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ΑΣΤΡΟΝΟΜΙΑ.— **Solar Activity and precipitation within the zones of Latitude 0° - 40° N** *by J. Xanthakis - C. Poulakos - B. Tritakis**. Ἀνεκοινώθη ὑπὸ τοῦ Ἀκαδημαϊκοῦ κ. Ι. Ξανθάκη.

Introduction. In a previous paper (Xanthakis, 1973) it has been shown that any investigation of the correlation between solar activity and precipitation should not be limited to isolated stations or small areas of the Earth, but it should refer rather to extended latitude zones of the Earth's surface defined for examble by the parallels corresponding to the latitudes φ_1 and φ_2.

By averaging over such a zone, the terrestrial influences on precipitation are to a large extend smoothed out and the extraterrestrial factors controlling precipitation emerge. On the basis of these considerations the following method has been used (Xanthakis, 1973) for the investigation of the correlation between solar activity and precipitation in the four latitude zones of the northern hemisphere defined by the relation

$$\varphi_i \leqslant \varphi \leqslant \varphi_{i+10^\circ}, \quad i = 0^\circ, 10^\circ, 20^\circ, 30^\circ.$$

1) For each latitude zone all stations ($i = 1, 2, \ldots N$) with a more or less long series of precipitation observations have been considered.

2) For each of these stations the values of the differences $R_i - R_o$ have been calculated where R_i is the mean annual precipitation in a given year corresponding to the station i and R_o is the minimum mean annual

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precipitation for the same station during the entire time interval under consideration.

3) For each year the «variation of the mean zonal annual precipitation»

$$\overline{R - R_o} = \frac{1}{N} \sum_{i=1}^{N} (R_i - R_o)$$

has been calculated. As mentioned already this quantity is more or less independent of the latitude zone, and the terrestrial influences, provided that the stations available in the corresponding zone are sufficienly numerous and uniformly distributed over the entire zone.

4) The areas index Ia defined with the help of the relation (Xanthakis, 1967)

$$Ia = \frac{1}{2} [\sqrt{A} + \sqrt{F}]$$

where A and F are respectively the areas of sunspots and faculae corrected for foreshortening has been used as the index of solar activity. The advantages resulting from the use of the areas index Ia instead of the relative sunspot numbers WN as an index of the solar activity have been discussed recently by Poulakos and Tritakis (1973).

The same method has been used in the present paper for an extention of the above investigation to the four latitude zones defined by the relation

$$\varphi_i \leqslant \varphi \leqslant \varphi_{i+10}, \ i = 0, 10°, 20°, 30°.$$

2. Latitude Zone $30° \leqslant \varphi \leqslant 40°$ N.

The majority of the stations of this zone have, as in the case of the zone $40° \leqslant \varphi \leqslant 50°$ (Xanthakis, 1973), rather long series of precipitation observations. Furthermore, these stations are more or less uniformly distributed between the longitudes 122° W and 141° E.

The names, the geographical coordinates and the values of R_o for these stations are given in Appendix A. The desert located stations are used separately.

Fig. 1 represents the relation between the variation of the mean zonal annual precipitation $\overline{R - R_o}$ and the areas index Ia. From this figure we see that the correlation between these two quantities is very low.

The same is also valid if we use the relative sunspot numbers WN instead of the areas index Ia.

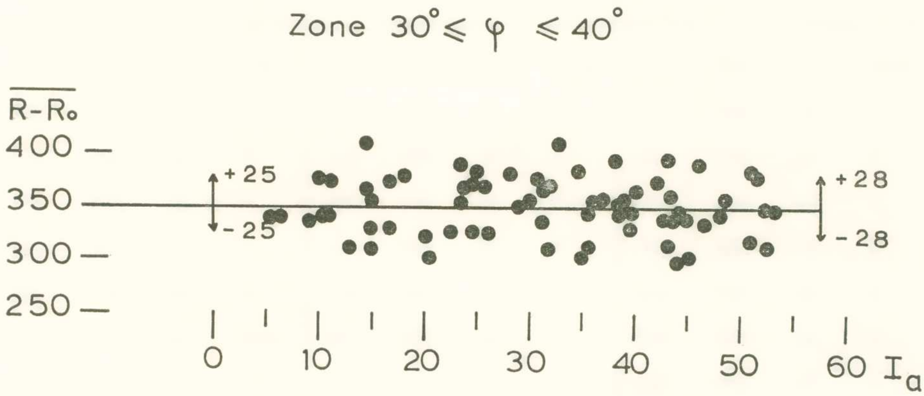


Fig. 1. Relation between the variation of the mean zonal annual precipitation $\overline{R - R_0}$ for the latitude zone $30° \leqslant \varphi \leqslant 40°$ N and the corresponding values of the areas index Ia.

In Fig. 2 the continuous line represents the variation of the mean zonal annual precipitation $\overline{R - R_0}$ during the period 1880 - 1960, while the dashed line gives the variation of the areas index Ia, during the same period.

From this figure we see that the variation of the mean zonal annual precipitation $\overline{R - R_0}$ during the period 1880 - 1960 corresponding to the zone $30° \leqslant \phi \leqslant 40°$ shows essential differences as compared to the variation of $\overline{R - R_0}$ during the same period corresponding to the four latitude zones $\phi_i \leqslant \phi \leqslant \phi_{i+10}$ (i = 40°, 50°, 60, 70°) studied by Xanthakis (1973).

In this zone, indeed, the values of $\overline{R - R_0}$ show sinusoidal oscillations with period varying between 5 to 7 years and amplitute of the order of 40 mm. Furthermore these oscillations seem to be uncorrelated to the corresponding variations of solar activity. Another remarkable feature shown by Fig. 2 is the decrease of the values of $\overline{R - R_0}$ after the year 1923.

The basic data concerning the zone $30° \leqslant \phi \leqslant 40°$ are summarized in Table 1.

T A B L E 1.

Basic data concerning the latitude zone 30° $\leqslant \varphi \leqslant$ 40°.

Years	N	$\overline{R-R_0}$	Sm	Years	N	$\overline{R-R_0}$	Sm	Years	N	$\overline{R-R_0}$	Sm
1880	17	478		1907	34	342	355	1934	49	281	311
1	19	403	444	8	36	343	354	5	49	358	351
2	19	492	450	9	35	386	367	6	49	405	375
3	19	413	464	1910	35	351	390	7	49	332	351
4	20	536	481	1	36	472	412	8	50	334	318
5	22	440	454	2	35	354	374	9	50	271	298
6	25	400	392	3	36	315	339	1940	52	314	312
7	25	327	357	4	36	372	373	1	50	348	338
8	25	375	385	5	36	431	410	2	54	342	324
9	26	464	456	6	35	405	384	3	54	265	299
1890	27	519	474	7	35	294	340	4	53	325	332
1	27	392	426	8	36	365	345	5	57	412	369
2	27	399	390	9	36	357	357	6	58	327	340
3	27	371	358	1920	35	347	355	7	56	295	314
4	27	291	329	1	38	372	365	8	57	338	336
5	28	362	346	2	38	370	383	9	58	371	358
6	29	370	377	3	39	419	372	1950	59	350	352
7	30	407	380	4	40	281	318	1	56	338	346
8	31	336	370	5	40	291	301	2	56	359	354
9	31	399	367	6	42	342	341	3	57	358	354
1900	32	333	342	7	42	389	362	4	57	342	337
1	32	304	340	8	42	329	345	5	59	306	324
2	32	418	388	9	47	332	315	6	58	343	346
3	33	410	386	1930	49	268	307	7	59	391	381
4	34	306	366	1	49	361	325	8	58	400	383
5	33	440	395	2	50	311	327	9	59	341	347
6	35	394	393	3	51	325	311	1960	58	305	

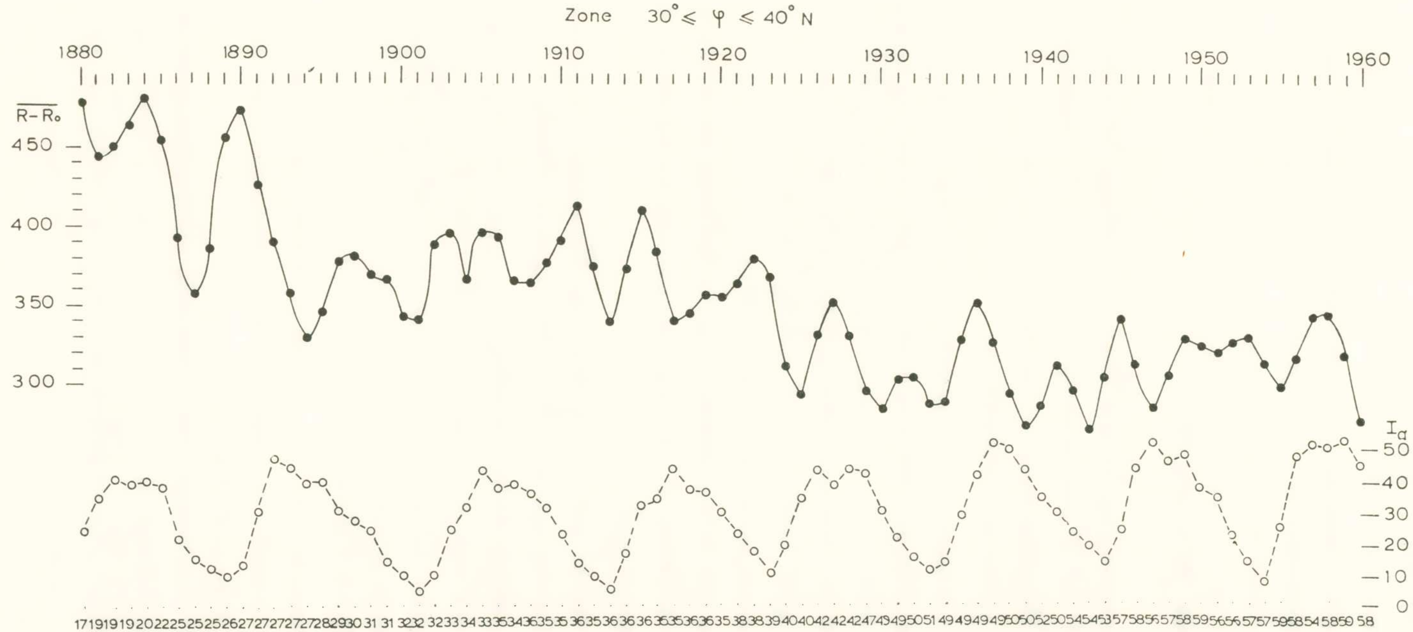


Fig. 2. Variation of the mean zonal annual precipitation $\overline{R - R_o}$ for the latitude zone $30° \leqslant \varphi \leqslant 40°$ (continuous line) and the areas index Ia (dashed line) during the period 1880 - 1960. Below is the number of the stations considered.

