Solar Influences Data analysis Center

Data Analysis Service supported by the FAGS

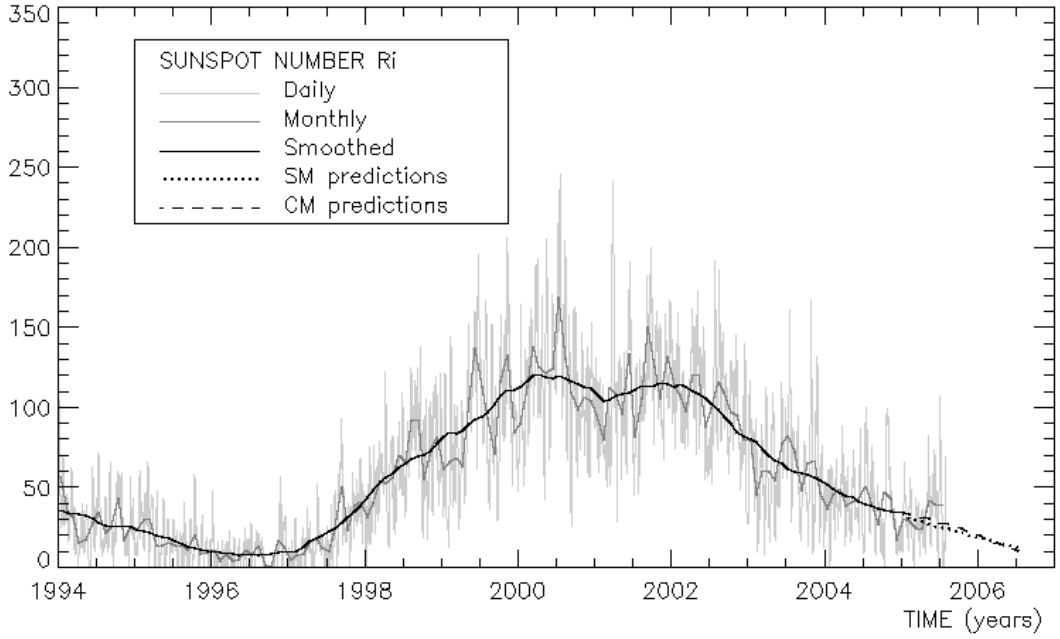
SUNSPOT BULLETIN

2005 n° 7

Provisional international and normalized hemispheric daily sunspot numbers for July 2005

computed at the *Royal Observatory of Belgium* using observations from an international network with the *Locarno Specola Solare* as reference station.

Date	R'_I	R'_N	R'_S
1	78	26	52
2	95	30	65
3	101	35	66
4	107	41	66
5	103	49	54
6	84	49	35
7	75	44	31
8	64	37	27
9	57	36	21
10	42	34	8
11	41	33	8
12	38	27	11
13	38	22	16
14	28	13	15
15	21	8	13
16	11	0	11
17	8	4	4
18	0	0	0
19	9	5	4
20	0	0	0
21	0	0	0
22	8	4	4
23	16	16	0
24	11	11	0
25	12	12	0
26	15	15	0
27	11	11	0
28	18	18	0
29	34	34	0
30	43	43	0
31	69	53	16
Monthly mean	**39.9**	**22.9**	**17.0**
Cooperating stations	**45**	**39**	**39**



Predictions of the monthly smoothed Sunspot Number

using the last provisional value, calculated for January 2005 : 34.6 (± 5%)

	SM	CM		SM	CM		SM	CM
2005 Feb	33	34	2005 Aug	28	27	2006 Feb	22	18
Mar	31	33	Sep	27	26	Mar	21	16
Apr	33	32	Oct	26	25	Apr	19	15
May	31	31	Nov	25	23	May	18	13
Jun	30	29	Dec	24	22	Jun	17	12
Jul	29	28	2006 Jan	23	20	Jul	16	11

