A Statistical Investigation on the Secular Precipitation Series of Hungary

by

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Magyarország szekuláris csapadéksorának statisztikai vizsgálata. A tanulmány Magyarország szekuláris csapadéksorának 1871—1973 közötti adatbázisa alapján a csapadékos és száraz hónapok ismétlődéseit elemzi. A szekuláris csapadéksort az ország területén egyenletesen elosztott 10 állomás havi összegeinek számtani közepe szolgáltatta. A sorozatot az *I. táblázat* tartalmazza. A statisztikai vizsgálatok azt bizonyították (eredményeiket a *II—VII.* táblázatok tartalmazzák), hogy a csapadékos és száraz hónapok szakaszai Magyarországon véletlenszerűen oszlanak meg, csupán az egymást követő nyári félévek azonos előjelű csapadékanomáliáinak ismétlődései mutatnak a véletlenszerű egymásra következésnél szorosabb kapcsolódást.

Statistische Untersuchung der saekularen Niederschlagsreihe von Ungarn. In der Arbeit werden, an Hand der saekularen Niederschlagsreihe von Ungarn für den Zeitraum 1871—1973, die Wiederholungen von niederschlagsreichen und von trockenen Monaten untersucht. Die saekulare Niederschlagsreihe des Landes wurde in folgender Weise hergestellt: es wurden die arithmetischen Mittelwerte der Monatssummen der Niederschläge an zehn Stationen ermittelt, undzwar sind die verwendeten Stationen gleichmässig über das Landesgebiet verteilt. Diese Reihe wird in *Tabelle I* mitgeteilt. Die statistischen Untersuchungen (deren Ergebnisse in den *Tabellen II—VII* mitgeteilt werden) ergaben, dass die Perioden von niederschlagsreichen und von trockenen Monaten in Ungarn eine zufallsmässige Verteilung aufweisen, mit der einzigen Ausnahme, dass die Wiederholungen der Niederschlagsanomalien gleichen Vorzeichens in den aufeinanderfolgenden Sommerhalbjahren einen höher als zufallsmässigen Zusammenhang besitzen.

This study is based on the secular precipitation series of this country extending from 1871 to 1973, and it is dealing with the sequences of wet and dry months. The secular precipitation series has been obtained in the following way. The monthly sums of precipitation on 10 stations, which are covering rather uniformly the area of the country, have been averaged. This series is reproduced in *Table I.* The statistical investigations (the results of which are listed in *Tables II—VII*) are indicating that periods consisting of wet and dry months are occurring, in this country, at a random manner, with the only exception that the sequences of consecutive summer half-years having the same sign of anomalies are possessing a closeness of relation which slightly exceeds the random value

I. BASIC DATA

By analysing statistically the long-range or secular data series of the various climatological elements, one is obtaining a number of results and findings, which are of fundamental importance both from the point of view of climatological research and from that of long-range meteorological forecasting.

Precipitation is, in this country, the meteorological element which is possessing the highest variations both in space and in time. In addition, it constitutes the most sensitive indicator for the fluctuations occurring within the general circulation. Therefore, it is justified to emphasize the importance of the analysis of the available secular series of precipitation.

The general statistical relationships exhibited by a precipitation time series are more clearly understood when *the disturbing influences caused by local variability* are screened out. The most suitable procedure to do this consists in relating the precipitation data *to a larger area* by computing *areal average values* from the data of stations which are characteristical for the area from climatical and geographical points of view.

Systematic measurements of precipitation were started in Hungary during the second half of the 19^{th} century. By taking into account the areal representativity of the stations, we selected 10 observing stations, from which long and reliable series