The second column of this table gives the number N of the stations used for the calculation of the value of $\overline{R - R_o}$ for the year considered, the third and fourth columns give the corresponding values of $\overline{R - R_o}$ and $\overline{R - R_o}$ smoothed with the help of the formula $(a + 2b + c) : 4$.

3. Latitude Zone $20° \leqslant \varphi \leqslant 30°$.

The stations belonging to this zone are located between the meridians 177° W and 154° E and more or less uniformly distributed.

The names, the geographical coordinates and the values of R_o for these stations are given in Appendix A.

In this zone the correlation between $\overline{R - R_o}$ and Ia is negative for the time intervals 1880 to 1908 and 1925 to 1933 (with the exception of the 5 years 1892, 1893, 1894, 1901 and 1902 and becomes positive for the time intervals 1909 to 1924 and 1934 to 1960 (with the exception of the 3 years 1938, 1957 and 1958). These results are shown in Fig. 3, which represents the relation between $\overline{R - R_o}$ and Ia.

In this figure the filled circles refer to the time intervals with negative correlation between $\overline{R - R_o}$ and Ia and the triangles to the time intervals with positive one.

Four out of the 34 stations of this zone for which we have precipitation data covering the period 1880 - 1960 present during certain years values of $\overline{R - R_o}$, which differ substantially from the values of $\overline{R - R_o}$ corresponding to the rest of the stations.

These «irregular values», which cause the reversal of the correlation between $\overline{R - R_o}$ and Ia during the corresponding years, are shown in Fig. 3 by open circles. Table 2 gives the names of these four stations and the corresponding values $R_i - R_o$. It should be noted that these four irregular stations are located, in a small area of the zone and lie between the meridians 85°, 2 E - 114°, 2 E.

In Fig. 4 the continuous line represents the variation of the mean zonal annual precipitation $\overline{R - R_o}$ during the period 1880 - 1960, while the dashed line gives the variation of the areas index Ia during the same period.

From this figure we see that during the years of minimum solar activity 1901 and 1902, as well as during the years of maximum solar activity 1938, 1957 and 1958, the variation of the mean zonal annual precipitation $\overline{R - R_o}$ presents secondary minima shown on the figure by open

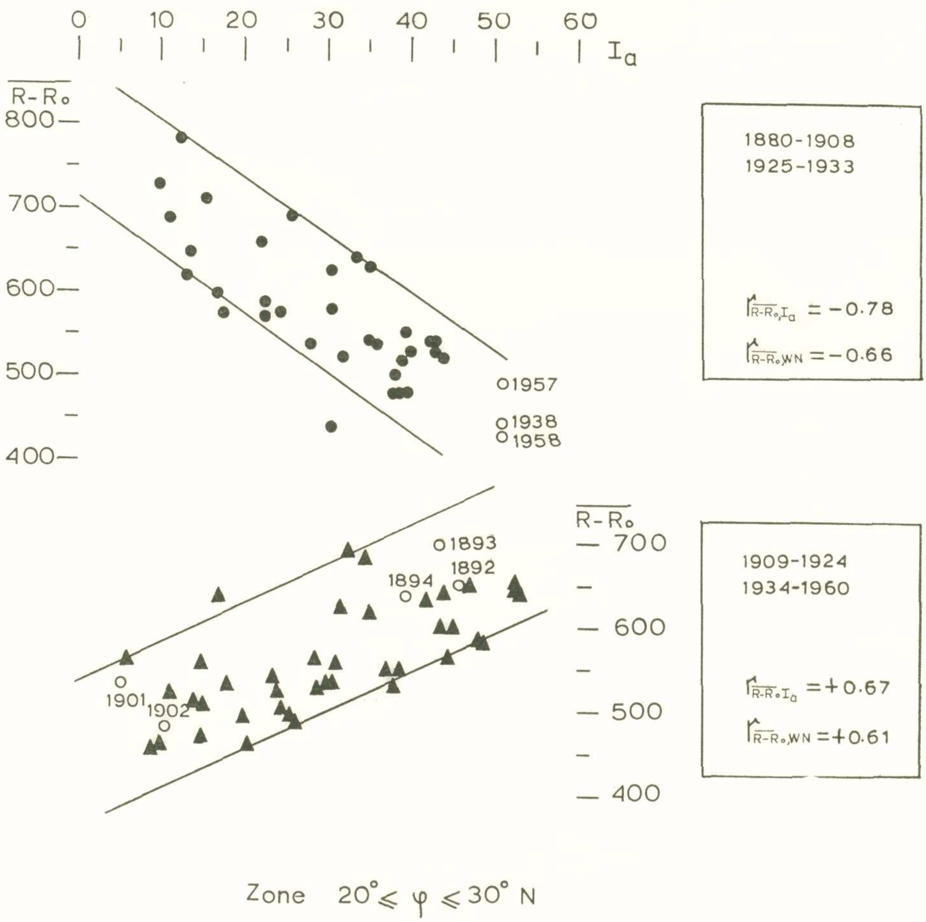


Fig. 3. Relation of the mean zonal annual precipitation $\overline{R - R_o}$ for the latitude zone $20° \leqslant \varphi \leqslant 30°$ N and the corresponding values of the areas index Ia. Filled circles and triangles refer respectively to the time intervals with negative or positive correlation between $\overline{R - R_o}$ and Ia, while open circles represent the years with irregular values.

circles accompanied by the number N of the stations used for the calculation of the corresponding value of $\overline{R - R_o}$. These secondary minima are

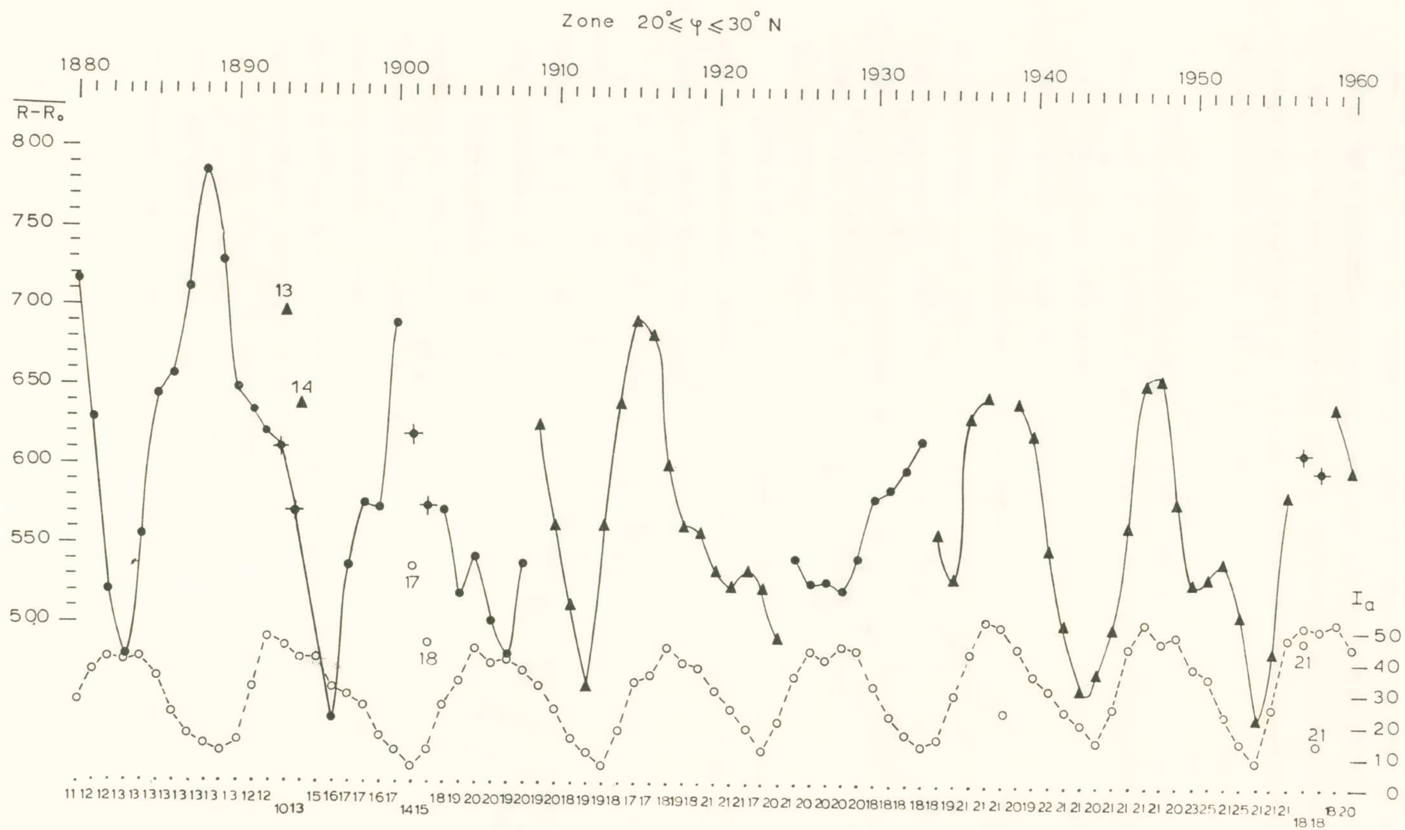


Fig. 4. Variation of the mean zonal annual precipitation $\overline{R - R_o}$ for the latitude zone $20° \leqslant \varphi \leqslant 30°$ N (continuous line) and the areas index Ia (dashed line) during the period 1880-1960. Open circles represent the values of $\overline{R - R_o}$ obtained from data containing irregular values of $R_i - R_o$, while asterisks give the corresponding values of $\overline{R - R_o}$ after elimination of these irregular values of $R_i - R_o$. The numbers next to the open circles or the asterisks give the number of the stations used in each case for the calculation of the corresponding value of $\overline{R - R_o}$.

due to the fact that the corresponding values of $R_i - R_o$ for the stations tabulated in Table 2 are disproportionally small as compared to those for the rest of the stations. If we omit, however, these «irregular» values of $R_i - R_o$, the secondary minima disappear and we get the values shown in Fig. 4 by asterisks.

