Solar Influences Data analysis Center

Data Analysis Service supported by the FAGS

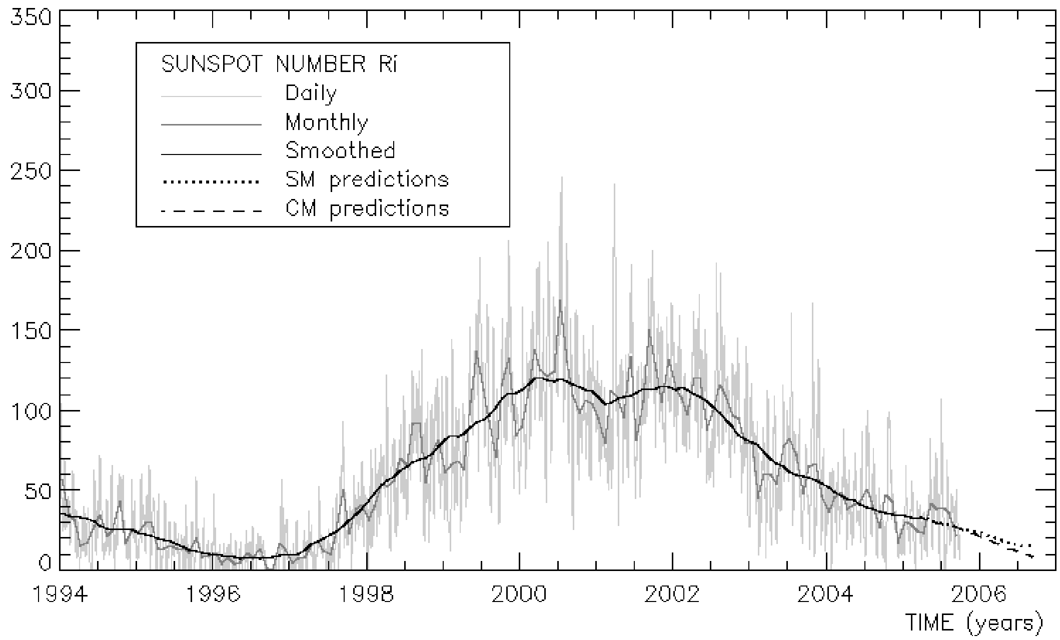
SUNSPOT BULLETIN

2005 n° 9

Provisional international and normalized hemispheric daily sunspot numbers for September 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	17	0	17
2	14	0	14
3	9	0	9
4	9	0	9
5	8	0	8
6	8	0	8
7	14	7	7
8	20	8	12
9	28	7	21
10	35	8	27
11	34	7	27
12	37	0	37
13	50	7	43
14	44	0	44
15	39	0	39
16	33	0	33
17	35	8	27
18	33	12	21
19	26	13	13
20	18	18	0
21	13	13	0
22	14	14	0
23	19	19	0
24	17	9	8
25	16	8	8
26	22	15	7
27	16	8	8
28	15	8	7
29	14	7	7
30	7	0	7
Monthly mean	**22.1**	**6.5**	**15.6**
Cooperating stations	**47**	**42**	**42**



Predictions of the monthly smoothed Sunspot Number
using the last provisional value, calculated for March 2005 : 33.5 (± 5%)

		SM	CM			SM	CM			SM	CM
2005	Apr	32	33	2005	Oct	30	26	2006	Apr	23	16
	May	33	32		Nov	29	25		May	22	14
	Jun	34	30		Dec	28	23		Jun	21	13
	Jul	33	29	2006	Jan	27	21		Jul	20	12
	Aug	32	28		Feb	26	20		Aug	19	11
	Sep	31	27		Mar	25	18		Sep	18	9

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, October 1, 2005 09:14 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	29	32	-	84	897	0	0/0	42	
1	17	15	-	79	906	0	0/0	14	
2	14	13	-	77	900	0	0/0	44	
3	9	12	-	74	892	0	0/0	23	
4	9	8	-	75	891	0	0/0	24	
5	8	6	-	75	896	0	0/0	14	
6	8	3	-	83	897	0	0/0	12	
7	14	3	-	100	893	100	0/1	10	
8	20	13	-	94	906	102	2/1	8	
9	28	93	-	99	902	222	5/3	15	
10	35	93	-	100	886	153	3/2	28	
11	34	137	-	110	781	16	3/0	73	
12	37	172	-	118	////	121	4/0	60	
13	50	177	-	114	729	118	1/2	31	
14	44	186	-	117	794	7	1/0	18	
15	39	171	-	119	794	109	2/1	42	
16	33	107	-	112	806	23	3/0	21	
17	35	57	-	104	822	104	1/0	14	
18	33	35	-	102	850	1	0/0	10	
19	26	23	-	91	859	0	0/0	7	
20	18	27	-	88	871	0	0/0	6	
21	13	33	-	86	879	0	0/0	3	
22	14	39	-	84	922	0	0/0	6	
23	19	44	-	83	////	1	0/0	8	
24	17	40	-	81	888	0	0/0	3	
25	16	27	-	81	891	0	0/0	6	
26	22	22	-	81	891	0	0/0	18	
27	16	19	-	77	896	0	0/0	14	
28	15	11	-	75	898	0	0/0	10	
29	14	5	-	74	892	0	0/0	8	
30	7	5	-	72	897	0	0/0	(15)	