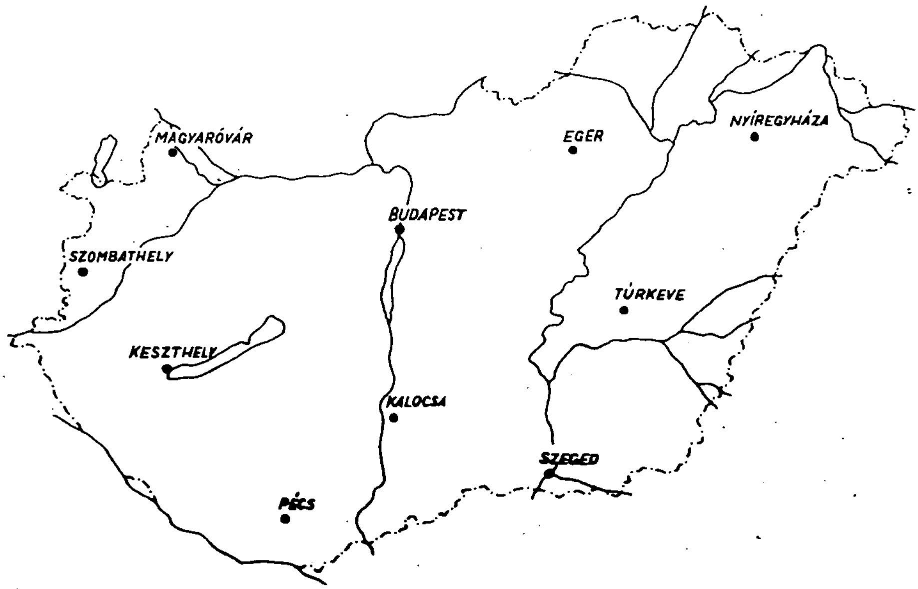

Fig. 1. The geographical localization of the observatorys
1. ábra A megfigyelő állomások földrajzi elhelyezkedése

are available, and which are spatially distributed in a way which is allowing to obtain, by averaging the data, an approximative areal average value of the monthly precipitation amounts for the territory of Hungary. These stations, which are possessing data series extending backwards to the year 1871, are the following ones (λ=geographical longitude, φ=geographical latitude, a=altitude above sea-level):

	λ	φ	a
1. Szombathely	16°36′ E	47°15′ N	218 m
2. Keszthely	17°14′	46°46′	128
3. Magyaróvár	17°16′	47°53′	122
4. Pécs	18°14′	46°03′	135
5. Kalocsa	18°59′	46°32′	96
6. Budapest	19°02′	47°31′	120
7. Szeged	20°09′	46°15′	79
8. Eger	20°23′	47°53′	173
9. Túrkeve	20°45′	47°07′	89
10. Nyíregyháza	21°43′	47°58′	107

The geographical locations of the stations are given on *Fig. 1.* It is seen that the spatial distribution is rather a uniform one, and this network is satisfactorily representing the more important geographical and climatical districts of this country.

The monthly precipitation amounts of the stations listed above have been averaged for every month starting with January, 1871, and in this way the time series reproduced in *Table I* has been obtained, which is therefore *characterizing, in a global way*, the average monthly precipitation amounts for the territory of Hungary. This areal secular precipitation series has been used for our statistical investigations, that is, this investigation is based on the data of 103 years (1871—1973) of observation.

II. MAIN RESULTS OF THE STATISTICAL ANALYSIS

1. Investigation of the Asymmetry Factor of the Data Series

In the knowledge of the arithmetical means of the precipitation series *(Table I)* we determined the probability of occurrence for monthly precipitation amounts which are higher or lower than the arithmetical mean value (these probabilities are designed by p, or, respectively, by $1-p$). In the possession of these values ,we determined the monthly values of *Köppen's* asymmetry number (A) by using the formula:

$$A = 2p-1 \tag{1}$$

The corresponding data are listed in *Table II.* It should be noted that, in the course of these calculations, monthly precipitation amounts which were equal to the arithmetic mean have been classed as being *higher than the average.* The distribution of monthly precipitation amounts is in all months (with the single exception of June) possessing a *negative asymmetry,* that is, the probability for the occurrence of a monthly precipitation amount lower than the arithmetical mean value is possessing a higher probability than that of the occurrence of monthly amounts which are higher than the arithmetic mean value. The largest values of negative asymmetry are occurring in the months of December, August and April. By a more detailed investigation of the frequency distribution of the precipitation amounts in the case of these three months, it is found that the frequency values are concentrated around *two characteristical maxima.* The stronger of these two maxima is situated at a lower precipitation level, while the other and weaker one is situated at a higher level. Thus, the distribution can be considered as having a dominant component which is causing a higher frequency of occurrence of the values lower than the arithmetic mean value which is the *characteristical* distribution for the month in question, and there is likewise superposed the influence of a weather pattern which is favourable for the occurrence of a higher precipitation amount. Apparently this means the influence, during the three months in question, of oceanic synoptical situations with a W or SW orientation, in contrast to the otherwise rather dominant continental influences. All this is well illustrated by *Fig. 2,* containing the distribution of the precipitation amounts of the months December and August. The stronger asymmetry is, in addition, also indicating that these two months should be considered, from the point of view of the circulation occurring over Central Europe, as months possessing a *transitory* character.

