Sci. Annals, Fac. Phys. & Mathem., Uuiv. Thessaloniki, Vol. 13, 159 (1973)

CLOUDINESS IN THE MAJOR AREA OF THESSALONIKI

By

VLADIMIROS E. ANGOURIDAKIS

(Meteorological Institut, University of Thessaloniki)

(Reseived 28.6.1973)

Summary : Cloudiness in the major area of Thessaloniki is examined, based upon observations of the common observational period, between the years 1936 - 40, *and* 1946 - 50, *in the three met. stations of the Aristotelian University of Thessaloniki (AUT), the American Farm School (AFS) and the Sindos Cotton Research Institute (SCRI).*

Correlation between observations of the three stations, taken two by two, proved «g o o d» to «s t r o n g», allowing to extend our conclusions to the whole observational period of each station.

From adjoined Tables and Graphs, we draw the following eonclusions :

— Cyclonic disturbances that occur during the cold season in the area examined, are the main factor of cloudiness maxima. On the contrary, high temperatures and the absence of cyclonic disturbances in the warm season, result in the minima of cloudiness during the summer.

— The atmospheric instability prevailing in the spring, produces the secondary maximum of cloudiness in the month of May, in the met. stations of AUT and AFS.

— The SCRI station is more subject to the cloud - dispersing effect of Vardaris wind, while the other two stations are clearly influenced by the orographic effect of the nearby hills.

— The effeet of the city is evident in the AUT station, having more cloudiness than the other two, rural stations.

— The distance between each station and the coast, has also some effect on its cloudiness.

The above account for the large number of clear days in all three stations during the summer, and the also large number of overeast days in winter.

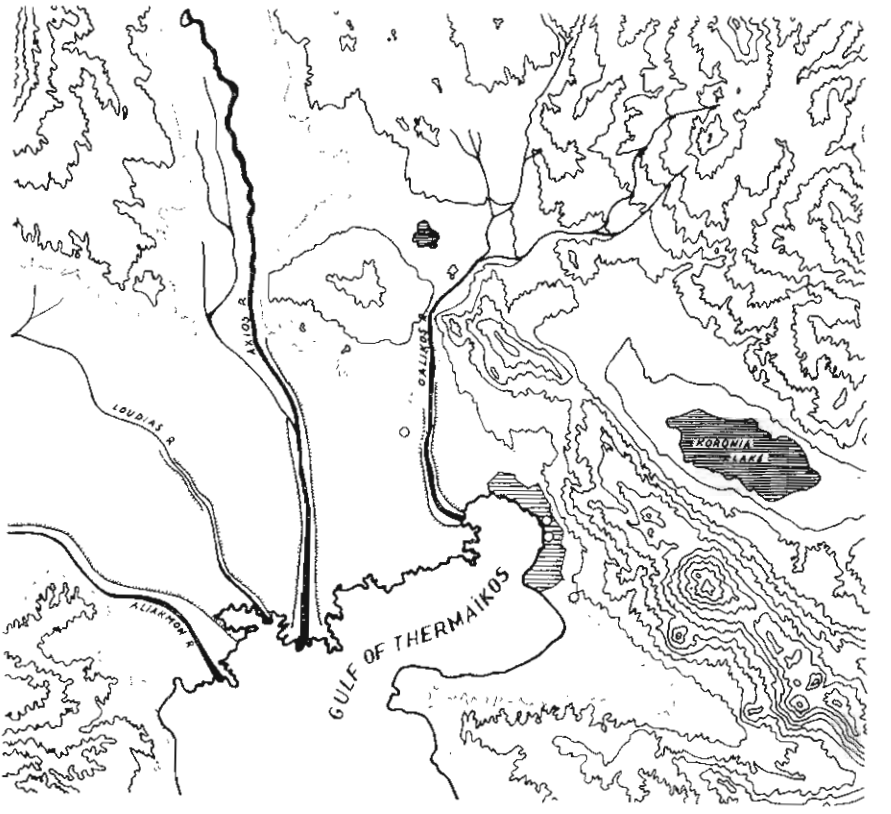
Introduction

Thermaikos Gulf, as compared with other, southern regions of Greece, has a comparatively high percentage of cloudiness (Mariolopoulos [13,14], Kyriazopoulos [8]).

Cloudiness in this area has been the subject of research from scientists working on the general subject of the climate of this region, or on the climate of the greek area (Kuhlbrodt [7], Alexandrou [3], Ma-

RIOLOPOULOS[13,14], KYRIAZOPOULOS [8], PHILIPPSON [15], ABADJOGLOU [1,2]), or works on this specific subject (ANGOURIDAKIS [5]).

In the present work we study cloudiness in the inner recess of Thermaikos Gulf, based upon observations from the following meteorological stations: Aristotelian University of Thessaloniki (AUT), Sindos Cotton Research Institute (SCRI), American Farm School (AFS).



MAP 1

Distances between these stations have as follows: AUT - SCRI: 13,6 km; AUT - AFS: 7,2 km; while the straight-line distance of each station from the sea is: AUT: 1050 m; SCRI: 6600 m; AFS: 2200 m.

The horizon is more open at the SCRI; in the other two stations it is confined by the neighboring hillocks of Redziki - Asvestohorion (elev. 400 - 500 m) and Mt Chortiatis (elev. 1201 m).

