SOLAR INDICES BULLETIN

AUGUST 2014

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♦ SOLAR RADIO EMISSIONS

The quiet Sun emits radio energy with a slowly varying intensity. These radio fluxes, which stem from atmospheric layers high in the chromosphere and low in the corona, change gradually from day-to-day, in response to the number and size of spot groups on the solar disk. The table below gives daily measurements of this slowly varying emission at selected wavelengths between about 1 and 100 centimeters. Many observatories record quiet-sun radio fluxes at the same local time each day and correct them to within a few percent for factors such as antenna gain, bursts in progress, atmospheric absorption, and sky background temperature. At 2800 megahertz (10.7 centimeters) flux observations summed over the Sun's disk have been made continuously since February 1947.

♦ SOLAR FLUX TABLE

Numbers in parentheses in the column headings below denote frequencies in megahertz. Each entry is given in solar flux units--a measure of energy received per unit time, per unit area, per unit frequency interval. One solar flux unit equals $10^{-22}\ \mathrm{J/m^2 Hz\,sec}$. During periods of low solar activity, the flux never falls to zero, because the Sun emits at all wavelengths with or without the presence of spots. The lowest daily Ottawa flux since 1947 occurred on November 3, 1954. On that day the observed noon value dropped to 62.6 units; the highest observed value of 457.0 occurred on April 7, 1947.

The preliminary observed and adjusted Penticton fluxes tabulated here are the "Series C" values reported by Canada's Dominion Radio Astrophysical Observatory in Penticton, British Columbia. Observed numbers are less refined, since they contain fluctuations as large as ±7% from the continuously changing sun-earth distance. Adjusted fluxes have this variation removed; they show the energy received at the mean distance between the Sun and Earth. Gaps in the Palehua, Hawaii (PALE), data reflect equipment problems. Fluxes measured either at Sagamore Hill, Massachusetts, or at San Vito, Italy, will be substituted for frequencies at which many Palehua values are missing.

AUGUST 2014 PRELIMINARY SUNSPOT NUMBERS AND SOLAR RADIO FLUX

Day	Sunspot Number Intl	Obs Flux Pentic (2800)	Solar Flux Adjusted to 1 Astronomical Unit RSTN (15400)	RSTN (8800)	RSTN (4995)	Pentic (2800)	RSTN (2695)	RSTN (1415)	RSTN (610)	RSTN (410)	RSTN (245)
01	115	168	607	306	196	168	151	133	86	49	19
02	115	156	607	303	191	156	153	125	79	48	19
03	107	152	599	294	181	152	141	123	79	49	22
04	102	139	612	299	178	139	142	114	72	44	28
05	89	139	594	293	174	139	131	115	71	46	22
06	79	137	608	289	177	137	133	113	71	45	20
07	86	136	611	295	177	136	131	109	74	55	37
08	62	123	558	284	165	123	122	98	63	49	38
09	58	113	572	261	155	113	111	88	66	50	37
10	43	108	595	274	151	108	104	89	65	47	33
11	48	105	594	273	151	105	103	86	63	45	23
12	52	104	578	268	148	104	100	81	58	44	24
13	55	103	586	270	146	103	96	79	60	42	20
14	60	103	598	264	147	103	103	80	62	45	19
15	75	113	597	284	159	113	107	87	64	47	20
16	76	112	596	276	155	112	104	87	62	53	44
17	81	115	595	276	155	115	106	88	61	43	31
18	73	111	592	267	152	111	106	84	59	40	30
19	69	111	582	269	151	111	107	86	61	42	22
20	71	118	610	283	165	118	118	96	65	52	58
21	84	128	604	290	171	128	121	97	64	44	22
22	87	126	599	285	167	126	120	93	67	44	21
23	105	132	601	294	176	132	125	105	73	49	30
24	104	141	585	297	182	141	131	110	73	49	22
25	81	152	605	301	176	135	127	101	71	46	26
26	60	128	600	284	176	128	123	93	70	45	22
27	66	123	536	254	161	123	109	96	73	45	21
28	57	119	593	285	159	119	114	100	74	46	20
29	46	120	597	291	168	120	119	102	73	46	20
30	53	123	593	291	172	123	121	98	72	47	20
31	57	125	557	285	172	125	123	103	69	48	40
Mean	74.7	125	592	283	166	125	119	99	68	47	27

JULY 2014 FINAL FLUX

Day	Observed Pentic (2800)	Adjusted Pentic 2800)
01	151.8	156.9
02	169.4	175.1
03	178.1	184.1
04	187.6	193.9
05	193.0	199.4
06	201.0	207.7
07	197.9	204.5
08	201.4	208.1
09	198.4	205.0
10	177.4	183.3
11	166.3	171.8
12	145.0	149.9
13	126.8	131.0
14	109.4	113.0
15	100.6	103.9
16	92.1	95.1
17	88.6	91.5
18	88.5	91.4
19	86.1	88.9
20	87.1	89.9
21	90.1	93.0
22	92.6	95.5
23	99.1	102.2
24	104.1	107.4
25	106.5	109.9
26	116.5	120.1
27	121.4	125.2
28	132.2	136.3
29	141.6	146.0
30	151.9	156.6
31	156.4	161.1
Mean	137.3	141.8

♦ SUNSPOT COUNTS

In 1848 the Swiss astronomer Johann Rudolf Wolf introduced a daily measurement of sunspot number. His method, which is still used today, counts the total number of spots visible on the face of the Sun and the number of groups into which they cluster, because neither quantity alone satisfactorily measures the level of sunspot activity.

