SOLAR INDICES BULLETIN

SEPTEMBER 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.

SEPTEMBER 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	85	112	562	267	161	112	105	100	53	34	15
02	88	115	556	272	154	115	104	105	54	36	16
03	91	119	549	271	162	119	108	105	53	37	19
04	68	119	538	266	162	119	109	105	54	39	18
05	74	119	555	289	168	119	109	105	54	36	18
06	58	112	517	259	151	112	97	86	53	43	43
07	47	113	507	277	158	113	103	102	53	39	35
08	35	110	540	276	159	110	100	103	60	50	48
09	47	112	563	271	160	112	104	103	64	62	82
10	52	116	563	275	151	116	107	105	59	49	41
11	61	121	565	279	168	121	109	107	51	32	19
12	90	124	539	301	176	124	122	119	55	31	12
13	94	129	563	284	167	129	122	119	80	66	49
14	110	143	560	297	186	143	131	126	53	32	12
15	124	141	570	291	177	141	137	126	54	34	12
16	124	143	580	307	186	143	135	130	63	48	25
17	104	145	579	291	189	145	135	128	56	34	13
18	93	150	581	298	184	150	138	128	63	41	18
19	92	141	577	280	179	141	129	125	61	40	18
20	80	144	525	287	190	144	132	123	59	37	17
21	70	144	573	292	183	144	133	130	60	39	19
22	71	151	548	312	197	151	141	135	65	41	19
23	59	158	578	349	219	158	158	163	74	48	31
24	75	190	627	326	208	190	150	145	81	52	65
25	79	169	624	335	222	169	155	142	80	49	29
26	73	148	582	327	198	148	137	131	88	70	149
27	67	139	562	309	190	139	136	129	62	40	37
28	71	133	563	294	184	133	126	126	57	35	30
29	83	137	549	292	180	137	123	121	58	39	29
30	75	138	568	301	186	138	131	128	57	39	26
31											
Mean		135	545	293	179	135	124	120	61	42	32

AUG 2011 FINAL FLUX

Day	Observed Pentic (2800)	Adjusted Pentic (2800)
01	124.9	128.7
02	121.6	125.2
03	119.9	123.5
04	116.3	119.7
05	109.4	112.5
06	110.0	113.2
07	105.4	108.4
08	101.5	104.3
09	97.5	100.2
10	90.3	92.7
11	84.2	86.5
12	83.4	85.7
13	83.1	85.3
14	88.1	90.4
15	90.4	92.7
16	93.0	95.4
17	97.5	100.0
18	97.8	100.2
19	98.2	100.6
20	100.5	102.9
21	100.9	103.3
22	108.2	110.7
23	103.7	106.1
24	104.1	106.4
25	104.2	106.4
26	104.6	106.8
27	103.8	106.0
28	101.0	103.1
29	101.2	103.2
30	101.3	103.2
31	109.0	111.0
Mean	101.7	104.3

♦ 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	37	39	42	44	46	48	50	53	55	57	45
				(3)	(6)	(10)	(12)	(14)	(17)	(21)	(25)	(28)	(11)
2012	59	61	62	64	65	66	68	70	72	74	74	75	67
	(31)	(33)	(35)	(36)	(37)	(37)	(37)	(36)	(36)	(36)	(36)	(36)	(36)
2013	76	78	78	78	78	79	79	78	78	77	78	78	78
	(38)	(38)	(37)	(38)	(39)	(41)	(43)	(43)	(41)	(40)	(40)	(40)	(40)

♦ 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. Subscriptions to this monthly bulletin are available free of charge. To become a subscriber either call (303) 497-6761, or write to the NATIONAL GEOPHYSICAL DATA CENTER, Solar-Terrestrial Physics Division (E/GC2), 325 Broadway, Boulder, Colorado 80305-3328, USA. Solar Indices Bulletin can also be accessed online via the .ftp link at: ***www.ngdc.noaa.gov/stp/solar/sibintro.html***.