Periods of complete observational series in the three stations being

TABLE I

*Monthly mean and extreme values of Cloudiness, as an average of the whole period, of full observational years in each station: AUT (39 years), SCRI (32 years), AFS (25 years)**

MONTH	MS/AUT					MS/SCRI					MS/AFS				
	MAX	YEAR	$\overline{N}$	MIN	YEAR	MAX	YEAR	$\overline{N}$	MIN	YEAR	MAX	YEAR	$\overline{N}$	MIN	YEAR
J	8,6	33,55	6,7	3,9	64	8,2	55	6,0	3,6	64	8,5	33	6,4	2,1	25
F	9,1	42	6,2	3,5	59	8,5	54	5,2	2,9	59	9,0	42	5,9	4,4	28,43,45
M	8,6	69	6,6	3,5	53	8,2	60	5,6	2,6	53	8,2	31,32	6,3	3,7	48
A	7,4	66	5,8	4,1	39	6,4	36	4,8	2,5	47	6,9	37	5,6	3,7	45
M	7,5	57	5,9	4,0	66	6,3	36,57	4,6	2,4	58	7,4	36	5,6	4,0	42
J	6,1	68	4,5	2,1	38	5,0	68	3,6	1,6	38	5,6	30	4,0	2,4	38
J	5,3	69	2,7	1,5	31,54	4,8	59	2,2	0,8	54	4,1	38	2,3	1,3	29,50
A	4,2	42,68	2,5	0,5	46	4,2	60	2,1	0,5	46,56	3,7	39	2,2	0,7	28,46
S	5,9	60	3,6	1,4	46	5,1	55	3,0	1,2	54	5,4	29	3,3	1,1	42
O	8,9	51	5,4	3,5	35,56	8,9	51	4,9	2,9	56	6,8	37	5,0	3,5	45
N	8,0	56	6,7	4,5	30,70	7,8	54	6,0	3,8	60	7,5	37	6,4	4,7	30
D	9,0	38	6,8	4,7	51	8,4	46	5,8	3,9	56	9,0	38	6,8	4,7	41
E	6,17	69	5,27	4,66	38	5,02	40,55	4,50	3,83	61	5,61	40	4,98	4,38	35
MAX	9,1 Feb.42					8,9 Oct. 51					9,0 Feb.40 and Dec. 38				
MIN				0,5 Aug. 46					0,5 Aug. 46					0,7 Aug. 28,46	

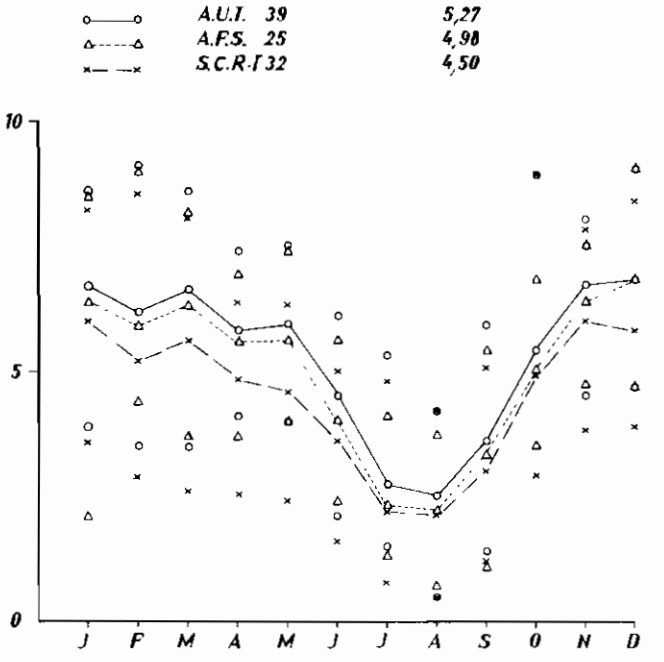
* Monthly mean values for the years: 1933, 34, 35, have been taken from «THE CLIMATE OF CENTRAL GREEK MACEDONIA» by B. D. Kyriazopoulos.

unequal (AUT: 1930 - 40, 42 - 43*, 46 - 71; SCRI: 1936 - 40, 43, 46 - 71; AFS: 1925 - 33, 35 - 42, 44 - 50) the period common for all three stations had to be restricted to the ten years between 1936 - 40, 1946 - 50.

Cloudiness was measured in tenths of sky covered, and whenever it was given in eighths it has been converted to tenths. We study and compare values of the three daily observations, as well as the resulting daily mean values of cloudiness:

$$MC = \frac{C_{8h} + C_{14h} + C_{20h}}{3}$$

The adjoined Table I and Graph I have been drawn according to



GRAPH I

* Years 1942 - 43 have been covered from observations of the german weather station, that has functioned during the country's occupation from the german army, at a site standing some 1000 m to the south of the AUT station (Livadas - Arseni - Paradimitriou [12]). A correlation between simultaneous observations of cloudiness at the two sites (at 08:00 hours, Jan. 1943 - June 1944), resulted in cloudiness correlation coefficient : $r = + 0,99$.

values of daily mean cloudiness for all the full calendar years of observations for each station examined.

In spite of the unequal periods (which can not be compared statistically), all series have certain common features, characterizing the distribution of cloudiness in the area of Thermaikos Gulf.

In the met. station of AUT are recorded the highest monthly mean values of cloudiness, while the station of SCRI has the smallest (differences do not exceed 1,3 tenths). The station of AFS records intermediate values, nearer to those of AUT, and sometimes tending to become equal. This graduation of cloudiness in the above stations is accounted for in the end of this paper.

