Solar Influences Data analysis Center

Data Analysis Service supported by the FAGS

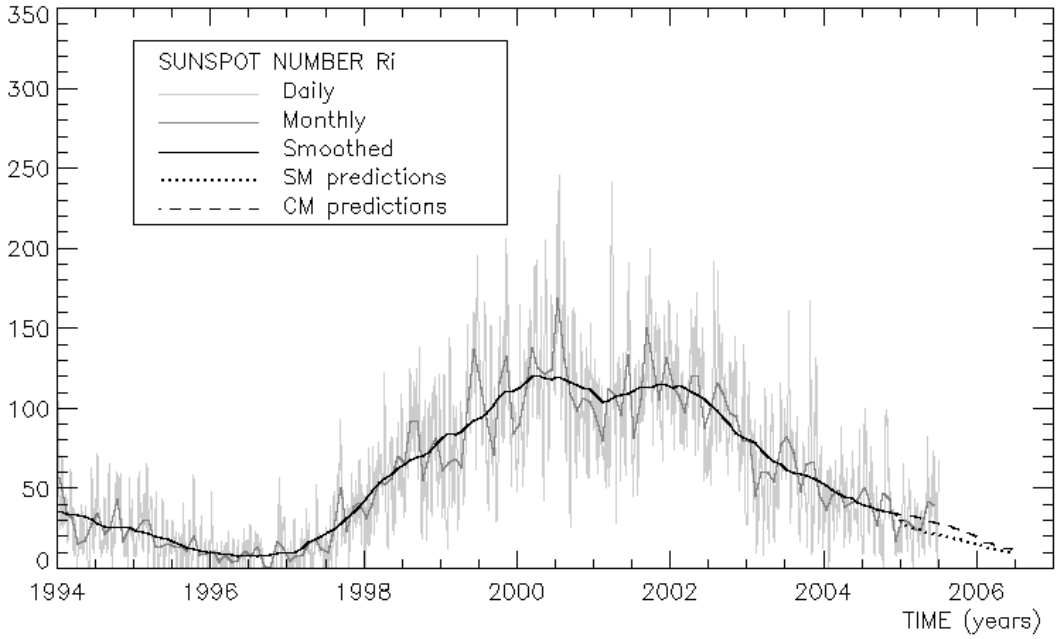
SUNSPOT BULLETIN

2005 n° 6

Provisional international and normalized hemispheric daily sunspot numbers for June 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	53	16	37
2	40	0	40
3	33	0	33
4	49	17	32
5	62	18	44
6	64	22	42
7	73	19	54
8	68	21	47
9	67	23	44
10	70	24	46
11	55	19	36
12	52	18	34
13	31	13	18
14	33	11	22
15	40	16	24
16	43	14	29
17	48	0	48
18	32	0	32
19	29	0	29
20	31	0	31
21	34	0	34
22	27	0	27
23	11	0	11
24	13	7	6
25	12	6	6
26	0	0	0
27	13	7	6
28	9	9	0
29	28	17	11
30	67	21	46
Monthly mean	**39.6**	**10.6**	**29.0**
Cooperating stations	**51**	**41**	**41**



Predictions of the monthly smoothed Sunspot Number

using the last provisional value, calculated for December 2004 : 35.2 (± 5%)

	SM	CM		SM	CM		SM	CM
2005 Jan	33	34	2005 Jul	24	28	2006 Jan	18	19
Feb	32	34	Aug	23	27	Feb	18	17
Mar	30	33	Sep	22	26	Mar	17	16
Apr	29	32	Oct	21	25	Apr	16	14
May	27	30	Nov	20	23	May	15	13
Jun	26	29	Dec	19	21	Jun	13	12

