

## Center

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**SUNSPOT BULLETIN**

2003

n° 8

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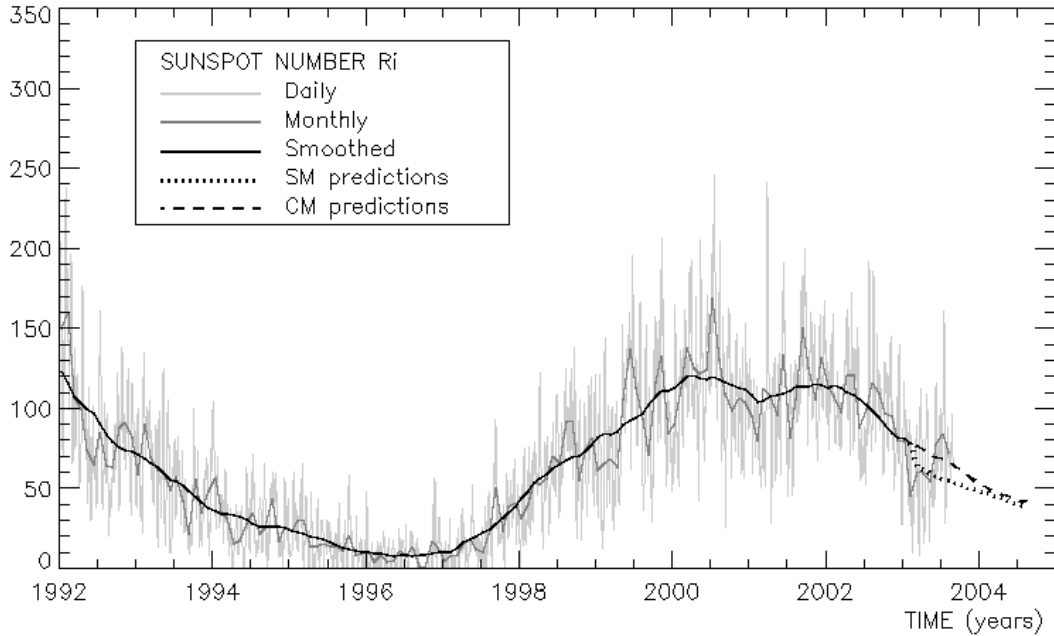
**Provisional international and normalized hemispheric daily sunspot numbers for August 2003**


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

Date	R' <sub>I</sub>	R' <sub>N</sub>	R' <sub>S</sub>
1	49	15	34
2	56	8	48
3	76	22	54
4	73	23	50
5	87	29	58
6	83	21	62
7	78	16	62
8	69	0	69
9	70	0	70
10	72	0	72
11	72	0	72
12	71	0	71
13	70	6	64
14	63	0	63
15	67	0	67
16	73	0	73
17	74	12	62
18	67	14	53
19	58	19	39
20	62	28	34
21	58	46	12
22	69	43	26
23	76	51	25
24	82	57	25
25	82	62	20
26	89	67	22
27	90	63	27
28	95	65	30
29	85	53	32
30	74	47	27
31	65	39	26
<b>Monthly mean</b>	<b>72.7</b>	<b>26.0</b>	<b>46.7</b>
<b>Cooperating stations</b>	<b>38</b>	<b>33</b>	<b>33</b>

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**Predictions of the monthly smoothed Sunspot Number**  
using the last provisional value, calculated for February 2003 : 78.5 ( $\pm 5\%$ )

		SM	CM			SM	CM			SM	CM
2003	Mar	73	77	2003	Sep	58	64	2004	Mar	50	48
	Apr	68	74		Oct	57	62		Apr	49	47
	May	66	72		Nov	55	58		May	47	46
	Jun	64	70		Dec	54	55		Jun	46	45
	Jul	62	69	2004	Jan	53	53		Jul	45	43
	Aug	60	67		Feb	52	50		Aug	43	42

