Solar Influences Data analysis Center

Data Analysis Service supported by the FAGS

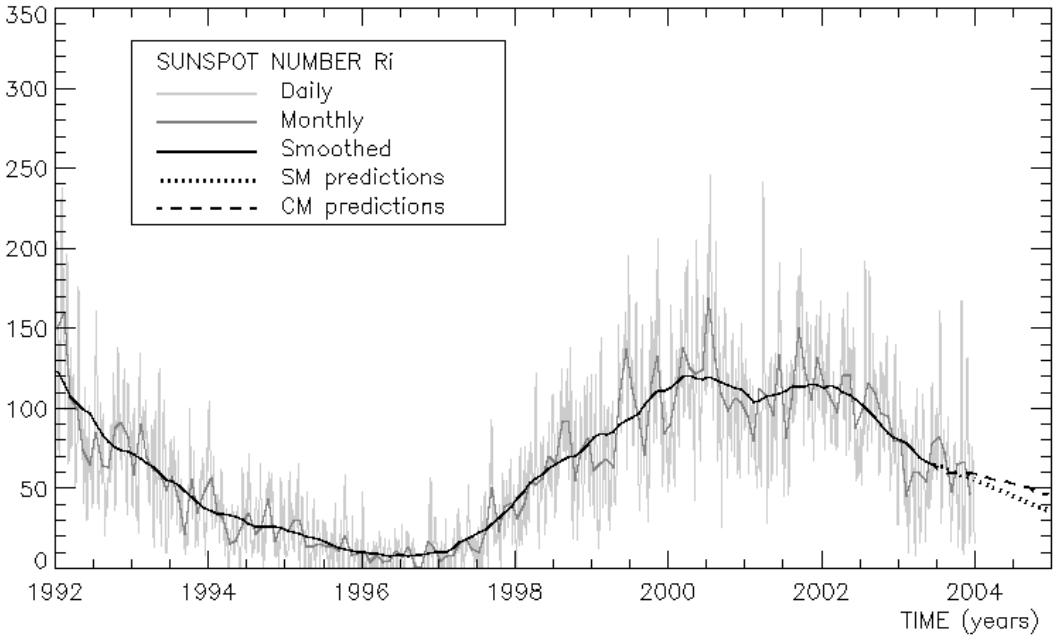
SUNSPOT BULLETIN

2003 n°12

Provisional international and normalized hemispheric daily sunspot numbers for December 2003

computed at the *Observatoire Royal de Belgique* using observations from an international network with the *Locarno Specola Solare* as reference station.

Date	R'_I	R'_N	R'_S
1	98	9	89
2	72	8	64
3	78	9	69
4	66	9	57
5	59	8	51
6	45	8	37
7	32	9	23
8	26	7	19
9	16	0	16
10	25	8	17
11	25	8	17
12	23	14	9
13	28	19	9
14	31	22	9
15	30	20	10
16	39	25	14
17	68	30	38
18	71	38	33
19	71	47	24
20	74	54	20
21	60	49	11
22	74	58	16
23	76	58	18
24	59	42	17
25	44	34	10
26	40	28	12
27	31	20	11
28	34	18	16
29	28	19	9
30	17	10	7
31	16	8	8
Monthly mean	**47.0**	**22.5**	**24.5**
Cooperating stations	**38**	**34**	**34**



Predictions of the monthly smoothed Sunspot Number
using the last provisional value, calculated for June 2003 : 65.0 (± 5%)

	SM	CM		SM	CM		SM	CM
2003 Jul	64	63	2004 Jan	60	59	2004 Jul	50	53
Aug	65	61	Feb	59	58	Aug	49	52
Sep	67	60	Mar	57	57	Sep	47	51
Oct	65	60	Apr	55	56	Oct	45	49
Nov	63	60	May	54	56	Nov	44	48
Dec	62	60	Jun	52	54	Dec	42	47

SM : SIDC classical method : based on an interpolation of Waldmeier's standard curves; the estimated error ranges from 7% (first month) to 35% (last month)
CM : Combined method : the combined method is a regression technique coupling a dynamo-based estimator with Waldmeier's idea of standard curves, due to K. Denkmayr.
ref. : **K. Denkmayr, P. Cugnon**, 1997 : "About Sunspot Number Medium-Term Predictions", in "Solar-Terrestrial Prediction Workshop V", eds G. Heckman et al., Hiraiso Solar Terrestrial Research Center, Japan, 103