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 SEPTEMBER 2005

DATE	UT	NUMBER OF GROUPS	NUMBER OF SPOTS	RELATIVE SUNSPOT NUMBERS TOTAL	NORTH	SOUTH	CENTRAL	PPSI 10-5 WM-2	QUAL	OBS
2	815	1	8	18	0	18	18	5.9	4	OB
4	1414	1	4	14	0	14	14	5.0	2	EP
5	1415	1	3	13	0	13	0	4.0	3	OB
6	1350	1	3	13	0	13	0	2.8	3	OB
7	1143	1	1	11	0	11	0	1.8	3	JD
8	1152	2	10	30	11	19	0	9.7	3	JD
10	930	2	23	43	11	32	0	50.0	2	GL
13	715	3	97	127	23	104	127	92.3	4	OB
14	715	1	88	98	0	98	98	95.3	4	OB
16	1135	1	57	67	0	67	0	75.2	3	OB
17	925	2	35	55	11	44	0	42.6	2	FC
18	820	3	42	72	33	39	14	33.6	2	AZ
19	720	2	21	41	24	17	0	9.2	3	OB
20	655	2	10	30	19	11	0	7.5	3	FC
21	1215	1	18	28	28	0	28	5.5	3	OB
22	650	1	15	25	25	0	25	6.0	4	OB
23	815	1	10	20	20	0	20	6.3	4	OB
24	1130	2	5	25	13	12	13	6.1	2	GL
25	1020	2	4	24	12	12	12	5.4	2	GL
26	820	3	6	36	24	12	12	5.8	2	FC
27	745	2	3	23	11	12	12	4.4	4	OB
28	1225	2	3	23	11	12	12	2.1	4	OB
29	700	2	2	22	11	11	11	1.4	4	OB

The relative mean sunspot number is 37.3.

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

K'= 0.844 (*)

1	***	7	9	13	107	19	35	25	20
2	15	8	25	14	83	20	25	26	30
3	***	9	***	15	***	21	24	27	19
4	12	10	36	16	57	22	21	28	19
5	11	11	***	17	46	23	17	29	19
6	11	12	***	18	61	24	21	30	***

The normalised relative monthly mean sunspot number is 31.

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

The Sun has been observed 23 days on 30 possible.

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

Uccle Nø	East Limb Date	Date and type 1st obs	CMP	Last obs	West Limb Date
13-2033	8 26.6	28 C	9 2.3	7 C	9 9.1
2-2034	9 7.2	8 E	9 13.9	18 E	9 20.7

PROBABLE RETURN OF MAJOR GROUPS FOR OCTOBER 2005

Nø	New East Limb	New CMP	New West Limb
2	10 4.8	10 11.5	10 18.3

MONTHLY SUMMARY OF SOLAR AND GEOMAGNETIC ACTIVITY

I. Solar Activity

This month was certainly a month to remember. The cause was the extreme activity of Catania sunspot group 37 (NOAA 0808). This group conquered a place in the annals and the ranking of the strongest flares ever recorded by. It dominates the noticeable events list of Sep 2005 completely.

The lifecycle of this sunspot group started last month when Catania sunspot group 24 (NOAA 0798) produced M2.6 and M5.6 flares on Aug 22 and an M2.7 on Aug 23 before rotating off the West limb. These 3 major events all had halo CMEs associated with them causing large geomagnetic disturbances. This group continued to be in overdrive on the backside of the solar disk producing several backsided halo CMEs. A halo CME was observed by LASCO, leaving the C2 occulter at 11h30UT on Sep 1. On the same day, just before midnight, LASCO and EIT observed another (full) halo event. Some part of this complex event might have been frontsided, but it was predominantly backsided. A third halo CME appeared from below the C2 occulter on Sep 3 around 03UT and was probably backsided, although no EIT imaging is available due to CCD bake-out.

At last, the group probably responsible for this backsided activity appeared at the east limb. On Sep 5, a long duration C-flare was recorded by GOES. SXI showed nice and big post-flare loops from behind the east limb of the Sun. A CME was associated with this event. On Sep 6, a long duration M1.4 flare peaking at 22:02UT was recorded. The source region was still located beyond the east limb. Finally, on Sep 7, the group became visible: old Catania sunspot group 24 returned as Catania 37 (NOAA 0808) after it gained strength on its trip on the backside of the Sun. As the group approached the visible side of the Sun, the background X-radiation increased stepwise with the same time cadence as the flares occurred.

