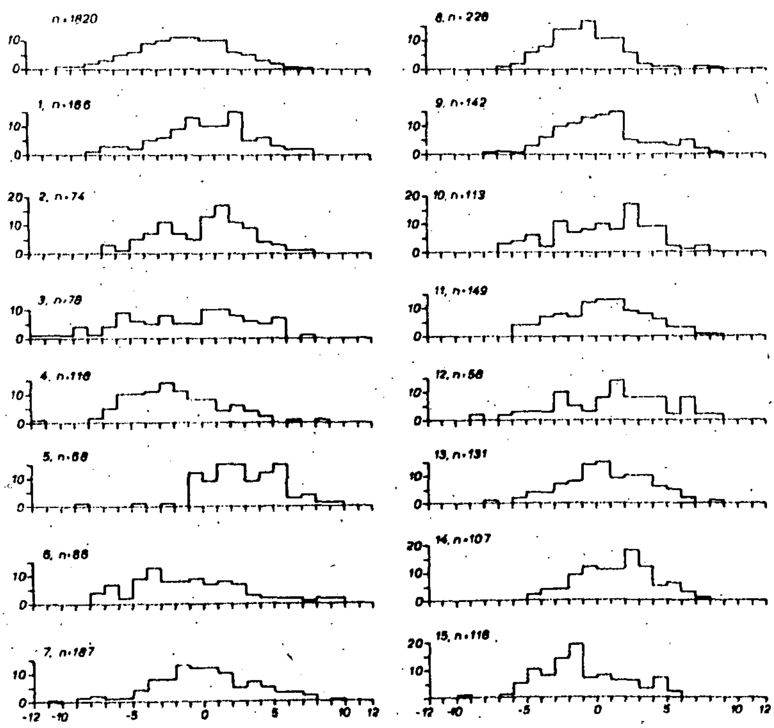

Fig. 3 The same as in Fig. 2, but in autumn

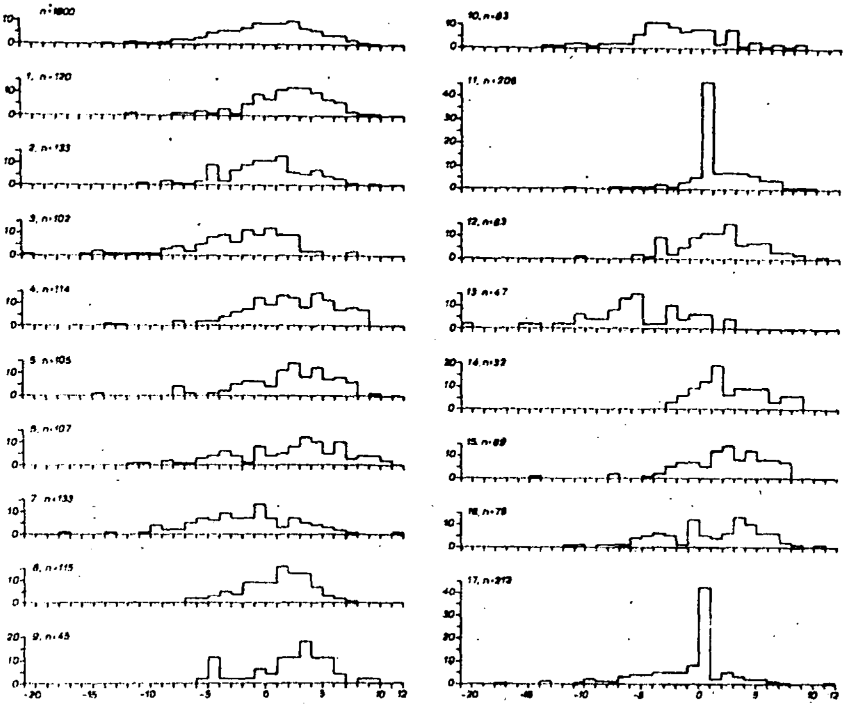

Fig. 4 Distribution of relative frequencies of daily temperatur anomalies in total population and in ABG-types in winter, at Szeged; n = number of cases