**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' <sub>i</sub>	PPSI	600	2800	COS	SFI	XI	Ak	SEA
31	42	59	47	102	836	1	0/0	39	
1	49	78	-	107	835	0	0/0	36	
2	56	80	-	111	838	21	1/0	24	
3	76	100	-	120	845	21	0/0	17	
4	73	152	-	123	846	0	0/0	14	
5	87	174	-	131	841	3	1/0	10	
6	83	181	-	129	845	0	0/0	24	
7	78	180	-	137	848	1	0/0	37	
8	69	191	-	133	////	1	0/0	41	
9	70	197	-	130	847	1	0/0	19	
10	72	121	-	131	845	3	0/0	12	
11	72	82	-	129	839	0	0/0	14	
12	71	64	-	123	833	3	0/0	26	
13	70	78	-	131	844	4	0/0	17	
14	63	102	-	130	844	2	0/0	17	
15	67	106	-	131	841	5	0/0	16	
16	73	81	-	127	837	1	0/0	12	
17	74	79	-	119	834	1	0/0	21	
18	67	42	-	116	827	3	0/0	64	
19	58	34	-	117	832	111	2/0	21	
20	62	25	-	112	842	0	0/0	19	
21	58	65	-	119	840	0	0/0	47	
22	69	91	-	121	837	1	0/0	40	
23	76	99	-	120	836	2	0/0	38	
24	82	101	-	116	843	10	0/0	21	
25	82	103	-	117	842	10	0/0	17	
26	89	80	-	121	839	10	0/0	14	
27	90	69	-	126	837	2	0/0	12	
28	95	64	50	119	843	2	0/0	21	
29	85	70	47	116	845	0	0/0	19	
30	74	55	47	114	838	2	0/0	16	
31	65	44	45	110	837	0	0/0	7	

**R'<sub>i</sub>** : provisional international sunspot numbers from the S.I.D.C.  
**PPSI** : prompt photometric sunspot index from the S.I.D.C. in  $10^{-5} \text{ w/m}^2$  : 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 :  $1 \times \text{Sn} + 10 \times "1" + 100 \times ">1"$ ).  
**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 AUGUST 2003

DATE	UT	NUMBER OF		RELATIVE SUNSPOT NUMBERS			PPSI 10-3	QUAL	OBS	
		GROUPS	SPOTS	TOTAL	NORTH	SOUTH				CENTRAL
1	1200	3	21	51	11	40	51	90.6	3	OB
2	815	5	30	80	11	69	30	95.7	3	EV
3	1315	6	43	103	32	71	52	55.0	3	RV
4	1025	6	48	108	28	80	42	71.1	3	OB
5	1000	7	66	136	53	83	17	99.6	3	OB
6	710	6	40	100	27	73	49	86.3	3	OB
7	1400	5	43	93	11	82	50	102.2	3	OB
8	1000	5	47	97	0	97	66	144.1	3	OB
9	940	5	53	103	0	103	34	176.7	3	OB
10	1030	5	47	97	0	97	20	77.5	3	JY
12	1350	5	68	118	0	118	0	83.9	3	FC
13	1120	6	64	124	0	124	47	83.8	3	FC
14	1110	4	60	100	0	100	60	70.3	2	FC
15	820	3	81	111	0	111	100	86.0	3	FC
16	845	4	66	106	0	106	82	65.5	2	FC
19	945	6	26	86	29	57	11	18.2	3	OB
20	845	7	36	106	52	54	33	22.8	3	OB
21	1020	4	36	76	61	15	63	90.3	3	OB
24	840	5	71	121	85	36	96	118.7	3	FC
25	1220	7	51	121	96	25	30	156.5	3	OB
26	1000	6	56	116	91	25	66	63.0	3	OB
27	1445	8	52	132	101	31	89	36.6	3	OB
28	1200	10	34	134	86	48	54	39.7	2	ER
29	1440	9	37	127	80	47	78	60.6	2	FC
30	735	7	31	101	64	37	51	15.9	2	VI
31	833	6	24	84	47	37	20	11.1	2	VI

The relative mean sunspot number is 105.0.

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

K' = 0.747 (\*)

1	38	7	69	13	93	19	64	25	90
2	60	8	72	14	75	20	79	26	87
3	77	9	77	15	83	21	57	27	99
4	81	10	72	16	79	22	***	28	100
5	102	11	***	17	***	23	***	29	95
6	75	12	88	18	***	24	90	30	75
								31	63

The normalised relative monthly mean sunspot number is 78.

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

The Sun has been observed 26 days on 31 possible.