TABLE 2.

Irregular values of $R_i - R_o$ for four stations of the latitude zone $20° \leqslant \varphi \leqslant 30°$.

Stations	1893	1894	1957	1958	Longitude
Calcuta	1265		248	224	88°,4 E
Hong - Kong	1389	1498			114°,2 E
Shillong	1119		133	130	91°,9 E
Patma			159	133	85°,2 E
$\overline{R-R_o}$	605	625	498	428	
σ	±173	±325	±208	±245	
N	10	13	18	18	

The values of the correlation coefficients between the variation of the mean zonal annual precipitation $\overline{R - R_o}$ and the solar activity indices Ia and WN are given in Table 3.

TABLE 3.

Correlation coefficients between the variation of the mean zonal annual precipitation $\overline{R - R_o}$ for the latitude zone $20° \leqslant \varphi \leqslant 30°$ N and the solar activity indices Ia (areas index) and WN (relative sunspot numbers).

$r_{\overline{R-Ro}, Ia}$	$r_{\overline{R-Ro}, WN}$	Period	Excepted years
− 0.78	− 0.66	1880 - 1908 1925 - 1933	1901, 1902
+ 0.67	+ 0.61	1909 - 1924 1934 - 1960	1938, 1957, 1958

The basic data concerning the zone $20° \leqslant \varphi \leqslant 30°$ are summarized in Table 4. The second column of this table gives the number N of the stations used for the calculation of the value of $\overline{R - R_0}$ for the year considered, the third and fourth columns give the corresponding values of $\overline{R - R_0}$ and $\overline{R - R_0}$ smoothed with the help of the formula $(a + 2b + c) : 4$.

4. Latitude Zone $10° \leqslant \varphi \leqslant 20°$ N.

The majority of the stations of this zone have long series of precipitation observations. Furthermore, these stations are uniformly distributed between the meridians 100° W and 166° E. The names and other characteristics for these stations are given in Appendix A.

Fig. 5 represents the relation between $\overline{R - R_0}$ and Ia. In this figure the triangles refer to the time intervals with positive correlation between $\overline{R - R_0}$ and Ia, the filled circles to the time intervals with negative correlation, while the open circles refer to the time intervals with no correlation between $\overline{R - R_0}$ and Ia.

Fig. 6 gives the scatter diagram between $\overline{R - R_0}$ and Ia for the stations of the zone located in deserts in the time intervals 1947 - 1960.

The same results are better shown in Fig. 7, where the upper continuous line represents the variation of the mean zonal annual precipitation $\overline{R - R_0}$ during the period 1880 - 1960, while the dashed line gives the variation of the areas index Ia during the same period. Finally the lower continuous line represents the variation of the mean annual precipitation $\overline{R - R_0}$ corresponding to the desert stations located in the zone considered.

From Fig. 7 we see that from the middle of the sunspot cycle No. 12 and subsequently during the entire sunspot cycle No. 13 until the maximum of the cycle No. 14 (1907) this correlation becomes negative with the only exception of the years 1899 and 1900. During the descending branch of the sunspot cycle No. 14 and the ascending branch of the cycle No. 15 (1908 - 1917) the correlation becomes again positive, while we have again a negative correlation during the descending branch of the sunspot cycle No. 15 (1918-1923). During the sunspot cycles No. 15 and 16 no correlation exists between $\overline{R - R_0}$ and Ia. In this period $\overline{R - R_0}$ presents a continuous decrease with superimposed sinusoidal oscillations having periods equal

TABLE 4.

Basic data concerning the latitude zone $20° \leqslant \varphi \leqslant 30°$.

Years	N	$\overline{R\text{-}R_0}$	Sm	Years	N	$\overline{R\text{-}R_0}$	Sm	Years	N	$\overline{R\text{-}R_0}$	Sm
1880	11	718		1907	20	449	481	1934	18	561	561
1	12	653	629	8	19	541	540	5	18	501	532
2	12	490	521	9	20	627	627	6	19	696	635
3	13	450	480	1910	19	569	564	7	21	648	648
4	13	534	557	1	20	490	516	8	21	446	446
5	13	708	644	2	18	398	463	9	21	642	642
6	13	627	658	3	19	606	568	1940	20	623	623
7	13	668	712	4	19	661	642	1	19	605	561
8	13	884	786	5	18	679	695	2	22	491	505
9	13	706	729	6	17	763	684	3	21	431	461
1890	13	621	649	7	17	530	599	4	21	489	473
1	13	648	631	8	18	574	552	5	20	481	498
2	13	609	655	9	19	530	550	6	21	541	566
3	13	755	701	1920	18	566	536	7	21	700	657
4	14	687	641	1	21	483	527	8	21	688	659
5	15	435	481	2	21	575	537	9	20	561	580
6	16	366	441	3	21	514	524	1950	20	508	531
7	17	598	541	4	19	493	493	1	23	547	535
8	17	603	577	5	20	544	544	2	25	537	545
9	16	505	576	6	21	514	529	3	26	559	509
1900	17	691	691	7	20	545	530	4	25	379	455
1	17	537	537	8	20	516	524	5	21	501	487
2	18	488	488	9	20	619	545	6	21	568	586
3	18	573	573	1930	20	625	582	7	21	494	494
4	18	501	520	1	18	559	588	8	21	428	524
5	19	596	544	2	18	608	599	9	18	748	643
6	20	484	503	3	18	620	620	1960	20	603	

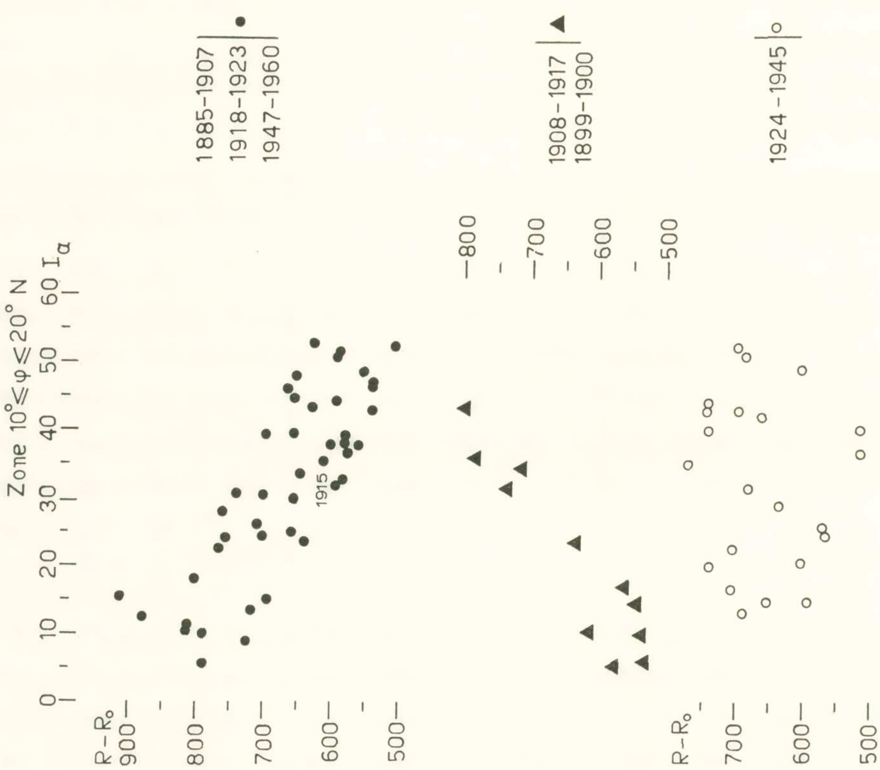


Fig. 5. Relation between the variation of the mean zonal annual precipitation $\overline{R - R_o}$ for the latitude zone $10° \leqslant \varphi \leqslant 20°$ N and the corresponding values for the areas index Ia. Filled circles and triangles refer respectively to the time intervals with negative or positive correlation between $\overline{R - R_o}$ and Ia, while open circles refer to the time interval with no correlation between $\overline{R - R_o}$ and Ia.