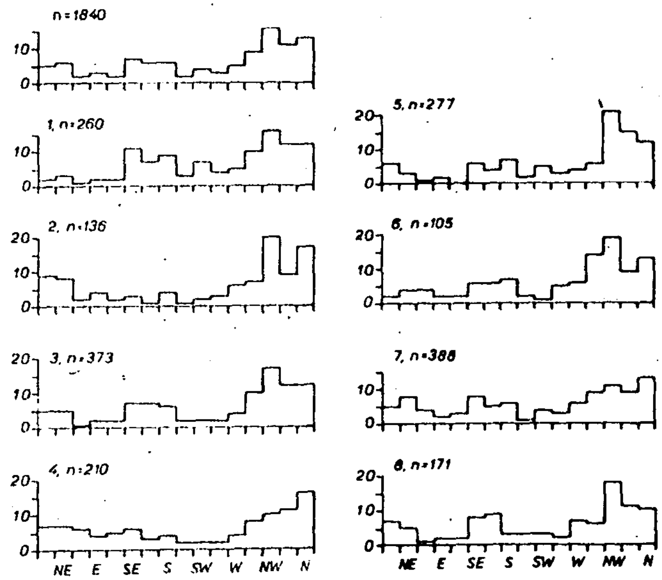

Fig. 6 Relative frequencies of directions of daily maximum gust in total population and in ABG-types at Szeged, in summer; n = number of cases

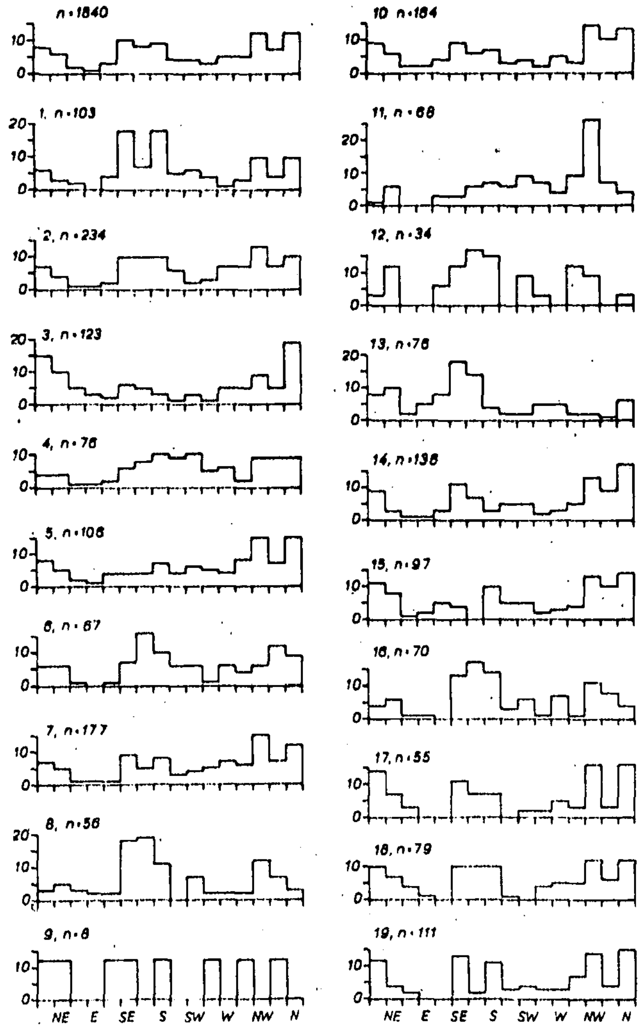

Fig. 5 Relative frequencies of directions of daily maximum gust in total population and in ABG-types at Szeged, in spring; n = number of cases