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, July 1, 2005 11:41 UT

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

Date	R'_i	PPSI	600	2800	COS	SFI	XI	Ak	SEA
31	58	38	37	96	895	1	0/0	20	
1	53	20	37	94	899	4	1/0	8	
2	40	23	38	93	////	1	0/0	10	
3	33	33	38	95	////	11	2/0	10	
4	49	73	40	97	907	4	0/0	25	
5	62	67	41	105	914	1	0/0	20	
6	64	85	41	106	913	21	0/0	12	
7	73	99	41	109	905	3	0/0	14	
8	68	147	44	116	911	3	0/0	5	
9	67	162	43	116	916	3	0/0	5	
10	70	170	44	114	919	1	0/0	3	
11	55	187	38	108	921	0	0/0	6	
12	52	167	38	103	907	6	0/0	50	
13	31	99	35	92	903	0	0/0	29	
14	33	60	36	94	909	12	0/0	16	
15	40	59	35	95	902	1	0/0	18	
16	43	63	39	98	896	2	1/0	25	
17	48	78	36	91	893	0	0/0	16	
18	32	79	35	90	899	8	0/0	8	
19	29	63	35	87	912	1	0/0	8	
20	31	41	34	86	915	0	0/0	5	
21	34	31	34	83	910	1	0/0	2	
22	27	20	34	80	914	1	0/0	8	
23	11	8	34	78	920	0	0/0	40	
24	13	2	34	77	920	0	0/0	11	
25	12	2	35	77	913	1	0/0	14	
26	0	0	35	79	////	0	0/0	9	
27	13	0	35	77	926	0	0/0	6	
28	9	3	36	80	931	0	0/0	5	
29	28	7	–	88	928	0	0/0	6	
30	67	48	38	103	929	0	0/0	9	

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 JUNE 2005

DATE	UT	NUMBER OF GROUPS	NUMBER OF SPOTS	RELATIVE SUNSPOT NUMBERS TOTAL	NORTH	SOUTH	CENTRAL	PPSI 10-5 WM-2	QUAL	OBS
1	630	4	25	65	24	41	0	10.4	3	OB
2	740	2	15	35	0	35	0	1.5	3	OB
3	800	2	12	32	0	32	18	8.3	2	OB
6	920	5	31	81	27	54	55	48.8	3	OB
7	1200	7	35	105	29	76	36	26.4	2	OB
8	700	6	40	100	27	73	42	60.2	4	OB
9	635	4	54	94	32	62	81	70.0	4	OB
10	750	5	69	119	40	79	83	77.7	4	OB
11	920	3	31	61	19	42	49	79.8	3	ST
13	1000	2	19	39	16	23	23	62.4	3	OB
14	1145	3	11	41	13	28	0	7.5	4	ST
15	740	4	19	59	24	35	22	31.9	4	OB
16	640	3	28	58	13	45	32	28.3	4	OB
18	1016	2	22	42	0	42	28	58.0	2	DB
19	740	2	26	46	0	46	0	47.1	3	DB
20	1330	2	38	58	0	58	0	35.0	4	OB
21	1400	2	24	44	0	44	25	10.4	3	OB
22	735	2	19	39	0	39	24	9.3	3	OB
23	650	1	10	20	0	20	20	0.4	4	OB
24	1225	0	0	0	0	0	0	0.0	4	OB
25	905	1	1	11	0	11	0	0.3	3	OB
26	730	0	0	0	0	0	0	0.0	2	OB
27	650	1	3	13	13	0	0	0.3	4	OB
28	720	1	1	11	11	0	0	0.1	2	OB
29	750	1	8	18	18	0	0	2.0	4	OB
30	720	5	40	90	27	63	28	36.1	4	OB

The relative mean sunspot number is 49.3.

NORMALISED UCCLE OBSERVATIONAL SUNSPOT NUMBERS U'=K'U FOR JUNE 2005
K'= 0.741 (*)

1	48	7	78	13	29	19	34	25	8
2	26	8	74	14	30	20	43	26	0
3	24	9	70	15	44	21	33	27	10
4	***	10	88	16	43	22	29	28	8
5	***	11	45	17	***	23	15	29	13
6	60	12	***	18	31	24	0	30	67

The normalised relative monthly mean sunspot number is 37.

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

The Sun has been observed 26 days on 30 possible.

