Solar Influences Data analysis Center

Data Analysis Service supported by the FAGS

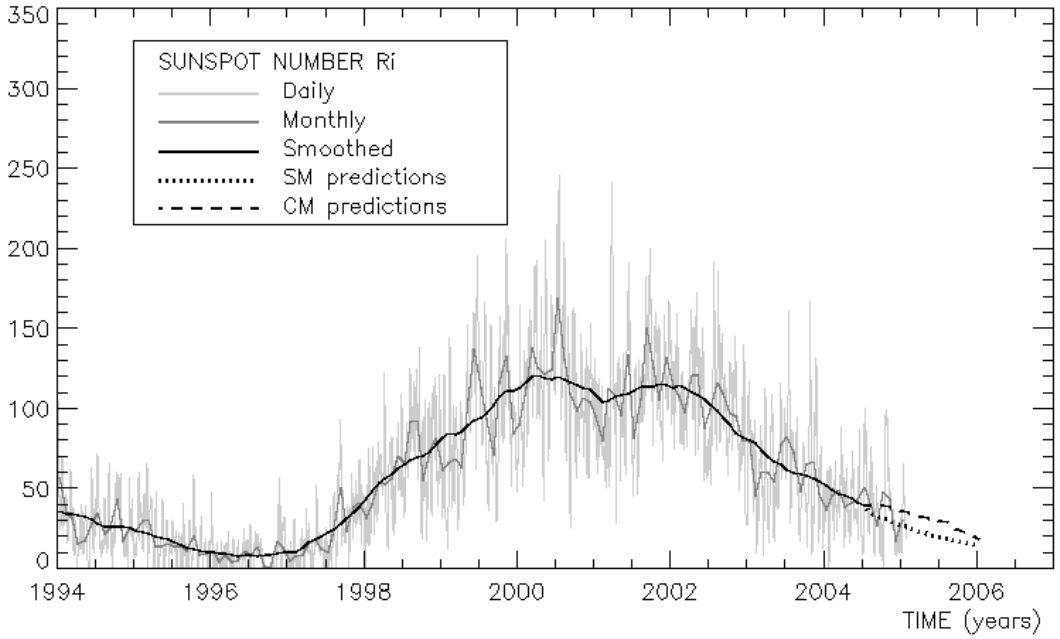
SUNSPOT BULLETIN

2005 n° 1

Provisional international and normalized hemispheric daily sunspot numbers for January 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	32	24	8
2	32	32	0
3	24	16	8
4	14	14	0
5	11	11	0
6	16	16	0
7	11	11	0
8	10	0	10
9	14	0	14
10	19	0	19
11	27	12	15
12	40	22	18
13	41	21	20
14	54	26	28
15	59	29	30
16	65	35	30
17	64	38	26
18	61	38	23
19	45	33	12
20	42	30	12
21	45	25	20
22	31	9	22
23	26	8	18
24	28	9	19
25	32	8	24
26	23	8	15
27	20	8	12
28	20	8	12
29	19	8	11
30	22	0	22
31	23	0	23
Monthly mean	**31.3**	**16.1**	**15.2**
Cooperating stations	**49**	**42**	**42**



Predictions of the monthly smoothed Sunspot Number
using the last provisional value, calculated for July 2004 : 40.2 (± 5%)

	SM	CM		SM	CM		SM	CM
2004 Aug	39	40	2005 Feb	31	35	2005 Aug	22	29
Sep	39	40	Mar	29	34	Sep	21	26
Oct	37	40	Apr	28	33	Oct	20	24
Nov	35	39	May	26	32	Nov	19	23
Dec	34	37	Jun	25	31	Dec	18	21
2005 Jan	32	36	Jul	23	30	2006 Jan	18	19