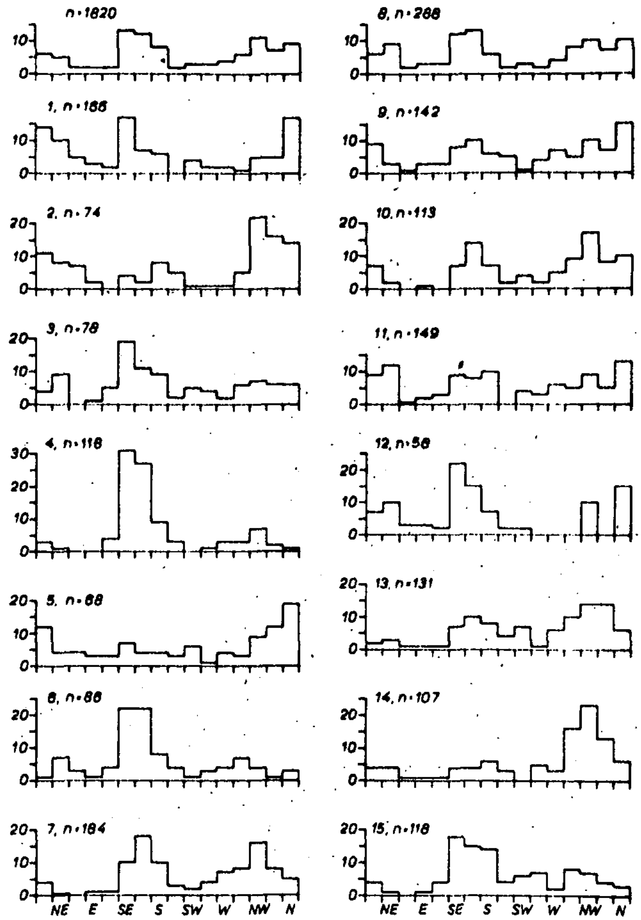

Fig. 7 Relative frequencies of directions of daily maximum gust in total population and in ABG-types at Szeged, in autumn; n = number of cases

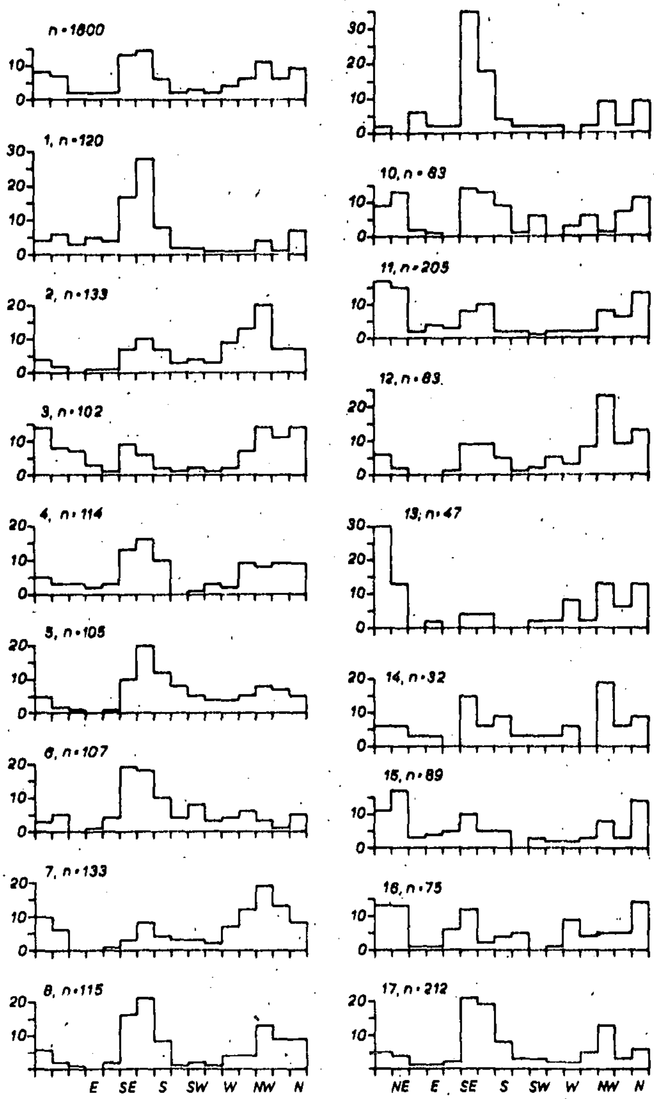

Fig. 8 Relative frequencies of directions of daily maximum gust in total population and in ABG-types at Szeged, in winter; n = number of cases

