SOLAR INDICES BULLETIN

MAY 2012

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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.

MAY 2012 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	69	110	365	281	136	110	106	103	62	38	19
02	68	116	540	290	142	116	110	108	63	39	18
03	69	114	544	289	140	114	109	106	55	32	19
04	62	114	388	281	145	114	110	106	58	34	16
05	63	116	561	297	146	116	110	105	54	33	12
06	62	117	562	299	151	117	113	106	54	32	33
07	57	122	560	301	156	122	116	107	54	33	22
08	61	123	487	307	155	123	113	103	53	30	21
09	65	127	427	334	173	127	122	109	56	44	73
10	69	131	548	332	178	131	127	111	59	45	83
11	79	136	564	332	176	136	128	111	58	41	60
12	72	130	560	309	168	130	124	112	61	35	26
13	75	131	575	287	157	131	120	115	57	33	19
14	85	130	579	295	149	130	125	101	57	35	15
15	87	129	588	300	152	129	124	118	60	34	22
16	98	131	472	301	157	131	123	120	57	36	71
17	79	136	580	299	159	136	132	120	56	35	28
18	73	132	591	299	162	132	130	119	61	37	22
19	78	131	579	298	162	131	131	119	59	34	19
20	83	131	583	297	158	131	132	118	57	34	19
21	79	125	574	284	150	125	126	114	57	35	22
22	57	121	381	299	149	121	117	111	55	33	20
23	55	117	580	286	144	117	114	109	56	33	17
24	62	116	588	295	148	116	114	108	55	34	22
25	67	117	582	292	146	117	119	107	56	39	38
26	57	110	573	287	140	110	115	102	54	39	27
27	59	111	576	285	137	111	113	103	54	35	24
28	78	110	572	281	137	110	113	105	54	36	23
29	56	106	565	282	134	106	106	101	22	12	9
30	52	111	554	288	139	111	109	107	62	39	26
31	64	117	582	289	145	117	119	108	52	32	17
Mean	64.4	122	541	297	151	122	118	109	56	35	28

APR 2012 FINAL FLUX

Day	Observed Pentic (2800)	Adjusted Pentic (2800)
01	107.3	107.2
02	105.9	105.9
03	103.5	103.6
04	102.1	102.1
05	100.9	101
06	97.4	97.6
07	98.5	98.7
08	93.3	93.5
09	94.5	94.9
10	93.3	93.7
11	93.4	93.8
12	95.3	95.8
13	97.7	98.3
14	98.1	98.8
15	101.7	102.4
16	107.9	108.8
17	113.8	114.7
18	121.5	122.6
19	137.8	139.1
20	141.7	143.1
21	149.1	150.6
22	147.9	149.5
23	141.8	143.4
24	133.6	135.2
25	127.2	128.8
26	119.2	120.7
27	117.9	119.5
28	121.1	122.8
29	116	117.7
30	114.1	115.9
31		
Mean	113.1	113.9

♦ 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
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	57	59	60	60	61	63	50
2012	64	66	67	68	69	70	72	74	76	78	78	79	72
	(7)	(9)	(12)	(15)	(16)	(19)	(21)	(22)	(23)	(26)	(28)	(30)	(19)
2013	81	82	83	83	83	84	83	83	82	82	82	82	82
	(32)	(34)	(34)	(36)	(37)	(39)	(41)	(40)	(39)	(38)	(39)	(39)	(37)
2014	82	81	80	79	79	78	77	75	73	71	69	67	76
	(38)	(37)	(36)	(37)	(36)	(35)	(34)	(34)	(33)	(31)	(30)	(29)	(34)

♦ 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.