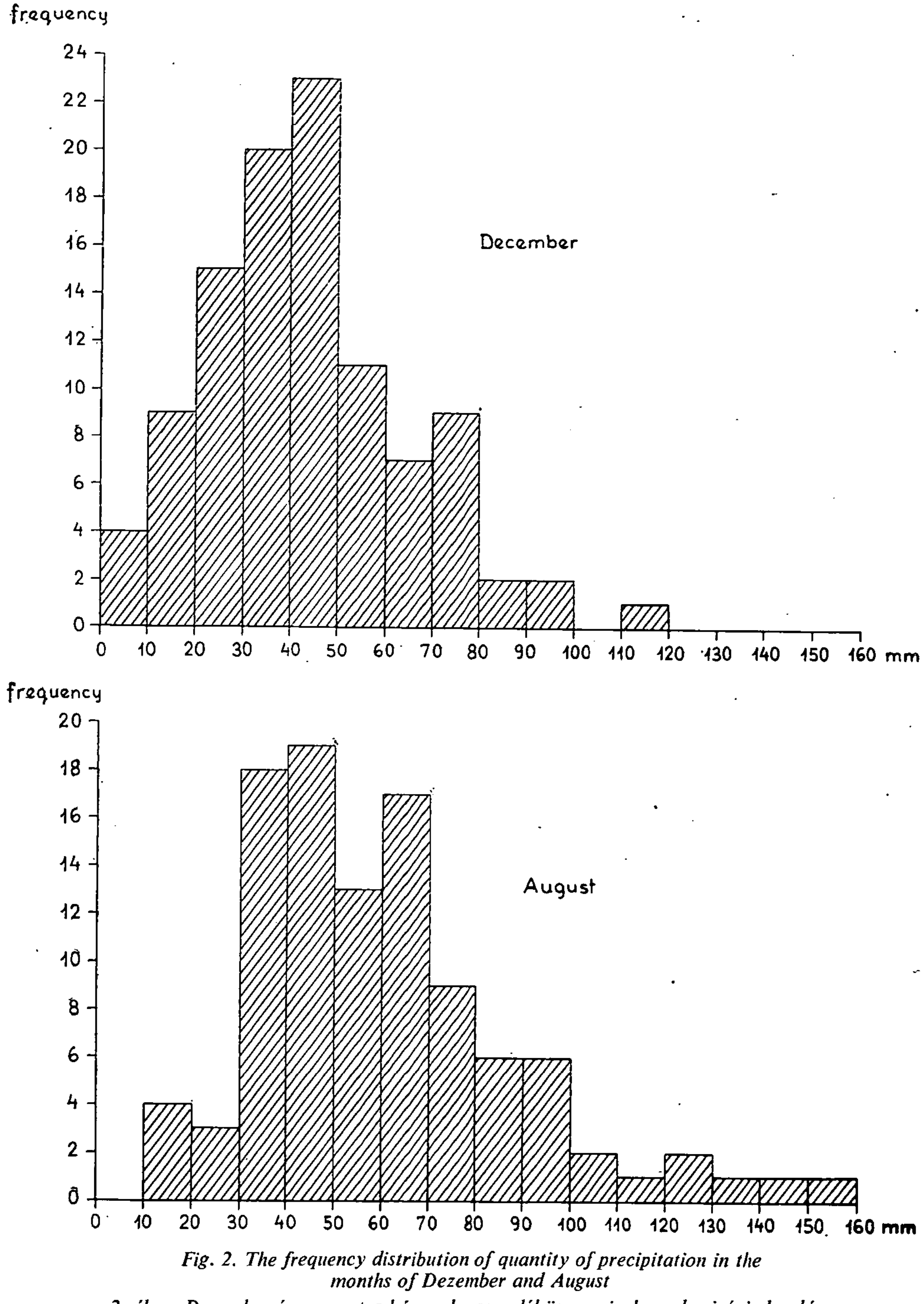

Fig. 2. The frequency distribution of quantity of precipitation in the months of Dezember and August