Table 1

Standard deviations and entropies of the daily temperature anomalies of the spring season at Szeged (1961-1980) in the total population as well as in the subsets arranged according to the Peczely and the ABG macrosynoptic types.
N = number of cases, S = standard deviation, °C, S_T = S of the total population, S_i = S of the subsets, E = entropy, bit, E_T =E of the total population, E_i = E of the subsets

	N	S	S_i/S_T	E	$E_T - E_i$	Average, °C
Total population	1840	3.71	-----	3.921	-----	0.00
			Peczely types			
mCc	118	3.16	0.852	3.570	0.351	-1.71
AB	119	2.97	0.801	3.440	0.481	-2.05
CMc	95	3.18	0.857	3.645	0.276	-2.62
mCw	244	3.29	0.887	3.690	0.231	+2.02
Ae	208	3.12	0.841	3.583	0.338	+2.57
CMw	188	3.53	0.951	3.732	0.189	+0.63
zC	98	3.44	0.927	3.716	0.205	+0.92
Aw	256	3.12	0.841	3.585	0.336	-0.85
As	52	2.90	0.782	3.346	0.575	+2.06
An	237	3.86	1.040	3.926	-0.005	-0.73
AF	86	3.20	0.863	3.605	0.316	-2.00
A	101	3.76	1.013	3.814	0.107	-0.34
C	38	2.88	0.776	3.379	0.542	-1.45
Average of the values ($E_T - E_i$)					0.303	
Average weighted according to frequency Peczely types					0.261	
			ABG types			
1	103	3.58	0.965	3.757	0.164	+1.58
2	234	3.78	1.019	3.895	0.026	-0.36
3	123	3.09	0.833	3.602	0.319	-0.45
4	76	3.89	1.049	3.887	0.034	-0.32
5	106	3.56	0.960	3.733	0.188	+0.47
6	67	3.11	0.838	3.580	0.341	+0.42
7	177	3.48	0.938	3.707	0.214	-0.37
8	56	3.69	0.995	3.708	0.213	+2.29
9	8	2.35	0.633	2.156	1.765	+0.81
10	164	3.46	0.933	3.761	0.160	-0.31
11	68	2.78	0.749	3.279	0.642	+0.78
12	34	4.01	1.081	3.763	0.158	+1.85
13	76	4.39	1.183	3.888	0.033	-0.17
14	136	3.17	0.854	3.586	0.335	+0.87
15	97	3.47	0.935	3.663	0.258	-2.06
16	70	3.56	0.960	3.762	0.159	+0.81
17	55	3.79	1.022	3.680	0.253	-2.51
18	79	3.62	0.976	3.607	0.314	+1.34
19	111	4.01	1.081	3.782	0.139	-1.29
Average of the values ($E_T - E_i$)					0.301	
Average weighted according to frequency ABG types					0.209	

Table II

Standard deviations and entropies of the daily temperature anomalies of the summer season at Szeged (1961-1980) in the total population as well as in the subsets arranged according to the Peczely and the ABG macrosynoptic types.
N = number of cases, S = standard deviation, °C, S_T = S of the total population, S_i = S of the subsets, E = entropy, bit, E_T = E of the total population, E_i = E of the subsets

