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SOLAR OBSERVATIONS

[Meteorological Research Division, EDGAR W. WOOLARD in charge]

SOLAR RADIATION OBSERVATIONS, SEPTEMBER 1938

By IRVING F. HAND

Measurements of solar radiant energy received at the surface of the earth are made at eight stations maintained by the Weather Bureau, and at nine cooperating stations maintained by other institutions. The intensity of the total radiation from sun and sky on a horizontal surface is continuously recorded (from sunrise to sunset) at all these stations by self-registering instruments; pyrheliometric measurements of the intensity of direct solar radiation at normal incidence are made at frequent intervals on clear days at three Weather Bureau stations (Washington, D. C., Madison, Wis., Lincoln, Nebr.) and at the Blue Hill Observatory of Harvard University. Occasional observations of sky polarization are taken at the Weather Bureau stations at Washington and Madison.

The geographic coordinates of the stations, and descriptions of the instrumental equipment, station exposures, and methods of observation, together with summaries of the data, obtained up to the end of 1936, will be found in the MONTHLY WEATHER REVIEW, December 1937, pp. 415 to 441; further descriptions of instruments and methods are given in Weather Bureau Circular Q.

Table 1 contains the measurements of the intensity of direct solar radiation at normal incidence, with means and their departures from normal (means based on less than 3 values are in parenthesis). At Madison and Lincoln the observations are made with the Marvin pyrheliometer; at Washington and Blue Hill they are obtained with a recording thermopile, checked by observations with a Marvin pyrheliometer at Washington and with a Smithsonian silver disk pyrheliometer at Blue Hill. The table also gives vapor pressures at 8 a. m. (75th meridian time) and at noon (local mean solar time).

Table 2 contains the average amounts of radiation received daily on a horizontal surface from both sun and sky during each week, their departures from normal and the accumulated departures since the beginning of the year. The values at most of the stations are obtained from the records of the Eppley pyrheliometer recording on either a microammeter or a potentiometer.

Direct solar radiation intensities averaged above normal for September at Washington and Blue Hill; below normal at Madison. The Lincoln data for September will be included in the October issue of the REVIEW.

Total solar and sky radiation was above normal at Chicago, New York, La Jolla, New Orleans, San Juan, Lincoln, and Fairbanks; and below normal at all other stations for which normals have been computed.

Polarization measurements made on nine days at Madison give a mean of 42.7 percent with a maximum of 62 percent on the 16th. Both of these values are considerably below the corresponding normals for the month. In connection with these data the official in charge at Madison reports: "The second rainiest month on record at Madison, with 10.29 inches. Dense smoke from a peat bog fire at International Falls, Minn., blew in on the night of the 26th, and the sky was smoky until Oct. 4th." Polarization values of 24, 29, and 15 percent on the 28th, 29th, and 30th of September, respectively, show markedly the effect of this smoke upon atmospheric transparency as do also the direct solar readings at Madison with the larger air masses on the 27th, 28th, and 29th.

LATE DATA

Total solar and sky radiation received on a horizontal surface at Miami for the weeks beginning July 30, August 6, and 13, are as follows: 434, 434, and 492, with corresponding departures of −51, −66, and +27. Instrumental defects prevented additional records for September.

TABLE 1.—*Solar radiation intensities during September 1938*

[Gram-calories per minute per square centimeter of normal surface]

WASHINGTON, D. C.

Date	Sun's zenith distance										
	8 a.m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon
	75th. mer. time	Air mass									Local mean solar time
		A. M.					P. M.				
	e	5.0	4.0	3.0	2.0	*1.0	2.0	3.0	4.0	5.0	e
	mm.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mm.*
Sept. 21	8.81					1.34					7.29
Sept. 22	7.04	0.44	0.63	0.81	1.19	1.44					6.76
Sept. 23	9.14				1.11	1.41	1.05				9.47
Sept. 24	10.59	.65	.73	.88	1.04	1.32					9.83
Sept. 26	7.87	.90	.98	1.08	1.11	1.39	.95				8.48
Sept. 27	11.38				.86						14.10
Means		.66	.78	.92	1.06	1.38	(1.00)				
Departures		−.03	+.02	+.04	+.01	+.06	−.07				

MADISON, WIS.