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

Uccle Nø	East Limb Date	Date and type			West Limb Date
		1st obs	CMP	Last obs	
1-2006	7 27.3	28 C	8 3.0	8 C	8 9.8
3-2006	7 31.7	2 C	8 7.5	9 E	8 14.2
4-2006	7 32.0	2 D	8 7.7	13 E	8 14.5
6-2006	8 3.3	6 C	8 10.1	14 B	8 16.8
8-2006	8 8.0	9 D	8 14.8	20 J	8 21.5
14-2006	8 15.9	19 C	8 22.6	28 J	8 29.4
18-2006	8 18.6	20 A	8 25.3	25 E	9 1.1

PROBABLE RETURN OF MAJOR GROUPS FOR SEPTEMBER 2003

Nø	New East Limb	New CMP	New West Limb
4	8 28.4	9 4.1	9 10.9
8	9 4.1	9 10.8	9 17.6
14	9 12.9	9 19.6	9 26.4

## MONTHLY SUMMARY OF SOLAR AND GEOMAGNETIC ACTIVITY

### I. Solar Activity

Solar activity was low this month, with only Aug 19 standing out as a more active day. Just four M-flares occurred; two of these were on Aug 19, which included the largest event of the month, a moderate M2.7 flare. Many days in the month had not even C-flare activity.

At the start of the month, there was reason to expect higher activity when on Aug 1 a new sunspot group appeared at the eastern limb and generated a sequence of large C-flares. These flares were clearly visible in EIT and SXI images, but the sunspot group only became observable on the disk the next day, when it was given Catania sunspot group number 90 (NOAA 0424). It became the dominant centre of solar activity for the first ten days of the month, reaching a maximum size of nearly 0.08% of the disk, distributed over 2 large spots and about 20 smaller ones. It had strong magnetic fields with clear polarity mixing for nearly the whole duration of its transit across the disk, but it did not live up to its anticipated flaring potential. Late on Aug 2, the first M-flare was observed from this group, with a second one following on Aug 05. On the other days only occasional small C-flares were observed, with several days having no C-flares at all. Most of this smaller scale activity also originated from sunspot group 90 and its close neighbour, group 88 (NOAA 0425). Sunspot group 90 started to decay on Aug 08, and finally disappeared from view on Aug 13 without producing much more activity.

On Aug 09 another large and complex sunspot group, Catania 96 (NOAA 0431) rotated over the eastern solar limb, producing a multitude of C-flare activity, in particular from Aug 12 onwards. At its peak, the group counted 70 spots covering slightly more than 0.07% of the solar disk. Although it started to decay rather rapidly from Aug 15, its biggest events were kept for the end, because it finally produced the 2 M-flares of Aug 19 before rotating over the western limb on Aug 21. On Aug 14, a short time after 20:00UT, a full halo CME was observed by LASCO. Although at first this event was thought to be backsided, it was later determined to have probably originated in sunspot group 96, where EIT images clearly show enhanced activity about half an hour earlier.

After the disappearance of group 96 on Aug 21, the main active region was Catania 04 (NOAA 0436), but this group only produced some minor C-flares. During the rest of the month, only isolated small C-flares were recorded. On Aug 25, a C3.6 flare from Catania sunspot group 12 (NOAA 0442) was associated with a modest EIT wave and dimming, primarily to the west, and also a wide partial halo CME. The mean plane-of-sky speed for this event was 308 km/s, with moderate acceleration.

In the beginning of the month, a northern hemisphere coronal hole rotated across the visible solar disk. The leading edge reached the central meridian on Aug 4. This coronal hole had two clearly separated equatorial extensions, the first of which became geo-effective on Aug 6, the second from Aug 11 onwards. On Aug 21, a large trans-equatorial coronal hole rotated in a geo-effective position in the Western hemisphere.

### II. Geomagnetic Activity

Due to the perturbations caused by three coronal hole passages and two CME shocks, geomagnetic conditions were frequently at minor geomagnetic storm levels this month, with major geomagnetic storms on Aug 18 and on Aug 21.