I. Cloudiness correlation coefficient in the three stations.

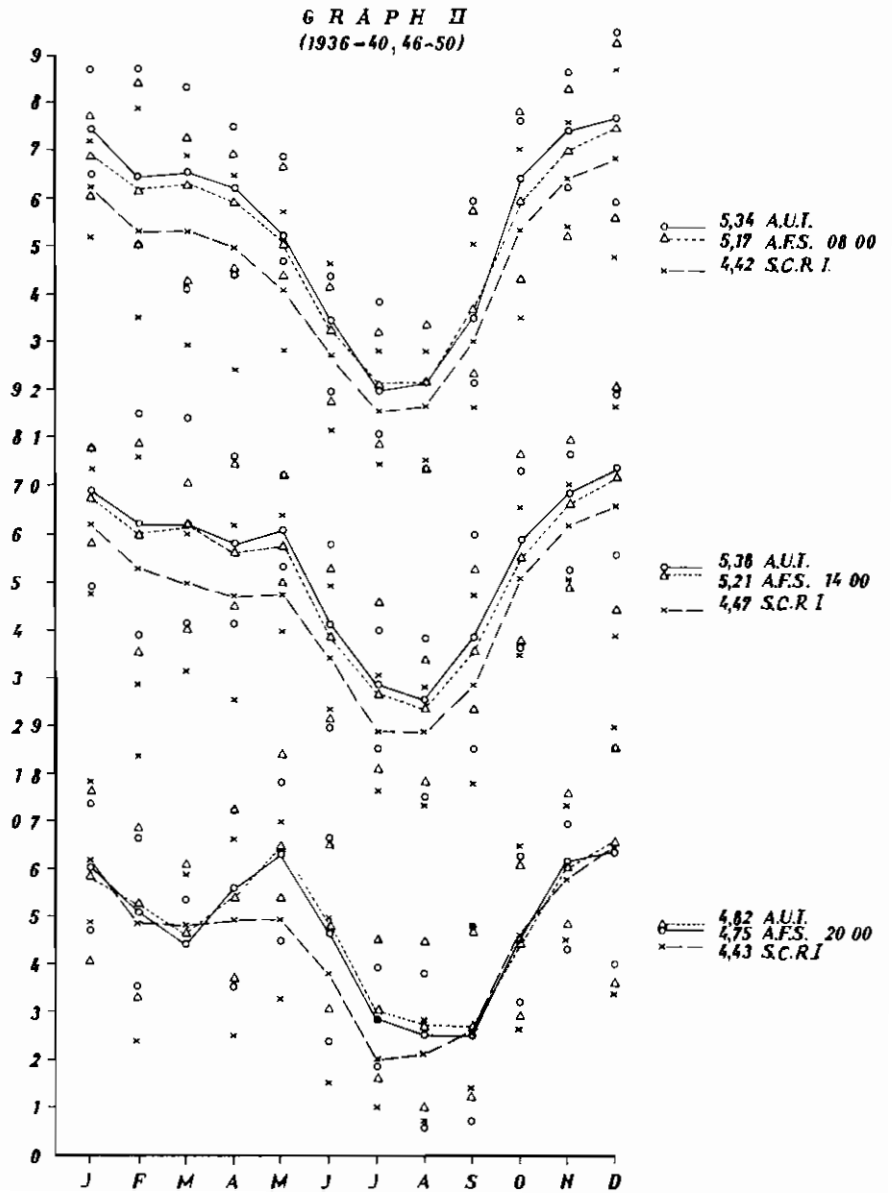
TABLE II

Correlation coefficients of monthly and annual values of cloudiness in the meteorological stations of: AUT, SCRI, and AFS, taken two by two, for their common period: 1936 - 40, 1946 - 50

	VALUES OF: r PER CENT (%)													
COUPLES OF M.S.	TIME	J	F	M	A	M	J	J	A	S	O	N	D	A
AUT/SCRI	08h00	65	94	86	76	93	89	88	93	97	90	84	89	94
»	14h00	77	95	82	83	66	75	67	88	82	91	91	94	77
»	20h00	75	87	68	82	89	86	82	90	63	81	51	93	65
»	M.D.	81	95	87	87	93	87	83	95	90	95	89	93	83
AUT/AFS	08h00	95	98	95	86	94	94	82	95	89	96	91	85	81
»	14h00	77	91	79	80	55	89	70	90	87	76	80	92	51
»	20h00	75	74	39	76	87	90	50	89	87	93	71	81	38
»	M.D.	87	93	80	87	86	94	66	93	88	95	90	89	64
SCRI/AFS	08h00	61	96	88	88	77	89	61	86	91	91	86	87	73
»	14h00	76	89	71	88	77	91	47	94	75	76	76	98	86
»	20h00	65	70	46	85	90	87	65	91	73	90	57	92	82
»	M.D.	76	91	71	93	84	94	57	99	94	97	92	95	87

From hereafter, all comparisons and conclusions, unless otherwise stated, refer to the common for all three stations period between the years: 1936 - 40, and 1946 - 50.

From Table II, which gives the correlation coefficient of monthly



and annual values of cloudiness in the three stations (taken two by two), we find that for all three couples of the correlated stations, more than 80 % of the total of the resulting figures, have correlation coefficients: $r \geqq 70$ %, while only 4 % of the figures of AUT/AFS and SCRI/AFS have correlation coefficients: $r < 50$ %. The correlation coefficient for the AUT/SCRI couple is always: $r \geqq 50$ %.