2. ábra. December és augusztus hónapok csapadékösszegeinek gyakorisági eloszlása

2. Duration Frequencies of Wet and Dry Periods

One of the most important characteristics of the statistical structure of the precipitation series concerns the law according to which wet and dry periods are distributed. A wet period is defined as a sequence of consecutive months in which $C \geqq M$, while dry periods are defined as a sequence of months for which $C < M$ (where C signifies the precipitation amount of the actual month and M is the arithmetical mean value for the given month).

From the 1236 months constituting the 103 years under investigation, the condition $C \geqq M$ has been fulfilled in 579 cases, while the condition $C < M$ occurred in 657 cases. Therefore the corresponding probabilities are:

$$p(C \geqq M) = 0{,}468$$
$$p(C < M) = 0{,}532$$
$$N = 1236$$

If the consecutive precipitation data are independent from one another, then the occurrence of the event with the probability p (that is, in the present case, the occurrence of a wet or else that of a dry month) could be expected in N_{qp} sequences, where $q = 1 - p$, that is, q is the probability of the opposite event.

It can be demonstrated by a simple calculation, that the number of sequences consisting of k consecutive occurrences of the event possessing the probability p is as follows:

$$r(k) = Nq^2p^k \tag{2}$$

and the average length (A) of these periods is:

$$A = \frac{1}{q} \tag{3}$$

If the consecutive data of the series are not independent from one another, then the empirically determined actual average length of the periods, A^*, is not the same as the length of period A yielded by relation 3) which is valid only for the case of independence.

Thus, one has

$$\frac{A^*}{A} \neq 1$$

The assumption of the independence of the consecutive data should be discarded when the numerical value of this quotient is lying outside the interval

$$Q = \frac{q}{q \pm d\sqrt{\frac{pq}{N}}} \tag{4}$$

where d is a coefficient corresponding to the significance limit adopted. In the present investigation, we selected a significance limit of 0,0027 and used the corresponding value $d=3$.

In *Table III* we are indicating the observed numbers of the wet and dry periods of a given length (row a); then the number of these periods as determined on the basis of the independence assumption by using relation 2) (row b); while, in *Table IV*, the values A^* and A are listed, as well as their quotients and the limits Q of the independence range.

From the analysis of these data it appears, that, although the average lengths A^* are higher than the value A expected on the basis of a theoretical distribution, however the difference of these two values is not reaching the value corresponding to the adopted significance limit, and thus our hypothesis zero (the independence of data) can be uphold, that is, *the facts do not contradict the assumption that the periods consisting of wet or dry months are possessing, in this country, a random distribution.*

M. Teich carried out a similar investigation for the area of Central Europe concerning the series of monthly average temperatures [1]. According to these investigations, the sequence of months possessing over-average and under-average temperatures cannot be considered as a chain of random events, that is, temperature anomalies are possessing a higher tendency of persistence than those of precipitation anomalies.

These statements can be corroborated by using the so-called index of conservation tendency which is characterizing the degree of closeness of the relation existing among the consecutive data. The degree of closeness of the relation in the data of an alternating series is determined by *Markov's* transition-probability matrix

$$\begin{matrix} p_{++} & p_{+-} \\ p_{-+} & p_{--} \end{matrix}$$

where p_{++} is the probability that a positive anomaly is followed by another positive anomaly; p_{+-} is the probability that a positive anomaly is followed by a negative one, etc. The degree of closeness of the relation is yielded by the determinant of this matrix:

$$D = (p_{++} \cdot p_{--}) - (p_{+-} \cdot p_{-+})$$

The value of this determinant can vary within the interval 0 to 1. As in each row of the matrix, the sum of probabilities is equal to 1, we have:

