SOLAR INDICES BULLETIN

DECEMBER 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.

DECEMBER 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	86	152	537	286	193	155	142	136	68	44	40
02	85	157	542	297	188	157	147	145	66	39	19
03	103	164	531	293	202	160	148	147	67	43	21
04	108	164	529	291	192	164	146	148	75	42	20
05	101	158	511	288	193	158	139	146	69	45	22
06	101	151	452	287	182	151	137	145	69	43	19
07	88	149	430	286	188	149	134	143	70	42	23
08	106	145	518	286	191	145	120	136	65	35	14
09	76	144	521	282	179	144	130	135	70	43	19
10	68	140	520	283	180	140	123	128	61	35	13
11	62	134	523	279	169	134	117	123	63	43	26
12	51	132	550	274	175	132	117	116	65	40	39
13	54	133	547	272	159	133	120	119	64	41	20
14	52	132	532	271	155	132	118	120	63	42	21
15	38	124	470	268	160	124	113	118	63	41	18
16	50	121	531	264	160	121	110	118	63	40	19
17	60	120	527	268	155	120	110	116	58	35	13
18	67	127	528	272	156	128	113	121	58	34	17
19	77	128	532	273	165	128	117	125	66	45	25
20	72	137	546	292	194	137	125	124	63	40	20
21	73	145	527	295	189	145	131	129	65	43	26
22	69	146	545	293	199	146	132	126	66	41	22
23	69	138	480	290	182	138	126	124	64	40	22
24	56	143	555	291	176	143	126	127	65	47	25
25	65	144	590	287	180	144	126	128	65	44	29
26	78	146	557	298	189	146	131	127	60	39	21
27	76	140	531	300	188	140	129	122	60	40	18
28	73	145	534	266	179	145	129	123	60	42	36
29	75	147	554	289	175	147	129	128	61	40	22
30	62	141	539	288	176	141	127	127	61	46	117
31	62	133	514	272	180	133	132	101	54	42	24
Mean		141	526	283	179	136	127	128	64	41	25

NOV 2011 FINAL FLUX

Observed Pentic (2800)	Adjusted Pentic (2800)
138.6	136.5
153.6	151.2
160.4	157.8
163.9	161.1
171.9	169.0
176.7	173.6
182.1	178.9
181.0	177.7
180.2	176.7
178.6	175.2
173.9	170.4
168.8	165.3
155.3	152.1
161.1	157.7
148.3	145.1
142.3	139.2
147.7	144.4
144.4	141.1
139.6	136.3
139.9	136.6
141.1	137.7
142.4	138.9
140.0	136.5
137.2	133.8
135.2	131.7
132.8	129.3
135.2	131.7
137.6	134.0
140.6	136.8
144.0	140.1
153.1	149.8

♦ 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
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	53	56	58	60	62	65	67	51
							(3)	(5)	(9)	(14)	(18)	(21)	(6)
2012	69	70	72	73	74	75	77	79	81	82	82	83	76
	(24)	(26)	(28)	(30)	(31)	(32)	(33)	(33)	(32)	(33)	(34)	(35)	(31)
2013	84	85	85	85	85	86	86	85	85	84	85	85	85
	(36)	(37)	(37)	(37)	(39)	(41)	(42)	(42)	(41)	(40)	.(41)	.(41)	(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***.