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S.I.D.C. SUMMARY OF THE URSIGRAMS

Date	R'_i	PPSI	600	2800	COS	SFI	XI	Ak	SEA
30	116	71	53	153	////	0	0/0	18	
1	98	77	–	143	////	0	0/0	13	
2	72	92	50	139	////	1	2/0	6	
3	78	85	47	124	////	0	0/0	4	
4	66	94	46	116	////	1	0/0	8	
5	59	88	43	112	////	1	0/0	32	
6	45	74	42	109	////	0	2/0	25	
7	32	41	39	92	////	0	0/0	17	
8	26	20	38	94	////	0	0/0	46	
9	16	10	38	92	////	0	0/0	33	
10	25	6	38	89	////	0	0/0	44	
11	25	14	37	86	////	0	0/0	40	
12	23	18	35	87	////	0	0/0	26	
13	28	37	36	88	////	0	0/0	26	
14	31	46	39	92	////	0	0/0	32	
15	30	39	46	101	////	0	0/0	25	
16	39	58	43	106	////	0	0/0	12	
17	68	50	45	118	////	1	0/0	8	
18	71	55	46	123	////	4	0/0	4	
19	71	74	50	123	////	7	0/0	2	
20	74	85	51	130	////	2	0/0	21	
21	60	95	55	133	////	2	0/0	25	
22	74	65	57	138	////	4	0/0	20	
23	76	162	60	142	////	4	0/0	10	
24	59	156	59	139	////	2	0/0	8	
25	44	181	56	139	////	8	0/0	5	
26	40	123	55	137	////	21	1/0	8	
27	31	98	52	127	////	0	0/0	14	
28	34	44	48	119	////	0	0/0	14	
29	28	42	46	115	////	0	0/0	6	
30	17	9	46	108	////	0	0/0	9	
31	16	3	46	106	////	0	1/0	28	

R'_i : provisional international sunspot numbers from the S.I.D.C.

PPSI : prompt photometric sunspot index from the S.I.D.C. in 10-5 w/m ^{2} : the quantity to be subtracted from the mean solar constant to account for the sunspot contribution.

600 : 600 Mhz solar flux from the station at Humain (Belgium).

2800 : 2800 Mhz solar flux from Ottawa (origin : Ursigrams - UGEOI). The 10.7cm Flux data are a service of the National Research Council of Canada.

COS : thousands of the cosmic ray counts (origin : Ursigrams - UCOSE Terre Adélie).

SFI : From October 1992, Solar Flare Index from the S.I.D.C. (origin : Ursigrams – UGEOR, evaluation : 1 x Sn+10 x "1"+100 x ">1".

XI : X-flares index from the Ursigrams (M-flares/X-flares) (origin : Ursigrams – UGEOR, UGEOI).

Ak : geomagnetic index from Wingst, Germany (origin : Ursigrams).

SEA : sudden enhancements of atmospherics from Uccle & Humain (Royal Observatory, Belgium).

Note that due to problems of interferences saturating our receivers, no SEA could be detected this month.

SOLAR PHYSICS DEPARTMENT

UCCLE DAILY PROVISIONAL RELATIVE SUNSPOT NUMBERS FOR DECEMBER 2003

DATE	UT	NUMBER OF GROUPS	NUMBER OF SPOTS	RELATIVE SUNSPOT NUMBERS TOTAL	NORTH	SOUTH	CENTRAL	PPSI 10-3 WM-2	QUAL	OBS
3	1350	9	31	121	11	110	68	48.1	2	OB
7	930	4	11	51	11	40	26	15.7	2	DB
8	1042	4	4	44	11	33	11	7.6	1	ST
9	935	2	2	22	0	22	0	4.1	2	ST
10	1330	4	4	44	22	22	0	4.0	3	OB
12	1130	3	5	35	23	12	0	6.7	2	ST
17	1035	8	34	114	54	60	37	41.6	3	OB
18	915	9	18	108	59	49	22	49.2	3	OB
19	1230	7	38	108	80	28	28	86.4	2	OB
22	928	8	24	104	81	23	64	26.7	2	ST
26	1102	2	6	26	13	13	26	2.9	1	ST
27	941	2	21	41	26	15	15	23.3	3	ST

The relative mean sunspot number is 68.2.