The first few days of the month, geomagnetic conditions were entirely dominated by the influence of a large coronal hole. This coronal hole covered a significant fraction of the southern solar hemisphere, reaching up to the solar equator. Its effect was already felt on July 27. Near the middle of July 28, the solar wind speed rose to 800km/s, and remained near that value until late on Aug 2. During this period, the interplanetary magnetic field was alternating between northwards and southwards orientation. These conditions led to the anticipated mix of active and minor geomagnetic storm

conditions. The K-index in Wingst was mostly at values of 4 or 5 until Aug 2. On Aug 3 the coronal hole rotated out of its geo-effective position and geomagnetic conditions returned to quiet.

Early on Aug 06, an equatorial extension of a northern hemispheric coronal hole started to influence the geomagnetic environment. The solar wind speed, which had reached a minimum of just above 400km/s on Aug 05, increased in three phases, reaching a maximum of nearly 800km/s in the morning of Aug 8, following which it started to gradually decrease (almost linearly). During most of this period, the interplanetary magnetic field was mainly oriented towards the north, except for a short interval early on Aug 6 and a second one starting at about noon on Aug 7, lasting about 24 hours. During these two intervals, and especially during the latter one, minor geomagnetic storm conditions were reported. On Aug 7, the K-index in Wingst reached an isolated peak of 7, being mostly at 5 before and after. The minor geomagnetic storm ended late on Aug 8, and conditions were quiet for the next two days.

From about midday (UT) on Aug 11, the influence of a second equatorial extension of the same coronal hole pushed up the solar wind speed to approximately 700km/s on Aug 12. The interplanetary magnetic field remained however mostly northwards, limiting the geo-effectiveness of this high speed wind stream. This resulted in active geomagnetic conditions during the second half of Aug 11 and on Aug 12 (the K-index in Wingst was mostly at 4 during this time). From Aug 13 onwards, the solar wind speed slowly decreased to 550km/s, was briefly pushed back up to 600 km/s on Aug 15, but then rapidly decreased to about 400km/s at midday UT on Aug 17. On the same day, the earth's geomagnetic field was perturbed by a shock in the solar wind (due to the halo CME observed on Aug 14). The shock was recorded by both ACE and SOHO/CELIAS at approximately 13:40 UT. Although the increase of the solar wind speed was moderate, jumping up by about 100km/s to a little above 500km/s, this shock led first to minor geomagnetic storm conditions, followed later by a major geomagnetic storm when the interplanetary geomagnetic field turned strongly southwards (at 01:00 UT on Aug 18).

On Aug 19 and 20, geomagnetic conditions were quiet, but on Aug 21 the Earth entered another high-speed solar wind stream, this time due to the low-latitude coronal hole. The solar wind reached a speed of 775km/s and stayed near this value until Aug 24 around 00:00UT, when it dropped to a new plateau at 600km/s. Bz oscillated between +10nT and -10nT. This triggered a long duration disturbance of the geomagnetic field, reaching major geomagnetic storm conditions on Aug 21, followed by minor storm level until late on Aug 23 and active conditions on Aug 24. On Aug 25, the solar wind speed displayed a small increase, but then slowly decreased to about 400 km/s on Aug 28. At the same time the interplanetary magnetic field (IMF) stayed consistently at about -5nT (i.e. slightly southward). This regime resulted in mostly quiet geomagnetic conditions with isolated active geomagnetic episodes.

On Aug 29 at 15h00 UT a shock in the solar wind arrived, boosting the wind speed up to 600 km/s and the IMF down to -10 nT. This shock may be related to the CME that was observed leaving the Sun on Aug 25. The geomagnetic field reacted only moderately to this shock with a brief period of minor storm conditions on Aug 29. By the end of the month geomagnetic conditions were back to quiet level.

### III. Noticeable solar events

DAY	BEGIN	MAX	END	LOC	XRAY	OP	10CM	RADIO	TYPE	600 (Humain)	Cat	NOAA	NOTE
02	2341	2354	0002	S19E63	M1.3	1F					90	0424	EIT derived loc.
05	1243	1249	1251	S16E33	M1.7	SN	40	II/1		12:45	90	0424	
19	0753	0759	0801	S12W61	M2.0	1N	39	V/3			96	0431	
19	0945	1006	1024	S11W60	M2.7	2F	230	II/2, IV/1		09:52	96	0431	

**loc:** approximate heliographic location

**Xray:** X-ray flare class

**op:** optical flare class

**10 cm:** radio flux on 10 cm

**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