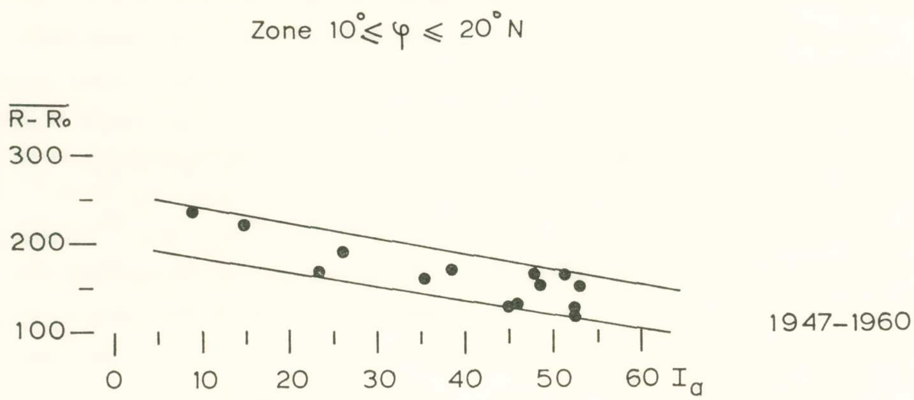
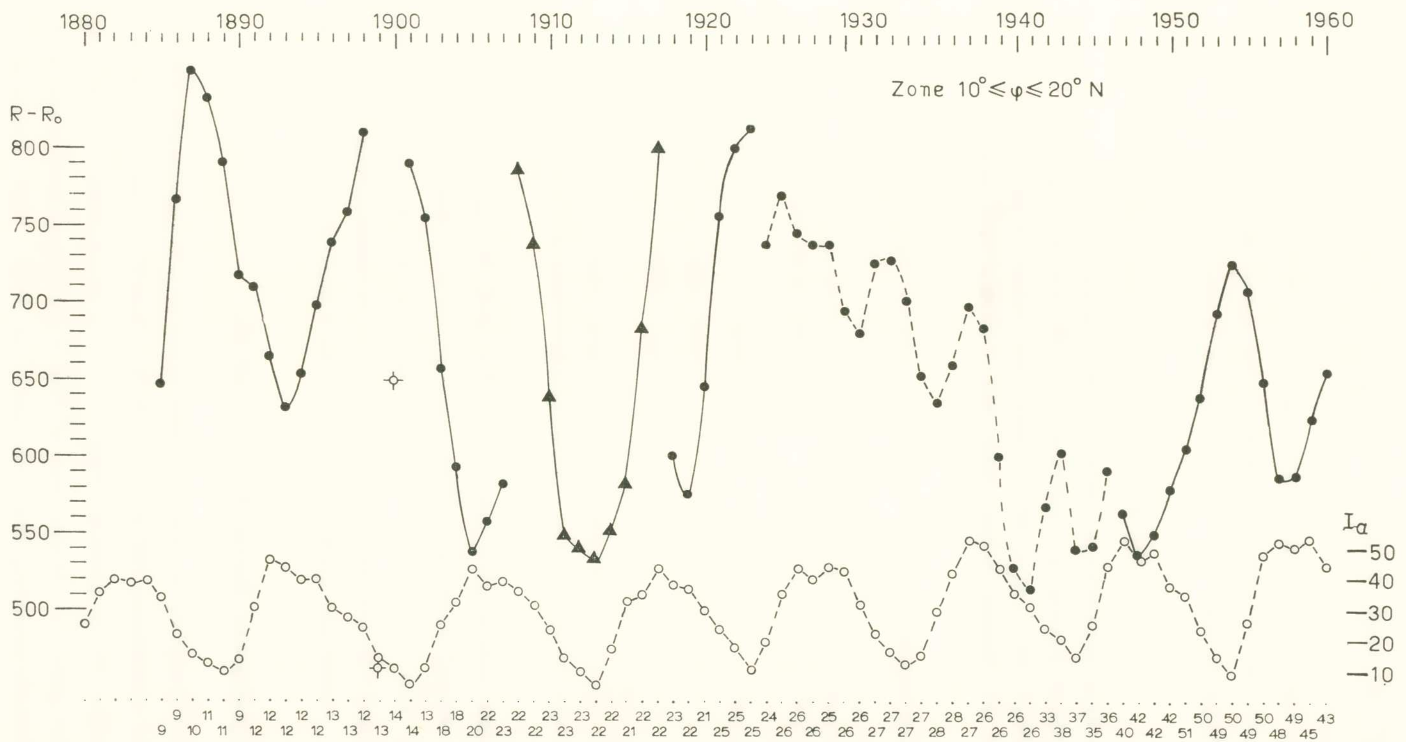


Fig. 6. Relation between the variation of the mean zonal annual precipitation $\overline{R - R_o}$ for the desert stations of the latitude zone $10° \leqslant \varphi \leqslant 20°$ N and the corresponding values of the areas index Ia.



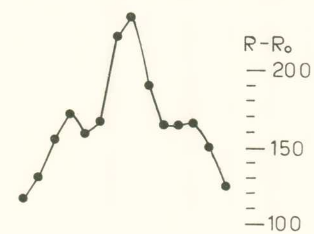


Fig. 7. Variation of the mean zonal annual precipitation $\overline{R - R_0}$ for the latitude zone $10° \leqslant \varphi \leqslant 20°$ N (upper continuous line) and the areas index Ia (dashed line) during the period 1880 - 1960. The lower continuous line represents the variation of the mean zonal annual precipitation $\overline{R - R_0}$ corresponding to the desert stations of the same latitude zone during the period 1947 - 1960. Filled circles and triangles refer respectively to the time intervals with negative or positive correlation between $\overline{R - R_0}$ and Ia.

to 4 to 6 years. Finally, during the time interval 1947 - 1960 the correlation between $\overline{R - R_o}$ and Ia becomes negative. Likewise we have a negative correlation between $\overline{R - R_o}$ and Ia during the same period for the 10 stations of the latitude zone considered located in deserts.

The values of the correlation coefficients between $\overline{R - R_o}$ and the solar activity indices Ia and WN are given in Table 5.

TABLE 5.

Correlation coefficients between the variation of the mean zonal annual precipitation $\overline{R - R_o}$ for the latitude zone $10° \leqslant \varphi \leqslant 20°$ N and the solar activity indices Ia (areas index) aud WN (relative sunspot numbers).

$\tau_{\overline{R-Ro}, Ia}$	$\tau_{\overline{R-Ro}, WN}$	Period
+ 0,69	+ 0,57	1899, 1900, 1908 - 1917
— 0,80	— 0,71	1885 - 1907 1918 - 1923 1947 - 1960
No correlation		1924 - 1945

The basic data concerning the zone $10° \leqslant \varphi \leqslant 20°$ are summarized in Table 6. The second column of this table gives the number N of the stations used for the calculation of the value of $\overline{R - R_o}$ for the year considered, the third and fourth columns give the corresponding values of $\overline{R - R_o}$ and $R - R_o$ smoothed with the help of the formula $(a + 2b + c) : 4$.

5. Northern Equatorial Zone $0° \leqslant \varphi \leqslant 10°$ N.

The stations belonging to this zone are more or less uniformly distributed between the meridians 84°W and 152°E. However, only for a few out of these stations we do possess long series of precipitation observations. For example only for 16 stations of this zone we dispose over precipitation observations covering the time interval 1882 - 1960. After 1920,

TABLE 6.

Basic data concerning the latitude zone $10^\circ \leqslant \varphi \leqslant 20^\circ$ N.

Years	N	$\overline{R\text{-}R_o}$	Sm	Years	N	$\overline{R\text{-}R_o}$	Sm	Years	N	$\overline{R\text{-}R_o}$	Sm
1880	8	638		1907	23	582	582	1934	27	620	652
1	10	590	707	8	22	787	787	5	28	634	635
2	9	1009	839	9	22	753	738	6	28	652	661
3	9	748	813	1910	23	660	638	7	27	705	698
4	9	686	692	1	23	479	548	8	26	729	685
5	9	646	650	2	23	574	541	9	26	576	600
6	9	620	620	3	22	535	536	1940	26	517	528
7	10	931	805	4	22	607	563	1	24	500	514
8	11	738	791	5	21	502	582	2	28	539	567
9	10	795	725	6	22	717	684	3	28	691	602
1890	11	573	666	7	22	801	801	4	28	541	541
1	12	723	649	8	23	500	599	5	25	503	542
2	12	578	612	9	22	596	575	6	26	678	591
3	12	569	581	1920	21	608	656	7	30	506	563
4	12	609	603	1	25	812	756	8	32	561	537
5	12	626	645	2	25	790	801	9	33	520	550
6	13	718	684	3	25	813	813	1950	33	600	579
7	13	672	702	4	24	739	739	1	41	595	607
8	12	744	744	5	26	810	769	2	40	636	639
9	13	506	506	6	26	717	745	3	39	689	694
1900	14	566	566	7	26	736	738	4	41	761	725
1	14	731	731	8	25	763	738	5	39	690	708
2	13	752	710	9	26	689	695	6	40	691	650
3	18	606	657	1930	26	638	680	7	38	526	587
4	18	663	593	1	27	756	705	8	39	603	588
5	20	441	537	2	27	669	708	9	37	620	625
6	22	604	558	3	27	736	690	1960	35	655	

however, the number of stations with precipitation observations steadily increases and finally during the decade 1951 - 1960 we dispose over uninterrupted precipitation observations. This for more than 54 stations, gradual increase in the number of stations does not influence substantially the amplitude of the mean zonal annual variation of the precipitation $\overline{R - R_o}$. The reason is that $\overline{R - R_o}$ presents minima and maxima, which are of the same order of magnitude over the entire time interval under consideration.

It should be noted, however, that 4 stations of this zone present during certain years of maximum solar activity values of $R_i - R_o$, which differ substantially from the values of $\overline{R - R_o}$ corresponding to the rest of the stations. These stations are tabulated in Table 7.

From this table we see that during the years of maximum solar activity 1927, 1928, 1929 the differences $R_i - R_o$ corresponding to there stations are more than twice as high as the corresponding values of $\overline{R - R_o}$. It is the same for the years 1896, 1901.

