SOLAR INDICES BULLETIN

NOVEMBER 2011

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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 $10^{-22}\ J/m^2 Hz\,sec$. 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.

NOVEMBER 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	87	139	568	305	192	139	129	127	57	39	29
02	89	154	570	323	215	154	141	138	64	51	45
03	87	160	562	328	216	160	150	140	59	47	47
04	69	164	561	334	231	164	156	144	63	57	68
05	79	172	545	335	220	172	160	151	72	66	58
06	101	177	557	318	216	177	165	153	64	40	22
07	120	182	556	272	212	182	163	151	64	41	29
08	119	181	536	305	216	181	166	162	70	43	26
09	123	180	542	298	224	180	164	167	72	47	47
10	118	179	478	297	207	179	158	164	63	39	19
11	113	174	-1	-1	-1	174	-1	-1	-1	-1	-1
12	109	169	554	306	201	169	154	155	72	42	17
13	113	155	553	295	189	155	141	146	67	39	18
14	114	161	545	311	198	161	146	151	63	36	14
15	98	148	515	298	182	148	129	140	53	31	12
16	87	142	521	293	173	142	131	139	59	33	13
17	84	148	541	283	175	148	129	136	63	34	14
18	92	144	551	279	178	144	128	133	59	33	12
19	89	140	541	284	176	140	125	131	61	38	16
20	95	140	528	282	176	140	120	130	52	27	10
21	88	141	533	282	172	141	129	133	56	35	17
22	96	142	537	283	179	142	132	134	64	40	21
23	99	140	483	276	173	140	129	134	60	41	18
24	91	137	509	275	171	137	122	131	66	42	18
25	110	135	530	278	169	135	123	127	67	36	17
26	91	133	524	275	163	133	118	110	55	32	12
27	86	135	525	280	170	135	122	127	61	40	19
28	68	138	517	280	167	138	124	127	63	39	34
29	94	141	510	276	172	141	128	129	64	39	19
30	92	144	527	293	200	144	137	133	63	40	17
31											
Mean	73	153	517	285	184	153	134	135	61	39	24

OCT 2011 FINAL FLUX

Observed Pentic (2800)	Adjusted Pentic (2800)
136.9	137.2
130.9	131.1
128.9	129.1
130.3	130.4
126.7	126.7
123.9	123.9
122.0	121.9
118.4	118.2
121.0	120.7
126.4	126.0
130.1	129.7
134.1	133.5
137.6	137.0
136.1	135.4
137.7	136.9
151.0	150.0
152.6	151.6
146.8	145.7
147.3	146.1
159.1	157.8
167.8	166.3
164.1	162.5
155.5	153.9
145.3	143.8
138.8	137.3
132.2	130.6
131.5	129.9
133.9	132.2
123.0	121.4
126.7	124.9
138.1	136.1
137.2	136.3

♦ 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	42	48	50	52	55	57	59	61	63	49
						(4)	(7)	(9)	(12)	(16)	(20)	(24)	(8)
2012	65	67	68	70	71	72	74	76	78	79	79	80	73
	(26)	(28)	(30)	(32)	(33)	(34)	(34)	(34)	(33)	(34)	(35)	(35)	(32)
2013	81	82	83	83	83	84	83	82	82	82	82	82	82
	(36)	(37)	(37)	(37)	(38)	(40)	(42)	(42)	(40)	(39)	(40)	(40)	(39)

♦ 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***.