	N	S	S_i/S_T	E	$E_T - E_i$	Average, °C
Total population	1840	2.96	-----	3.647	-----	0.00
Peczely types						
mCc	154	2.47	0.834	3.353	0.294	-2.15
AB	133	2.83	0.956	3.450	0.197	-1.62
CMc	53	2.70	0.912	3.200	0.447	-2.65
mCw	156	2.26	0.764	3.181	0.466	+1.10
Ae	147	2.05	0.693	3.073	0.574	+2.82
CMw	74	2.82	0.953	3.362	0.285	-0.54
zC	89	2.53	0.855	3.237	0.410	-0.57
Aw	419	2.75	0.929	3.447	0.200	-0.92
As	29	3.02	1.020	3.411	0.236	+2.26
An	261	2.46	0.831	3.342	0.305	+1.40
AF	91	2.49	0.841	3.213	0.434	-0.74
A	207	2.41	0.814	3.251	0.396	+1.14
C	27	2.91	0.983	3.207	0.440	-1.03
Average of the values ($E_T - E_i$)					0.360	
Average weighted according to frequency Peczely types					0.333	
ABG types						
1	260	2.76	0.932	3.458	0.189	+0.52
2	136	2.69	0.909	3.421	0.226	+0.06
3	373	3.05	1.030	3.638	0.009	-0.09
4	210	2.92	0.986	3.532	0.115	-0.46
5	277	3.06	1.034	3.545	0.102	-0.76
6	105	3.11	1.051	3.550	0.097	-0.36
7	308	2.96	1.000	3.547	0.100	+0.57
8	171	2.66	0.899	3.394	0.253	+0.33
Average of the values ($E_T - E_i$)					0.301	
Average weighted according to frequency ABG types					0.209	

Table III

Standard deviations and entropies of the daily temperature anomalies of the autumn season at Szeged (1961-1980) in the total population as well as in the subsets arranged according to the Peczely and the ABG macrosynoptic types.
N = number of cases, S = standard deviation, °C, S_T = S of the total population, S_i = S of the subsets, E = entropy, bit, E_T = E of the total population, E_i = E of the subsets

	N	S	S_i/S_T	E	$E_T - E_i$	Average, °C
Total population	1820	3.71	-----	3.806	-----	0.00
Peczely types						
mCc	52	2.64	0.779	3.157	0.649	-1.34
AB	97	2.41	0.711	3.272	0.885	-2.48
CMc	47	3.03	0.892	3.252	0.633	-1.33
mCw	175	3.49	1.029	3.753	0.053	+2.41
Ae	313	2.78	0.818	3.449	0.357	+1.30
CMw	159	3.57	1.053	3.806	0.000	+1.49
zC	67	2.79	0.822	3.319	0.487	+1.51
Aw	281	2.74	0.808	3.456	0.350	-0.94
As	102	2.50	0.737	3.268	0.538	+1.05
An	211	3.25	0.959	3.632	0.174	-0.73
AF	38	4.06	1.197	3.544	0.262	-2.36
A	263	3.27	0 965	3.691	0.115	-1.49
C	15	2.30	0.677	2.606	1.200	-0.65
Average of the values (E_T - E_i)					0.406	
Average weighted according to frequency Peczely types					0.282	
ABG types						
1	166	3.38	0.010	3.721	0.085	+0.37
2	74	3.55	1.047	3.548	0.258	+1.25
3	78	3.99	1.177	3.992	-0.186	-0.97
4	118	3.30	0.973	3.634	0.172	-1.97
5	68	2.90	0.855	3.360	0.446	+1.78
6	86	4.17	1.230	3.912	-0.106	-0.88
7	184	3.64	1.074	3.817	-0.011	-0.05
8	228	2.59	0.764	3.348	0.458	-0.82
9	142	3.12	0.920	3.610	0.196	+0.42
10	113	3.37	0.994	3.593	0.213	+0.32
11	149	3.14	0.926	3.621	0.185	+0.46
12	58	3.83	1.130	3.731	0.075	+0.91
13	131	3.03	0.894	3.569	0.237	+0.58
14	107	2.65	0.782	3.398	0.408	+1.34
15	118	3.04	0.897	3.488	0.318	-1.10
Average of the values (E_T - E_i)					0.183	
Average weighted according to frequency ABG types					0.197	

Table IV

Standard deviations and entropies of the daily temperature anomalies of the winter season at Szeged (1961-1980) in the total population as well as in the subsets arranged according to the Peczely and the ABG macrosynoptic types.
N = number of cases, S = standard deviation, °C, S_T = S of the total population, S_i = S of the subsets, E = entropy, bit, E_T = E of the total population, E_i = E of the subsets