NORMALISED UCCLE OBSERVATIONAL SUNSPOT NUMBERS U'=K'U FOR DECEMBER 2003

K'= 0.868 (*)

1	***	7	44	13	***	19	94	25	***
2	***	8	38	14	***	20	***	26	23
3	105	9	19	15	***	21	***	27	36
4	***	10	38	16	***	22	90	28	***
5	***	11	***	17	99	23	***	29	***
6	***	12	30	18	94	24	***	30	***
								31	***

The normalised relative monthly mean sunspot number is 59.

(*) K' is the mean of the monthly K' for the last five years.

The Sun has been observed 12 days on 31 possible.

UCCLE OBSERVATIONAL MAJOR SUNSPOT GROUPS FOR DECEMBER 2003
E AND F BRUNNER'S TYPE GROUPS

Uccle Nø	East Limb Date	Date and type 1st obs	CMP	Last obs	West Limb Date
2-2011	12 15.4	17 C	12 22.2	22 B	12 28.9

PROBABLE RETURN OF MAJOR GROUPS FOR JANUARY 2004
NONE

MONTHLY SUMMARY OF SOLAR AND GEOMAGNETIC ACTIVITY

I. Solar Activity

During December 2004, solar activity has been much lower than in the preceding months. In stark contrast to the record flares observed in October and November, flaring activity in December was confined to 6 small M-flares, the largest one being an M2.0 on Dec 06.

In the beginning of the month, the sunspot count was still rather high. About 10 sunspot groups were visible, totaling more than 100 spots. The largest (and most active) groups were however already located at the west limb: Catania sunspot groups 96, 97 and 98 (NOAA 0507, 0508 and 0511 respectively) rotated off the visible disk in the course of the first few days of December. On Dec 02, sunspot groups 97 and 98 generated *M1.4 and M1.5 flares*. Immediately after the M1.4 X-ray peak at 1308 UT, a small *proton event* started (the only such event this month). The low energy (>10MeV) proton flux exceeded the threshold until late on Dec 04. From the vicinity of groups 97 and 98 also originated on Dec 02 a long duration event associated with a C7.2 flare, including a *prominence eruption* very nicely visible in EIT 195. LASCO reported a faint *full halo CME*.

A second active day was again due to a sunspot group on the west limb, viz. Catania 03 (NOAA 510). It produced 2 *M-flares* on Dec 06, including the largest flare of the month (M2.0). On Dec 07, also this group rotated behind the west limb and flaring activity was reduced to a very low level. The X-ray background nearly vanished and for many days in the ensuing period not a single C-flare was recorded. The reason for this lack of activity was the absence of any noteworthy active region. Instead a huge coronal hole passed the disk, which pushed the solar wind to a speed of more than 800 km/s. Two beautiful *prominences* erupted from the west limb: one in the morning of Dec 08 and the second one around 07h19 on Dec 14. The period of extremely low flaring activity was briefly interrupted on Dec 14, on which day two minor C-flares occurred (C1.1 at 19h40 UT and C2.0 at 23h40), but on Dec 15 and 16, again only B-flare activity was observed.

From Dec 16 onwards, new active regions appeared in EIT images at the east limb, leading to an increase of solar activity to moderate levels (mainly C-class flares) from Dec 17 onwards. Most of this activity originated from Catania sunspot groups 18 (NOAA 0525) and 20 (NOAA 0528). Both groups produced about 30 C-class flares, while Catania 20 was also responsible for an *M1.5 flare* on Dec 26 and an *M1.0 flare* on Dec 31 just before passing behind the West limb.

II. Geomagnetic Activity

The month started with a decreasing solar wind speed as a small coronal hole causing the slightly elevated speed value of *450 km/s* turned over the west limb. Geomagnetic conditions were therefore quiet from Dec 01 to Dec 04. A period of slightly increased solar wind speed values was initiated on Dec 05. The cause could be the arrival of a glancing blow of the faint full halo CME associated with the prominence eruption on Dec 02, but on the other hand the swing of the solar wind magnetic vector over 180 degrees was a possible indication that the Earth entered a coronal hole wind stream. Indeed, a *small coronal hole* was at that time situated west of the central meridian. Minor geomagnetic storm conditions were measured on Dec 05, continuing on Dec 06, when the solar wind speed decreased again.