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, February 1, 2005 12:13 UT

Ed. Ronald Van der Linden, avenue Circulaire, 3 B-1180 BRUXELLES - BELGIUM
Fax 32-(0)2-373 02 24 Tel 32-(0)2-373 04 91
e-mail : arille@oma.be, ronald@oma.be
ftp anonymous : omaftp.oma.be, directory dist/astro/sidcdata
http://sidc.oma.be

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

Date	R'_i	PPSI	600	2800	COS	SFI	XI	Ak	SEA
31	24	34	40	99	////	4	1/0	8	
1	32	39	39	99	878	1	0/1	19	
2	32	42	40	100	889	0	0/0	45	
3	24	40	39	94	862	1	0/0	18	
4	14	14	38	88	852	3	0/0	28	
5	11	6	35	88	855	0	0/0	18	
6	16	6	34	83	860	0	0/0	6	
7	11	3	33	84	859	0	0/0	47	
8	10	3	–	89	868	0	0/0	34	
9	14	11	35	88	////	11	1/0	4	
10	19	20	34	90	870	0	0/0	8	
11	27	37	35	94	878	0	0/0	17	
12	40	80	35	102	880	2	0/0	38	
13	41	161	38	116	882	5	0/0	20	
14	54	287	–	130	889	9	3/0	25	
15	59	336	49	145	890	4	6/2	18	
16	65	320	48	145	////	17	1/0	14	
17	64	298	–	138	873	105	1/1	44	
18	61	183	44	124	802	117	2/0	64	
19	45	99	–	133	757	215	3/1	43	
20	42	93	43	123	////	104	0/1	20	
21	45	62	43	114	828	2	2/0	73	
22	31	58	42	102	784	0	0/0	30	
23	26	34	41	96	////	0	1/0	22	
24	28	32	42	95	870	0	0/0	12	
25	32	43	41	94	880	0	0/0	4	
26	23	42	40	89	887	0	0/0	3	
27	20	42	37	87	884	0	0/0	2	
28	20	22	37	85	////	0	0/0	8	
29	19	13	37	86	886	0	0/0	25	
30	22	26	37	86	897	0	0/0	16	
31	23	28	35	86	895	0	0/0	22	

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 JANUARY 2005

DATE	UT	NUMBER OF GROUPS	NUMBER OF SPOTS	RELATIVE SUNSPOT NUMBERS TOTAL	NORTH	SOUTH	CENTRAL	PPSI 10-5 WM-2	QUAL	OBS
2	900	2	19	39	39	0	27	67.4	3	ER
3	1040	2	15	35	18	17	35	23.7	2	OB
4	910	1	9	19	19	0	19	22.6	2	OB
6	1030	2	4	24	13	11	0	4.4	2	OB
9	1050	1	14	24	0	24	0	19.5	3	OB
10	1120	1	9	19	0	19	0	36.4	3	OB
11	1035	2	10	30	14	16	0	52.6	3	OB
12	1420	2	35	55	35	20	20	105.4	2	OB
13	925	3	49	79	41	38	38	96.6	3	OB
14	906	3	38	68	28	40	68	106.5	3	VI
15	1105	4	51	91	38	53	79	110.6	2	FC
16	1205	4	67	107	51	56	93	109.1	3	FC
18	1455	6	66	126	74	52	14	54.1	3	OB
19	1045	4	73	113	91	22	0	41.0	3	OB
22	937	3	17	47	11	36	23	51.7	2	DB
23	913	3	8	38	11	27	22	36.4	3	DB
24	1020	4	10	50	11	39	11	32.6	3	OB
25	930	4	10	50	11	39	27	50.6	3	OB
26	1150	2	12	32	11	21	21	44.4	3	OB
29	940	2	5	25	11	14	14	10.8	2	VI

The relative mean sunspot number is 53.5.

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

K'= 0.882 (*)

1	***	7	***	13	70	19	100	25	44
2	34	8	***	14	60	20	***	26	28
3	31	9	21	15	80	21	***	27	***
4	17	10	17	16	94	22	41	28	***
5	***	11	26	17	***	23	34	29	22
6	21	12	49	18	111	24	44	30	***
								31	***

The normalised relative monthly mean sunspot number is 47.