$$D = 1 - (p_{+-}) - (p_{-+}) \tag{5}$$

It is obvious that the probability p_{+-} is equal to the quotient of the number of the positive periods by the total number of the months which are possessing a positive anomaly. Similarly, the probability p_{-+} is equal to the quotient of the number of the negative periods by the total number of the months possessing a negative anomaly. Thus, in the present case

$$D = 1 - \frac{285}{579} - \frac{286}{657} = 0{,}073$$

which is indicating only a very weak correlation. For comparison, we are mentioning that according to the investigation [1], the measure of the closeness of the relation among the temperature anomalies in Central Europe is equal to 0,16, that is, this index of closeness is twice as high than the value found for the precipitation series which can be considered as a chain of random events.

3. Annual Distribution of the Numbers of Wet and Dry Months

We determined the numbers of wet and dry months among the 12 months of a particular year. The frequency distribution obtained is reproduced in *Table V*.

In the case of independent data, the experienced frequencies may be described by the binomial distribution:

$$P(k, n) = \frac{n!}{k!\,(n-k)!}\; p^k(1-p)^{n-k} \qquad (6)$$

where $k \leqq n$ is the frequency of the occurrence of an event of probability, p among n cases.

Taking into account the corresponding probability values (probability of the occurrence of a wet month: $p=0{,}468$ and thus $1-p=0{,}532$), we listed the values $P(k, n)$ calculated from the relation 6) and the corresponding frequencies, as well as the empirical frequencies in *Table VI.*

Comparing the frequencies calculated with the binomial formula (row *b*) to the empirical distribution (row *c*) by using the χ^2-test (and combining the data of the first four and the last four classes) we obtain the following result:

$$\chi^2_{(6)} = 2{,}53$$

a value which is indicating no significant relation between the two series b) and c). Therefore, the statement can be uphold that *the distribution of wet and dry months of a year corresponds to the binomial distribution which is characteristic for the independence of the data.*

4. Conservation Tendency of the Wet and Dry Patterns from Year to Year

In the following we are investigating the question, *for how many of consecutive years* the identic patterns of the singular months, of the seasons and of the whole year are persisting. The final results of these calculations are contained in *Table VII.* There, similarly as in *Table IV* we are listing the empirically determined average lengths of the wet and dry periods (A^*) as well as the lengths calculated on the basis of the assumption of independence (A), and the quotients of these two quantities A^*/A.

The values of the quotient A^*/A are indicating that the year to year repetition of the wet or dry pattern of a given period is constituting again a series of events that has a random character. The only exception is represented by the *summer half-year,* where the length of period is, for the dry pattern, *significantly higher* than in the case of a random sequence of events. In this case, the quotient A^*/A is possessing a value of 1,5, which is lying outside the range of the interval Q as defined according to the relation 4), the limits of this range being (for the significance level 0,0027) as follows: 0,769 and 1,429. It is further seen from *Table VII,* that the quotient A^*/A for the wet periods in the summer half-year is lying very near to the upper limit of the range in question (having a value of 0,148), and if a less rigorous significance level would be adopted, then the tendency of persistence would be again considered as a significant one. Incidentally, the value of the quotient is for all the months between June and November, as well as for every season and for the winter half-year, lower than 1, which means that in these cases, there is no question of a relation among the data, if not in a negative sense, as the length of the sequences of identical periods is even lower than that which could be expected in the case of a random repetition.

However, in the summer half-year, one can demonstrate the persistence extending to several years of the identical patterns, which is indicating the possibility of periodical changes, and the measure of closeness given under 5) is also reaching an important value, being equal to 0,307.