TABLE 7.

Irregular values of $R_i - R_o$ for four stations of the northern equatorial zone $0^\circ \leqslant \varphi \leqslant 10^\circ$.

Stations	1896	1901	1927	1928	1929	Longitude
Freetown	2571	2349				0°,2 W
Calabar			2531	1302		8°,3 E
Sadakan				2762		118°,2 E
Koror			1818	1531	2283	134°,5 E
$\overline{R-R_o}$	928	690	781	686	747	
σ	±300	±307	±419	±352	±464	
N	12	12	21	20	22	

The values of $R_i - R_o$ tabulated in Table 7 have been omitted during the calculation of the values of the $\overline{R - R_o}$ given in Table 9.

Fig. 8 represents the relation between $\overline{R - R_o}$ and Ia for the zone under consideration. In this figure the triangles refer to the time intervals with positive correlation between $\overline{R - R_o}$ and Ia, the filled circles refer to the time intervals with negative correlation, while the irregular values are marked with asterisks.

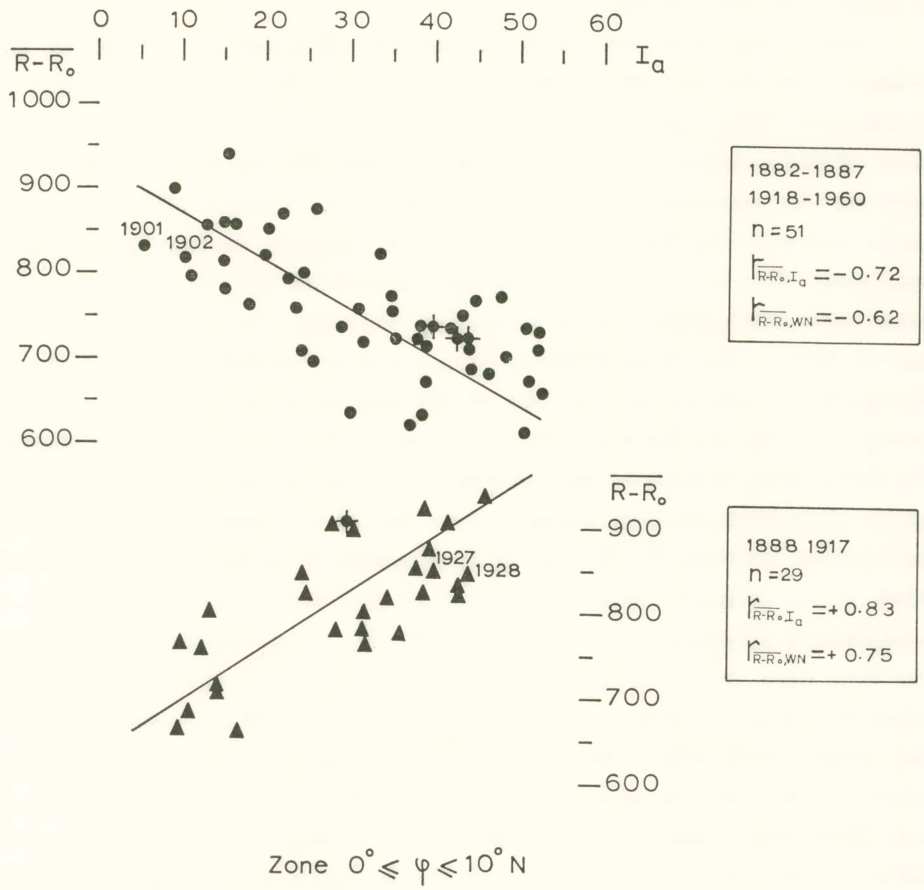


Fig. 8. Relation between the variation of the mean zonal annual precipitation $R - R_o$ for the northern equatorial zone $0° \leqslant \varphi \leqslant 10°$ N and the corresponding values of the areas index Ia. Filled circles and triangles refer respectively to the time intervals with negative or positive correlation between $\overline{R - R_o}$ and Ia, while asterisks represent the years with irregular values.

In Fig. 9 the continuous line represents the variation of the mean zonal annual precipitation $\overline{R - R_o}$ during the period 1880 - 1960, while the dashed line gives the variation of the areas index Ia during the same period. Triangles and filled circles in this figure refer respectively to the years with positive or negative correlation between $\overline{R - R_o}$ and Ia. Open circles refer to the years with irregular values of $R_i - R_o$, while asterisks give the corresponding values of $\overline{R - R_o}$ found after elimination of these irregular values.

From. Fig. 9 we see that during the descending branch of the sunspot cycle No. 13 (1882 - 1887) the correlation between $\overline{R - R_o}$ and Ia is negative. This correlation becomes positive one year before the maximum of the sunspot cycle No. 13 (1889 - 1900). During the year 1896 i. e. between the maximum and the minimum of the sunspot cycle No. 13 the curve representing the variations of $\overline{R - R_o}$ appears to have a secondary maximum. The same phenomenon also occurs during the sunspot minimum years 1901, 1902. These secondary maxima, however, are mainly due in 1896 to the comparetively high value of the difference $R_i - R_o$ for the station Freetown and in 1901 to the equally high value of the difference $R_i - R_o$ for the same station. In the period 1918 - 1960 i. e. during the descending branch of the sunspot cycle No. 15 as well as over the entire time interval from sunspot cycle No. 16 to sunspot cycle No. 19 the correlation between $\overline{R - R_o}$ and Ia is negative. It is only around the maxima of the sunspot cycles No. 16 and 17 that we perceive a tendency to a secondary maximum of the curve of $\overline{R - R_o}$. This tendency is due to the very high values of $R_i - R_o$ corresponding to the few stations tabulated in Table 7. Thus, the values of $R_i - R_o$ steadily decrease around the years 1896, 1901, 1927, 1928 and 1929 for the remaining stations, while for the stations tabulated in Table 7 these values present a steady rise. This effect may be attributed to local factors which we cannot evaluate at present. These values of $R_i - R_o$ show a striking divergence

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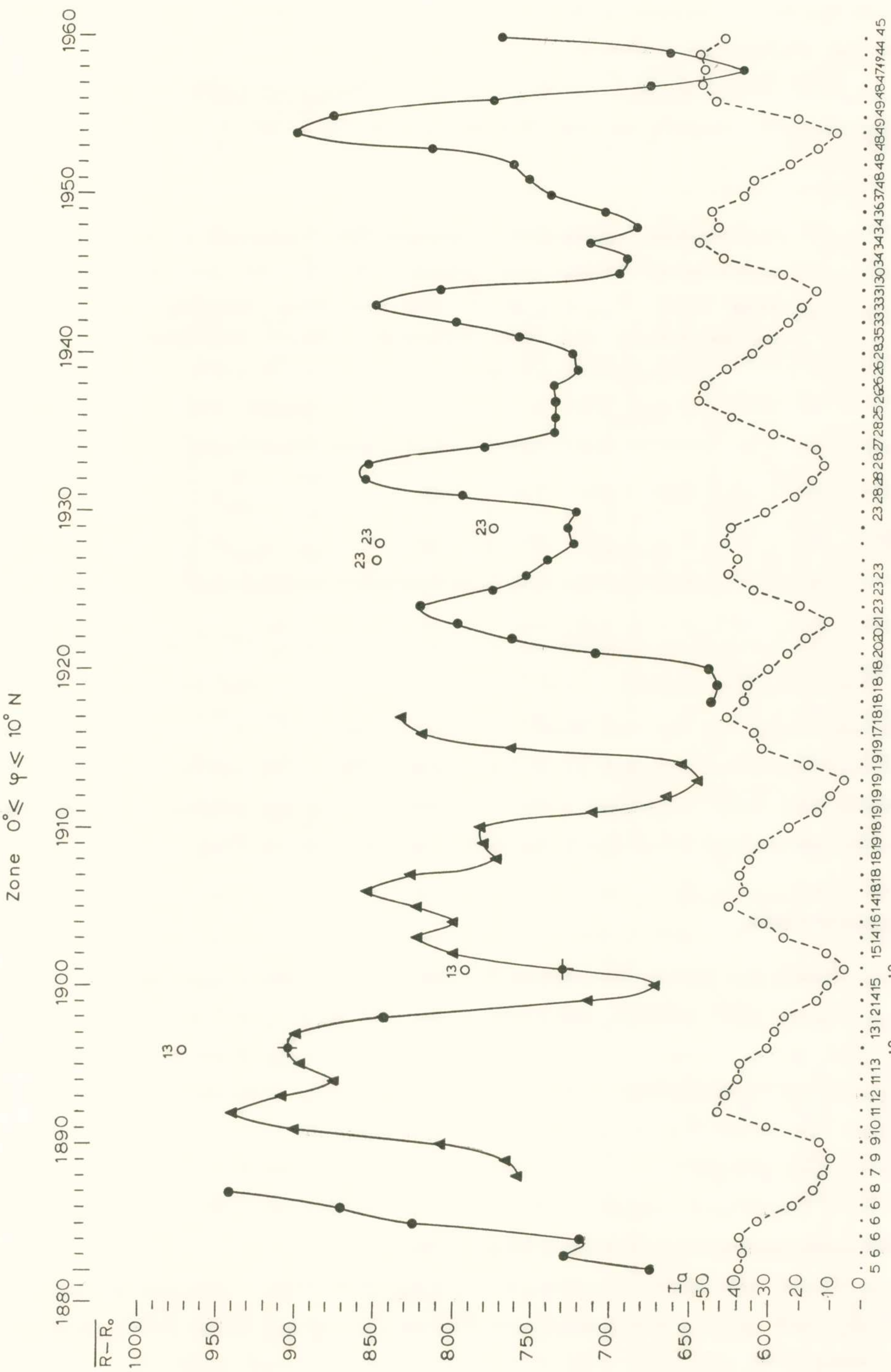
Fig. 9. Variation of the mean zonal annual precipitation $\overline{R - R_o}$ for the northern equatorial zone $0° \leqslant \varphi \leqslant 10°$ (continuous line) and the areas index Ia (dashed line) during the period 1882 - 1960. Filled circles and triangles refer respectively to the time intervals with negative or positive correlation between $\overline{R - R_o}$ and Ia. Open circles refer to the years with irregular values of $R_i - R_o$, while asterisks give the corresponding values of $\overline{R - R_o}$ after elimination of these irregular values of $R_i - R_o$. The numbers to the open circles and the asterisks give the number of stations used in each case for the calculation of the corresponding values of $\overline{R - R_o}$. →


Zone 0° ≤ φ ≤ 10° N
1880
1890
1900
1910
1920
1930
1940
1950
1960
R−R₀
1000
950
900
850
800
750
700
650
600
Iₐ
50
40
30
20
10
0

from the mean values of $\overline{R - R_o}$ and for this reason have been designated as «irregular values».