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

The Sun has been observed 20 days on 31 possible.

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

Uccle Nø	East Limb Date	Date and type 1st obs	CMP	Last obs	West Limb Date
1-2025	12 27.5	28 D	1 3.3	6 C	1 10.0
4-2025	1 7.6	9 E	1 14.4	19 C	1 21.1
5-2025	1 8.9	11 C	1 15.7	19 E	1 22.4
11-2025	1 12.6	22 E	1 19.3	24 C	1 26.1

PROBABLE RETURN OF MAJOR GROUPS FOR FEBRUARY 2005

Nø	New East Limb	New CMP	New West Limb
5	2 5.2	2 11.9	2 18.7
11	2 8.4	2 15.2	2 21.9

MONTHLY SUMMARY OF SOLAR AND GEOMAGNETIC ACTIVITY

I. Solar Activity

The sun was quite agitated this month, untypical for the current phase of the solar cycle. The main culprit by far was Catania sunspot group 05 (NOAA 0720), which caused extreme space weather conditions from Jan 14 to Jan 22. Its largest event was an X7.1 flare on Jan 20.

Following on from the activity at the end of December 2004, Catania 98 made the New Year start with a bang, producing an X1.7 flare in the first hour of the month, accompanied by a full halo CME. After this major flare, the activity became lower, with regular C-flares until Jan 04. Nearly all of the flares had associated coronal dimmings and CMEs. Since the group was near the center of the solar disk on Jan 03, this led to (very) faint full halo CMEs on Jan 04 and Jan 05. On Jan 05, a large prominence erupted from the north-east quadrant, also producing a full halo CME. After Jan 05, Catania sunspot group 98 became completely quiet. The solar X-ray output did not reach the C-level on Jan 05-07. On Jan 08-09, two new active groups appeared close together at the east limb: Catania sunspot groups 03 and 04 (NOAA 0718 and 0719). These boosted solar activity, producing some small C-flares and an isolated M2.4 event on Jan 09.

The biggest player of the month was Catania sunspot group 05 (NOAA 0720). It first came in view on Jan 10 and grew very fast in size and complexity, although it was until Jan 13 responsible for only a few B-flares. From Jan 14 onwards, when the group had grown to its biggest size of 1.5 percent of the solar disk (it was visible on the solar disk with the naked eye), Catania 05 marked a new period. Up till its disappearance at the west limb on Jan 23, it was responsible for 5 X-flares (including as biggest event of the month an X7.1 flare on Jan 20), 17 M-flares and tens of C-flares. At the same time, Catania 03 and 04 remained active as well, both producing 2 M-flares. We pay special attention to some of the flares below.

1) A long duration M8.4 flare peaked at 04:31 UT, Jan 15 and was accompanied by a full halo CME. A strong 10cm radio emission was measured (3000 sfu). The >10, >50, >100MeV proton fluxes increased, but did not pass the threshold.
2) A long duration X2.6 flare peaked at 23:02 UT, Jan 15. A full halo CME with median/maximum speed of 1488/1960 km/s was detected by CACTus at 23:06 UT in LASCO/C2. An even stronger output at 10cm wavelength was measured: 6400 sfu. On Jan 16, just after midnight, all proton fluxes increased; the >10MeV flux passed the threshold a little later, the >50 MeV exceeded the threshold briefly around 15:00UT.
3) An X3.8 flare was seen, with a bulge in the X-ray radiation output curve before the peak time at 09:52 UT, Jan 17. An associated full halo CME at 1567/1974 km/s was detected at 09:30 UT; this is before the peak in X-rays. A steep increase of all three proton fluxes above the threshold was measured. On Jan 18, only the >10 and >50 MeV curves were still above the threshold.
4) A triple M6.7/X1.3/M2.7 flare peaked at 08:22 UT, Jan 19 with an associated full halo CME coming out of the occulting disk of LASCO/C2 at 08:29 with a median/maximum speed of 1516/1977 km/s. The 10cm flux measured at a time linked with the M6.7 flare had the value of 5000 sfu. These events had no significant impact on the proton fluxes.
5) The last flare was the most energetic one: it peaked at the value of X7.1 at 07:01 UT, Jan 20. A full halo CME was detected at 06:54 UT with median/maximum speed of 994/1689 km/s. The 10cm flux output was 8400 sfu. This flare caused an EXTREME proton event: from 06:55 UT, the >10, >50 and >100 MeV-curves increased sharply. The >100 MeV curve went up to almost the same extremely high level as the >10 MeV and >50 MeV curves. This proton event ended on Jan 22.

