SOLAR INDICES BULLETIN

AUGUST 2011

National Geophysical Data Center
325 Broadway, E/GC2
Boulder, CO 80305-3328

Solar Terrestrial Physics Division
Telephone: 303-497-6135

♦ 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 $10^{-22}\ J/m^2 Hz\,sec$. 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 2011 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	82	125	568	291	182	125	108	100	55	40	17
02	73	122	569	293	182	122	109	100	55	44	50
03	62	120	566	289	171	120	108	101	54	41	36
04	71	116	559	280	170	116	108	98	54	41	43
05	68	109	558	253	149	109	88	82	53	39	29
06	61	110	556	279	163	110	104	95	53	38	24
07	61	105	370	274	158	105	102	94	53	35	34
08	54	102	507	272	154	102	95	90	54	34	18
09	47	98	560	263	144	98	90	91	51	30	12
10	28	90	464	263	137	90	84	85	48	29	10
11	29	84	559	250	133	84	79	81	50	32	15
12	22	83	551	245	131	83	81	81	50	33	15
13	14	83	551	250	132	83	78	80	46	30	11
14	0	88	545	252	135	88	84	83	52	33	15
15	9	90	450	260	137	90	86	83	51	34	17
16	24	93	547	255	139	93	89	84	51	34	14
17	39	98	548	254	141	98	94	87	51	38	17
18	45	98	540	255	140	98	98	89	51	34	14
19	46	98	550	255	145	98	97	90	54	32	13
20	45	101	546	258	139	101	93	93	49	31	12
21	56	101	546	259	150	101	97	94	46	29	11
22	71	108	556	278	156	108	99	96	48	29	11
23	75	104	554	260	146	104	53	95	50	27	10
24	54	104	557	267	150	104	97	98	56	34	14
25	50	104	549	254	151	104	91	83	47	37	16
26	66	105	550	265	148	105	96	97	56	36	15
27	59	104	556	263	148	104	94	100	54	36	15
28	49	101	384	263	143	101	93	96	54	35	15
29	43	101	567	264	146	101	95	95	54	35	15
30	69	101	562	273	146	101	95	95	53	35	15
31	96	109	561	282	156	109	98	99	54	36	16
Mean	78.0	102	553	265	149	102	93	91	52	35	18

JUL 2011 FINAL FLUX

Observed Pentic (2800)	Adjusted Pentic (2800)
87.6	90.5
85.6	88.5
86.2	89.2
85.0	87.9
84.8	87.7
84.6	87.5
85.5	88.4
85.8	88.7
85.6	88.5
90.7	93.7
90.1	93.1
91.7	94.7
94.6	97.7
94.1	97.2
93.8	96.9
93.8	96.9
103.6	107.0
102.0	105.3
100.3	103.6
100.1	103.4
96.0	99.1
92.4	95.4
88.2	91.1
86.2	88.9
87.0	89.8
93.5	96.4
99.3	102.5
107.3	110.7
111.7	115.2
112.7	116.2
118.6	122.2
94.1	97.2

♦ 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
1997	10	11	14	17	18	20	23	25	28	32	35	39	23
1998	44	49	53	57	59	62	65	68	70	71	73	78	62
1999	83	85	84	86	91	93	94	98	102	108	111	111	95
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	35	37	40	42	44	46	48	51	53	55	43
			(3)	(5)	(6)	(9)	(11)	(13)	(16)	(21)	(25)	(28)	(11)
2012	57	59	60	62	62	64	66	68	70	72	72	73	65
	(31)	(33)	(35)	(36)	(37)	(37)	(37)	(37)	(36)	(36)	(37)	(37)	(36)
2013	74	76	77	77	77	78	78	77	76	76	77	77	77
	(38)	(38)	(38)	(39)	(40)	(42)	(44)	(43)	(42)	(41)	(41)	(41)	(41)

♦ 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.

Although every effort has been made to ensure that these data are correct, we can assume no liability for any damages any inaccuracies might cause.
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