Sept. 15	9.47		1.11								12.24
Sept. 16	7.87	1.07	1.13	1.24	1.40						8.48
Sept. 21	7.57			1.15	1.33	1.43					7.87
Sept. 22	8.48	.79	.84	.89	1.18	1.45					9.47
Sept. 23	10.59	.82	.96	1.09	1.23	1.45					11.38
Sept. 24	9.14	.78	.93	1.04	1.28	1.54					13.61
Sept. 26	9.83			.94	1.13	1.32					10.59
Sept. 27	6.76			.69	.78						8.81
Sept. 28	6.50	.55	.64	.75	.91	1.29					7.04
Sept. 29	8.18	.36	.44	.52	.66						10.59
Means		.73	.86	.92	1.10	1.41					
Departures		−.07	−.03	−.09	−.06	+.01					

*Extrapolated.

TABLE 1.—*Solar radiation intensities during September 1938*—Con.

[Gram-calories per minute per square centimeter of ormal surface]

BLUE HILL, MASS.

Date	Sun's zenith distance										
	8 a.m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon
	75th. mer. time	Air mass									Local mean solar time
		A. M.					P. M.				
	e	5.0	4.0	3.0	2.0	*1.0	2.0	3.0	4.0	5.0	e
	mm.	*cal.*	*ca.*	*TI.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*mm.*
Sept. 2	8.6				1.17						8.6
Sept. 3	9.2				1.20	1.29					8.9
Sept. 5	6.3				1.26	1.50	1.25				6.8
Sept. 6	6.3		1.13	1.22	1.31	1.40	1.30				6.1
Sept. 8	5.8	.97	1.08	1.18	1.30	1.44	1.19				5.8
Sept. 9	5.6		1.12	1.21	1.31	1.42	1.21	1.04			6.1
Sept. 10	5.6		1.10	1.17	1.29	1.41	1.25	1.19			6.8
Sept. 11	7.9		1.04	1.15	1.27	1.38	1.12	.89			8.8
Means		(.97)	1.09	1.19	1.26	1.41	1.22	1.04			
Departures		+.15	+.14	+.14	+.10	+.04	+.08	+.08			

LATE DATA—BLUE HILL, MASS.

Aug. 2	16.9			.72	.99	1.33	.92				15.8
Aug. 3	18.2			.61	.84	1.12	.79				18.8
Aug. 8	14.7				.99	1.34					15.8
Aug. 9	13.7			.94	1.18	1.49					15.3
Aug. 10	10.7			1.20	1.35	1.49					10.3
Aug. 12	12.8			1.30	1.44						9.9
Aug. 13	12.3				1.07	1.34	1.10				13.2
Aug. 14	13.7					1.36					15.8
Aug. 16	20.8			1.01	1.11	1.22					21.5
Aug. 23	11.9		1.07	1.16	1.28	1.40					11.9
Aug. 25	10.3					1.38					9.6
Means			(1.07)	.99	1.12	1.35	.94				
Departures			+.15	+.03	+.06	+.07	−.13				

TABLE 2.—*Average daily totals of solar radiation (direct+diffuse) received on a horizontal surface*

Week beginning—	Washington	Madison	Lincoln	Chicago	New York	Fresno	Fairbanks	Twin Falls	La Jolla	Miami	New Orleans	Riverside	Blue Hill	San Juan	Friday Harbor	Ithaca	Newport
	Gram-calories per square centimeter																
	cal.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
Sept. 3	384	209	464		500	578	190	541	498		355	481	491	509	355	441	555
Sept. 10	256	284	403		275	498	210	472	428		352	446	373	618	488	232	401
Sept. 17	205	288	494	361	217	457	154	410	425	430	493	437	202	481	255	143	207
Sept. 24	317	408	449	400	335	395	154	317	415	330	442	386	386	608	229	325	407
	Departures of daily totals from normals																
Sept. 3	+3	−163	+9		+170	+4	−5	+42	+10		−51	−21	+103	−56	−63	+91	
Sept. 10	−109	−53	−26		−39	−42	0	+16	−72		+14	−18	+14	+53	+110	−79	
Sept. 17	−157	−57	+67	+39	−79	−37	−4	+2	+29	−5	+115	+13	−144	−61	−57	−157	
Sept. 24	−31	+112	+71	+125	+51	−65	+25	−104	+56	−49	+74	−24	+40	+103	−80	+62	
	Accumulated departures since Jan. 1																
	−11,582	−1,995	+86	+7,735	+2,842	−1,904	+4,319	−6,447	−2,625	−5,107	+5,985	−5,992	−2,884	+11,508	+7,308	+1,260	