Sci. Annals, Fac. Phys. & Mathem., Univ. Thessaloniki, 14, 305, (1974)

ON THE ANNUAL VARIATION OF AIR TEMPERATURE IN LARISSA-GREECE

by

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(Introduced by Prof. G. C. Livadas)

(Received 29.10.74)

Abstract: *The annual variation of air temperature in Larissa is examined, by reducing monthly mean values of every meteorological station that ever functioned in this area, during the 1899-1973 period, to one homogeneous series. This has been achieved through various criteria of homogeneity.*

There is proof of a small decreasing trend for annual mean and minimum and less for maximum values, resulting in a small increase of the annual temperature range.

INTRODUCTION.

The study of the annual variation of air temperature in Larissa is effected in this paper from annual mean values resulting from observations of the period 1899-1973, that is 75 full consecutive years.

The same subject has been examined in the past by such scientists as PHILIPPSON[16], LIVANTHINOS[11,12], MARIOLOPOULOS[13] and others, in works concerning the climate of the greek area, including Larissa.

However, in all such works, the study of air temperature has been based on observational data of rather short series, effected till the year 1929.

On the other hand the material used in the present work came from various stations operating during the 1899-1973 period in different locations and with different hours of observations, thus rendering impossible comparison among them, unless they were submitted to further processing.

Such difficulties may be overcome by establishing a homogeneous series of monthly mean values. This homogenization is achieved by reducing all the monthly mean air temperature values of every station operating during the period examined, to one and the same location; as such has been chosen the location of the met. station of Larissa's airport,

where a fully equipped weather station has been operating ever since 1950.

Similar homogenizing processes have been applied recently in various observational series of air temperature values by PAESLER[15] for the city of Münich and for the period between the years 1781-1968, by ARSENI[1] for the city of Athens (period 1858-1972) and by FLOCAS - ARSENI[7] for the city of Thessaloniki (period 1892-1973).

Through such homogenized series of monthly mean values for the 1899-1973 period, we obtain a complete picture not only of the annual variation but also of the course of air temperature in Larissa, a city standing in the middle of the plain of Thessalia, a closed large plain surrounded by high mountains (FLOCAS[5]).

MATERIAL-SOURCES-HOMOGENIZING PROCESSES

The material for the present work has been collected from the following sources:

1. Meteorological observations from Larissa's met. station covering the period between 1.1.1899-30.6.1940 with certain observations missing at various intervals. The above observations have been published as follows:

a) Those from 1.1.1899 till 31.12.1931 in the Annales de l'Observatoire National d'Athènes, Vol. III-XII[17].

b) From 1.1.1932 till 30.6.1940 in the Annales of the Hellenic National Meteorological Service Vol. I-VIII[18] (1932-1939) and in the Bulletin of the Meteorological Service of the Air Ministry[19] (1.1.1936-30.6.1940).

The hours of observation at the met. station of Larissa from 1.1.1899 till 31.12.1929 have been the same as for the whole greek network (08:00, 14:00, 21:00), while from 1.1.1930 the evening observation alone was moved to 20:00h.

During this operational period the meteorological station of Larissa has been shifted within a small distance at various places of the town, while the height of the thermometers from the ground surface varied between 1.10-1.80 m.

Monthly mean temperature values for the period 1.1.1899-31.12.1929 have been calculated by using the formula $\frac{8^h + 14^h + 21^h}{3}$, while for the period 1.1.1930-30.6.1940 the formula used was $\frac{8^h + 14^h + 20^h}{3}$

2. The observational series of the Larissa Institute for Forage Cultivations (L.I.F.C.), covering the period 1.1.1940-31.12.1973. They have been

published by BANOUTSOS - SEMERTZIDIS[20], in the series «Climatologika» of the Aristotelian University of Thessaloniki.

Observations in this station were effected at 08:00, 14:00, 20:00, and monthly mean values have again been calculated by the formula

$$\frac{8^h + 14^h + 20^h}{3}$$

3. The observational series of Larissa Airport, covering the period 1.1.1950-31.12.1973. This series is the sequel of the series of Larissa Meteorological Station whose operation was interrupted from the last quarter of 1940 till the end of 1949, because of war conditions in the area of Greece.

Monthly mean values of air temperature have been published in the Monthly Climatological Bulletin, of the Hellenic National Meteorological Service[21].

The observation hours were again at 08:00, 14:00, 20:00, and the monthly mean air temperature values were calculated again by the formula $\frac{8^h + 14^h + 20^h + 20^h}{4}$.

Moreover for the interval 1.6.1963 — 31.12.1973 we have used hourly values from observations effected at Larissa airport, obtained from the archives of the National Meteorological Service, and accordingly the monthly mean values have been calculated from the corresponding 24 hours mean of the same period.

An examination of the existing material indicates a lack of homogeneity in the monthly mean values of air temperature, mainly due to the difference in the observational hours, and also to the different processes followed for calculating monthly mean values of the various stations that operated in the area of Larissa during the period 1899-1973. However this obstacle has been overcome by reducing all monthly mean air temperature values to 24-hours mean.

In order to investigate the existence of homogeneity between monthly mean air temperature values of two stations, we have used Abbe's criterion (as it was later completed by CONRAD[2,3,4]). This same criterion has been lately used by PAESLER[15] and FLOCAS - ARSENI[7].

The resulting figures of correlation coefficients between various observational series (and for each month separately) indicate the existence of a strong correlation. Consequently, by the use of the regression line equation, the various observational series can be unified in one complete

series, while missing values of one series can be filled in by the corresponding values of another.

The process of correlation coefficient and regression line equation was also used in relative works by MOSKAL[14] and FLOCAS - ARSENI[7].

Thus we have unified the various existing observational series of air temperature in one complete series.

Moreover, using Abbe's criterion between the series of annual mean air temperature values in the met. station of Trikala and the corresponding series of Larissa met. station for the period 1899-1939, we find the existing homogeneity between those two series ($0.79 < \frac{2A}{B} = 1.17 < 1.21$).

The resulting figures of correlation coefficients varying between 0.86-0.96 (separately for each month), prove a strong correlation between air temperature values of these two stations. Thus, by the regression line equation, we have found the missing air temperature values of Larissa from the corresponding values of Trikala station, and in this way established a complete series of monthly mean values for the period between 1.1.1899-30.6.1940.

