SOLAR INDICES BULLETIN

JANUARY 2007

NATIONAL GEOPHYSICAL DATA CENTER
Solar-Terrestrial Physics Division (E/GC2)
Telephone (303) 497-6346

325 Broadway
Boulder, Colorado 80305-3328 USA
ISSN 1046-1914

♦ 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 low periods of 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.

JANUARY 2007 PRELIMINARY SUNSPOT NUMBERS AND SOLAR RADIO FLUX

Day	Sunspot Number Intl	Obs Flux Pentic (2800)	Solar Flux Adjusted to 1 Astronomical Unit: PALE (15400)	PALE (8800)	PALE (4995)	Pentic (2800)	PALE (2695)	PALE (1415)	PALE (610)	PALE (410)	PALE (245)
01	22	87	475	245	140	84	94	46	32	24	11
02	24	90	471	244	141	87	98	50	33	21	9
03	25	81	486	241	141	78	94	50	33	24	11
04	25	89	487	242	144	86	96	49	33	24	12
05	28	89	467	234	138	86	94	48	31	22	10
06	27	87	476	237	136	84	91	47	33	23	11
07	26	87	459	234	138	84	93	49	34	22	14
08	30	88	---	---	---	85	---	---	---	---	---
09	27	92	487	238	141	88	96	50	32	23	12
10	24	86	472	236	---	83	91	46	33	23	8
11	23	84	479	236	135	81	90	45	32	23	10
12	16	84	492	236	135	81	87	45	32	20	8
13	17	81	492	237	133	78	87	44	31	19	8
14	11	82	498	237	133	79	88	44	31	21	9
15	11	82	493	233	130	79	88	47	30	19	7
16	11	79	486	230	128	76	83	---	30	20	8
17	9	78	489	231	129	75	80	43	31	19	7
18	10	77	478	227	124	74	82	41	29	20	7
19	8	76	471	231	128	73	80	41	31	19	7
20	18	79	481	234	126	76	83	44	31	20	7
21	11	79	457	224	127	76	83	43	31	18	9
22	12	79	487	235	131	76	83	48	31	21	10
23	10	79	472	222	128	76	82	43	30	20	9
24	11	80	472	233	129	77	82	43	31	23	9
25	8	80	486	229	128	77	83	41	32	20	10
26	7	80	490	231	128	77	82	42	32	21	10
27	7	81	494	239	137	78	86	44	35	26	22
28	8	82	492	239	137	79	90	46	32	23	13
29	18	87	489	247	147	84	95	49	33	22	28
30	20	88	472	236	140	85	93	50	34	22	8
31	20	89	484	242	141	86	93	45	33	---	---
Mean	16.9	83	481	235	134	80	88	46	32	21	10

DEC 2006 FINAL FLUX

Observed Pentic (2800)	Adjusted Pentic (2800)
84.2	81.8
87.3	84.8
87.1*	84.6*
96.3#	93.6#
102.4	99.4
*-1800UT Reading	
102.7*	99.7*
95.8*	92.9*
96.0	93.1
92.4	89.6
90.0	87.3
#-2200UT Reading	
92.2	89.4
102.0+	98.9+
93.6	90.7
93.4	90.5
87.1	84.4
+-Burst in Progress	
82.3	79.7
81.3	78.7
74.7	72.3
72.9	70.6
71.5	69.2
72.3	70.0
73.2	70.8
72.7	70.3
73.5	71.1
76.4	73.9
75.0	72.5
73.3	70.9
76.3	73.8
78.4	75.8
80.0	77.4
83.3	80.5
84.5	81.9

♦ SUNSPOT COUNTS

In 1848 the Swiss astronomer Johann Rudolph 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 Pierre Cugnon of the SUNSPOT INDEX DATA CENTER, 3 avenue Circulaire, B-1180 BRUXELLES, BELGIUM. The January 2007 observations from 48 stations. (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 22 AND 23

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Mean
1993	71	69	67	64	60	56	55	52	48	45	41	38	56
1994	37	35	34	34	33	31	29	27	27	27	26	26	30
1995	24	23	22	21	19	18	17	15	13	12	11	11	17
1996	10	10	10	9	8*	9	8	8	8	9**	10	10	9
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	103	108	111	111	96
2000	113	117	120	120.7#	119	119	120	119	116	115	113	112	117
2001	109	104	105	108	109	110	112	114	114	114	115	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	34	42
2005	35	34	34	32	29	29	29	27	26	26	25	23	29
2006	21	19	17	17	17	16	15	15	14	13	12	12	16
								(1)	(3)	(4)	(5)	(5)	(2)
2007	11	11	11	11	11	12	12	13	14	15	15	17	13
	(5)	(6)	(6)	(7)	(9)	(10)	(12)	(14)	(15)	(17)	(19)	(21)	(12)

*May 1996 marks Cycle 22's mathematical minimum. **October 1996 marks the consensus Cycle 22 minimum which NGDC is now using.
April 2000 marks Cycle 23 maximun.

♦ SUNSPOT NUMBER PREDICTIONS

For the end of Solar Cycle 22, and the beginning of Cycle 23, 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 Sep 2006 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 precise. 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 July 2007 prediction. There exists a 90% chance that in July 2007, the actual smoothed sunspot number will fall somewhere between 0 and 24.

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 13 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. The new cycle predictions tabulated above are based on the consensus minimum value of 8.8 that occurred in October 1996. For solar maximum discussions, visit http://www.sec.noaa.gov.

Although every effort has been made to ensure that these data are correct, we can assume no liability for any damages their inaccuracies might cause. The charge for a 1-year subscription to this monthly bulletin is US$17.00. To become a subscriber, you may either call (303) 497-6346 or write the NATIONAL GEOPHYSICAL DATA CENTER, Solar-Terrestrial Physics Division (E/GC2), 325 Broadway, Boulder, Colorado 80305-3328 USA. Please include with your written order a cheque or money order payable in U.S. currency to the "Department of Commerce, NOAA/NGDC". Payment may also be made through VISA, MasterCard or American Express credit cards.