From the above, we may conclude that the correlation between corresponding values of cloudiness in the three stations, taken two by two, is «good» to «strong», allowing to extend the conclusions drawn from the common decade, to the whole observational periods of full calendar years in the three stations examined.

II. Cloudiness at 08 : 00, 14 : 00 and 20 : 00 hours.

The annual variation of cloudiness as a mean of the period examined, for the three daily observations, in all three stations, mostly shows a double fluctuation. An exception to this rule, are the cases of the met. station of SCRI/08 : 00 hours (single fluctuation), and the met. station of AFS/14 : 00 hours (triple fluctuation).

Graph 11 clearly illustrates the similarity between the annual variation of cloudiness in the met. stations of AUT and AFS, especially at 20 : 00 hours.

In all three daily observations, in the three stations examined, as a mean for the whole period, the primary maximum is observed in December, while the primary minimum in the months of July or (and) August, and in one case (AUT/20 : 00h) in the months of August and September.

The monthly mean values of cloudiness, as well as the annual mean, are higher in the AUT met. station and smaller in the SCRI, while those of the AFS are in between, tending sometimes to equal those of the AUT.

During the cold season, at 20 : 00 hours, the monthly mean values of all three stations are practically identical, their differences varying around the observational error.

All the above conclusions, as well as those drawn from the study of Graph II, are discussed in the end of this paper.

III. Daily mean cloudiness.

As a mean for the whole period, the annual variation of cloudiness has a double fluctuation in the met. stations of AUT and AFS, and

TABLE III

Monthly mean and extreme values of cloudiness (M.D.) and their standard devations of the meteorological stations: AUT, SCRI, AFS. Common period: 1936 - 40, 1946 - 50.

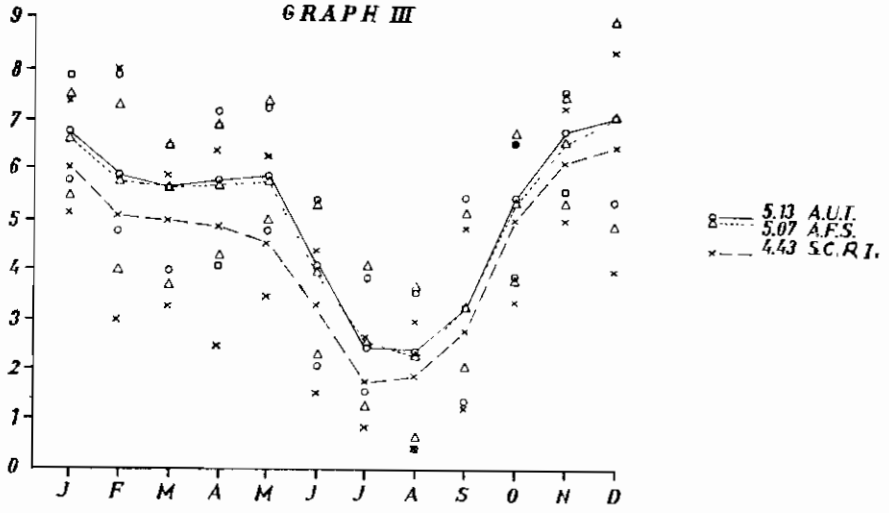
M	MS/AUT						MS/SCRI						MS/AFS					
	MAX	YEAR	$\overline{N}$	SD	MIN	YEAR	MAX	YEAR	$\overline{N}$	SD	MIN	YEAR	MAX	YEAR	$\overline{N}$	SD	MIN	YEAR
J	7.9	1946	6.8	0.60	5.8	1937	7.4	1946	6.1	0.74	5.2	1937	7.5	1940,46	6.6	0.68	5.5	1948
F	7.9	1947	5.9	1.05	4.8	1939	8.0	1947	5 1	1 30	3 0	1949	7 3	1947	5 8	0.99	4.0	1949
M	6.5	1950	5.7	0.79	4.0	1938	5.9	1940	5.0	0.92	3.3	1948	6.5	1939	5.7	0.80	3.7	1948
A	7.2	1948	5.8	1 00	4 1	1939	6 4	1937	4 9	1 10	2 5	1947	6 9	1937	5 7	0 88	4 3	1947
M	7 3	1946	5.9	0.72	4.8	1938	6.3	1936	4.6	0.84	3.5	1938	7.4	1936	5.8	0.76	5.9	1949
J	5.4	1940	4.1	1.11	2.1	1938	4.4	1948	3.3	0.94	1.6	1938	5.3	1936	4.0	1.03	2.4	1936
J	3.9	1947	2.5	0.68	1.6	1946,50	2.7	1947	1.8	0.61	0.9	1950	4.1	1938	2.6	0.81	1.3	1950
A	3.6	1939	2.4	0.86	0.5	1946	3.0	1939	1.9	0.69	0.5	1946	3.7	1939	2.3	0.84	0.7	1946
S	5.5	1939	3.3	1.01	1.4	1946	4.9	1939	2.8	0.97	1.3	1946	5.2	1939	3.3	0.83	2.1	1946
O	6.6	1937,46	5.5	0.93	3.9	1938	6.6	1946	5.0	1.12	3.4	1950	6.8	1937	5.4	1.10	3.8	1950
N	7.6	1946,48	6.8	0.66	5.6	1938	7.3	1946	6.2	0.71	5.0	1938	7.5	1937	6.6	0.62	5.4	1938
D	9.0	1938	7.1	1.17	5.4	1936,48	8.4	1946	6.5	1.46	4.0	1948	9.0	1938	7.1	1.24	4.9	1948
A	5.59	1947	5.15	0.27	4.66	1938	5.02	1940	4.43	0.33	3.97	1938	5.61	1940	5.07	0.41	4.48	1948
MAX	9.0 Dec. 38						8.4 Dec. 46						9.0 Dec. 38					
MIN					0.5 Aug. 46						0.5 Aug. 46						0.7 Aug 46	

(8.2 Dec. 38)

single fluctuation in the SCRI station.