Again by using Abbe's criterion between the series of monthly mean values of the met. station of Larissa for Forage Cultivation (L.I.F.C.) and the met. station of th eAmerican Farm School (A.F.S.) in Thessaloniki, we find the existing homogeneity ($0.78 < \frac{2A}{B} = 0.85 < 1.22$) of these two series.

Then from the resulting correlation coefficient values, varying from 0.86 to 0.98, between monthly mean values of the above two stations and using the regression line equation (separately for each month), we have filled in the missing mean values of the L.I.F.C. station from the corresponding values of the A.F.S. station, for the period between 1.1.1941-31.3.1949. Thus, we established a complete series of monthly mean air temperature values in this L.I.F.C. station, which is still operating, for the whole period between 1.1.1940-31.12.1973.

Further on we found the existing homogeneity, using Abbe's criterion, between the series of mean temperature values of the two met. stations of Larissa and L.I.F.C. during their common operational period from 1.1.1950-31.12.1973, and on the other hand a strong correlation between them resulting from the correlation coefficients varying between 0.95-0.99 (for each month separately). Then by the regression line equation the series of monthly mean values of Larissa's met. station from the corresponding readings of L.I.F.C.

The lack of homogeneity of this unified series of monthly mean air

temperature values at Larissa's met. station for the period 1899-1973 caused by the different modes of calculation (i.e. $\frac{8^h + 14^h + 21^h}{3}$ or $\frac{8^h + 14^h + 20^h}{3}$ or $\frac{8^h + 14^h + 20^h + 20^h}{4}$) has been overcome by reducing all values to 24-hours means.

The complete full series of monthly mean air temperature values at Larissa's met. station for each month and year separately, is given in the Appendix.

Conclusions

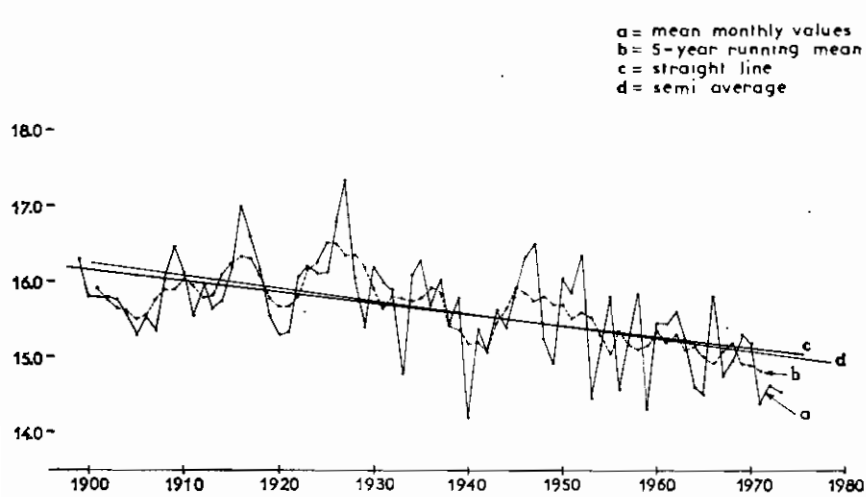
I. The annual mean and extreme values of air temperature in Larissa in 75 years (1899-1973) have as follows

Maximum	17.03° C	(1916, 1927)
Mean	15.63° C $\pm$ 0.64	
Minimum	14.20° C	(1940)

The maximum annual value of air temperature has been recorded in 1916 and in 1927, that is on the same years that it was recorded at the met. stations of Thessaloniki[7] and Athens[1]. The variation of annual air temperature values during the period 1899-1973 is illustrated in the adjoined Graph I.

GRAPH I

VARIATION OF THE MEAN ANNUAL AIR TEMPERATURE IN LARISSA



From the following TABLE I we find that 40 annual mean values of air temperature (53%) are included within the interval of 15.5-16.5° C, meaning that the (normal) annual mean temperature of 15.63° C stands within the values with the greatest frequency.

TABLE I

Distribution of annual mean air temperature values in Larissa (1899-1973).

Grades (°C)	14.0	14.5	15.0	15.5	16.0	16.5	17.0	17.5
Cases	4	9	17	22	18	3	2	
Percentage (%)	5	12	23	29	24	4	3	

II. The annual variation of air temperature in Larissa has a single oscillation, with a maximum in July and a minimum in January (TABLE II, GRAPH II).

The minimum of monthly mean temperature of various years is recorded either in December, or in January, or February: Thus out of 75 years, in 21 cases (28%), in 41 cases (55%), and in 12 cases (16%) the minima of monthly mean values were recorded in December,