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

Brussels, August 1, 2005 10:53 UT

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

Date	R'_i	PPSI	600	2800	COS	SFI	XI	Ak	SEA
30	67	48	38	103	929	0	0/0	9	
1	78	177	39	115	926	0	0/0	22	
2	95	389	45	124	924	6	0/0	16	
3	101	408	46	130	928	3	0/0	10	
4	107	412	43	124	////	1	0/0	6	
5	103	400	43	127	934	4	0/0	6	
6	84	395	42	123	935	11	0/0	6	
7	75	376	43	125	931	5	1/0	10	
8	64	368	39	110	929	5	0/0	6	
9	57	261	38	107	934	12	1/0	30	
10	42	174	38	102	////	2	0/0	62	
11	41	113	35	93	903	3	0/0	26	
12	38	71	36	96	901	7	3/0	35	
13	38	42	36	92	892	20	5/0	35	
14	28	24	-	90	898	11	4/1	8	
15	21	15	35	87	899	2	0/0	8	
16	11	10	34	76	////	2	1/0	11	
17	8	1	33	74	838	0	0/0	20	
18	0	0	32	72	859	0	0/0	24	
19	9	2	-	71	882	0	0/0	9	
20	0	0	33	72	908	0	0/0	23	
21	0	0	32	73	921	0	0/0	23	
22	8	8	32	74	920	0	0/0	18	
23	16	13	34	80	922	0	0/0	6	
24	11	27	35	80	919	0	0/0	6	
25	12	45	35	84	921	0	0/0	6	
26	15	75	35	87	923	0	0/0	6	
27	11	50	36	91	924	0	1/0	19	
28	18	47	37	96	915	1	2/0	26	
29	34	66	40	104	904	0	0/0	21	
30	43	71	40	105	895	211	0/1	14	
31	69	999	40	110	894	2	1/0	12	

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 JULY 2005

DATE	UT	NUMBER OF GROUPS	NUMBER OF SPOTS	RELATIVE SUNSPOT NUMBERS TOTAL	NORTH	SOUTH	CENTRAL	PPSI 10-5 WM-2	QUAL	OBS
1	930	7	51	121	39	82	70	95.0	3	DB
3	911	7	53	123	43	80	70	156.2	4	EP
5	1500	8	71	151	78	73	101	169.0	3	AE
7	1300	4	65	105	56	49	51	169.2	3	OB
8	815	4	35	75	44	31	40	161.8	2	OB
9	1030	5	25	75	37	38	61	141.3	3	GL
10	1300	4	22	62	51	11	15	112.4	3	GL
11	745	3	16	46	35	11	12	98.1	3	ST
12	1020	3	11	41	30	11	13	58.2	2	ST
13	800	4	11	51	24	27	0	44.1	2	ST
14	810	3	9	39	12	27	0	31.5	2	ST
15	750	2	17	37	11	26	0	10.2	2	AE
16	820	1	9	19	0	19	0	3.7	3	AE
17	1000	0	0	0	0	0	0	0.0	4	AE
18	945	0	0	0	0	0	0	0.0	3	OB
19	910	0	0	0	0	0	0	0.0	3	OB
20	830	1	1	11	11	0	0	0.0	2	ST
21	845	1	1	11	0	11	0	0.2	2	SG
22	800	1	2	12	0	12	0	0.3	1	ST
23	900	2	7	27	15	12	0	2.8	1	AE
24	755	1	8	18	18	0	0	14.1	1	AE
25	1430	1	14	24	24	0	24	19.4	3	AE
27	706	1	10	20	20	0	20	6.2	3	JD
28	750	1	8	18	18	0	18	6.1	3	ST
29	1155	3	24	54	54	0	29	26.8	3	JD
30	810	4	42	82	82	0	32	33.0	2	AZ

The relative mean sunspot number is 47.0.

NORMALISED UCCLE OBSERVATIONAL SUNSPOT NUMBERS U'=K'U FOR JULY 2005

K'= 0.755 (*)

1	91	7	79	13	39	19	0	25	18
2	***	8	57	14	29	20	8	26	***
3	93	9	57	15	28	21	8	27	15
4	***	10	47	16	14	22	9	28	14
5	114	11	35	17	0	23	20	29	41
6	***	12	31	18	0	24	14	30	62
								31	***

The normalised relative monthly mean sunspot number is 35.