Here also the primary maximum for all three stations occurs in December, while the primary minimum of the AUT and AFS stations is recorded in August, and that of SCRI in July.

The mean annual variation of cloudiness is practically identical in the met. stations of AUT and AFS, while the monthly mean values of cloudiness in the SCRI are nearer those of the other two stations du-



ring the cold season, than they are during the warm one.

From the distribution of standard deviations for all three stations, for each month as well as for the whole year, we observe that these values are strongly gathered around the $\overline{N} - \sigma$, $\overline{N} + \sigma$ interval, and also that significant deviations are not recorded in any case.

Finally, Table V, contains percentages of monthly mean values of cloudiness in the three stations, in the main grades of the cloudiness scale.

Except for the interval of 5,0 - 5,9 tenths, in all the remaining grades of Table V, percentages are almost the same for the met. stations of AUT and AFS.

All the conclusions drawn from the above Tables and Graphs, are discussed in the end of this paper.

TABLE IV

Standard devations. Distribution of cloudiness values in the met. stations of: AUT, SCRI, AFS.
Common period: 1936 - 1940, 1946 -1950

M	MS/AUT						MS/SCRI						MS/AFS					
	-3σ	-2σ	-σ	+σ	+2σ	+3σ	-3σ	-2σ	-σ	+σ	+2σ	+3σ	-3σ	-2σ	-σ	+σ	+2σ	+3σ
J	0	1	7	2	0		0	1	6	3	0		0	2	5	3	0	
F	0	2	7	1	0		0	2	7	0	1		0	2	5	3	0	
M	1	1	7	1	0		0	2	8	0	0		1	1	8	0	0	
A	0	2	6	2	0		1	0	8	1	0		0	2	7	2	0	
M	0	1	7	2	0		0	1	7	1	1		0	1	7	1	1	
J	0	2	6	2	0		0	1	7	2	0		0	3	5	2	0	
J	0	3	6	0	1		0	3	5	2	0		0	2	7	1	0	
A	1	0	7	2	0		1	0	8	1	0		0	1	8	1	0	
S	0	1	8	0	1		0	2	7	0	1		0	2	7	0	1	
O	0	2	6	2	0		0	3	4	3	0		0	3	5	2	0	
N	0	2	6	2	0		0	3	5	2	0		0	2	6	2	0	
D	0	2	6	2	0		0	2	6	2	0		0	2	6	2	0	
A	0	2	7	1	0		0	2	7	1	0		0	3	5	2	0	

TABLE V

M.S.	5,0 - 5,9	4,0 - 6,9	3,0 - 7,9	2,0 - 8,9	1,0 - 10,0	0 - 0,9
AUT	21,7 %	59,2 %	80,0 %	94,2 %	99,2 %	0,8 %
SCRI	24,2 %	53,4 %	72,5 %	89,2 %	98,4 %	1,7 %
AFS	24,2 %	60,0 %	79,2 %	93,4 %	99,2 %	0,8 %

TABLE VI

Mean numbers of clear, cloudy and overcast days over the Thermaïkos Gulf

M	—A— MEAN OF THE WHOLE OBSERVATIONAL PERIOD OF EACH STATION									—B— MEAN OF THE COMMON PERIOD OF THE STATIONS								
	CLEAR			CLOUDY			OVERCAST			CLEAR			CLOUDY			OVERCAST		
	AUT	SCRI	AFS	AUT	SCRI	AFS	AUT	SCRI	AFS	AUT	SCRI	AFS	AUT	SCRI	AFS	AUT	SCRI	AFS
J	4,0	5,4	3,9	13,1	14,3	12,2	13,9	11,3	14,9	4,8	7,0	5,1	11,3	10,0	11,5	14,9	14,0	14,4
F	4,6	5,8	4,6	12,7	14,7	12,1	10,9	7,7	11,5	6,5	8,1	6,1	10,3	11,2	11,5	11,5	9,0	10,7
M	3,6	6,0	4,4	15,1	15,5	16,6	12,3	9,6	9,9	6,0	8,5	5,1	15,9	13,6	16,7	9,1	8,9	9,2
A	4,2	5,6	5,2	17,5	19,3	17,3	8,3	5,2	7,5	6,0	8,2	5,7	14,4	14,2	15,1	9,6	7,6	9,2
M	2,9	5,3	3,6	21,0	21,9	19,8	7,2	3,8	7,6	4,8	8,3	3,8	17,4	16,4	18,2	8,8	6,3	9,0
J	5,9	8,6	7,6	20,7	19,7	19,1	3,4	1,8	3,3	10,5	12,5	9,6	15,7	15,4	17,0	3,8	2,1	3,4
J	13,7	14,9	16,3	16,3	15,6	13,6	1,0	0,6	1,1	18,7	22,1	17,2	10,3	8,1	11,6	2,0	0,8	2,2
A	15,0	16,0	15,6	14,9	14,3	14,5	1,2	0,8	0,9	18,8	21,3	17,7	10,8	8,7	12,0	1,4	1,0	1,3
S	10,9	11,8	13,6	16,1	15,8	13,9	3,0	2,4	2,5	14,0	16,7	14,2	13,1	11,0	13,4	2,9	2,3	2,4
O	6,7	7,3	8,6	15,9	16,7	14,6	8,5	7,1	7,8	7,6	9,2	8,0	13,3	12,9	12,3	10,1	8,9	10,7
N	3,3	4,4	4,1	14,2	15,1	13,5	12,5	10,5	12,4	3,9	5,2	4,4	11,6	12,1	11,8	14,5	12,7	13,8
D	3,6	5,7	3,4	13,6	14,4	11,4	13,8	10,9	16,2	3,3	5,4	3,4	10,9	10,1	11,0	16,8	15,5	16,6
A	78,3	96,6	91,1	191,0	197,2	178,6	95,9	71,5	95,6	104,9	132,5	100,3	155,0	143,7	162,1	105,4	89,1	102,9