TABLE II

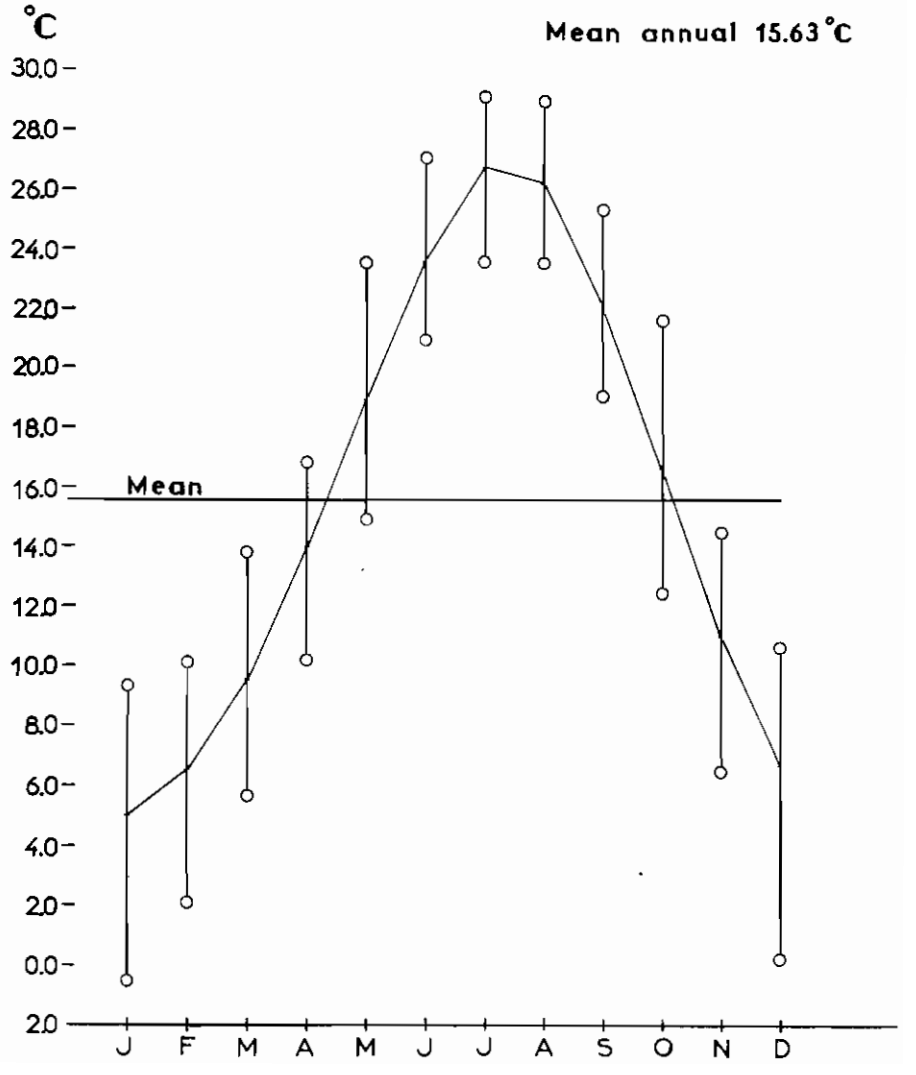
Data of air temperature in Larissa

	T_{max}	Year	T_M	$\pm \sigma$	C.V.%	T_R	T_{min}	Year
J	9.1	1915, 36, 55	5.00	1.96	39.20	9.4	—0.3	1942
F	10.0	1902, 55	6.74	1.88	27.89	7.9	2.1	1929
M	13.8	1947	9.64	1.83	18.98	8.1	5.7	1956
A	16.9	1924	14.05	1.31	9.32	6.3	10.3	1955
M	23.6	1908	18.94	1.45	7.66	8.6	15.0	1919
J	27.1	1916	23.63	1.20	5.07	6.1	21.0	1921
J	29.2	1931	26.73	1.04	3.89	5.6	23.6	1971
A	29.1	1952	26.33	1.28	4.86	5.5	23.6	1940
S	25.4	1952	22.06	1.49	6.75	6.3	19.1	1929
O	21.7	1932	16.62	1.55	9.33	9.2	12.5	1959
N	14.5	1926	11.10	1.48	13.33	8.0	6.5	1920
D	10.6	1916	6.71	1.82	27.12	10.4	0.2	1922
Year	17.35	1927	15.63	0.64	4.09	3.15	14.20	1940

T_M = Monthly mean air temperature
σ = Standard deviation
C.V. = Coefficient of variation
T_{max} = Monthly mean maximum air temperature.
T_{min} = Monthly mean minimum air temperature.
T_R = Monthly temperature range.

GRAPH II

ANNUAL VARIATION OF AIR TEMPERATURE IN LARISSA



January and February respectively and in 1 case only (1%) in February and December of the same calendar year.

Although the coldest months are the true winter months (December, January, and February), still the number of cases when the minimum thermometer read zero temperature or even below zero, in November, March and April, are not few because of cold invasions occuring in those months (LIVADAS[10]).

On the other hand, maximum values of monthly mean air temperatures of every year occur either in July or in August; thus 60% (45 out of 75 cases) have been recorded in July, and 40% (30 cases) in August.

As a rule, the temperature difference between July and August is small while the September mean (22.06° C) is by 1.57° C smaller than that of June.

It should be mentioned that in 1916, which was the warmest year of the period examined (MARIOLOPOULOS[13]), in Larissa as well as in Thessaloniki were recorded the highest monthly mean temperatures of June and December (FLOCAS - ARSENI[7]).

To the same, exactly as in Thessaloniki (FLOCAS - ARSENI[7]), the lowest monthly mean temperature of January (—0.3° C) and February (2.1° C) were recorded in 1942 and in 1929 respectively, that is in the coldest winters of the whole period examined (PH. KARAPIPERIS[8], LIVADAS[9]).

III. Values of standard deviation (σ.) and coefficient of variation (c.v.) for each month, indicate that the mean variability of various months (TABLE II) is greater during the cold quarter from December to February, and smaller during the June-September four-months.

This is a consequence of weather conditions prevailing in December, January and February, that is months characterized by intense weather changes, while during the main two summer months of July and August the weather changes less and less from day to day (FLOCAS[5,6]).

IV. The mean annual temperature range in Larissa is 21.73° C, and it is larger than that of Athens by 2,4° C (ARSENI[1]) and also that of Thessaloniki by 1.27° C (FLOCAS - ARSENI[7]).

However the annual temperature range amply varies from year to year: during the period from 1899 to 1973 examined herein, its highest value is 28.0° C (in 1922) and its smallest is 18.5° C (in 1955), meaning that the difference between these two magnitudes is 9.5° C.

V. Absolute temperature maxima and minima recorded in Larissa during the period examined, whose knowledge was deemed important, from the climatological point of view, are included in Table III.

From Table III we find that the absolute maximum air temperature of 45.0° C was recorded on two dates, the 23.7.1916 and the 23.7.1934 while weather types V and IV prevailed (radiation weather types) in the area of Greece and also on the 23.8.1958 with weather type VIII (westerlies) (FLOCAS[5,6]).

TABLE III

Data of air temperature in Larissa.

Month	Abs.Max.	Date	Year	Abs.Min.	Day	Year	Abs. Range of temperature
J	21.0	29	1960	—21.6	15	1968	42.6
F	26.0	24	1903	—11.3	5	1929	37.3
M	31.8	30	1952	— 7.5	5	1949	39.3
A	33.6	20,21	1899	— 3.4	1	1966	37.0
M	40.0	30,31	1969	2.0	1	1965	38.0
J	41.8	25	1957	7.0	6	1959	34.8
J	45.0	12 23	1916 1934	10.5 10.6	3,6 3	1947 1933	34.5
A	45.0	23	1958	7.5	21	1949	37.5
S	41.0	20 7	1908 1911	4.8	29	1906	36.2
O	38.6	1	1928	— 1.0	22	1947	39.6
N	29.0	14	1907	— 6.5	30	1915	35.5
D	22.6	18	1955	—14.0	4	1957	36.6
Period 1899-1973	45.0	12.7.1916 23.7.1934 23.8.1958		—21.6 (15.1.1968)			66.6

On the other hand, the obsolute minimum temperature of —21.6° C was recorded on 15.1.1968 with weather type I/VII.

