SOLAR RADIATION AND SUNSPOT DATA FOR NOVEMBER 1940

SOLAR RADIATION OBSERVATIONS

By HELEN CULLINANE

Measurements of solar radiant energy received at the surface of the earth are made at 9 stations maintained by the Weather Bureau and at 10 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 two Weather Bureau stations (Madison, Wis.; Lincoln, Nebr.) and at the Blue Hill Observatory at Harvard University. Occasional observations of sky polarization are taken at the Weather Bureau station at Madison and at Blue Hill Observatory.

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 parentheses). At Lincoln the observations are made with the Marvin pyrheliometer; at Madison and Blue Hill they are obtained with a recording thermopile, checked by observations with a Smithsonian silver-disk pryheliometer at Blue Hill. The table also gives vapor pressures at 7:30 a. m. and at 1:30 p. m. (75th meridian 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.

The supervising station for the Solar Radiation Investigations of the Weather Bureau was moved on November 1, 1940, to the Harvard Blue Hill Meteorological Observatory at Milton, Mass., where it is thought mutual benefit will result through cooperation with the many other research workers in solar studies in and around Boston. Moreover, it is thought that the skies at Blue Hill will be somewhat better than those in the suburbs of Washington, D. C.

Some extension of the work of the Solar Radiation Investigations Section will occur, notably the addition of studies of certain component radiations, a careful check on all radiation apparatus in use by our own and cooperating stations, the addition of new equipment at Weather Bureau stations already established, and an attempt to improve existing apparatus. It also is expected that much closer cooperation will exist with other institutions and individuals engaged in similar work.

Difficulties at Twin Falls, Idaho, have been straightened out, and radiation data for several months at that station will be found later in this report.

Total solar and sky radiation was below normal at Washington, D. C., Twin Falls, and Blue Hill, while it was practically normal at all other stations.

There was only one polarization measurement at Madison, Wis., on November 25, giving a value of 62.7, compared with a mean for the month of 66 and a maximum of 69.

TABLE 1.—*Solar radiation intensities during November 1940*

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

Date	Sun's zenith distance										
	7:30 a. m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	1:30 p. m.
	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.*
MADISON, WIS.											
November 13	1.37	0.84	1.06	1.16	------	1.56	------	1.13	------	------	1.52
November 15	1.37	.95	1.07	1.22	------	------	------	------	------	------	1.68
November 25	2.36	.76	.95	1.14	------	1.65	------	------	------	------	3.00
November 29	1.37	.87	1.02	1.21	------	1.65	------	------	------	------	2.26
Means	------	.86	1.02	1.18	------	1.62	------	(1.13)	------	------	------
Departures	------	−.02	+.02	+.02	------	+.05	------	+.01	------	------	------

* Extrapolated.

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

[Gram-calories per square centimeter]

Week beginning—	Washington	Madison	Lincoln	Chicago	New York	Fresno	Newport	Fairbanks	Twin Falls	La Jolla	Miami	New Orleans	Riverside	Blue Hill	Cambridge	Friday Harbor	Ithaca	Albuquerque
	cal.	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*	*cal.*
October 29	205	189	------	------	156	322	214	58	178	363	268	306	338	202	201	123	------	368
November 5	208	125	127	------	176	299	180	40	156	310	319	230	314	146	157	125	------	352
November 12	148	235	260	------	70	251	97	16	222	233	368	308	226	71	64	122	------	401
November 19	178	122	91	------	145	237	164	14	145	296	321	200	285	154	146	94	------	179
November 26	166	109	138	------	136	223	170	21	146	301	298	238	284	173	166	56	------	295
DEPARTURES FROM WEEKLY NORMALS																		
October 29	−41	+2	------	------	−25	−20	+2	+17	−41	+39	−47	+9	+29	−21	------	−10	------	------
November 5	−18	−43	−115	------	+17	−6	+12	+3	−50	+14	−21	−56	+12	−53	------	+14	------	------
November 12	−48	+84	+48	------	−61	−4	−37	−12	+52	−59	+34	+77	−62	−76	------	+28	------	------
November 19	−7	−9	−111	------	+17	−6	+15	−4	−11	+12	−1	−48	+9	+6	------	−10	------	------
November 26	+2	−16	−46	------	+20	+12	+14	+7	−5	+27	+9	+12	+22	+10	------	−34	------	------
ACCUMULATED DEPARTURES ON DECEMBER 2, 1940																		
	+5,761	+5,887	------	------	+9,534	−714	−1,999	+5,236	------	−3,829	−2,702	+11,097	------	−5,670	------	------	------	------

LATE DATA

The following total solar and sky radiation figures represent late data for the stations at Blue Hill, Massachusetts; Fairbanks, Alaska; and Twin Falls, Idaho, for the periods shown.