	N	S	S_i/S_T	E	$E_T - E_i$	Average, °C
Total population	1840	4.39	-----	4.139	-----	0.00
Peczely types						
mCc	87	3.65	0.831	3.692	0.447	+0.60
AB	76	4.08	0.929	3.733	0.405	-2.56
CMc	66	3.79	0.863	3.689	0.450	-1.76
mCw	187	3.74	0.852	3.823	0.315	+2.87
Ae	301	3.85	0.877	3.909	0.230	+0.20
CMw	164	3.88	0.884	3.948	0.190	+1.71
zC	93	2.79	0.636	3.430	0.708	+3.57
Aw	233	3.42	0.779	3.685	0.453	+1.08
As	100	3.58	0.815	3.775	0.363	+2.00
An	265	3.72	0.847	3.857	0.281	-2.79
AF	47	3.50	0.797	3.450	0.689	-2.72
A	175	4.81	1.096	4.070	0.064	-3.23
C	16	2.58	0.587	2.483	0.440	+2.57
Average of the values ($E_T - E_i$)					0.481	
Average weighted according to frequency Peczely types					0.338	
ABG types						
1	120	3.63	0.827	3.793	0.346	+1.88
2	133	4.06	0.925	3.888	0.251	+1.02
3	102	4.88	1.112	4.033	0.106	-2.47
4	114	3.94	0.897	3.801	0.338	+0.87
5	105	4.03	0.918	3.712	0.427	+2.04
6	107	4.82	1.098	4.073	0.066	+1.97
7	133	4.70	1.071	4.103	0.036	-1.78
8	115	2.97	0.677	3.557	0.582	+2.97
9	45	3.53	0.804	3.473	0.666	+1.88
10	83	4.75	1.082	4.109	0.030	-2.11
11	205	3.97	0.904	3.934	0.205	-1.60
12	83	3.30	0.752	3.625	0.514	+0.40
13	47	4.13	0.941	3.672	0.467	-3.28
14	32	3.25	0.740	3.355	0.784	+0.57
15	89	3.38	0.770	3.653	0.486	-2.59
16	75	3.67	0.836	3.587	0.552	-0.96
17	212	4.30	0.957	3.960	0.179	+1.52
Average of the values ($E_T - E_i$)					0.355	
Average weighted according to frequency ABG types					0.297	

Table V

Entropies of the directions of daily maximum wind gusts of the spring season at Szeged (1961-1980) in the total population as well as in the subsets arranged according to the Peczely and the ABG macrosynoptic types.
N = number of cases, E = entropy, bit, E_T = E of the total population, E_i = E of the subsets

	N	E	$E_T - E_i$
Total population	1840	3.788	-----
Peczely types			
mCc	118	3.116	0.672
AB	119	3.437	0.351
CMc	95	3.380	0.408
mCw	244	3.675	0.113
Ae	208	3.331	0.457
CMw	188	3.647	0.141
zC	98	3.480	0.308
Aw	256	3.280	0.508
As	52	3.551	0.237
An	237	3.743	0.045
AF	86	3.466	0.322
A	101	3.814	-0.026
C	38	3.296	0.492
Average of the values ($E_T - E_i$)			0.310
Average weighted according to frequency Peczely types			0.291
ABG types			
1	103	3.525	0.263
2	234	3.733	0.055
3	123	3.623	0.165
4	76	3.790	-0.002
5	106	3.728	0.060
6	67	3.654	0.134
7	177	3.760	0.028
8	56	3.430	0.358
9	8	3.000	0.788
10	164	3.727	0.061
11	68	3.463	0.325
12	34	3.245	0.543
13	76	3.659	0.129
14	136	3.655	0.133
15	97	3.615	0.173
16	70	3.510	0.278
17	55	3.394	0.394
18	79	3.582	0.206
19	111	3.489	0.299
Average of the values ($E_T - E_i$)			0.231
Average weighted according to frequency ABG types			0.159

Table VI

Entropies of the directions of daily maximum wind gusts of the summer season at Szeged (1961-1980) in the total population as well as in the subsets arranged according to the Peczely and the ABG macrosynoptic types.
N = number of cases, E = entropy, bit, E_T = E of the total population, E_i = E of the subsets