The absolute temperature range in Larissa is 66.6° C.

Moreover it is worth noting that the maximum temperature of every month from May to September is $> 40.0°$ C, while the absolute minimum of every month from October to April $< -1.0°$ C.

VI. The distribution of the σ of 900 monthly mean values and another 75 annual mean values is given in Table IV.

From this Table IV we find that 2 values out of the sum of 900 monthly mean values (0.2%) have a mean temperature $< T_M' - 3\sigma$, and they are the following

a) December 1922: monthly mean air temperature 0.20° C.

$$T_M - 3\sigma = 1.25° \text{ C} > 0.20° \text{ C}$$

TABLE IV

Distribution of deviations from mean annual and monthly values.

										Percentages				
		-3σ	-2σ	$-\sigma$	T_M	$+\sigma$	2σ	3σ	Total	$\pm\sigma$	$\pm 2\sigma$	$\pm 3\sigma$	T+	T−
A. (Annual)		2	11	23	29	8	2		75					
	%	3	15	30	38	11	3		100	69	95	100	52	48
B. (Monthly)	*2	21	112	315	301	130	19		900					
	% 0.2	2.3	12.5	35.0	33.4	14.5	2.1		100.0	95.3	68.4	99.8	50.0	50.0

*significant deviations: November (1920): 6.5 (6.66)
December (1922): 0.2 (1.25)

TABLE V

Distribution of monthly mean values of air temperature.

Grades (°C)	J	F	M	A	M	J	J	A	S	O	N	D	Total	%
29.0- 29.9							2	1					3	0.3
28.0- 28.9							7	4					11	1.2
27.0- 27.9						1	19	19					39	4.3
26.0- 26.9						1	32	22					55	6.1
25.0- 25.9						11	10	18	3				42	4.7
24.0- 24.9						18	4	8	7				37	4.1
23.0- 23.9					1	18	1	3	11				34	3.8
22.0- 22.9						20			15				35	3.9
21.0- 21.9					5	6			24	1			36	4.0
20.0- 20.9					9				9				18	2.0
19.0- 19.9					21				6	5			32	3.6
18.0- 18.9					19					6			25	2.8
17.0- 17.9					15					17			32	3.6
16.0- 16.9				4	4					25			33	3.7
15.0- 15.9				14	1					13			28	3.1
14.0- 14.9				25						4	2		31	3.4
13.0- 13.9			3	15						2	7		27	3.0
12.0- 12.9			7	12						2	11		32	3.6
11.0- 11.9			10	4							21		35	3.9
10.0- 10.9		2	6	1							20	2	31	3.4
9.0- 9.9	3	8	20								8	5	44	4.9
8.0- 8.9	2	11	15								3	11	42	4.7
7.0- 7.9	9	15	9								2	15	50	5.6
6.0- 6.9	11	14	4								1	22	52	5.8
5.0- 5.9	11	10	1									9	31	3.4
4.0- 4.9	16	9										5	30	3.3
3.0- 3.9	11	5										3	19	2.1
2.0- 2.9	9	1										2	12	1.3
1.0- 1.9	1												1	0.1
0.0- 0.9	1											1	2	0.2
—1.0- —0.1	1												1	0.1
Total	75	75	75	75	75	75	75	75	75	75	75	75	900	100.0

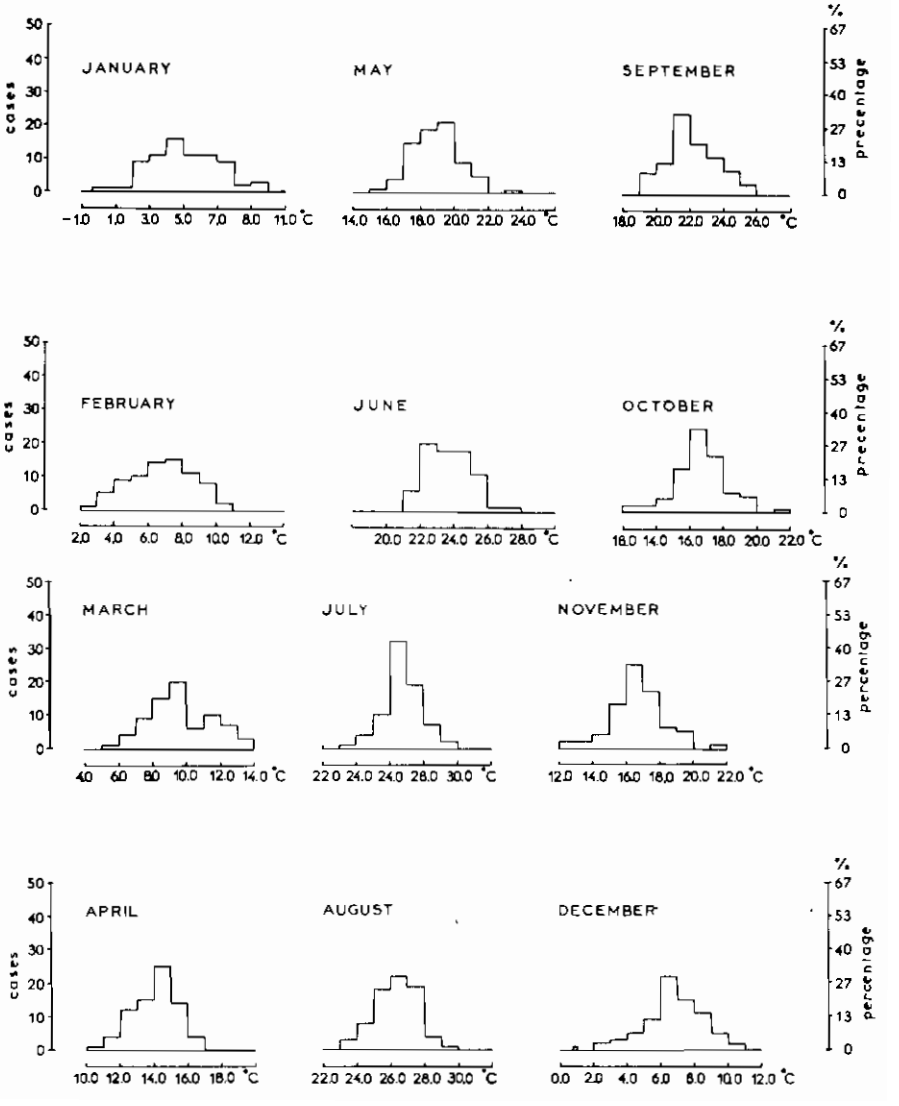
b) November 1920: monthly mean air temperature 6.50° C

$$T_M - 3\sigma = 6.66^0\ C > 6.50^0\ C$$

An examination of the weather conditions prevailing in December 1922, shows that during the period from 1 to 15/12/1922, the area of Greece and especially Northern Greece was under the continuous

HISTOGRAM I

FREQUENCIES DISTRIBUTION OF MONTHLY MEAN VALUES



influence of high pressure systems, resulting in days of partial or total frost in the area examined.

