SOLAR INDICES BULLETIN

OCTOBER 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.

OCTOBER 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	83	137	552	288	175	137	126	119	53	31	18
02	83	131	559	292	166	131	125	122	61	43	67
03	79	129	570	294	166	129	118	119	58	38	17
04	90	130	558	271	165	130	117	113	61	39	17
05	70	127	572	286	168	127	116	120	61	42	27
06	70	124	580	286	159	124	116	121	61	40	22
07	62	122	573	273	152	122	111	118	60	39	20
08	48	118	564	281	159	118	114	117	61	39	17
09	55	121	570	285	160	121	113	119	60	40	18
10	63	126	554	285	168	126	116	120	61	40	20
11	87	130	565	289	166	130	120	126	64	41	20
12	102	134	559	290	180	134	123	128	64	44	33
13	113	138	490	290	175	138	130	133	75	45	28
14	119	136	527	287	176	136	124	132	65	41	18
15	104	138	599	294	179	138	130	131	66	43	20
16	108	151	571	301	201	151	144	138	65	41	23
17	123	153	579	319	193	153	144	142	69	43	20
18	109	147	543	291	181	147	136	134	62	44	20
19	99	147	229	304	181	147	139	130	61	42	20
20	128	159	536	307	196	159	148	140	65	44	24
21	136	168	573	306	209	168	155	144	66	44	25
22	122	164	573	261	184	164	143	139	64	40	24
23	94	156	559	294	179	156	140	138	63	42	38
24	91	145	553	291	171	145	131	136	57	36	18
25	77	139	555	289	164	139	125	130	59	37	23
26	73	132	531	280	160	132	119	126	60	42	25
27	65	132	519	277	164	132	120	124	61	41	53
28	71	134	559	293	166	134	119	124	74	45	54
29	66	123	531	270	164	123	114	111	55	37	27
30	72	127	548	289	173	127	120	116	58	43	32
31	67	138	601	292	172	138	120	120	56	42	21
Mean	96.7	137	547	289	173	137	126	127	62	41	26

SEP 2011 FINAL FLUX

Observed Pentic (2800)	Adjusted Pentic (2800)
111.8	113.8
115.4	117.5
118.7	120.8
119.4	121.5
118.7	120.7
111.5	113.2
112.8	114.5
110.1	111.7
111.8	113.4
116.2	117.8
121.3	122.9
123.9	125.5
129.4	131.0
142.6	144.3
140.7	142.3
143.1	144.6
144.8	146.2
150.1	151.6
140.9	142.2
144.3	145.5
144.2	145.3
150.8	151.9
158.2	159.3
190.4	191.6
168.8	169.8
148.2	149.0
139.0	139.6
133.4	134.0
136.6	137.0
138.1	138.5
134.5	135.9

♦ 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
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	44	47	49	51	53	56	58	60	47
					(4)	(8)	(11)	(13)	(15)	(19)	(23)	(26)	(10)
2012	62	64	65	67	68	69	70	73	75	76	76	77	70
	(29)	(31)	(33)	(35)	(35)	(36)	(36)	(35)	(35)	(35)	(36)	(36)	(34)
2013	78	80	80	80	80	81	81	80	79	79	80	80	80
	(37)	(37)	(37)	(38)	(39)	(40)	(42)	(42)	(40)	(39)	(39)	(39)	(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.