IV. CLEAR (<2 TENTHS), CLOUDY (2 - 8 TENTHS) AND OVERCAST (>8 TENTHS) DAYS.

Table VI contains the number of clear, cloudy, and overcast days in the three stations examined, as a mean: (A) of the whole period of full calendar years of observations in each station; (B) of the common for the three stations period.

Table VI - A is included in the above Table VI only for comparison's sake, while all our conclusions are based on values of Table VI - B of the decade common for all three stations.

CONCLUSIONS.

From the above mentioned, we have come to the following conclusions:

—The annual variation of cloudiness, as a mean of the whole period examined, shows a double fluctuation in the met. stations of AUT and AFS, and single fluctuation in the SCRI station. The primary maximum for all three stations occurs in December, while the primary minimum of the AUT and AFS stations occurs in August, and that of SCRI in July. In the stations of AUT and AFS, having a double fluctuation, the secondary maximum occurs in the month of May, and the secondary minimum in March. The above are explained as follows:

(a) The frequent cyclonic disturbances, caused by the mediterranean branch of the polar front, contribute to the increase of cloudiness during the cold season, and especially in December, when it attains its maximum.

Another important factor contributing to the increase of cloudiness in this area during the cold season in general, are the sea breezes: Air masses stagnating above the Thermaikos Gulf, increase its water vapor content, and are then induced by sea breezes to move landwards. The relief of the area, and especially that of the AUT and AFS met. stations, induces the orographic lifting of these moving air masses (if we consider the fact that the peak of Mt Chortiatis — elev. 1201 m — stands at a distance of merely 20 km from the coast, it follows that this lifting should be rather rapid), and thus we have condensation of vapors into clouds, due to convection, which results in the increase of cloudiness, especially above the met. stations of AUT and AFS.

A third factor that contributes to the increase of cloudiness in December, is the occurence of fogs in the area examined (ANGOURIDAKIS [5]),

which are more frequently recorded during the months of December and January (it should be noted that in all three stations the mean monthly cloudiness of January is a little smaller than that of December).

Finally, we can mention (though this is in a much smaller scale) the formation of clouds due to condensation of water vapors from the lakes that lie to the NE of Mt Chortiatis, with the concurrence of suitable meteorological conditions.

Indeed, lakes Coronia and Volvi, lie to N and NE of Mt Chortiatis in the valley between Mts Kroussia and Chortiatis. Radiation fogs being quite frequent over both lakes, during the cold season, driven by lights valley breezes, are often carried over the northern slopes of Mt Chortiatis as stratus clouds; sometimes these stratus clouds reaching over the crest of the mountain, which defines the eastern horizon of the area examined, rise above it, thus increasing the cloudiness of the above stations.

(b) The primary minimum of July and August is due to high temperatures (July and August being the hottest months in this area), as well as to the absence of cyclonic disturbances during this season.

(c) The occurence of the secondary maximum in the month of May for the met. stations of AUT and AFS, we attribute to the instability prevailing during this season, which results in convective clouds that are boosted by the neighboring hills and mountain. The SCRI station standing much further than the above two from these hills, is not greatly influenced; thence the absence of a secondary maximum in this station.

Besides, an important factor which abolishes the secondary maximum in the SCRI station, and generally contributes to the lesser cloudiness in this station, as compared with that of the other two, is the wind Vardaris (Map I), which, because of its cloud - dispersing properties, diminishes the cloudiness over the SCRI station, while this same wind gets milder and only slows - up cloudiness in the other two stations, because of the hills that shelter them.

(d) The secondary minimum in the month of March, is due to the arrival over the Balkans of continental air masses from bigger latitudes.

—As an average for the whole period examined, the monthly mean values of cloudiness in the AUT station are higher than those of the other two stations, the SCRI having the smallest. The values of the AFS are in - hetween, yet nearer those of the AUT.

The factors of this gradation are the following:

(a) *The urban factor:* The influence of the city upon the increase of cloudiness over it, is evident (GRIFFITHS [6], LANDSBERG [9], SAKALIS [16], TOUT [17]). The numerous sources of condensation nuclei in the city of Thessaloniki (AUT met. station) contribute to the increase of cloudiness over it, as compared with the other two rural stations (AFS and SCRI). As a matter of fact, the heating installations, exhaust gases, dust from traffic, various industries and factories, ships riding at anchor in the port, etc., continuously enrich the air of the city with condensation nuclei, which, under suitable meteorological conditions (arrival of humid air masse, drop of temperature etc.), increase the cloudiness over the met. station of the AUT. The met. station of the AFS, standing nearer to the city than that of the SCRI, is more subject to the influence of the city, and consequently records values of cloudiness nearer to those of the AUT station.