VII. Monthly mean air temperature values of almost every month of the period examined, are within the limits with the greatest frequency.

The five months from November to March whose monthly mean air temperature values are $< 15.0^0$ C consist the main cold season; while the five months from May to September, with mean values between 16.0^0-29.9^0 C (except for the case of May 1919, whose mean was 15.0^0 C, the same as Thessaloniki's (FLOCAS - ARSENI[7]), consist the warm season. April and October whose mean temperatures register more frequently values between 13.0 -17.9° C, are considered as transitional months between the cold and the warm season and vice versa.

VIII. Winter (December, January and February) is of course the coldest season, and summer (June, July and August) the warmest, while of the other two seasons, autumn (September, October and November) is warmer than spring (March, April May).

This applies not only to the seasonal values of air temperature for the whole period 1899-1973, but also for each decade separately (TABLE VI).

TABLE VI

Mean Seasonal and Annual Air Temperature Values in Larissa.
(1899-1973)

Period	Winter	Spring	Summer	Autumn	Year	Mean Annual Temperature Range
1899-1903	6.77	14.69	24.81	16.87	15.89	20.54
1904-1913	6.24	14.62	25.64	16.68	15.76	22.36
1914-1923	6.72	15.07	25.67	16.54	15.92	20.51
1924-1933	5.98	14.53	26.31	17.56	16.07	22.41
1934-1943	5.71	14.03	25.75	16.68	15.56	23.09
1944-1953	6.11	14.24	25.97	16.57	15.67	22.09
1954-1963	6.02	13.31	25.50	16.19	15.28	21.48
1964-1973	5.88	13.41	24.48	15.79	14.87	20.83
1899-1973	6.13	14.20	25.56	16.59	15.63	21.73

The seasonal variation of air temperature in the various years of the period 1899-1973 is clearly illustrated in GRAPH III.

The above graph indicates that the superiority of autumn temperatures over those of spring is a rule, since out of 75 years only 5 (7%) autumns have smaller values than those of the corresponding spring.

It is worth noting that during the last decade 1964-1973, seasonal temperatures of spring, summer and autumn in Larissa as in Thessaloniki (FLOCAS - ARSENI[7]) show a decreasing trend.

IX. Calculations on annual air temperature values of the period 1899-1973 yield the following straight line equation

$$Y = 16.198 - 0.015\,t \qquad (1)$$

where t the order of each value
Then, by applying the method of semi-averages, we get the following equation:

$$Y = 16.290 - 0.017\,t \qquad (2)$$

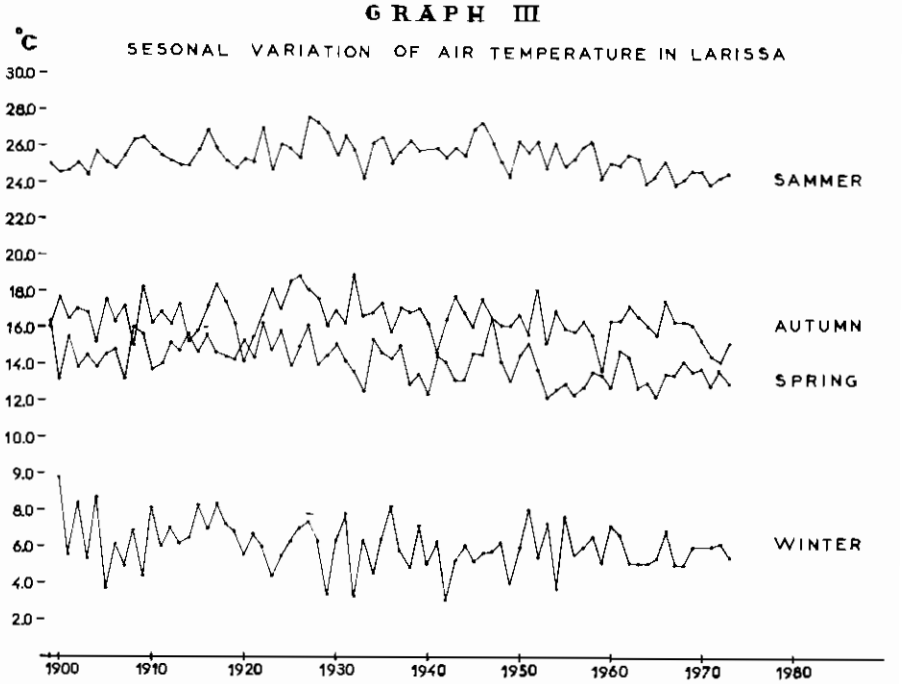
Equations (1) and (2) as well as Graph I indicate a decreasing trend of air temperature in Larissa, analogous to that observed in Thessaloniki (FLOCAS-ARSENI[7]).