After the disappearance of Catania 05 on Jan 23, the solar activity dropped to very low levels and remained so during the rest of the month. Only a few small sunspot groups were present on the solar disk and flaring was confined to isolated B flares, while the X-ray background remained largely below the B-level. Only on Jan 31 solar activity gained some momentum due to the birth and fast growth of Catania sunspot group 16 in the eastern hemisphere, producing a C1.3 flare peaking at 10:51UT.

Several coronal holes influenced the earth this month. An elongated trans-equatorial coronal hole was situated near the central meridian on Dec 28 and became geo-effective on Jan 01. A second coronal hole reached disk center on Dec 31. A small coronal hole in the southern solar hemisphere (which was near the central meridian on Jan 07) pushed the solar wind speed up to values around 700 km/s on Jan 12. A high-latitude northern coronal hole was located at the central meridian on Jan 09. A northern hemispheric coronal hole was situated at the central meridian on Jan 19. Finally, the returning large trans-equatorial coronal hole reached central meridian on Jan 26 and became geo-effective on Jan 29.

II. Geomagnetic Activity

Like the solar conditions, the geomagnetic activity was quiet volatile this month. Several coronal holes led to minor and major geomagnetic storms, while CMEs contributed to geomagnetic storms reaching extreme levels on Jan 07-08, 17-19 and 21-22.

Late on Jan 01, the fast flow from the first trans-equatorial coronal hole mentioned above reached the earth. The solar wind speed rapidly increased to 800km/s. It declined to about 600 km/s on Jan 03, but later on the same day it started to increase again due to the second coronal hole. On this occasion the solar wind speed peaked at 700 km/s on Jan 04, gradually decreasing to 500 km/s by Jan 07. During all this time, the IMF was oscillating between northwards and southwards orientation, leading to very variable geomagnetic conditions. In the period Jan 01-05 active and minor storm conditions were reached several times. On Jan 06, the IMF turned firmly northwards, so geomagnetic conditions became suddenly very quiet until noon UT on Jan 07. At that time, an ICME cloud passed the earth (without shocks). The solar wind speed increased to 600 km/s, and the IMF field strength went up to more than 20 nT. Since the IMF was strongly southwards for some time, strong geomagnetic perturbations resulted in a severe geomagnetic storm during the second half of Jan 07 and the first half of Jan 08. After that, geomagnetic conditions became quiet again.

From Jan 11 onwards the small southern coronal hole pushed the solar wind speed up to values around 700 km/s and caused active to minor geomagnetic storm conditions. On Jan 14-15, we had another minor storm period, this time caused by the northern coronal hole. On Jan 16, ACE data showed a change in several physical quantities (around 10:30UT): higher density, decreasing temperature, high solar wind speed, increased total interplanetary magnetic field. These are signatures of an ICME passing ACE, probably the arrival of the first full halo CME. A minor storm just after midnight in the night between Jan 16 and Jan 17 was the consequence. A clear shock in ACE data on Jan 17 at 07:00UT marked the arrival of the second full halo CME, associated with the X2.6 flare peaking at 23:02UT on Jan 15. This initiated a severe storm on Jan 17. In the night between Jan 17 and Jan 18, around 23:00UT, 02:30UT, 05:30UT, several drastic changes in Bt and Bz were visible. (Note: ACE/SWEPAM was not available due the proton storm from around 13:00UT, Jan 17 until 22:00UT, Jan 18. Early on Jan 19, the solar wind speed was 1000 km/s). The result was two further days (Jan 18 and Jan 19) of severe geomagnetic disturbances.