(*) 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 JULY 2005
E AND F BRUNNER'S TYPE GROUPS

Uccle Nø	East Limb Date	Date and type 1st obs	CMP	Last obs	West Limb Date
7-2031	6 23.9	30 D	6 30.6	5 C	7 7.4
9-2031	6 27.7	30 D	7 4.4	9 E	7 11.2
11-2031	6 23.7	1 C	6 30.4	1 E	7 7.2
12-2031	6 30.5	1 A	7 7.2	13 E	7 14.0
13-2031	7 1.3	3 J	7 8.0	14 E	7 14.8
7-2032	7 28.1	29 E	8 3.8	30 E	8 10.6

PROBABLE RETURN OF MAJOR GROUPS FOR AUGUST 2005

Nø	New East Limb	New CMP	New West Limb
7	7 20.8	7 27.5	8 3.3
9	7 24.5	7 31.2	8 7.0
12	7 28.2	8 3.9	8 10.7
13	7 28.6	8 4.4	8 11.1

MONTHLY SUMMARY OF SOLAR AND GEOMAGNETIC ACTIVITY

I. Solar Activity

The solar activity was moderate to high during two main periods in July 2005: July 7 to 14 and after July 28. This was due almost entirely to two large active and recurrent sunspot groups that produced a total of 18 M flares and two X flares, with multiple associated halo CMEs and two minor proton events.

The month of July 2005 started with a low activity, and a few C flares mainly from active region NOAA0786 (Catania #96), which was the returning active region NOAA0775. This region had produced several long-duration flares during the past rotation. Early in the month, AR 96/786 was the main active region on the Sun, but several other active regions appeared in the first days of July. Over the same time interval, the daily 10cm flux increased from 77 to 130.

The second week (July 4) began quietly and ended with moderate activity. Active region NOAA 0786 (Catania #96) produced two long-duration M-class flares, while close to disk centre, as well as numerous C-lass events. The first M flare was observed by LASCO from 17:06 UT on July 7 with its primary emission to the NE and a speed of ~561 km/s, and the second one from 22:30 UT on July 9 primarily to the NW with speed 976 km/s. Two full halo CMEs were observed in association with the M-class flares. A recurrent coronal hole was observed to be far smaller than on the previous rotation and the Earth did not enter the associated fast solar wind stream, though it is possible that the interaction region was encountered late on July 9. A very modest proton event was observed in association with the July 9 flare, but the >10MeV proton levels did not reach 1 pfu and decayed to background level within 36 hours.

The third week (July 11) started with a moderate activity. After a climax with a high activity on July14, the solar activity decayed at the end of the week. Solar activity was dominated by one beta-gamma-delta region in the northern hemisphere, NOAA 0786 (Catania 96), until it rotated over the West limb on July 14. Between July 12 and 14, this sunspot group has produced 12 M flares and one X1.2. From July 15 onwards, southern region NOAA 0790 (Catania #04) produced some moderate solar activity near the limb. The GOES X-ray background decayed below B-level after July 16 noon.

From July 12 onwards a series of increasing C and M flares was produced. We give a summary of the largest events which all originated from NOAA 0786:

- On July 12 starting at 12:47 UT there was a long duration M1.5 flare, associated with a bright partial halo CME. The CME was mostly directed to the NW. The CACTus algorithm measured a speed of 405 km/s. It was first visible in LASCO C2 images at 16:30 UT. No significant geomagnetic impact was observed.
- On July 13 two bright CMEs occurred in association with 2 long-duration flares: The first one accompanied an M1.1 LDE at 02:35 UT. The CME was first visible in c2 at 03:06 UT and had an estimated speed of 700 km/s. The second CME on July 13 is associated with the long duration M5.0 flare starting at 14:01 UT. The CME was first seen in LASCO C2 images at 14:30 UT and had an estimated speed of 1420 km/s. A halo CME alert was sent out automatically for this event. The event triggered a gradual increase of the proton and electron fluxes (thus probably CME driven), which exceeded slightly the event threshold at 00 UT on July 14. This induced the active geomagnetic conditions of July 15.
- On July 14, while the region was rotating over the west limb, a M9.1 flare peaked at 07:25 UT. The associated bright CME was first visible in LASCO C2 at 06:54 UT. A glancing blow probably arrived at Earth on July 16.
- Finally, on July 14, an X1.2 flare of long duration started at 10:16 UT. The high energy proton fluxes rose above the event threshold and a full halo CME was first visible in LASCO C2 at 10:54 UT. An automatic halo alert was sent out. The estimated projected speed towards the West was

estimated to be 2000 km/s (bulk) and 1000 km/s (shock) towards the East. It arrived at Earth on July 17/18.