Week of—	Blue Hill		Fairbanks		Twin Falls	
	Observation	Departure	Observation	Departure	Observation	Departure
Feb. 24					211	−76
Mar. 4					406	+66
Mar. 11					397	+73
Mar. 18					526	+132
Mar. 25					239	−110
Apr. 1					356	−75
Apr. 8					564	+98
Apr. 15					518	+35
Apr. 22					560	+54
Apr. 29					631	+105
May 6					594	+3
May 13					668	+57
May 20					635	−10
May 27					621	+22
July 2					643	+45
July 9					719	+112
July 16					633	+17
July 23					634	+161
July 30					673	+115
Aug. 6					599	+42
Aug. 13					610	+100
Aug. 20					493	−30
Aug. 27					447	−37
Sept. 3					353	−120
Sept. 10					383	−63
Sept. 17					387	−21
Sept. 24					333	−81
Oct. 1	278	−32	151	+33	359	−4
Oct. 8	313	−9	85	−7	380	+31
Oct. 15	272	−21	85	+12	326	+1
Oct. 22	262	+36	46	−13	154	−127
Accumulated departures on Oct. 28	−4,732		+5,159			

POSITIONS, AREAS, AND COUNTS OF SUN SPOTS

[Communicated by Capt. J. F. Hellweg, U. S. Navy (Ret.), Superintendent, U. S. Naval Observatory.] All measurements and spot counts were made at the Naval Observatory from plates taken at the observatories indicated. Difference in longitude is measured from the central meridian, positive toward the west. Latitude is positive toward the north. Areas are corrected for foreshortening and expressed in millionths of Sun's hemisphere. For each day, under longitude, latitude, area of spot or group, and spot count, are included assumed longitude of center of the disk, assumed latitude of center of the disk, total area of spots and groups, and total spot count.

Date	Eastern standard time	Mount Wilson group No.	Heliographic: Difference in longitude	Heliographic: Longitude	Heliographic: Latitude	Heliographic: Distance from center of disk	Area of spot or group	Spot count	Plate quality	Observatory
1940	*h m*		°	°	°	°				
Nov. 1	10 48	7022	−44	60	+14	45	267	12	G	U.S. Naval.
		7025	−37	67	−9	40	12	7		
		7023	−32	72	−9	34	24	1		
		7021	−3	101	+13	10	48	9		
		7019	+78	182	−3	78	97	3		
		7024	+80	184	−9	80	12	1		
				(104)	(+4)		460	33		
Nov. 2	10 37	7022	−31	60	+14	33	242	17	VG	Do.
		7025	−25	66	−9	28	73	8		
		7023	−16	75	−9	21	24	3		
		7021	+12	103	+14	16	24	5		
		7027	+44	135	+9	44	48	3		
		7026	+56	147	−8	57	24	2		
				(91)	(+4)		435	38		
Nov. 3	11 56	(*)	−75	2	−17	77	6	1	G	Do.
		(*)	−68	9	+15	68	48	2		
		7022	−17	60	+17	22	54	11		
		7022	−11	66	+14	15	121	5		
		7025	−11	66	−7	16	97	13		
		7023	0	77	−7	11	6	2		
		(*)	+60	137	+3	60	97	6		
		(*)	+70	147	−17	73	48	3		
				(77)	(+4)		477	43		
Nov. 4	10 45	7030	−57	7	+8	57	73	13	G	Do.
		7029	−49	15	−18	53	12	2		
		7022	−7	57	+16	13	12	1		
		7022	+1	65	+14	10	145	11		
		7025	+3	67	−7	11	73	11		
		7023	+15	79	−7	20	6	1		
		7028	+22	86	+8	22	12	1		
		7027	+70	134	+10	70	109	5		
				(64)	(+4)		442	45		