On Dec 07, a small *shock* was measured in the solar wind, while from Dec 08 onwards the Earth came under the influence of a *very large coronal hole*. This made the solar wind speed rise to more than *800 km/s* by Dec 10. The geomagnetic conditions were at the active or minor storm levels from Dec 07 until Dec 15, with isolated brief periods of major storm levels (Kp=6). On Dec 15, the coronal hole rotated over the western solar limb, making geomagnetic conditions return to quiet from late on Dec 15 until early on Dec 20. The solar wind speed, still at nearly 800 km/s early on Dec 15, started decreasing during the second half of that UT day, going down quasi-linearly to about *300 km/s* by the end of Dec 19.

Another *transequatorial coronal hole* with an elongated north-south shape was situated near the central solar meridian on Dec 17-18 and rotated into a geo-effective position on Dec 19-20. At the start of the UT day on Dec 20, the solar wind speed started rising again, reaching the range *600-650 km/s* on Dec 22. The interplanetary field, however, remained mostly northwards, and thus geomagnetic perturbations remained limited to active conditions on Dec 20-22. From Dec 23 onwards, the influence of this coronal hole waned and the solar wind speed started decreasing. Geomagnetic conditions became quiet and remained so until Dec 31, with the exception of a brief period of active conditions late on Dec 27 due to another high-speed solar wind stream (*550-650 km/s* from Dec 27 until Dec 29). On 31/12/03 around 11:00UT, the Earth entered yet another high-speed stream from a *small equatorial coronal hole* (the return of the one causing minor storm conditions on Dec 05). The solar wind speed rose to *550 km/s*, and the month closed with minor storm conditions on Dec 31.

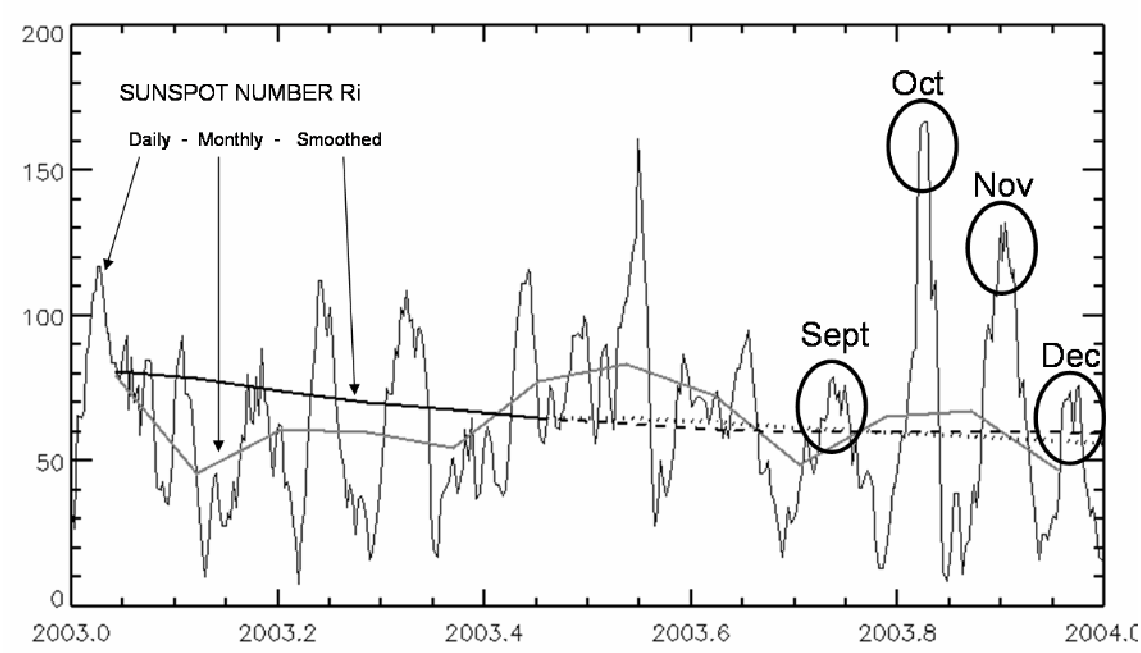
III. Noticeable solar events

DAY	BEGIN	MAX	END	LOC	XRAY	OP	10CM	RADIO TYPE	600 (Humain)	Cat	NOAA	NOTE
02	1247	1308	1322	S08W89	M1.4	-	-	-	-	98	0511	**p**, EIT derived loc., also contrib. from CAT97
02	2250	2300	2307	S19W89	M1.5	-	-	-	-	98	0511	EIT derived location, also contrib. from CAT97
06	1058	1120	1128	S23W89	M1.3	-	-	-	-	03	0510	EIT derived location
06	1539	1546	1553	S23W89	M2.0	-	-	-	-	03	0510	EIT derived location
26	1913	1928	1933	N09W30	M1.5	1N	-	-	-	20	0528	
31	1821	1824	1826	N10W89	M1.0	-	-	III/3	-	20	0528	SXI derived location