(b) *The distance of each met. station from the coast:* The met. station of the AUT is nearer to the coast, and consequently undergoes more strongly the effects of humid air masses coming from the sea, and thence records more fogs than the other two. As a matter of fact, a check (not only between observational days, but also between individual observations) proved that quite often the AUT station records fogs that do not reach to the AFS station.

(c) *The relief of the area:* Orographic clouds considerably increase the cloudiness of the AUT and AFS met. stations, while they have very little effect in the remote station of SCRI. Besides, this same relief allows the direct and unhindered flow of cloud-dispersing wind Vardaris in the SCRI station, while the hills standing to the north of the AUT and AFS stations, slighten or slow down the effect of Vardaris on these stations.

— Generally there is an increase of cloudiness around midday: This, of course, is due to the greater temperature differences during this time of day.

Exceptions to the above rule are: (a) Radiation fogs, which, when they occur, increase eventually the cloudiness of 08 : 00 hours (since, as a rule, they disperse by 11 : 00 or 12 : 00 hours). (b) Cases when cloudiness increases around 20 : 00 hours, during the month of May. This is due to the formation of the above mentioned convective clouds, which usually start around 11 : 00 hours, and are fully developed in the evening.

— If we consider the percentage of cloudiness values from the three stations, around certain grades of the cloudiness scale (Table V), we

find a certain similarity in the distribution of cloudiness values in the stations of AUT and AFS; this similarity is explained by the above mentioned effect of the city (urban factor) and the local relief on these two stations. The same two factors explain the smaller cloudiness in the SCRI station, on account of the Vardaris wind.

— From Table VI - B, we find that the months of July and August have the largest number of clear days in all three stations, while December (AUT, AFS) and November (SCRI) have the smallest number of clear days. This is in full accordance with all the above mentioned conclusions on the annual variation of cloudiness in the area examined. Moreover, the SCRI station has an overall larger number of clear days than the other two; this too is explained by the above conclusions.

Exactly the opposite applies regarding the number of overcast days: We should however mention that, figure of Table VI - A for overcast days in the months of July and August, do not agree with those mentioned by LIVADAS [10]; but this difference arises from the fact that, while figures in Livadas' work are based on continuous recordings of sunshine recorder charts, our characterization of a day as «cloudy» or «overcast» is based on the mean of the three daily observations (at 08 : 00, 14 : 00, and 20 : 00 hours).

We observe only a slight month to month variation in the number of cloudy days, in all three stations examined. This however can be explained by the fact that the characterization of «cloudy» days, includes days with cloudiness' values as high as 60 % of the cloudiness scale. Thus, summer days with little more than two tenths of cloudiness, and winter days with little less than eight tenths, are both termed «cloudy» days. Consequently, the probability of cloudy days' occurence, rises to 60 %.

REFERENCES

1. ABADJOGLOU, C., 1968: «The Climate of Sindos». Sindos Coton Research Institute. Scientific Bulletin No. 14.
2. ABADJOGLOU, C., 1971: «Climatic Data of Sindos». Sindos Cotton Research Institute. Scientific Bulletin No. 21.
3. ALEXANDROU, L., 1933: «The Climate of Thessaloniki» Sci. Annals Fac. Phys. and Mathem., Univ. Thessaloniki, Vol. I.
4. ANGOURIDAKIS, VL., 1966: «On Weather Conditions Reducing the Horizontal Visibility in Thessaloniki» Doctoral Thesis. Thessaloniki.
5. ANGOURIDAKIS, VL., 1969: «Cloudiness in Thessaloniki». Publications of the

Meteorological Institute No. 2, Mathematics Section of Ioannina Campus (A.U.T.).

6. Griffiths, John F., 1966: «Applied Climatology. An Introduction». Oxford University Press. London.
7. Kuhlbrodt, Erich, 1920: «Klimatologie und Meteorologie von Mazedonien». Hamburg.
8. Kyriazopoulos, B. D., 1939: «The Climate of Central Greek Macedonia» Publ. Lab. Agric. Physics and Climatology, No. 14, Athens.
9. Landsberg, H. E., 1960: «Physical Climatology». Gray Publ. Co.
10. Livadas, G. C., 1969: «Sunshine duration in Thessaloniki (I). Puhl. of the Meteorological Institute No. 1, Mathematics Section of Ioannina Campus (A.U.T.).
11. Livadas, G. C., Maldhoyannis, Th. and Flocas, A. A., «Sunshine Duration iu Thessaloniki (II). Publ. of the Meteorologieal Institute No. 3, Mathematics Section of Ioannina Campus (A.U.T.).
12. Livadas, G. C. and Arseni-Papadimitriou, A., 1972: «Meteorological Observations of the German Weather Station in Thessaloniki 1941 - 1944». «Climatologika» No. 1, Publications of the Meteorological - Climatological Iustitute, Uuiv. of Thessaloniki.
13. Mariolopoulos, E. G., 1936:«The Distributiou of Meteorological Elements in Greece». Athens.
14. Mariolopoulos, E. G., 1938:«The Climate of Greece». Athens.
15. Philippson, Alfred, 1948: «Das Klima Griechenlaud». Bonn.
16. Sakalis, Basil, 1951: «The Climate of the City». Athens.
17. Tout, D. G., 1973: «Manchester Sunshine». «Weather», Vol. 28, No. 4, (pp. 164 - 166). April 1973.