Early on Jan 20, ACE showed some evidence (in solar wind speed and total magnetic field) for another ICME passage. From 07:00UT, data from the SWEPAM instrument was for a second time unreliable, as a consequence of the X7.1 flare. This ICME caused active to minor storm conditions in the second half of Jan 20.

A last shock was identified at 16:48UT on Jan 21. The solar wind speed jumped from 600 to 1000 km/s. The Bz went up to more than -20nT, leading to a sudden severe geomagnetic storm with estimated Kp reaching up to 8 on Jan 21-22.

Late Jan 22, continuing Jan 23, we experienced active conditions as consequence of a northern hemisphere coronal hole. By Jan 26 the solar wind speed had decreased again to 350km/s. The interplanetary magnetic field was weak (<5nT) and Bz fluctuated around 0 nT. As a consequence, the geomagnetic field was quiet to unsettled on Jan 24, and it became mostly quiet (Kp=0 - 1) for several days thereafter, from Jan 25 to Jan 28. On Jan 27 at 23:00UT, there was a sector boundary crossing. Finally, on Jan 29, the solar wind speed increased to 600km/s, while the interplanetary magnetic field became

stronger (10nT) and its Bz component fluctuated strongly to negative values. This induced active to minor storm geomagnetic conditions on Jan 28-30. On Jan 31, the solar wind speed further increased to 700km/s. The IMF was alternating between north- and southward orientation, causing geomagnetic activity briefly reaching minor storm conditions round noon UT on Jan 31. By the end of that day, the solar wind speed started decreasing again and quiet conditions returned.