X. By applying the least square method on mean maximum and minimum air temperature values, we have found the following straight line equations:

$$Y_{max} = 27.374 - 0.008t \qquad (3)$$

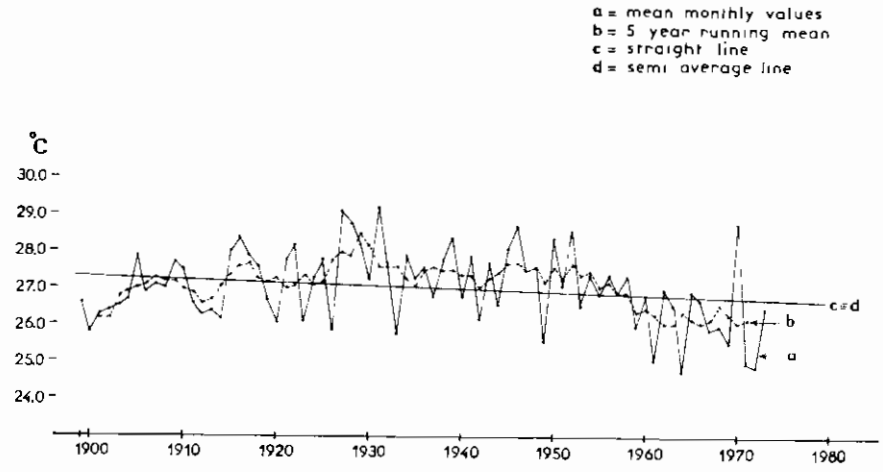
$$Y_{min} = 4.652 - 0.011t \qquad (4)$$

GRAPH III



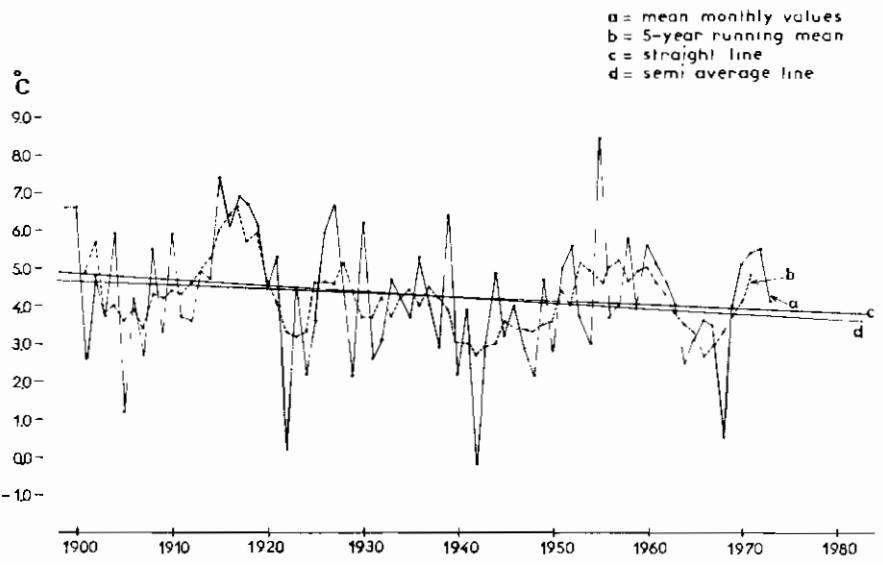
GRAPH IV

VARIATION OF MEAN MAXIMUM VALUES AIR TEMPERATURE
IN LARISSA



GRAPH V

VARIATION OF MEAN MINIMUM VALUES OF AIR TEMPERATURE
IN LARISSA



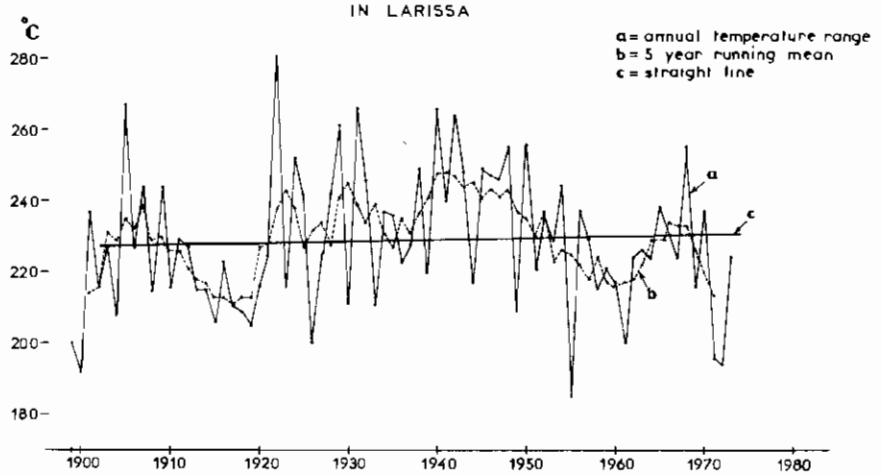
To the same, by applying the method of semi-averages, we obtain the following equations:

$$Y_{max} = 27.390 - 0.008\ t \quad (5)$$

$$Y_{min} = 4.830 - 0.015\ t \quad (6)$$

GRAPH VI

VARIATION OF THE ANNUAL TEMPERATURE RANGE IN LARISSA



Equations (3) and (5) as well as Graph IV indicate a decreasing trend of mean maximum values of air temperature; this decreasing trend is more pronounced in mean minimum values (equations (4) and (6), Graph V).

To a similar conclusion we have arrived for the city of Thessaloniki (Flocas - Arseni[7]).

From Graph VI and the straight line equation

$$Y_{range} = 22.732 + 0.003t$$

resulting from the application of the least squares method on values of annual range for the period 1899-1973, we find a small increasing trend of the annual temperature range.

Monthly mean air temperature (°C) in Larissa (1899-1973).