UCCLE OBSERVATIONAL MAJOR SUNSPOT GROUPS FOR JUNE 2005
E AND F BRUNNER'S TYPE GROUPS

Uccle Nø	East Limb Date	Date and type 1st obs	CMP	Last obs	West Limb Date
3-2030	5 20.8	22 D	5 27.6	1 D	6 3.3
14-2030	6 4.6	6 E	6 11.4	16 C	6 18.1
2-2031	6 9.8	14 A	6 16.5	22 D	6 23.3

PROBABLE RETURN OF MAJOR GROUPS FOR JULY 2005

Nø	New East Limb	New CMP	New West Limb
3	6 16.9	6 23.6	6 30.4
14	7 1.6	7 8.4	7 15.1
2	7 7.0	7 13.7	7 20.5

MONTHLY SUMMARY OF SOLAR AND GEOMAGNETIC ACTIVITY

I. Solar Activity

Solar activity was split this month in an active half (June 1-June 17) and a quiet half (June 18-June 29). The first half typically showed about 4 active regions on the solar disc and had a 10cm flux of more than 100. The quiet half showed at most two active regions on the solar disc and a sunspot number that dropped to zero on June 26. Towards the end of the period (June 30) the Sun was getting ready to show us its active face again with 4 active regions on the disc. The active phase was dominated by NOAA AR 0772 (Catania sunspot group 74) and NOAA AR 775 (Catania sunspot group 78), both producing M-flares and geo-effective CMEs.

The active side of the Sun

During June 1 - 4, NOAA AR 772 produced numerous C-flares and two M-flares on June 1 and 3. The M1.7 flare on June 1 was accompanied by a backsided CME first detected by SOHO/LASCO at 03:32 UT. Another M-flare occurred on June 3 in an active region which was at that time behind the north-east limb. It would only come into view on June 4th and become known as NOAA AR 0775, Catania number 78. The June 3 M-flare was associated with an asymmetric full halo CME. This CME was obviously not Earth directed, given the position of the source region position at the West limb. The CME-driven shock, however, gave the appearance of a full halo. A third noteworthy active region was, NOAA AR 0776, Catania sunspot group 79, which appeared on the east limb on June 5 and subsequently produced many B and a few C-flares.

On June 7 starting at 10:36 UT, there was a large filament eruption, accompanied by a CME directed to the NE (68 degrees wide). The filament was clearly visible in BBSO Hα images. Possibly on June 8 in the morning there was a second filament eruption in the SE. A very slow (134 km/s) faint partial halo CME was visible in LASCO C2 data from 07:12 UT onwards.

On June 9 starting at 13:28 UT, a (very) long duration flare was recorded. SXI/GOES data showed post eruptive loops in active region NOAA 0775 (Catania 78), which had turned into a beta-gamma-delta group. LASCO data show a very faint halo CME mainly towards the NE, first visible in C2 around 14:00 UT on June 9, probably related to this long duration flare. It caused a major geomagnetic storm on June 12 (see below). Also around 02:00 UT a very faint halo CME was seen in LASCO data, but due to the lack of solar data (SOHO telemetry keyhole) we could not determine whether it is front-or backsided.

A sequence of long duration flares was produced by NOAA AR 775 from June 12 onwards, producing several CMEs. The first CME was geo-effective, see below. It was first visible in C2 at 02:36 UT (June 12) and is a partial halo, spanning 124 degrees, and erupting at a projected speed of 446 km/s. The second CME was more narrow (98 degrees) and was not geo-effective. Two more events occurred on June 14: a C4.2 flare peaking at 07:30UT with a faint full halo CME visible in C2 around 07:36UT and a C7.4 flare peaking at 15:48UT with again a faint full halo CME visible in C2 around 16:00UT. This last CME was faster then the previous one.

June 16, with NOAA AR 775 already on the West limb, was the last day of the sequence of long duration events: GOES measured a LD C1.7 flare peaking at 09:05UT with an associated CME visible at 08:48UT in C2 and a LD M4.0 flare peaking at 20:22UT. There was a westward directed CME associated with this M-flare. At the moment of the M-flare, the group was already behind the west limb. A proton event was induced: just before midnight, the >=10MeV curve

past the threshold and lasted until around 17:00UT, June 17. This was the only excursion of the proton flux levels during the period.