loc: approximate heliographic location
Xray: X-ray flare class
op: optical flare class
10 cm: 10 cm radio flux
type: type of radio burst

600: peak UT time of 600 Mhz radio bursts in Humain
Cat: Catania sunspot group identification
NOAA: NOAA active region identification
p: proton event
CME: Coronal Mass Ejection

IV. Picture of the month



Did the Sun lose track?

On a number of days in October and November, the daily sunspot number was very high. This seems unusual since we are in the declining phase of the solar cycle. In this figure, the curve with the highest variability is the daily sunspot number, while the other lines are the monthly and the smoothed monthly indices. In the daily values we can easily detect a recursive pattern. The first peak occurs in September 2003. On Sept 27, a sunspot number of 79 was recorded. Almost one month later, the sunspot index reached 167 on Oct 29 and 30. (As we can remember, this was the time that the Sun became a TV star. In virtually all the media the Sun was mentioned as the source of radio-disturbances, satellite disruptions, GPS disturbances...) One month later, a peak of 132 occurred on Nov 27. The December 23 peak of 76 was comparable with the September peak. This recursive behavior finds its origin in the solar rotation: the Sun rotates around its axis in about 27 days.

However, these peaks in the daily values do not disturb the global trend of the 11-year solar cycle (as can be seen from the graph on the second page of this bulletin). During the month of June, the Sun adorned itself also with a whole bunch of sunspots producing several X-flares. The flares were not so energetic compared to the ones of October and November and did not cause so much fuss. But the line representing the monthly sunspot number shows a higher value in June than in October 2003, and the smoothed sunspot index continues its decreasing trend.

To conclude: it's not because we have a cold summer day that the summer season is not summer any more. *So, we can heave a sigh of relief: the Sun did not lose track and will continue its route on the 11-year cycle.*

SIDC DEFINITIVE INTERNATIONAL AND HEMISPHERIC SUNSPOT NUMBERS FOR 2003

	JULY			AUGUST			SEPTEMBER		
Date	Ri	Rn	Rs	Ri	Rn	Rs	Ri	Rn	Rs
1	100	78	22	49	15	34	46	13	33
2	97	88	9	56	8	48	46	13	33
3	80	80	0	76	22	54	47	9	38
4	67	67	0	73	23	50	50	7	43
5	56	56	0	87	29	58	39	0	39
6	63	63	0	83	21	62	37	0	37
7	85	51	34	78	16	62	30	0	30
8	89	46	43	69	0	69	25	0	25
9	90	46	44	70	0	70	17	0	17
10	74	30	44	72	0	72	25	0	25
11	61	13	48	72	0	72	34	0	34
12	68	13	55	71	0	71	29	0	29
13	96	37	59	70	6	64	30	0	30
14	96	46	50	63	0	63	33	0	33
15	105	63	42	67	0	67	42	14	28
16	105	65	40	73	0	73	46	17	29
17	112	72	40	74	12	62	58	33	25
18	121	72	49	67	14	53	58	34	24
19	128	67	61	58	19	39	52	30	22
20	161	72	89	62	28	34	46	25	21
21	146	66	80	58	46	12	50	35	15
22	123	52	71	69	43	26	57	30	27
23	100	47	53	76	51	25	65	35	30
24	78	45	33	82	57	25	64	37	27
25	47	30	17	82	62	20	67	43	24
26	28	20	8	89	67	22	77	48	29
27	33	21	12	90	63	27	79	46	33
28	50	31	19	95	65	30	71	37	34
29	43	21	22	85	53	32	74	32	42
30	38	22	16	74	47	27	66	21	45
31	42	20	22	65	39	26			
MEAN :	83.3	48.4	34.9	72.7	26.0	46.7	48.7	18.6	30.1