Year	J	F	M	A	M	J	J	A	S	O	N	D	Annual mean
1899	8.3	8.0	11.1	16.1	21.9	24.2	26.6	24.5	23.0	16.0	9.4	6.6	16.31
1900	6.9	9.8	8.9	13.2	17.5	22.6	25.8	25.4	20.7	19.3	13.2	6.6	15.82
1901	2.6	7.6	12.8	15.3	18.3	22.8	26.3	25.0	22.0	17.5	10.1	9.1	15.78
1902	6.2	10.0	9.8	14.0	18.0	22.7	26.4	26.3	22.9	19.0	9.4	4.8	15.79
1903	3.8	7.2	10.0	14.1	19.4	21.7	25.4	26.5	22.1	18.1	10.4	10.3	15.75
1904	6.0	9.9	9.4	13.3	18.9	24.0	26.7	26.6	21.1	17.0	7.8	5.9	15.55
1905	1.2	4.0	9.7	14.5	19.4	21.5	26.2	27.9	23.5	16.7	12.6	6.6	15.32
1906	4.2	7.6	12.6	13.9	17.9	22.7	26.9	25.1	21.6	16.0	11.7	6.7	15.57
1907	2.7	5.4	6.4	12.3	21.3	23.5	27.1	26.1	21.8	18.7	11.2	7.7	15.35
1908	5.5	7.6	10.4	14.3	23.6	25.5	27.0	26.8	21.7	15.1	8.6	6.3	16.03
1909	3.9	3.3	11.5	15.9	19.6	24.5	27.7	27.6	25.3	17.7	11.9	8.9	16.48
1910	5.9	9.8	8.6	14.4	18.4	23.3	27.3	27.5	21.8	16.7	10.4	9.3	16.12
1911	4.9	3.7	9.3	14.2	18.7	24.0	26.2	26.6	22.0	16.5	12.3	8.1	15.54
1912	3.6	9.7	13.1	13.4	19.2	24.0	25.6	26.3	21.2	16.2	11.5	8.2	15.99
1913	5.6	4.9	11.6	14.9	17.9	23.5	26.4	25.0	23.5	16.9	11.6	6.0	15.65
1914	4.7	8.9	12.2	15.5	19.5	22.6	26.2	26.1	20.9	14.9	10.0	7.4	15.74
1915	9.1	8.5	11.3	14.3	18.4	23.5	28.0	26.3	19.8	16.8	11.2	7.4	16.21
1916	6.4	7.4	12.8	14.4	19.9	27.1	28.4	25.5	21.6	17.1	13.1	10.6	17.03
1917	7.7	7.0	11.5	15.8	17.4	23.6	26.5	27.9	23.6	18.9	12.9	6.9	16.59
1918	7.0	8.1	9.3	14.8	19.5	22.7	27.6	25.7	24.8	17.9	9.7	6.7	16.15
1919	7.3	6.6	12.1	15.9	15.0	22.8	26.7	25.2	21.8	16.4	10.7	6.1	15.55
1920	6.3	4.5	11.3	15.5	19.4	24.0	26.1	26.1	21.8	14.2	6.5	7.9	15.30
1921	7.1	5.3	9.0	13.7	20.4	21.0	26.9	27.8	20.6	15.8	10.2	6.0	15.32
1922	5.4	6.6	12.8	16.2	19.9	25.7	28.2	27.5	23.9	18.4	8.2	0.2	16.08
1923	4.5	8.4	10.3	14.1	20.4	22.7	25.7	26.1	23.2	18.0	13.3	7.9	16.22
1924	2.2	6.3	9.9	16.9	21.0	24.6	27.3	26.8	25.1	16.8	9.5	6.9	16.10
1925	3.6	8.2	9.2	14.1	18.7	22.7	27.4	27.8	24.5	17.3	14.0	6.1	16.13
1926	5.9	9.2	9.9	15.3	19.8	25.2	25.9	25.4	23.0	19.1	14.5	8.2	16.78
1927	6.4	4.9	12.4	15.3	19.8	26.1	29.1	27.9	24.2	17.4	13.1	7.8	17.03
1928	6.2	4.8	7.7	15.8	18.6	25.1	28.4	28.8	24.2	16.3	12.5	4.6	16.08
1929	3.5	2.1	7.6	14.6	21.4	25.2	27.4	28.2	19.1	16.1	13.1	6.8	15.42
1930	6.2	6.1	11.1	15.8	18.7	22.4	27.3	27.1	23.3	16.9	10.9	8.6	16.20
1931	7.3	7.9	10.4	12.5	19.5	25.8	29.2	27.7	22.1	16.4	10.5	2.6	15.99

APPENDIX (Continued)

Year	J	F	M	A	M	J	J	A	S	O	N	D	Annual mean
1932	4.3	3.1	7.4	14.2	19.6	24.2	27.7	25.9	24.3	21.7	10.9	7.4	15.89
1933	4.7	7.0	7.8	12.8	17.2	22.4	25.8	24.7	20.0	17.1	13.0	5.1	14.80
1934	4.4	4.2	11.2	15.4	19.7	23.7	27.9	27.3	22.1	17.0	11.7	8.8	16.12
1935	3.7	7.1	8.7	15.4	20.1	25.6	27.3	26.9	22.1	19.2	11.2	8.1	16.28
1936	9.1	7.8	11.2	14.9	17.0	22.2	27.6	25.7	21.0	15.6	11.1	5.3	15.71
1937	4.0	8.2	12.8	13.9	18.6	24.0	26.8	26.5	22.4	16.8	12.3	6.1	16.03
1938	2.9	5.7	9.5	11.7	17.7	24.0	27.8	27.3	21.6	17.4	11.6	8.1	15.44
1939	7.0	6.5	7.7	14.6	18.1	22.7	28.4	26.6	22.5	18.1	10.8	6.4	15.78
1940	2.2	6.4	8.2	12.9	16.0	21.4	26.8	23.6	22.2	15.1	11.7	3.9	14.20
1941	6.1	8.9	10.2	14.8	18.5	23.7	26.5	27.9	19.3	15.3	9.5	3.9	15.38
1942	—0.3	5.9	8.8	13.5	20.1	24.3	26.2	25.9	23.5	16.3	9.7	6.8	15.06
1943	2.9	6.2	7.2	14.4	18.1	22.6	27.6	27.7	23.0	17.8	12.6	7.4	15.62
1944	4.9	6.2	8.1	13.8	17.7	24.7	26.6	25.6	22.8	17.5	10.5	6.4	15.40
1945	3.2	6.1	8.6	13.8	21.8	25.1	27.9	28.1	21.9	15.1	11.3	6.4	15.77
1946	4.0	6.7	9.8	14.3	19.7	25.4	28.1	28.7	24.8	15.5	12.9	6.3	16.35
1947	2.9	8.1	13.8	16.5	19.4	25.1	27.5	26.7	21.7	16.1	11.8	8.4	16.50
1948	8.3	5.3	9.0	13.8	19.7	22.3	26.1	27.6	21.0	17.1	10.6	2.1	15.24
1949	4.7	5.4	6.0	13.8	19.7	23.8	25.6	23.8	20.7	16.3	11.7	7.7	14.93
1950	2.8	7.4	9.8	15.2	18.8	24.1	28.4	26.7	24.0	16.1	10.4	9.1	16.06
1951	6.3	8.9	11.1	14.3	20.3	24.1	26.1	27.1	22.1	13.3	11.5	5.0	15.85
1952	5.9	5.6	8.7	14.8	18.0	23.9	26.2	29.1	25.4	17.9	11.4	9.4	16.36
1953	5.2	7.2	6.3	13.5	17.1	23.4	26.6	24.8	22.4	15.6	7.7	3.7	14.46
1954	3.0	4.3	9.9	11.2	16.9	25.1	27.4	26.4	23.6	16.6	10.9	7.1	15.20
1955	9.1	10.0	9.2	10.3	19.6	23.7	26.9	24.3	20.7	16.8	10.5	8.4	15.79
1956	4.8	3.7	5.7	13.7	17.9	22.2	26.8	27.4	21.3	15.6	10.9	4.9	14.57
1957	4.0	9.0	8.8	12.7	16.9	24.6	26.7	26.9	21.8	16.2	11.1	5.0	15.30
1958	5.8	9.1	8.1	12.3	20.8	24.8	27.1	27.4	20.1	15.9	11.1	7.8	15.86
1959	3.9	4.0	9.9	12.3	18.3	21.9	26.0	25.1	19.2	12.5	9.9	8.8	14.32
1960	5.6	7.3	8.5	12.2	17.8	23.1	25.7	26.8	19.4	17.7	12.4	9.4	15.49
1961	5.1	5.7	10.6	15.0	18.9	23.7	25.9	25.6	21.3	16.1	12.0	5.7	15.47
1962	5.4	4.6	9.9	13.1	20.5	23.5	26.6	27.0	22.5	16.4	13.0	4.6	15.51
1963	4.0	6.8	7.9	13.0	17.5	23.4	26.4	26.6	22.1	16.0	12.1	7.2	15.25
1964	2.4	5.8	9.5	12.7	17.1	23.0	24.8	24.5	20.3	17.2	11.3	7.0	14.63
1965	6.0	3.1	8.7	11.5	16.8	22.9	26.9	23.7	21.7	14.9	10.4	7.4	14.50
1966	3.6	9.8	8.9	14.3	17.6	22.6	26.5	26.7	21.3	19.7	11.7	6.8	15.79
1967	3.5	4.9	9.3	12.6	18.6	21.7	24.5	25.9	21.2	17.4	10.7	6.8	14.76
1968	0.5	7.7	7.9	14.2	20.9	22.6	26.0	24.3	21.6	15.1	12.5	6.1	14.95
1969	4.0	8.0	8.7	11.9	20.6	24.0	24.7	25.6	21.9	15.3	11.4	7.5	15.30
1970	7.7	7.4	9.7	14.6	17.3	22.8	25.8	25.8	21.3	14.8	10.2	5.1	15.19
1971	7.8	5.5	7.3	12.4	19.0	23.4	23.6	25.0	19.4	13.9	10.2	5.4	14.40
1972	6.3	6.8	8.6	14.3	18.4	24.1	24.9	24.2	20.0	12.6	9.9	5.5	14.63
1973	4.1	6.8	6.7	12.8	19.5	23.2	26.5	24.2	21.6	15.9	8.5	4.9	14.56