POSITIONS, AREAS, AND COUNTS OF SUN SPOTS—Continued

Date	Eastern standard time	Mount Wilson group No.	Heliographic: Difference in longitude	Heliographic: Longitude	Heliographic: Latitude	Heliographic: Distance from center of disk	Area of spot or group	Spot count	Plate quality	Observatory
1940	*h m*		°	°	°	°				
Nov. 5	11 8	7030	−45	6	+7	45	12	4	G	U. S. Naval.
		7030	−39	12	+9	39	73	9		
		7029	−36	15	−17	41	6	1		
		7031	−16	35	+10	18	12	1		
		7022	+8	59	+15	13	12	1		
		7022	+15	66	+14	19	121	12		
		7025	+20	71	−8	24	24	6		
		7023	+30	81	−9	33	24	2		
		7028	+40	91	+9	40	12	6		
				(51)	(+4)		296	42		
Nov. 6	13 4	7034	−83	314	−11	83	145	2	G	Do.
		7030	−31	6	+7	32	48	7		
		7030	−26	11	+9	27	97	12		
		7033	−22	15	+16	25	6	1		
		7031	− 2	35	+10	6	6	1		
		7032	+27	64	−1	27	48	4		
		7022	+29	66	+12	30	97	7		
		7025	+33	70	−8	35	24	4		
		7023	+44	81	−8	47	24	6		
				(37)	(+4)		495	44		
Nov. 7	11 59	7035	−77	307	+7	77	12	1	F	Do.
		7034	−70	314	−11	71	97	1		
		7030	−17	7	+7	18	73	18		
		7030	−11	13	+9	12	61	1		
		7032	+40	64	0	41	97	4		
		7022	+41	65	+13	42	73	4		
		7025	+47	71	−8	49	12	1		
		7023	+59	83	−8	60	36	1		
				(24)	(+4)		461	31		
Nov. 8	11 20	7038	−86	285	+9	86	48	1	VG	Mt. Wilson.
		7037	−82	289	+16	82	24	1		
		7035	−63	308	+7	63	36	5		
		7034	−57	314	−10	59	97	1		
		7036	−53	318	+7	53	12	4		
		7030	−3	8	+9	6	121	20		
		7030	+5	16	+9	5	48	2		
		7032	+54	65	0	54	73	5		
		7022	+55	66	+13	56	133	10		
		7023	+72	83	−8	72	24	1		
				(11)	(+4)		616	50		
Nov. 9	11 44	7038	−72	286	+8	72	48	1	G	U. S. Naval.
		7037	−68	290	+16	69	24	4		
		7035	−48	310	+7	48	48	10		
		7034	−44	314	−10	46	61	1		
		7036	−38	320	+7	38	242	15		
		(*)	+8	6	+10	11	12	1		
		7030	+10	8	+8	11	24	6		
		7030	+19	17	+8	20	24	3		
		7022	+69	67	+12	69	97	7		
				(358)	(+3)		580	48		
Nov. 10	11 6	7040	−70	275	−8	70	6	1	G	Mt. Wilson.
		7038	−59	286	+10	59	73	3		
		7037	−52	293	+17	53	6	2		
		7035	−33	312	+7	33	97	10		
		7034	−30	315	−11	33	61	1		
		7036	−24	321	+7	24	436	16		
		7039	−4	341	−15	19	24	3		
		7030	+32	17	+8	32	36	2		
		(*)	+33	18	−17	39	24	3		
		7022	+80	65	+11	80	24	1		
				(345)	(+3)		787	42		
Nov. 11	11 2	7044	−78	254	−17	79	48	1	G	U. S. Naval.
		7038	−45	287	+9	45	48	3		
		7035	−20	312	+7	21	73	9		
		7034	−17	315	−11	22	61	1		
		7043	−12	320	−11	19	12	6		
		7036	−11	321	+7	12	364	23		
		7042	+21	353	+18	26	6	1		
		7030	+45	17	+9	45	24	1		
		7041	+66	38	+10	66	6	2		
				(332)	(+3)		642	47		
Nov. 12	12 14	7044	−65	253	−16	68	48	1	F	Mt. Wilson.
		7038	−32	286	+9	32	36	2		
		7046	−17	301	−12	22	48	7		
		7035	−6	312	+8	8	73	12		
		7034	−2	316	−11	14	61	1		
		7043	+2	320	−11	14	6	1		
		7036	+4	322	+8	6	412	16		
		7042	+37	355	+17	40	6	1		
		7045	+44	2	+20	46	6	2		
		7030	+61	19	+9	61	12	1		
				(318)	(+3)		708	44		