	N	E	$E_T - E_i$
Total population	1840	3.735	-----
	Peczely types		
mCc	154	3.172	0.563
AB	133	3.229	0.506
CMc	53	3.033	0.702
mCw	156	3.525	0.210
Ae	147	3.470	0.265
CMw	74	3.678	0.057
zC	89	3.517	0.218
Aw	419	3.212	0.523
As	29	3.388	0.347
An	261	3.657	0.078
AF	91	3.476	0.259
A	207	3.746	-0.011
C	27	3.176	0.559
Average of the values ($E_T - E_i$)			0.329
Average weighted according to frequency Peczely types			0.311
	ABG types		
1	260	3.724	0.011
2	136	3.536	0.199
3	373	3.632	0.103
4	210	3.752	-0.017
5	277	3.519	0.216
6	105	3.535	0.200
7	308	3.797	-0.062
8	171	3.665	0.070
Average of the values ($E_T - E_i$)			0.090
Average weighted according to frequency ABG types			0.075

Table VII

Entropies of the directions of daily maximum wind gusts of the autumn season at Szeged (1961-1980) in the total population as well as in the subsets arranged according to the Peczely and the ABG macrosynoptic types.
N = number of cases, E = entropy, bit, E_T = E of the total population, E_t = E of the subsets

	N	E	$E_T - E_t$
Total population	1820	3.756	-----
Peczely types			
mCc	52	3.157	0.599
AB	97	3.020	0.736
CMc	47	3.294	0.462
mCw	175	3.296	0.460
Ae	313	3.053	0.703
CMw	159	3.540	0.216
zC	67	3.269	0.487
Aw	281	3.180	0.576
As	102	3.437	0.319
An	211	3.475	0.281
AF	38	3.083	0.673
A	263	3.846	-0.090
C	15	3.057	0.699
Average of the values ($E_T - E_t$)			0.371
Average weighted according to frequency Peczely types			0.416
ABG types			
1	166	3.518	0.238
2	74	3.520	0.236
3	78	3.640	0.116
4	118	2.865	0.871
5	68	3.690	0.066
6	86	3.422	0.334
7	184	3.472	0.284
8	228	3.752	0.004
9	142	3.727	0.029
10	113	3.590	0.168
11	149	3.685	0.071
12	58	3.165	0.591
13	131	3.641	0.115
14	107	3.301	0.455
15	118	3.520	0.236
Average of the values ($E_T - E_t$)			0.254
Average weighted according to frequency ABG types			0.228

Table VIII

Entropies of the directions of daily maximum wind gusts of the winter season at Szeged (1961-1980) in the total population as well as in the subsets arranged according to the Peczely and the ABG macrosynoptic types.
N = number of cases, E = entropy, bit, E_T = E of the total population, E_i = E of the subsets

	N	E	$E_T - E_i$
Total population	1800	3.720	-----
Peczely types			
mCc	87	3.090	0.630
AB	76	3.350	0.370
CMc	66	3.350	0.370
mCw	187	3.314	0.406
Ae	301	2.990	0.730
CMw	154	3.422	0.298
zC	93	3.462	0.258
Aw	233	3.322	0.398
As	100	3.358	0.362
An	265	3.380	0.340
AF	47	2.776	0.944
A	175	3.608	0.112
C	16	3.078	0.642
Average of the values ($E_T - E_i$)			0.451
Average weighted according to frequency Peczely types			0.426
ABG types			
1	120	3.326	0.394
2	133	3.517	0.203
3	102	3.573	0.147
4	114	3.561	0.159
5	105	3.554	0.166
6	107	3.486	0.234
7	133	3.482	0.238
8	115	3.362	0.358
9	45	3.030	0.690
10	83	3.469	0.251
11	205	3.534	0.186
12	83	3.401	0.319
13	47	3.075	0.645
14	32	3.544	0.176
15	89	3.623	0.097
16	75	3.564	0.156
17	212	3.433	0.287
Average of the values ($E_T - E_i$)			0.277
Average weighted according to frequency ABG types			0.254

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