The quiet side of the Sun

After, the active half of the Sun had rotated out of the field of view and solar activity dropped significantly. A few C-flares were produced by the only significant active region on the solar disc (Catania 85, NOAA 0780). After June 22, this region decayed continuously and disappeared on June 26, leaving a spotless Sun.

After that the X-ray background started to increased again, and together with several minor flares on June 26 and 27, it indicated the upcoming return of the active side of the Sun. A first active region (NOAA AR 781) popped up behind the North-East limb on Tuesday June 28. Also a strong CME was observed by the LASCO coronagraphs on June 28. The CME was predominantly Eastward (at a speed of about 1000km/s) but had also a slower component westward. From then on, a quick rise resulted in again 4 active regions at the end of the period (June 30).

II. Geomagnetic Activity

Three periods of strongly enhanced geomagnetic activity were observed during the month: June 4-5, June 12-16 and June 23. The first and the last were due high solar wind speeds coming from coronal holes. The period from June 12-16 was due to the multiple CMEs associated with the long duration flares in NOAA AR 775 from June 9 onwards.

A large low-latitude coronal hole passed the central meridian during June 1 - 2. In the end of June 4 an interaction region between slow and fast solar wind flows arrived, followed by the fast flow from the low-latitude coronal hole. The solar wind contained only short intervals of southward IMF, so the Kp index reached only 5 on June 4. In the end of June 5 the geomagnetic situation was quiet again.

On June 12 due to the arrival of the halo CME of June 9, the earth experienced quiet to major geomagnetic storm conditions. Solar wind data from ACE and CELIAS/SOHO measured a weak shock at 06:50UT. A jump was recorded in the solar wind speed, density and in the magnetic field parameters. The z-component of the IMF was however positive leading thus to only to active geomagnetic conditions. From 16 UT onwards the Bz turned southward to -15 nT. From this time onwards most stations recorded minor to major geomagnetic storm conditions until noon June 13. Extreme local K-values of k=7 were recorded in Izmiran and Niemegk.

On June 14, a new shock in the solar wind was measured (18h00 UT) by the ACE spacecraft. The speed of the solar wind jumped from 450 to 550 km/s. The z-component of the interplanetary field remained mostly north. This shock is presumably related to the faint full halo CME associated with the first LDE of June 12. This led to minor storm conditions on June 15. Finally, on June 16, a strong jump in the total interplanetary magnetic field Bt and Bz was visible. The jump was less pronounced in the speed of the solar wind. This blast can be related with the plasma clouds ejected on June 14. A possible scenario is that the second faster CME was capable to catch up with the first one of that day. This is called CME cannibalism, which is more violent when arriving at earth. The result was a minor storm, with one period where Kp= 6.

On June 23, the solar wind speed rose again with the arrival of a corotating interaction region generated by a transequatorial coronal hole located just NW of NOAA AR 780. The high speed

approaching 500 km/s, combined with a strong -20nT Bz southward component, triggered a moderate to major geomagnetic storm (Kp=6-7) for a few hours starting at 07:00UTC. Unsettled to minor storm conditions (Kp=3-5) followed, until mid-June 24. The solar wind speed rose further to a maximum of 650km/s on June 25, but in the meantime, the interplanetary magnetic field got weaker to < 10 nT and Bz turned positive or fluctuated around zero. Consequently, on June 25 & 26, the geomagnetic field returned to quiet to unsettled conditions while the high-speed stream decayed down to 450km/s at the end of the period.

After that the geomagnetic activity was low (K<=3) during the remainder of the period.

III. Noticeable solar events

DAY	BEGIN	MAX	END	LOC	XRAY	OP	10CM	RADIO TYPE	600 (Humain)	Cat	NOAA	NOTE
01	0236	0243	0246	S18E49	M1.7		61	V/2,III/3,II/3		74	0772	GOES-12/SXI der. loc.
03	0403	0411	0416	S18E21	M1.3	1B	150	V/2,III/2,II/1	0409	74	0772	
03	1151	1226	1245	N15E90	M1.0		150	III/1,II/2	1159			Behind E limb, CME
16	2001	2022	2042	N09W87	M4.0	SF	170	III/1,II/3,IV/1		78	0775	CME

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