An observer computes a daily sunspot number by multiplying his estimated number of groups by ten and then adding this product to his total count of individual spots. Results, however, vary greatly, since the measurement strongly depends on observer interpretation and experience and on the stability of the Earth's atmosphere above the observing site. Moreover, the use of Earth as a platform from which to record these numbers contributes to their variability, too, because the Sun rotates and the evolving spot groups are distributed unevenly across solar longitudes. To compensate for these limitations, each daily international number is computed as a weighted average of measurements made from a network of cooperating observatories. The international sunspot numbers tabulated on page 1 are provisional values taken from a bulletin prepared monthly by the SOLAR INFLUENCE DATA CENTER, RINGLAAN 3, 1180 BRUSSELS, BELGIUM. (http://sidc.oma.be)

♦ HISTORICAL SUNSPOT COUNTS

How do sunspot numbers in the table on page 1 compare to the largest values ever recorded? The highest daily count on record occurred December 24-25, 1957. On each of those days the sunspot number totaled 355. In contrast, during years near the spot cycle minimum, the count can fall to zero. Today, much more sophisticated measurements of solar activity are made routinely, but none has the link with the past that sunspot numbers have. Our archives, for example, include reconstructed daily values from January 8, 1818; monthly means from January 1749; and yearly means beginning in 1700.

SMOOTHED (OBSERVED AND PREDICTED) SUNSPOT NUMBERS: CYCLES 23 AND 24

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
2000	113	117	120	121	119	119	120	119	116	115	113	112	117
2001	109	104	105	108	109	110	112	114	114	114	116	115	111
2002	114	115	113	111	109	106	103	99	95	91	85	82	102
2003	81	79	74	70	68	65	62	60	60	58	57	55	66
2004	52	49	47	46	44	42	40	39	38	36	35	35	42
2005	35	34	34	32	29	29	29	27	26	26	25	23	29
2006	21	19	17	17	17	16	15	16	16	14	13	12	16
2007	12	12	11	10	9	8	7	6	6	6	6	5	8
2008	4	4	3	3	4	3	3	3	2	2	2	2	3
2009	2	2	2	2	2	3	4	5	6	7	8	8	4
2010	9	11	12	14	16	16	17	17	20	23	27	29	18
2011	31	33	37	42	48	53	57	59	60	60	61	63	50
2012	66	67	67	65	62	59	58	58	58	59	60	61	61
2013	59	58	58	58	60	63	66	69	73	75	75	75	66
2014	77	77	76	76	75	74	73	72	70	68	67	65	72
		(4)	(9)	(12)	(14)	(16)	(17)	(17)	(17)	(18)	(19)	(20)	(14)
2015	63	61	60	59	58	56	53	52	50	49	48	47	55
	(19)	(16)	(13)	(12)	(12)	(13)	(13)	(14)	(14)	(15)	(16)	(17)	(15)
2016	46	45	43	42	40	39	38	37	37	35	33	32	39
	(18)	(20)	(22)	(24)	(24)	(24)	(25)	(24)	(24)	(24)	(25)	(26)	(23)

♦ SUNSPOT NUMBER PREDICTIONS

For the end of Solar Cycle 23, and the beginning of Cycle 24, the table gives smoothed sunspot numbers up to the one calculated that first uses the most recently measured monthly mean. These smoothed, observed values are based on final, unsmoothed monthly means through June 2010 and on provisional ones thereafter. We compute a smoothed monthly mean by forming the arithmetic average of two sequential 12-month running means of monthly means.

Table entries with numbers in parentheses below them denote predictions by the McNish-Lincoln method. This method estimates future numbers by adding a correction to the mean of all cycles that is proportional to the departure of earlier values of the current cycle from the mean cycle. (See page 9 in the July 1987 supplement to *Solar-Geophysical Data*). We use and predict only smoothed monthly means, because we believe the errors are too great to estimate any values more precisely. In the table above, adding the number in parentheses to the predicted value generates the upper limit of the 90% confidence interval; subtracting the number from the predicted value generates the lower limit. Consider, for example, the August 2011 prediction. There exists a 90% chance that in August 2011, the actual smoothed sunspot number will fall somewhere between 18 and 62.

The McNish-Lincoln prediction method generates useful estimates of smoothed, monthly mean sunspot numbers for no more than 12 months ahead. Beyond a year these predictions regress rapidly toward the mean of all 14 cycles used in the computation. Moreover, the method is very sensitive to the date defined as the beginning of the current sunspot cycle, that is, to the date of the most recent sunspot minimum.