Table I

Areal average precipitation, mm

	J	F	M	A	M	J	J	A	S	O	N	D	YEAR
1871	41	10	44	39	54	110	53	43	33	69	98	23	617
1872	31	27	50	36	35	116	63	102	66	55	54	43	678
1873	46	44	32	69	102	93	33	27	72	27	41	10	596
1874	15	25	26	25	81	85	42	93	22	29	46	113	602
1875	22	25	17	22	52	93	77	35	28	99	88	30	588
1876	28	42	65	30	85	86	63	44	100	33	47	75	698
1877	30	34	42	113	81	47	66	28	52	25	27	62	607
1878	54	8	48	48	35	60	164	71	61	85	95	58	787
1879	41	79	35	136	111	75	66	47	57	77	48	34	806
1880	10	31	24	34	122	73	49	134	105	89	56	42	769
1881	41	13	74	80	76	82	45	76	71	133	40	19	750
1882	2	17	36	42	37	62	111	98	94	64	73	65	701
1883	24	12	54	49	63	83	79	39	64	71	64	26	628
1884	16	12	33	92	17	82	72	82	29	100	20	65	620
1885	19	14	19	24	108	50	67	90	38	80	42	29	580
1886	70	29	34	56	35	101	31	45	41	61	29	71	603
1887	27	12	61	14	100	36	32	57	47	98	60	65	609
1888	30	48	29	62	31	83	81	79	44	69	14	22	592
1889	14	36	79	96	63	59	77	34	87	86	43	29	703
1890	34	2	18	85	48	66	43	47	25	71	76	41	556
1891	69	6	45	90	50	78	108	69	20	10	55	33	629
1892	55	40	45	65	80	88	47	40	54	75	14	36	639
1893	49	37	32	8	57	151	95	39	43	45	114	18	688
1894	5	19	16	55	81	53	29	51	48	100	22	36	515
1895	56	51	59	66	73	98	77	62	19	106	16	75	758
1896	17	27	29	94	70	92	73	143	74	35	57	37	748
1897	38	21	60	55	116	76	96	66	58	85	10	22	703
1898	9	23	41	91	101	88	75	48	30	62	32	10	610
1899	35	25	32	50	144	64	68	29	90	37	12	58	644
1900	70	40	70	48	86	78	80	70	31	58	75	33	739
1901	33	25	66	53	44	59	80	70	61	54	43	44	632
1902	25	76	44	47	85	76	74	42	38	89	12	40	648
1903	28	12	23	106	44	97	107	48	50	47	74	59	695
1904	28	78	50	28	56	50	18	57	78	77	41	28	589
1905	19	14	33	52	97	79	44	48	51	121	91	27	676
1906	38	33	57	33	63	87	92	60	116	10	44	88	721
1907	39	15	15	95	45	59	66	33	32	18	26	56	499
1908	19	64	50	76	40	35	55	78	24	9	46	38	534
1909	23	32	44	26	78	73	63	66	60	29	26	93	613
1910	56	42	6	74	95	87	59	58	82	19	93	41	712
1911	22	21	24	41	110	50	19	49	41	57	23	43	500
1912	34	45	71	61	79	53	45	67	101	53	47	29	685
1913	32	8	20	38	68	63	122	112	77	21	38	36	635
1914	16	7	74	19	78	112	125	42	78	42	15	61	669
1915	80	36	57	42	50	102	105	83	76	98	55	49	833
1916	30	41	57	95	50	66	44	31	76	47	38	59	634
1917	62	17	41	43	19	14	63	36	24	46	39	46	450
1918	14	13	13	33	63	56	63	90	51	83	63	77	619
1919	38	35	62	77	73	51	68	49	36	52	113	51	705
1920	40	15	29	43	50	87	108	61	44	16	11	57	561