The values of the correlation coefficients between $\overline{R - R_o}$ and the solar activity indices Ia and WN are given in Table 8.

TABLE 8.

Correlation coefficients between the variation of the mean zonal annual precipitation $\overline{R - R_o}$ for the latitude zone $0° \leqslant \varphi \leqslant 10°$ N and the solar activity Ia (areas index) and WN (relative sunspot numbers).

$r_{\overline{R-Ro}, Ia}$	$r_{\overline{R-Ro}, WN}$	Period
— 0.72	— 0.62	1882 - 1887 1918 - 1960
+ 0.83	+ 0.75	1888 - 1917

The basic data concerning the zone $0° \leqslant \varphi \leqslant 10°$ N are summarized in Table 9. The second column of this table gives the number N of the stations used for the calculation of the value of $\overline{R - R_o}$ for the year considered the third column gives the number n of the omitted stations, the fourth and fifth columns give the corresponding values of $\overline{R - R_o}$ and $\overline{R - R_o}$ smoothed with the help of the formula (a + 2b + c) : 4.

Conclusions.

From the above discussion we get the following conclusions :

1) In the middle latitude zone $30° \leqslant \varphi \leqslant 40°$ N the variation of the mean zonal annual precipitation $\overline{R - R_o}$ does not present any significant correlation with the solar activity expressed in terms of either the areas index Ia or the relative sunspot numbers WN. Furthermore, the quantity $\overline{R - R_o}$ presents sinusoidal oscillations with period of 5 - 7 years and amplitude of the order of 40 mm. The precipitation in this zone appears to decrease after 1923.

2) In the latitude zone $20° \leqslant \varphi \leqslant 30°$ N the correlation between $\overline{R - R_o}$ and Ia is mainly negative during the period 1880 - 1960. It is only between 1908 and 1923 that this correlation becomes positive.

TABLE 9.

Basic data concerning the northern equatorial zone $0° \leqslant \varphi \leqslant 10°$.

Years	N	n	$\overline{R\text{-}R_o}$	Sm	Years	N	n	$\overline{R\text{-}R_o}$	Sm	Years	N	$\overline{R\text{-}R_o}$	Sm
1882	5		674		1908	18		753	776	1934	27	704	782
3	6		852	729	9	19		770	780	5	28	759	738
4	6		536	719	1910	18		825	782	6	25	729	738
5	6		999	826	1	19		707	713	7	26	734	737
6	6		771	871	2	19		613	665	8	26	749	740
7	8		942	942	3	19		727	644	9	26	727	722
8	7		759	751	4	19		508	656	1940	28	686	726
9	9		776	767	5	19		882	764	1	35	803	760
1890	9		756	808	6	17		784	821	2	33	748	801
1	10		945	900	7	18		834	834	3	33	906	852
2	11		952	941	8	18		637	637	4	31	847	810
3	12		915	908	9	18		625	623	5	30	638	696
4	11		848	877	1920	18		603	638	6	34	659	692
5	13		896	893	1	20		721	711	7	34	810	716
6	12	1	928	909	2	20		797	764	8	34	584	685
7	13		885	911	3	21		740	798	9	36	762	706
8	12		945	845	4	23		914	828	1950	37	717	740
9	14		606	717	5	23		718	777	1	48	765	754
1900	15		709	671	6	23		758	754	2	48	769	763
1	12	1	690	730	7	21	2	781	741	3	48	748	816
2	15		830	800	8	20	3	686	725	4	49	989	902
3	14		846	824	9	22	1	747	728	5	49	881	879
4	16		773	801	1930	23		633	722	6	48	766	777
5	14		811	822	1	28		877	796	7	47	695	677
6	18		894	857	2	28		798	858	8	49	553	617
7	18		828	826	3	28		959	855	9	44	666	665
										1960	45	773	

3) In the latitude zone $10° \leqslant \varphi \leqslant 20°$ N the variation of $\overline{R - R_0}$ is rather anomalous and the correlation between $\overline{R - R_0}$ and Ia becomes alternatively positive or negative during consecutive time intervals, each of which is of a rather short duration. Between 1924 aud 1946 the values of $\overline{R - R_0}$ present sinusoidal oscillations with half period of 4 - 6 years. Furthermore there is not significant correlation between $\overline{R - R_0}$ and Ia during this period.

4) The correlation between $\overline{R - R_0}$ and Ia in the Northern equatorial zone is negative during the time intervals 1882 - 1887 and 1918 - 1960. This correlation becomes positive during the period 1888 to 1917 with a few exceptions in the years 1896, 1901 and 1927 - 1929.

It should been noted, however, that the correlation coefficients between $\overline{R - R_0}$ and Ia are considerably higher than those between $\overline{R - R_0}$ and WN.

APPENDIX I.

Station names, coordinates, time interval of observations and values of Ro.
Zone 40° - 30° N.

	Stations	Lat.	Long.	Interval	Ro
1	Ankara, Turkey	39° 57′	32° 53′ E	1926 - 1960	100
2	Philadelphia, U.S.A.	39 57	75 09 W	1880 - 1960	750
3	Erzurum, Turkey	39 55	41 16 E	1929 - 1960	150
4	Denver, U.S.A.	39 46	104 53 W	1880 - 1960	150
5	Sivas, Turkey	39 45	37 01 E	1929 - 1960	150
6	Akita, Japan	39 43	140 06 E	1886 - 1960	1350
7	Miyako, Japan	39 38	141 58 E	1884 - 1960	850
8	Concordia, U.S.A.	39 34	94 40 W	1886 - 1960	300
9	Palma, Spain	39 34	2 39 E	1881 - 1959	350
10	Parkersburg, U.S.A.	39 16	81 34 W	1885 - 1960	500
11	Cincinati, U.S.A.	39 09	84 31 W	1885 - 1960	450
12	Washington, U.S.A.	38 54	77 03 W	1880 - 1960	550
13	Lisboa, Portugal	38 43	9 09 W	1880 - 1960	400
14	St. Louis, U.S.A.	38 38	90 12 W	1880 - 1960	500
15	Sacramento, U.S A.	38 35	121 21 W	1880 - 1960	150
16	Horta, Azores	38 31	28 38 W	1902 - 1934	750
17	Izmir, Turkey	38 24	27 10 E	1929 - 1960	350
18	Athens, Greece	37 58	23 43 E	1900 - 1960	100
19	San Francisco, U.S.A.	37 47	122 25 W	1880 - 1960	250
20	Ponta Delgada, Azores	37 45	25 40 W	1930 - 1960	500
21	Wajima, Japan	37 23	136 54 E	1930 - 1960	1700
22	Adana, Turkey	36 59	35 18 E	1929 - 1960	250
23	Antalya, Turkey	36 53	30 42 E	1929 - 1960	450
24	Mosul, Irag	36 19	43 09 E	1941 - 1960	100
25	Matsumoto, Japan	36 15	137 58 E	1897 - 1960	600
26	Nashvile, U.S.A.	36 07	86 41 W	1880 - 1960	750
27	Las Vegas, U.S.A.	36 05	115 10 W	1937 - 1960	0
28	Taegu, Korea	35 53	128 37 E	1898 - 1960	600
29	Tokyo, Japan	35 41	139 45 E	1880 - 1960	100
30	Oran, Algeria	35 38	00 37 W	1926 - 1960	50
31	Asheville, U.S.A.	35 36	82 32 W	1903 - 1960	600
32	Yonago, Japan	35 26	133 21 E	1940 - 1960	1300
33	Hatteras, U.S.A.	35 13	75 41 W	1880 - 1960	750
34	Nicosia, Cyprus	35 09	33 17 E	1900 - 1960	150
35	Albuqueque, U.S.A.	35 05	106 37 W	1901 - 1960	100
36	Kyoto, Japan	35 01	135 44 E	1881 - 1960	1000
37	Biskra, Algeria	34 48	05 44 E	1936 - 1960	0
38	Mokpo, Korea	34 47	126 23 E	1906 - 1960	700
39	Little Rock, U.S.A.	34 44	92 14 W	1880 - 1960	800
40	Khanaquin, Irag	34 18	45 26 E	1942 - 1960	100
41	Leh, India	34 09	77 34 E	1880 - 1960	0
42	Casablanka, Maroko	33 35	07 39 E	1924 - 1960	200
43	Fukuoka, Japan	33 35	130 23 E	1890 - 1960	1000
44	Phoenix, U.S.A.	33 25	112 02 W	1896 - 1960	50
45	Rutba, Irag	33 02	40 17 E	1942 - 1960	0
46	Yuma, U.S.A.	32 45	114 36 W	1880 - 1960	0
47	Nagasaki, Japan	32 44	129 53 E	1880 - 1960	1000
48	San Diego, U S.A.	32 44	117 10 W	1880 - 1960	100
49	Funchal, Madeira	32 38	16 55 W	1921 - 1960	100
50	Abilene, U.S.A.	32 26	99 41 W	1886 - 1960	250
51	Benina, Libya	32 05	20 16 E	1946 - 1960	0