MATERIAL

18. Observations Mètèorologiques de Thessaloniki 1930 - 1969, Annuaire de l'Institut Mètèorologique et Climatologique No. 1 - 37 [Mariolopoulos (1-8), Kyriazopohlos (9-25), Livadas (26-37)].
19. E.M.Y. (Hellenic National Meteorological Service). Records of Meteorological Observations from the met. Station of the American Farm School in Thessaloniki: 1930 - 1950.

ΠΕΡΙΛΗΨΙΣ

Η ΝΕΦΩΣΙΣ ΕΙΣ ΤΗΝ ΠΕΡΙΟΧΗΝ ΜΕΙΖΟΝΟΣ ΘΕΣΣΑΛΟΝΙΚΗΣ

Ὑπὸ

ΒΛΑΔ. ΑΓΓΟΥΡΙΔΑΚΗ

(Ἐργαστήριον Μετεωρολογίας Πανεπιστημίου Θεσσαλονίκης)

Μελετᾶται ἡ νέφωσις εἰς τὴν περιοχὴν μείζονος Θεσσαλονίκης, ἐπὶ τῇ βάσει τῶν παρατηρήσεων νεφώσεως τῶν μετεωρολογικῶν σταθμῶν : Ἀριστοτελείου Πανεπιστημίου Θεσσαλονίκης, Ἀμερικανικῆς Γεωργικῆς Σχολῆς, καὶ Ἰνστιτούτου Βάμβακος Σίνδου, κατὰ τὴν κοινὴν αὐτῶν περίοδον παρατηρήσεων : 1936 - 40, 1946 - 50.

Συσχέτισις γενομένη μεταξὺ τῶν παρατηρήσεων τῶν τριῶν σταθμῶν (λαμβανομένων ἀνὰ δύο), ἀπεδείχθη «καλὴ» ἕως «ἰσχυρά», ἐπιτρέπουσα τὴν ἐπέκτασιν τῶν συναγομένων συμπερασμάτων εἰς ὁλόκληρον τὴν περίοδον παρατηρήσεων ἑκάστου σταθμοῦ.

Ἐκ τῶν παρατιθεμένων Πινάκων καὶ Διαγραμμάτων, συνάγονται τὰ ἀκόλουθα συμπεράσματα :

—Αἱ κυκλωνικαὶ διαταράξεις, αἱ ὁποῖαι λαμβάνουν χώραν κατὰ τὴν ψυχρὰν περίοδον τοῦ ἔτους εἰς τὴν θεωρουμένην περιοχήν, εἶναι τὸ κύριον αἴτιον τῆς δημιουργίας τῶν μεγίστων τιμῶν τῆς νεφώσεως. Ἀντιθέτως, αἱ ὑψηλαὶ θερμοκρασίαι ἀφ' ἑνὸς καὶ ἡ ἔλλειψις τῶν ἀνωτέρω κυκλωνικῶν διαταράξεων κατὰ τὴν θερμὴν περίοδον τοῦ ἔτους ἀφ' ἑτέρου, ἔχουν ὡς ἀποτέλεσμα τὴν ἐμφάνισιν τοῦ ἐλαχίστου τῆς νεφώσεως κατὰ τὸ θέρος.

—Ἡ ἐπικρατοῦσα ἀτμοσφαιρικὴ ἀστάθεια τῆς ἐαρινῆς περιόδου, ἀποτελεῖ τὸ αἴτιον δημιουργίας τοῦ δευτερεύοντος μεγίστου τοῦ μηνὸς Μαΐου εἰς τοὺς μετεωρολογικοὺς σταθμοὺς ΑΠΘ καὶ ΑΓΣ.

—Ὁ μετεωρολογικὸς σταθμὸς ΙΒΣ ἐπηρεάζεται ἀμεσώτερον τῶν δύο ἄλλων, ἀπὸ τὰς νεφοδιαλυτικὰς ἰδιότητας τοῦ ἀνέμου Βαρδάρη, ἐνῶ οἱ δύο ἕτεροι σταθμοὶ ὑφίστανται σαφῶς τὴν ἐπίδρασιν τῶν πλησιέστερον πρὸς αὐτοὺς κειμένων ὑψωμάτων.

—Ἡ ἐπίδρασις τῆς πόλεως εἶναι σαφὴς εἰς τὸν μετεωρολογικὸν σταθμὸν τοῦ ΑΠΘ, προκαλοῦσα αὔξησιν τῆς νεφώσεως, ἔναντι τῶν ἑτέρων δύο κειμένων ἐν ὑπαίθρῳ.

—Ἡ ἀπόστασις τῆς θαλάσσης ἀφ' ἑκάστου σταθμοῦ, ἐπηρεάζει ἐπίσης τὴν νέφωσιν ἑκάστου.

Τὰ ἀνωτέρω ἑρμηνεύουν ἐπίσης καὶ τὸν μεγάλον ἀριθμὸν αἰθρίων ἡμερῶν εἰς τοὺς τρεῖς σταθμοὺς κατὰ τὸ θέρος, ὡς καὶ τὸν μεγάλον ἀριθμὸν νεφοσκεπῶν ἡμερῶν κατὰ τὸν χειμῶνα.