	J	F	M	A	M	J	J	A	S	O	N	D	Year
1921	22	39	3	50	53	65	33	62	14	24	73	19	457
1922	56	31	47	84	25	58	29	34	121	103	37	19	644
1923	33	44	41	53	21	62	31	32	37	67	105	47	572
1924	16	39	40	74	80	91	51	77	40	24	9	11	552
1925	5	39	30	43	71	93	111	63	74	22	85	41	677
1926	34	25	24	34	64	125	92	60	34	79	23	41	635
1927	40	12	62	46	69	54	58	99	69	38	51	44	642
1928	12	24	22	44	72	75	19	48	80	28	57	43	524
1929	42	32	4	60	67	71	35	61	28	68	61	29	558
1930	19	45	39	74	59	36	49	64	54	110	45	75	669
1931	41	47	52	52	40	58	32	72	90	47	48	20	599
1932	28	12	42	51	75	32	60	55	17	82	25	23	502
1933	23	26	42	38	95	83	39	70	33	75	83	50	697
1934	17	15	18	26	32	96	65	55	57	48	63	33	525
1935	28	49	30	60	56	36	22	67	32	36	39	76	531
1936	53	82	32	47	108	48	70	38	72	131	23	21	725
1937	46	31	117	59	51	82	71	97	60	30	97	80	821
1938	43	9	22	33	99	56	72	126	25	54	22	51	612
1939	23	15	54	13	135	75	28	79	54	114	65	24	679
1940	42	55	36	36	110	109	90	121	79	87	49	29	843
1941	37	41	71	80	56	60	66	66	30	65	72	31	675
1942	40	58	24	88	80	53	51	46	14	30	37	18	539
1943	33	43	13	24	62	97	69	20	40	14	114	46	575
1944	21	48	78	32	82	81	76	38	42	108	104	43	753
1945	58	12	14	40	60	46	50	44	59	46	71	37	537
1946	15	36	21	9	70	77	54	47	8	51	65	47	500
1947	35	92	43	36	30	48	55	17	6	13	43	49	467
1948	69	43	9	47	39	99	88	61	42	37	32	20	586
1949	17	3	14	19	91	71	66	77	22	19	118	40	557
1950	44	26	7	68	30	28	35	34	56	100	86	79	597
1951	29	56	61	44	89	120	77	57	61	7	50	35	686
1952	47	50	40	17	62	52	17	31	76	88	101	92	673
1953	41	22	9	61	82	134	69	57	34	29	16	9	563
1954	37	15	42	60	89	118	88	44	49	29	44	51	666
1955	45	61	36	51	34	46	114	154	34	83	37	49	744
1956	24	44	21	51	78	89	55	50	5	40	71	40	568
1957	20	65	20	32	80	61	99	45	44	27	25	34	552
1958	36	34	44	39	24	129	39	52	30	43	53	54	577
1959	40	3	20	52	57	100	100	35	25	5	31	79	547
1960	37	34	34	36	39	58	100	60	55	76	93	45	657
1961	23	31	7	54	65	66	50	17	6	31	71	37	458
1962	28	32	59	30	35	31	73	19	41	15	122	31	516
1963	63	53	39	30	48	64	35	88	69	30	32	50	601
1964	2	22	54	48	56	89	44	60	62	106	31	66	640
1965	45	12	44	84	96	120	96	64	48	1	120	64	794
1966	45	34	33	58	54	100	130	78	34	54	84	57	761
1967	39	24	29	56	76	50	39	34	77	30	17	42	513
1968	29	21	20	24	36	30	62	89	84	14	59	32	500
1969	28	85	35	22	40	122	31	93	27	16	55	89	643
1970	42	52	67	58	55	76	73	103	18	23	44	49	660
1971	39	12	29	31	53	53	47	33	38	13	54	17	419
1972	31	32	17	65	94	54	115	91	29	40	55	3	626
1973	22	31	10	71	17	86	63	33	35	33	32	39	472
1974	37	34	15	25	81	109	53	98	46	143	30	41	712
1975	12	6	40	36	83	106	93	89	37	48			
Average	34	32	38	52	66	75	66	61	50	54	53	44	625

Table II

Probability (p) of the occurrence of a precipitation amount higher than the arithmetic mean value and probability ($1-p$) of the occurrence of a precipitation amount lower than the mean value along with the values of the asymmetry measure of Köppen (A)

	J	F	M	A	M	J	J	A
p	0,466	0,485	0,476	0,447	0,476	0,515	0,495	0,437
$1-p$	0,534	0,515	0,524	0,553	0,524	0,485	0,505	0,563
A	−0,068	−0,030	−0,048	−0,106	−0,048	0,030	−0,010	−0,126

	S	O	N	D	Winter half-year	Summer half-year	Year
p	0,466	0,466	0,456	0,437	0,485	0,485	0,505
$1-p$	0,534	0,534	0,544	0,563	0,515	0,515	0,495
A	−0,068	−0,068	−0,088	−0,126	−0,030	−0,030	0,010

