SOLAR INDICES BULLETIN

OCTOBER 2014

National Geophysical Data Center
325 Broadway, E/GC2
Boulder, CO 80305-3328

Solar Terrestrial Physics Division
Telephone: 303-497-6135

♦ 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 2014 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	91	155	607	295	189	155	150	123	79	50	22
02	85	149	615	299	187	149	142	122	80	50	23
03	79	137	597	299	178	137	131	117	78	54	44
04	71	128	597	277	163	128	123	110	78	56	36
05	60	128	595	279	165	128	123	115	76	49	32
06	46	130	592	282	168	130	126	116	78	51	27
07	46	125	579	284	165	125	118	109	77	47	22
08	50	126	601	285	171	126	125	105	75	51	28
09	40	119	589	278	160	119	115	103	73	53	29
10	24	121	591	282	163	121	113	104	70	44	20
11	20	112	584	274	153	112	107	96	68	43	19
12	20	111	581	271	152	111	105	95	65	41	18
13	28	113	588	276	156	113	108	92	68	45	19
14	50	133	613	302	182	120	141	114	67	43	26
15	60	126	599	285	168	126	123	106	78	57	29
16	47	139	596	299	187	139	131	111	78	66	48
17	43	146	604	318	198	146	144	110	79	58	91
18	41	172	620	352	227	160	162	121	79	57	43
19	62	173	262	194	163	173	142	121	83	50	22
20	74	204	649	432	294	185	194	136	91	56	44
21	72	199	625	431	309	199	190	143	90	55	23
22	83	216	620	457	319	216	199	146	88	54	22
23	89	227	630	415	335	227	210	149	93	59	23
24	93	218	574	449	335	218	211	135	85	51	23
25	92	219	659	396	300	219	195	140	86	53	22
26	89	217	685	393	275	217	185	141	84	53	22
27	72	188	671	390	271	188	178	138	83	53	23
28	68	167	659	371	247	167	162	130	83	54	24
29	62	150	614	331	205	150	143	119	81	50	25
30	69	140	595	291	173	140	124	111	73	44	17
31	54	121	584	278	154	121	111	100	78	47	22
Mean	70	155	599	325	210	154	146	119	79	51	29

SEPTEMBER 2014 FINAL FLUX

Day	Observed Pentic (2800)	Adjusted Pentic 2800)
01	126.6	128.9
02	136.3	138.7
03	137.7	140.1
04	146.0	148.4
05	143.9	146.3
06	157.3	159.8
07	160.2	162.6
08	163.9	166.3
09	159.3	161.6
10	174.6	177.0
11	151.4	153.4
12	152.0	154.0
13	145.1	146.9
14	139.3	141.0
15	132.9	134.4
16	132.7	134.1
17	132.8	134.2
18	120.2	121.3
19	121.8	122.8
20	119.1	120.1
21	123.9	124.9
22	135.8	136.8
23	138.2	139.1
24	144.7	145.6
25	166.9	167.8
26	170.2	171.0
27	181.4	182.2
28	181.1	181.8
29	175.0	175.6
30	162.1	162.6
31		
Mean	141.4	143.2

♦ 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
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	66	67	67	65	62	59	58	58	58	59	60	61	61
2013	59	58	58	58	60	63	66	69	73	75	75	75	66
2014	77	78	81	82	81	80	78	77	74	72	71	69	77
					(4)	(7)	(10)	(11)	(11)	(11)	(12)	(14)	(7)
2015	67	65	63	62	61	58	56	54	52	51	50	49	57
	(14)	(12)	(10)	(9)	(10)	(11)	(11)	(12)	(12)	(12)	(14)	(15)	(12)
2016	47	46	44	42	41	40	39	38	37	36	34	32	40
	(16)	(18)	(20)	(21)	(22)	(22)	(23)	(22)	(22)	(23)	(24)	(25)	(22)

♦ 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.