On July 18, the Sun was spotless and solar activity remained very low over the fourth week (July 18). This week was characterized by the return of conditions similar to the previous solar rotation (week from June 20 to 27). Not a single flare (above B-class level) was observed during the period. The X-ray background remained at A-level for the whole week. From July 19 to July 22, the GOES X-ray channel 1-8Å was even almost flat. The X-ray Sun had virtually disappeared. Towards the end of the period, a single active region (NOAA AR 791, beta) appeared on the solar disc, but it stayed quiet.

A recurrent, trans-equatorial coronal hole was the source of geomagnetic disturbances on July 20-21. In the meantime, solar activity seemed to be more interesting on the far side of the Sun: two backsided halo CMEs were observed (July 21: 03h54, July 22:23h54, July 24: 13h54).

On the last week of July (July25), the solar activity rose again with the arrival a new prominent active region. On July 25, only one active region (NOAA0791, Catania #07) was present on the solar disc. It did not produce any noticeable flare until July 31 (C7.0 flare peaking at 09:23 UT). However, much higher activity was about to rotate into view at the East limb. A partial halo CME was detected by the CACTus software on July 25 above the East limb starting at 11:30 UT. It had an angular width of 210º and an estimated speed of around 1500 km/s. The source region of this halo was the NOAA AR 0792 (Catania #09, return of NOAA0786 of the previous rotation), still behind the East limb at that time. Therefore, this CME had no influence on the Earth. On July 27 NOAA AR 0792 (still behind the limb!) produced the first of a series of M-flares. It was associated with a partial halo CME detected by the CACTus software (starting time 05:08 UT; angular width 220º; average speed around 1200 km/s). Again, this CME was not directed towards the Earth.

Active region 09/792 finally appeared at the East limb on July 28 and produced two more M-flares on that day. The CME associated with the first flare was, however, only 88 degrees wide (according to the CACTus software). The second M-flare was accompanied by a CME detected by CACTus as a partial halo (126 degrees wide) moving at a speed around 1300 km/s. None of those CMEs has arrived to the Earth, again because of the position of the source region close to the limb. Finally, the active region 09/792 produced an X1.3 flare on July 30. The CACTus software detected an associated full halo CME first appearing in the LASCO C2 field of view at 06:50 UT, with estimated speed of about 800 km/s. Due to its position near the limb, only a CME-driven shock has arrived to the Earth (around 06:00 on August 1). The last essential flare of the week was the M1.1 flare from the same NOAA AR 0792 on July 31. No halo CME has been detected in association with this flare. A small equatorial coronal hole was situated at the central meridian on July 26. The fast flow emanating from this coronal hole arrived to the Earth on July 28 (see below).

The proton flux started to rise late on July 26 and exceeded the event threshold near the end of July 27. These protons were probably accelerated by the shock driven by a halo CME that erupted on July 25. The proton flux remained above the threshold until the end of the week (although declining since July 29), with protons accelerated at the shocks driven by the following halo CMEs.

II. Geomagnetic Activity

The main geomagnetic events of July 2005 were successive geomagnetic storms on July 10, 12, 13, 17-18 induced by the arrival of several halo CMEs, and a last minor storm on July 28 triggered by the arrival of a co-rotating interaction region and associated fast wind stream at the end of the month.

The quiet geomagnetic conditions prevailing at the end of June changed on July 1st, when the solar wind speed rose to about 600 km/s, as a consequence of a recurrent low-latitude coronal hole. The increased wind speed led to enhanced geomagnetic activity (up to K=4) on the first days of July.

The geomagnetic activity increased further with the successive arrival of two halo CMEs from the July 7 and 9 M flares (cf. above). The first disturbance was observed in ACE data at 03:00UT on July 10 and activity peaked at major storm levels after noon on that day. Storm conditions persisted for the remainder of July 10. It then decreased to active/minor storm levels for all of July 11th apart from an isolated peak at Kp=5 mid-morning, although Bz remained at moderately negative levels for most of the day. Geomagnetic conditions then returned to storm levels (Kp=5-6) on July 12 when the second CME hit the Earth magnetosphere early on that day. The IMF turned southward (-10nT,-15nT), and around 4 UT the solar wind speed rose to above 500 km/s. The storm lasted for 18 hours.