Table III

Wet and dry periods of various lengths
a) according to the empirical data, and
b) based on the assumption of independence

1. wet periods

k=	1	2	3	4	5	6	7	8	9	10	months
a)	141	69	39	17	8	6	1	3	—	1	cases
b)	163	77	36	17	8	4	2	1	0,4	0,2	cases

2. dry periods

k=	1	2	3	4	5	6	7	8	9	10	months
a)	122	78	32	25	15	3	4	5	1	1	cases
b)	145	77	41	22	11	6	3	2	1	0,5	cases

Table IV

Characteristics of the length of wet and dry periods

	A*	A	A*/A	Q
wet	2,03	1,88	1,08	0,93—1,09
dry	2,30	2,14	1,08	0,92—1,10

Table V

Frequency distribution of the wet and dry months within a year

Wet	Dry	Frequency
0	12	0
1	11	0
2	10	5
3	9	6
4	8	18
5	7	18
6	6	25
7	5	16
8	4	8
9	3	5
10	2	2
11	1	0
12	0	0
	Total:	103

Table VI

Probability distribution of the wet months within a year on the basis of a binomial distribution (column *a*), the corresponding frequency distribution (column *b*) and the empirically observed frequency distribution (column *c*)

	a	b	c
k=0	0,0005	0,0	0
1	0,0054	0,6	0
2	0,0263	2,7	5
3	0,0770	7,9	6
4	0,1524	15,7	18
5	0,2144	22,1	18
6	0,2200	22,6	25
7	0,1660	17,1	16
8	0,0913	9,4	8
9	0,0357	3,7	5
10	0,0094	1,0	2
11	0,0015	0,2	0
12	0,0001	0,0	0
Σ	1,0000	103,0	103

Table VII

Lengths of dry and wet periods (consecutive years)

a) dry

	J	F	M	A	M	J
A^*	1,93	1,89	1,82	2,04	2,00	1,75
A	2,13	2,02	2,08	2,20	2,06	2,04
A^*/A	0,906	0,936	0,875	0,927	0,971	0,858
Occurred maximum length (number of years)	6	8	4	7	7	4

	J	A	S	O	N	D
A^*	2,14	2,20	2,23	2,09	1,77	2,08
A	1,92	2,20	2,02	2,04	2,22	2,16
A^*/A	1,115	1,000	1,104	1,025	0,797	0,963
Occurred maximum length (number of years)	9	7	7	5	4	7

	Winter	Spring	Summer	Autumn	Winter half-year	Summer half-year	Year
		9	7	7	5	4	7
A^*	1,79	2,04	1,96	1,65	1,75	3,00	2,13
A	2,06	2,13	2,04	1,81	2,02	2,00	1,94
A^*/A	0,869	0,958	0,961	0,912	0,867	1,500	1,098
Occurred maximum length (number of years)	7	9	7	7	5	9	6

b) wet

	J	F	M	A	M	J
A^*	1,78	1,85	1,68	1,64	1,88	1,74
A	1,89	1,98	1,92	1,83	1,94	1,96
A^*/A	0,942	0,934	0,875	0,896	0,969	0,888
Occurred maximum length (number of years)	4	5	4	5	7	4

Table VII, continued

	J	A	S	O	N	D
A^*	2,22	1,77	2,09	2,00	1,45	1,73
A	2,08	1,83	1,98	1,96	1,82	1,87
A^*/A	1,067	0,967	1,056	1,020	0,797	0,925
Occurred maximum length (number of years)	9	5	8	13	4	7

	Winter	Spring	Summer	Autumn	Winter half--year	Summer half--year	Year
A^*	1,69	1,74	1,88	2,04	1,71	2,78	2,17
A	1,94	1,89	1,96	2,23	1,98	1,96	2,06
A^*/A	0,871	0,921	0,959	0,915	0,864	1,418	1,053
Occurred maximum length (number of years)	4	9	4	6	3	10	6

Reference

[1] *Teich, M.:* Statistische Untersuchung zur Vorhersagbarkeit monatlicher Temperaturanomalien. (Statistical Studies Concerning the Previsibility of Mensual Temperature Anomalies). In German.

Időjárás (78) pp. 140—154. 1974.