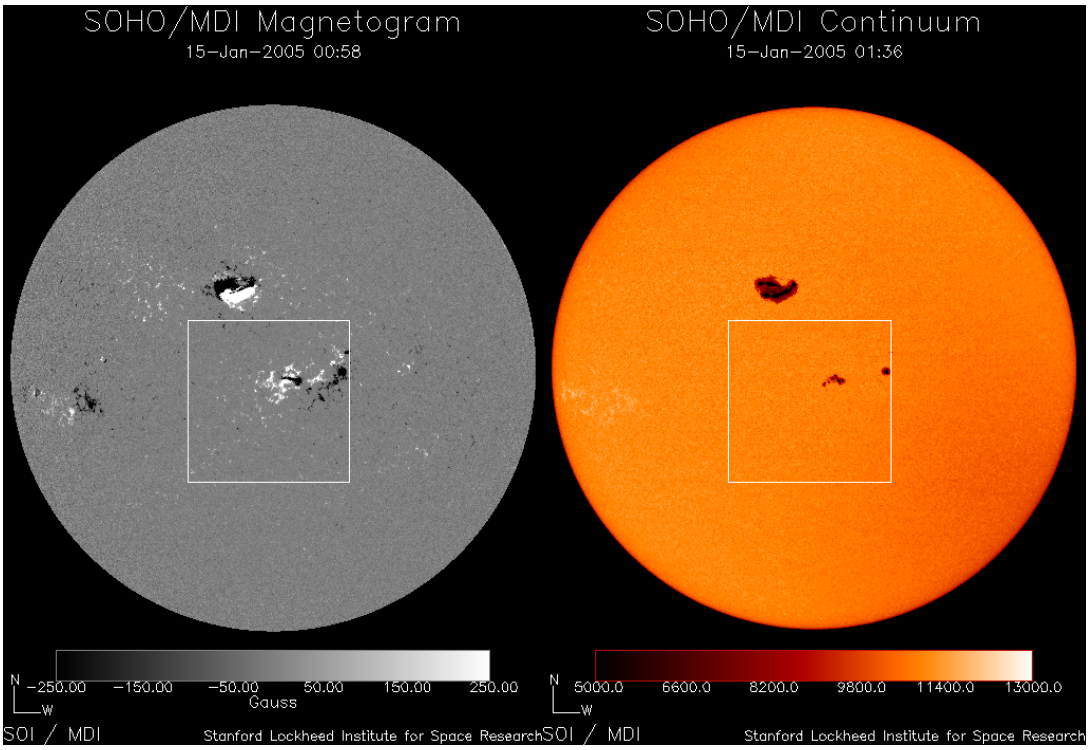
III. Noticeable solar events

DAY	BEGIN	MAX	END	LOC	XRAY	OP	10CM	RADIO TYPE	600 (Humain)	Cat	NOAA	NOTE
01	0001	0031	0039	N06E34	X1.7		760	CTM/1,II/2, IV/2,III/2		98	0715	SXI-derived loc.
09	0825	0851	0909	S09E69	M2.4	1N	77	II/1		04	0719	
14	1353	1411	1445	N13E14	M1.8	SF				05	0720	
14	1602	1606	1614	S07E02	M1.0		67	V/2		03	0718	SXI-derived loc.
14	1753	1757	1803	N13E11	M1.5				05	0720		SXI-derived loc.
14	2108	2126	2139	N15E08	M1.9	2N				05	0720	
15	0022	0043	0102	N11E10	X1.2	1B	97			05	0720	
15	0409	0416	0422	N11E08	M1.3	2N		III/2		05	0720	
15	0426	0431	0436	N14E06	M8.4	2N				05	0720	
15	0554	0638	0717	N11E06	M8.6	SF	3000	IV/2,II/2		05	0720	fast full halo CME
15	1141	1148	1150	N12E04	M1.2	SF				05	0720	
15	1408	1423	1439	S08W11	M3.2	SF	420	III/3	1419	03	0718	
15	2201	2208	2216	N14W09	M1.0	SF				05	0720	
15	2225	2302	2331	N14W08	X2.6	3B	6400	II/2		05	0720	full halo CME
16	2155	2203	2222	N13W16	M2.4	1N	54	III/3		05	0720	
17	0310	0321	0332	N12W19	M2.6				05	0720		SXI-derived loc.
17	0659	0952	1007	N15W26	X3.8			0758	05	0720		SXI-derived loc., full halo CME
18	1123	1132	1159	N13W38	M1.6					05	0720	SXI-derived loc.
18	1538	1551	1559	N14W40	M4.6	2N	100		1550	05	0720	
19	0658	0731	0755	N19W47	M6.7	2N	5000	CTM/1,III/3		05	0720	1st part of triple flare
19	0803	0822	0840	N15W50	X1.3			II/2,IV/2		05	0720	full halo CME, 2th part of triple flare
19	1019	1024	1029	N18W47	M2.7	1N		III/3		05	0720	3th part of triple flare
19	1532	1540	1548	N13W50	M1.6	2F				05	0720	
20	0636	0701	0726	N12W58	X7.1	2B	8400	IV/2,II/2	0739,0809 0833	05	0720	full halo CME
21	1010	1016	1019	N17W73	M1.7	51		III/1	1014	05	0720	SXI-derived loc.
21	1347	1355	1410	S07W89	M1.2				04	0719		SXI-derived loc.
23	0128	0151	0201	N15W88	M1.0					05	0720	SXI-derived loc.

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

IV. Picture of the month



MDI images of the solar disk near the time of the burst of solar activity. The naked-eye sunspot group responsible for this activity (Catania sunspot group 05, NOAA 0720) is prominently visible in the northern hemisphere. MDI is an instrument onboard the joint ESA/NASA mission SOHO.