(Table 2 - continued)

	Stations	Lat.	Long.	Interval	Ro
52	Amman, Jordan	31° 58′	35° 57′ E	1923 - 1960	50
53	El Adem, Libya	31 51	23 55 E	1946 - 1960	0
54	El Paso, U.S.A.	31 48	106 24 W	1880 - 1960	50
55	Marrakech, Maroko	31 37	08 02 W	1919 - 1960	100
56	Lahore, Pakistan	31 33	74 20 E	1880 - 1960	150
57	Port Said, Egypt	31 17	32 15 E	1945 - 1960	0
58	Alexandria, Egypt	31 12	29 57 E	1889 - 1960	50
59	El Golea, Algeria	30 34	02 52 E	1930 - 1960	0
60	Cairo, Egypt	30 08	31 34 E	1945 - 1960	0
	Zone 30° – 20° N.				
1	New Orleans, U.S.A.	29° 57′ N	90° 04′ W	1880 - 1960	800
2	Helwan, Egypt	29 52 »	30 20 E	1904 - 1956	0
3	Lhasa, Tibet	29 40 »	91 07 E	1942 - 1955	250
4	Galveston, U.S A	29 16 »	94 51 W	1880 - 1960	550
5	Chihuahua, Mexico	28 38 »	106 04 W	1901 - 1960	100
6	New Delhi, India	28 35 »	77 12 E	1880 - 1960	300
7	Midway Ild	28 13 »	177 21 W	1921 - 1960	600
8	Minya, Egypt	28 05 »	30 44 E	1945 - 1956	0
9	Sebha, Libye	27 01 »	14 26 E	1946 - 1956	0
10	Aoulef, Algeria	26 58 »	01 05 E	1934 - 1956	0
11	Naha, Japan	26 14 »	127 41 E	1893 - 1960	1100
12	Luxor, Egypt	25 40 »	32 42 E	1941 - 1955	0
13	Patna, India	25 37 »	85 10 E	1880 - 1960	650
14	Shillong, India	25 34 »	91 53 E	1880 - 1960	1300
15	Allahabad, India	25 27 »	81 44 E	1880 - 1960	500
16	Nassau, Bahamas	25 03 »	77 28 W	1880 - 1930/ 1945 - 1960	650
17	Taipeih, Taihoko	25 02 »	121 31 E	1847 - 1960	1500
18	Riyadh, Saudi Arabia	24 42 »	46 43 E	1952 - 1960	50
19	Ouallen, Algeria	24 36 »	01 17 E	1932 - 1959	0
20	Key west, U.S.A	24 33 »	81 45 W	1880 - 1955	500
21	Marcus Ild	24 18 »	153 58 E	1952 - 1960	600
22	Muscat, Saudi Arabia	23 45 »	58 35 E	1894 - 1956	0
23	Habana, Cuba	23 09 »	82 21 W	1880 - 1960	700
24	Tainan, Taiwan	23 00 »	120 13 E	1941 - 1960	1200
25	Calcutta, India	22 36 »	88 24 E	1880 - 1960	900
26	Hong - Hang, China	22 18 »	114 10 E	1884 - 1960	1150
27	Lihue, Hawaiian Isl.	21 59 »	159 21 W	1905 - 1960	750
28	Wadi Halfa, Sudan	21 50 »	31 18 E	1941 - 1950	0
29	Honolulu, Hawaiian Isl.	21 19 »	157 52 W	1880 - 1960	200
30	Progresso, Mexico	21 17 »	89 40 W	1906 - 1960	200
31	Leon, Mexico	21 07 »	101 41 W	1881 - 1960	300
32	Merida, Mexico	20 58 »	89 38 W	1895 - 1960	400
33	Port Etienne, N. Africa	20 56 »	17 03 W	1941 - 1956	0
34	Atar, N. Africa	20 31 »	13 04 W	1941 - 1956	50
	Zone 20° – 10° N.				
1	Port Soudan*, Sudan	19° 35′ N	37° 13′ E	1943 - 1960	0
2	Takubaya, Mexico	19 24 »	99 11 W	1921 - 1960	450
3	Puebla, Mexico	19 02 »	98 11 W	1880 - 1960	550
4	Wake Isl., North Pacific	19 17 »	166 39 E	1934 - 1960	400

(Table 2 - continued)

	Stations	Lat	Long.	Interval	Ro
5	Bombay, India	18° 54′ N	72° 49′ E	1880 - 1960	850
6	Port-au-Prince, Haiti	18 34 »	72 22 W	1885 - 1940 1951 - 1960	800
7	San Juan, Puerto Rico	18 29 »	66 07 W	1899 - 1960	1100
8	Aparri, Philippines	18 22 »	121 38 E	1903 - 1960	1200
9	Negril, Jamaica	18 15 »	78 23 W	1931 - 1950	850
10	Vientiane, Lagos	17 57 »	102 34 E	1941 - 1960	1300
11	Atbara, Sudan	17 42 »	33 58 E	1941 - 1960	0
12	Belize, Hondouras	17 30 »	88 11 W	1941 - 1960	950
13	Salalah*, Saudi Arabia	17 03 »	54 06 E	1943 - 1960	50
14	Agadez, W. Africa	16 59 »	07 59 E	1945 - 1960	0
15	Rangoon, Burma	16 46 »	96 10 E	1880 - 1940 1951 - 1960	1950
16	Oaxaca, Mexico	17 04 »	96 43 W	1891 - 1955	450
17	Nema*, W. Africa	16 36 »	07 16 W	1941 - 1960	0
18	Cao*, W. Africa	16 16 »	00 03 W	1941 - 1960	100
19	Salina Cruz, Mexico	16 12 »	95 12 W	1903 - 1940 1954 - 1959	450
20	Tourane, Wiet - Nam	16 02 »	108 11 E	1941 - 1960	800
21	Belgaum, India	15 51 »	74 32 E	1880 - 1960	700
22	Khartoum, Sudan	15 36 »	32 33 E	1905 - 1960	50
23	Kassala*, Sudan	15 28 »	36 24 E	1941 - 1960	100
24	Riyan*, Saudi Arabia	14 39 »	49 24 E	1942 - 1960	0
25	Manila, Philippines	14 35 »	120 59 E	1887 - 1960	1000
26	Kayes, W. Africa	14 26 »	11 26 W	1942 - 1960	300
27	Legaspi, Philippines	13 08 »	123 44 E	1903 - 1930 1951 - 1960	1900
28	Abecher, Equ. Africa	13 51 »	20 51 E	1941 - 1960	150
29	Zinder, Equ. Africa	13 48 »	09 00 E	1942 - 1960	250
30	Bang-Kong, Tailand	13 44 »	100 30 E	1931 - 1960	700
31	San-Salvator, El Salvator	13 42 »	89 12 W	1921 - 1960	1000
32	Madras, India	13 04 »	80 15 E	1880 - 1960	550
33	El Fasher*, Sudan	13 38 »	25 20 E	1941 - 1960	150
34	Niamey, W. Africa	13 29 »	02 10 E	1941 - 1960	200
35	Guam, Mariana Isl.	13 36 »	144 48 E	1931 - 1940 1951 - 1960	1300
36	Kosti*, Sudan	13 10 »	32 40 E	1943 - 1960	250
37	El Obeid, Sudan	13 10 »	30 14 E	1942 - 1960	150
38	Mangalore, India	12 52 »	74 51 E	1880 - 1960	2250
39	Aden Khormaqkar, Saudi Arabia	12 49 »	45 02 E	1902 - 1960	0
40	Bamako, W. Africa	12 38 »	08 02 W	1941 - 1960	650
41	Mergui, Burma	12 26 »	98 36 E	1880 - 1940 1951 - 1960	3400
42	Nhatrang, Wiet-Nam	12 15 »	109 12 E	1897 - 1930 1951 - 1960	650
43	Kano, W. Africa	12 03 »	08 32 E	1905 - 1960	500
44	Port Blair, Indian Ocean	11 40 »	92 43 E	1880 - 1940 1951 - 1960	350
45	Kandi, W. Africa	11 08 »	02 56 E	1941 - 1960	650
46	Saigon, Wiet-Nam	10 49 »	106 40 E	1906 - 1960	1400
47	Iloilo City, Philippines	10 42 »	122 34 E	1903 - 1960	1600
48	Piarco, Trinidad	10 37 »	61 21 W	1931 - 1960	1200
49	Caracas, Venezuela	10 30 »	66 55 W	1891 - 1940 1951 - 1960	500
50	Mamou, W. Africa	10 22 »	12 05 W	1880 - 1940 1951 - 1960	550
51	Kodaikanal, India	10 14 »	77 28 E	1890 - 1960	950

(Table 2 - continued)

Zone 10° - 0° N.