A new minor storm occurred on July 13, probably due the arrival of the partial halo CME of July 10 (C1.6 flare in AR 0783). The solar wind speed reached > 600 km/s (shock recorded at 04:24UT) and the IMF turned Southward (-5 nT) for a short period in the morning.

The geomagnetic field then returned to quiet to unsettled levels, except for temporary active conditions recorded in some ground-based stations on July 15 and 16. This weak geomagnetic activity may be the consequence of the partial halo CME of July 13 (~ M5.0 flare) and the CMEs from early July 14, which erupted before the full halo CME related to the X1.2 flare.

Then, on July 17 at 00:52 UT, a weak shock probably related to the full-halo CME of July 14 (X1.2 flare in AR 96/786) was detected in the solar wind. This caused mostly active conditions on July 17. Around 19:00 UT on July 17, the interplanetary magnetic field turned Southward again to -10 nT. This immediately caused a period of major storm conditions that persisted from late July 17 and to July 18 around 12:00UT.

Thereafter, the geomagnetic activity was again low (Kp<=3) until July 21, when another geomagnetic storm was caused by the passage of a recurrent coronal hole. The solar wind speed remained high from July 20 to July 24, with a maximum of 600km/s on July 21. The Bz component of the interplanetary magnetic field fluctuated between ± 10 nT.

The geomagnetic field was quiet again on July 25, with the Earth only submitted to a slow solar wind flow with a weak magnetic field. Late on July 28, a co-rotating interaction region and sector boundary swept past the Earth. The embedded shock was detected by SOHO/CELIAS at 18:43 UT. The source of the faster flow is probably a small equatorial coronal hole that was located at the central meridian on July 26. The interaction region contained intervals of Southward interplanetary magnetic field. The geomagnetic field became disturbed and the Kp index reached 5 (minor storm) on July 28-29. Thereafter, Kp reached occasionally 4 until July 30, when the fast flow decayed and the geomagnetic field returned to quiet conditions.

III. Noticeable Solar Events

DAY	BEGIN	MAX	END	LOC	XRAY	OP	10CM	RADIO TYPE	Cat	NOAA	NOTE
07	1607	1629	1640	N09E03	M4.9	SN	180		96	0786	EIT pos. Fast wide CME
09	2147	2206	2219	N11W27	M2.8	1N	1500	IV/2	96	0786	EIT pos., full halo CME, p
12	1247	1306	1325	N12W69	M1.0		65	CTM/1	96	0786	
12	1547	1624	1807	N11W64	M1.5	SF	100	IV/2	96	0786	associated bright CME
12	2235	2252	2302	N08W72	M1.3	SF			96	0786	
13	0235	0316	0347	N13W71	M1.1	SF	250		96	0786	
13	1203	1219	1224	N08W79	M3.2		67	III/3	96	0786	
13	1401	1449	1538	N11W90	M5.0		2000	V/2,III/2	96	0786	partial halo CME
13	1902	1909	1913	N13W82	M1.2	1F			96	0786	
13	2149	2154	2158	N08W90	M1.2		250	V/3,III/3	96	0786	
14	0302	0323	0328	N13W86	M1.0	SF		III/3	96	0786	
14	0557	0725	0743	N09W90	M9.1		81	CTM/2,III/3	96	0786	
14	1016	1055	1129	N11W90	X1.2		3400	III/1,IV/2	96	0786	full halo CME
14	1716	1725	1728	N09W90	M1.3			III/3	96	0786	
14	2250	2257	2302	N09W90	M1.1		100	III/3	96	0786	
16	0327	0338	0345	S10W72	M1.0				04	0790	
27	0433	0502	0530	N11E90	M3.7			II/3			Above E limb (AR 0786), GOES/SXI derived location

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28  0001  0030 0054 N09E90 M1.0                            09  0792 GOES-12/SXI-derived
location
28  2139  2208 2224 N08E84 M4.8 SF 60    II/1,CTM/1,III/2  09  0792
30  0617  0635 0701 N12E61 X1.3 2B 2100  II/3,IV/2         09  0792
31  1215  1224 1233 N13E45 M1.1    51                      09  0792 GOES-derived location
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LOC: approximate heliographic location
XRAY: X-ray flare class
OP: optical flare class
10CM: peak 10 cm radio flux

RADIO TYPE: radio burst type
Cat: Catania sunspot group number
NOAA: NOAA active region number
NOTES: **p** = proton event
CME = coronal mass ejection