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ΠΕΡΙ ΤΗΣ ΕΤΗΣΙΑΣ ΠΟΡΕΙΑΣ ΤΗΣ ΘΕΡΜΟΚΡΑΣΙΑΣ ΤΟΥ ΑΕΡΟΣ ΕΝ ΛΑΡΙΣΗ

Ὑπὸ

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(Ἐργαστήριον Μετεωρολογίας καὶ Κλιματολογίας)

Μελετᾶται ἡ ἐτησία πορεία τῆς θερμοκρασίας τοῦ ἀέρος εἰς τὴν πόλιν τῆς Λαρίσης, διὰ τῆς ἀναγωγῆς εἰς μίαν ἐνιαίαν καὶ ὁμογενῆ σειρὰν τῶν μέσων μηνιαίων τιμῶν ὅλων τῶν λειτουργησάντων ἐκεῖ μετεωρολογικῶν σταθμῶν, κατὰ τὴν περίοδον 1899-1973, ἤτοι ἐπὶ 75 πλήρη καὶ συνεχῆ ἔτη, τῇ βοηθείᾳ διαφόρων κριτηρίων ὁμογενείας καὶ τύπων ἀναγωγῆς.

Ἐκ τῆς μελέτης διαπιστώνονται τὰ κάτωθι:

—Ἁπλῆ κύμανσις τῆς ἐτησίας πορείας τῆς θερμοκρασίας ἀέρος, μὲ μεγίστην κατὰ τὸν Ἰούλιον καὶ ἐλαχίστην κατὰ Ἰανουάριον.

—Ἡ μέση μεταβλητότης παρουσιάζεται μεγαλυτέρα κατὰ τὸ ψυχρὸν τρίμηνον Δεκεμβρίου-Ἰανουαρίου-Φεβρουαρίου καὶ μικροτέρα κατὰ τὸ τετράμηνον Ἰουνίου-Σεπτεμβρίου.

—Ἡ τιμὴ τοῦ μέσου ἐτησίου θερμομετρικοῦ εὔρους εἶναι 21.73° C, μὲ σημαντικὰς πάντως αὐξομειώσεις κυμαινομένας ἀπὸ 18.5° C (1955) ἕως 28.0° C (1922), δηλαδὴ παρουσιάζει ἀπόλυτον κύμανσιν 9.5° C.

—Ὁ μέγιστος θερμομετρικὸς δρόμος ἀνέρχεται εἰς 66.6° C, μὲ ἄκρας τιμὰς 45.0° C (23.7.1916, 23.7.1934 καὶ 23.8.1958) καὶ —21.6° C (15.1. 1968).

—Ὑπεροχή, κατὰ κανόνα, τῶν τιμῶν τῆς θερμοκρασίας τοῦ Φθινοπώρου ἔναντι ἐκείνων τῆς ἀνοίξεως· ἐκ τῶν 75 τιμῶν θερμοκρασίας Φθινοπώρου, μόνον οἱ 5 (7 %) εἶναι μικρότεραι τῶν ἀντιστοίχων τῆς ἀνοίξεως.

—Ἐλαφρὰ τάσις ἐλαττώσεως τῆς μέσης ἐτησίας ὡς καὶ τῶν ἐλαχίστων καὶ μεγίστων μέσων μηνιαίων τιμῶν τῆς θερμοκρασίας ἀέρος· μικρὰ τάσις αὐξήσεως τῆς τιμῆς τοῦ μέσου θερμομετρικοῦ εὔρους.