	Stations	Lat.	Long.	Interval	Ro
1	Entebbe, Uganda	00° 03′ N	32° 27′ E	1900 - 1960	1000
2	Kambala, »	00 20 »	32 36 E	1941 - 1950	500
3	Impfondo, Congo	01 37 »	18 04 E	1935 - 1960	1300
4	Medan, Indonesie	03 34 »	98 41 E	1987 - 1960	1400
5	Tabou, Ivory Island	04 55 »	07 22 W	1941 - 1960	1300
6	Bangui, Congo	04 23 »	18 34 E	1945 - 1960	1200
7	Bangassou, Congo	04 44 »	22 50 E	1941 - 1960	1200
8	Bogota, Colombia	04 36 »	74 05 W	1887 - 1960	600
9	Juba, Sudan	04 52 »	31 36 E	1945 - 1960	600
10	Takoradi, Ghana	04 53 »	01 46 E	1941 - 1960	800
11	Calahar, Nigeria	04 58 »	08 21 W	1889 - 1960	2300
12	Apoera/Kapoeri, Surinam	05 10 »	57 09 W	1931 - 1960	1500
13	Abidjan, Ivory Coast	05 15 »	03 56 W	1941 - 1960	1000
14	Freetown, Siera Leone	05 12 »	00 12 W	1892 - 1960	2600
15	Zanderij, Surinam	05 27 »	55 12 W	1951 - 1960	1000
16	Warri, Nigeria	05 30 »	05 44 W	1941 - 1960	2100
17	Accra, Ghana	05 36 »	00 10 W	1882 - 1960	200
18	Koundja	05 37 »	10 45 E	1951 - 1960	1500
19	Kuta-Raja, India	05 32 »	95 20 E	1921 - 1960	1200
20	Sadakan, Borneo	05 54 »	118 04 E	1890 - 1935	1500
21	Paramaribo, Surinam	05 49 »	55 09 W	1931 - 1960	1700
22	Carel François	05 50 »	55 46 W	1931 - 1960	1000
23	Hambantota, Ceylon	06 07 »	81 08 E	1921 - 1960	800
24	Singapore	01 21 »	103 54 E	1931 - 1960	1500
25	Harbel, Liberia	06 23 »	10 25 W	1937 - 1960	2300
26	Lagos, Nigeria	06 27 »	33 24 E	1892 - 1960	1000
27	Atkinson, Guyane	06 30 »	58 15 W	1951 - 1960	1800
28	Bria	06 32 »	21 59 E	1941 - 1960	1000
29	Georgetown, Guyane	06 50 »	58 12 W	1897 - 1960	1300
30	Colombo, Ceylon	06 54 »	79 53 E	1882 - 1960	1100
31	Nuwara Eliya, Ceylon	06 58 »	80 46 E	1931 - 1950	1600
32	Tumeremo, Venezuela	07 18 »	61 27 W	1951 - 1960	700
33	Koror, Palau Island	07 20 »	134 29 E	1924 - 1960	2500
34	Truk, Carolin Island	07 28 »	151 51 E	1941 - 1960	2000
35	Bonthe, Siera Leone	07 32 »	12 30 W	1951 - 1960	3000
36	Wau, Sudan	07 42 »	28 01 E	1941 - 1960	700
37	San Gristobal, Venezuela	07 46 »	72 14 W	1919 - 1946	400
38	San Fernado, Venezuela	07 54 »	67 25 W	1951 - 1960	1000
39	Giudad Bolivar	08 09 »	63 33 W	1951 - 1960	700
40	Minicoy	08 17 »	72 49 E	1898 - 1960	1000
41	Trivandrum, India	08 29 »	76 57 E	1891 - 1960	1000
42	Trincomalee, Ceylon	08 34 »	81 14 E	1882 - 1960	800
43	Moengo, Meigongo	08 37 »	16 04 E	1951 - 1960	1000
44	Tchaourou	08 52 »	2 36 E	1941 - 1960	300
45	Balboa Heights, Panama	08 57 »	79 33 W	1951 - 1960	1000
46	Addis Abeba, Ethiopia	09 02 »	38 45 E	1906 - 1960	900
47	Pamban, India	09 16 »	79 18 E	1895 - 1960	400
48	Fort Archambault	09 08 »	18 23 E	1941 - 1960	800
49	Malakal, Sudan	09 33 »	31 39 E	1941 - 1960	0
50	Colon, Gristobal	09 23 »	74 54 W	1882 - 1960	1500
51	Maturin, Venezuela	09 45 »	63 11 W	1951 - 1960	900
52	San José, Costa Rica	09 56 »	84 08 W	1887 - 1960	1100
53	Fort Cochin, India	09 58 »	76 14 E	1885 - 1960	2000
54	Victoria Port, Burma	09 58 »	98 35 E	1951 - 1960	3000

ΠΕΡΙΛΗΨΙΣ

Εἰς προηγουμένην ἐργασίαν μου, ἀνακοινωθεῖσαν εἰς τὸ Πρῶτον Εὐρωπαϊκὸν Ἀστρονομικὸν Συνέδριον, ἀπεδείχθη ὅτι ὁ 11ετὴς κύκλος τῆς ἡλιακῆς δραστηριότητος παρουσιάζει στενὴν συσχέτισιν μετὰ τῆς ἐτησίας μεταβολῆς τῆς βροχοπτώσεως εἰς τὰς μεγάλου γεωγραφικοῦ πλάτους ζώνας τῆς γῆς.

Ἡ συσχέτισις αὕτη εἶναι θετικὴ διὰ τὴν ζώνην πλάτους 70° - 80° N καθ᾽ ὅλον τὸ χρονικὸν διάστημα τῶν παρατηρήσεων. Ἀντιθέτως εἰς τὴν ἀμέσως ἑπομένην ζώνην πλάτους 60° - 70° N ἡ συσχέτισις καθίσταται σαφῶς ἀρνητικὴ καθ᾽ ὅλον τὸ χρονικὸν διάστημα ἀπὸ τοῦ ἔτους 1880 μέχρι καὶ τοῦ ἔτους 1960. Τέλος εἰς τὴν μεθεπομένην ζώνην πλάτους 50° - 60° N ἡ συσχέτισις εἶναι ἀρνητικὴ διὰ τὰ τριάκοντα πρῶτα ἔτη τῶν παρατηρήσεων (1883 - 1913) καὶ εἶτα καθίσταται σαφῶς θετικὴ διὰ τὸ ὑπόλοιπον χρονικὸν διάστημα (1914 - 1960).

Μὲ τὴν συνεργασίαν τῶν κ.κ. Κωνσταντίνου Πουλάκου καὶ Βασιλείου Τριτάκη, τοῦ Κέντρου Ἐρευνῶν Ἀστρονομίας καὶ Ἐφηρμοσμένων Μαθηματικῶν τῆς Ἀκαδημίας Ἀθηνῶν, ἐπεξετείναμεν τὴν ἔρευναν ταύτην εἰς τὰς ὑπολοίπους ζώνας τοῦ Βορείου Ἡμισφαιρίου, τὰς περιλαμβανομένας μεταξὺ 0° - 40° N γεωγραφικοῦ πλάτους:

Δὲν θὰ ἐκθέσω ἐνταῦθα λεπτομερῶς τὰ πορίσματα τῆς ἐρεύνης ταύτης. Τοῦτο ἐπιφυλάσσομαι νὰ πράξω, εὐθὺς ὡς περαιώσω τὴν σχετικὴν ἔρευναν καὶ διὰ τὰς ζώνας τοῦ Νοτίου Ἡμισφαιρίου τῆς Γῆς. Περιορίζομαι μόνον νὰ ἀναφέρω ὅτι εἰς τὴν ζώνην τῶν 30° - 40° N γεωγραφικοῦ πλάτους, εἰς τὴν ὁποίαν περιλαμβάνονται ἡ Μεσογειακὴ Λεκάνη, ἡ Κεντρικὴ Ἀμερική, πρὸς ἀνατολὰς δὲ ἡ Τουρκία, τὸ Πακιστάν, αἱ Ἰνδίαι, καὶ ἡ νότιος Ἰαπωνία, δὲν παρατηρεῖται οὐδεμία συσχέτισις μεταξὺ ἡλιακῆς δραστηριότητος καὶ ἐτησίας μεταβολῆς τῆς βροχοπτώσεως καθ᾽ ὅλον τὸ χρονικὸν διάστημα ἀπὸ τὰς ἀρχὰς τοῦ 20οῦ αἰῶνος ἕως τὸ 1960. Πράγματι εἰς τὴν ζώνην ταύτην ἡ ἐτησία μεταβολὴ τῆς βροχοπτώσεως, ἥτις ἐξάγεται ἀπὸ μακροχρονίους παρατηρήσεις ἑξήκοντα ἐν ὅλῳ σταθμῶν, παρουσιάζει ἡμιτονοειδεῖς κυμάνσεις μικροῦ σχετικῶς εὔρους καὶ βραχείας περιόδου (5 - 7 ἐτῶν). Ἀπὸ δὲ τοῦ ἔτους 1923 μέχρι σήμερον ἡ καμπύλη τῆς ἐτησίας μεταβολῆς παρουσιάζει αἰσθητὴν πτῶσιν.

Τοὐναντίον εἰς τὴν ζώνην 10° - 20° N γεωγραφικοῦ πλάτους καὶ εἰς τὴν Βορείαν ἰσημερινὴν ζώνην 0° - 10° N γεωγραφικοῦ πλάτους ἐπανευρίσκομεν στενὴν συσχέτισιν μεταξὺ ἡλιακῆς δραστηριότητος καὶ ἐτησίας μεταβολῆς τῆς βροχοπτώ-

σεως. Ἡ συσχέτισις δὲ αὕτη εἶναι κατὰ περιόδους μὲν θετικὴ καὶ κατὰ περιόδους ἀρνητική.

Τὸ ὅλον πρόβλημα τῆς ἐτησίας μεταβολῆς τῆς βροχοπτώσεως εἰς ὅλας τὰς ζώνας τῆς ἐπιφανείας τῆς Γῆς προτίθεμαι, λόγῳ τῆς ἐξαιρετικῆς σημασίας αὐτοῦ τόσον ἀπὸ θεωρητικῆς, ὅσον καὶ ἀπὸ πρακτικῆς ἀπόψεως, νὰ ἐκθέσω λεπτομερέστερον εἰς προσεχῆ ἀνακοίνωσίν μου.