The group proved immediately to be no softy: an **X17** flare was measured by GOES on Sep 7, peaking at 17:40UT. This flare level X17 is just a little lower then the saturation level of the detector. That this is serious becomes clear looking at the ranking of X-radiation flares since 1976 made by IPS (RWC Australia): this flare takes the fourth place. The 10cm flux caused by this outburst was measured to be 27.000 sfu! *(The 10 cm flux is a full-disc measurement which means that all radiation with a wavelength of 10 cm from the whole visible solar surface is counted.)* For comparison: the background 10cm flux on Sept 7 was 92 sfu. A type II outburst was also detected, indicating the presence of a **CME**. Unfortunately, LASCO and EIT were not available and no estimates could be made of the speed and strength of the associated CME. Due to the position of the sunspot group at that moment, we knew that it was mainly east-directed.

The group continued on Sep 8 with two M2.1 flares and a X5.4 flare (with a 10cm flux output of 990 sfu). On Sept 9 followed 5 M-flares, an X1.1 flare, an X3.6 flare (10cm flux of 270 sfu) and at the end of the day an **X6.2** flare (10cm flux of 4200 sfu), peaking at 20:04UT. This flare was important since a strong **CME** was associated with it. On Sep 10, we had 3 M-flares, an X1.1 flare (10cm flux of 600 sfu) and an **X2.1** flare (10cm flux of 1600 sfu) with an associated **CME**. On Sep 11, the group was responsible for at least 2 M-flares. The **M3.0** flare peaking at 13:12UT had an associated **CME** coming out of the FOV of C2 at 13:00UT. On Sep 12, 4 M-flares were measured by GOES. The background X-radiation, which was located in the C-band before Sep 12, showed a decreasing trend. Despite this steady decreasing background radiation, we could witness a triple X-flare late on Sep 13! The X-radiation curve had three peaks close together: an X1.5, an X1.4 and an X1.7 peaking at 19:27UT, 20:04UT and 23:22UT respectively. A CME was associated with this event, and since the group was that moment located at central meridian, this led to a nice full halo CME.

The group stayed active and produced at least 5 more M-flares (one was a M9.8, Sep 17) and an X1.1 flare. Then this turbulent group started to decay as the background of the X-radiation decreased to the lower part of the B-band. It rotated over the west limb on Sep 22. Accordingly, the background X-ray flux decreased down to the A-level. A lowest level was reached on Sept 28-29 when the curve was mostly straight around A1.

On Sep 17 and Sep 24 respectively, two other active regions appeared on the east limb: Catania 40/NOAA 0810 and Catania 44/NOAA 0812. They stayed present until the end of the month. Both small groups remained stable or decayed steadily.

Together with all this flaring activity from the source group 37/0808, elevated **proton flux** levels were measured at the L1 point. All curves, except >100 MeV passed the threshold. We list for each day, the possible causes of the increase/decrease of the proton flux.

- A first increase was seen late **Sep 7**. The flux increase was mainly initiated by a CME as the form of the curve shows. The curve increased gradually. If the protons were accelerated by the flare itself, the curve would be very steep. The cause was the ejection of the **CME associated with the X17** flare. Early Sep 8, the >10MeV curve passed the threshold.
- The >50MeV curve passed the threshold around 15UT, **Sep 8**. The wobbling part of the curve is possibly related with the **M- and X-flaring activity** of that time. Both curves, >10, 50 MeV, continued to increase as the protons were still accelerated by the shock front of the CME linked with the X17 flare.
- All three curves (>10, 50, 100 MeV) got a boost up on **Sep 9**, from 15UT onwards: extra acceleration was provided by the **CME associated with the X6.2** flare.
- The passage of the CME associated with the X17 at the L1 point around 13:15UT on Sept 9, was not visible in the curves of the proton flux: no clear decrease was seen.
- Early on **Sep 10**, the curves >50, 100 MeV started to decrease steadily as the CME shock fronts were not able to accelerate them further. The >10 MeV protons stayed at the same level.
- Early on **Sep 11**, the **X2.1 flare and associated CME** of that day, pushed the >10 MeV curve up for a short period. As the **CME linked with the X6.2 flare of Sep 9 and the CME linked with the X2.1 flare of Sep 10** passed the L1 point on Sep 11, 01UT and Sep 12, 06UT respectively, all curves started to decrease more rapidly. The >50 MeV curve dropped below the threshold on Sep 11, around 06UT, while the >10 MeV curve passed did so only late Sep 12.
- The >10,>50 MeV fluxes were pushed up once again late **Sep 13**. The protons were accelerated by the CME shock front related with the triple X-flare. But only the >10 MeV curve passed the threshold, around midnight.
- From mid Sep 15, both curves started to decrease as this CME shock front passed L1.

The proton event ended early Sep 16. On Sep 17, just after the flux of the >10MeV protons reached again the normal level, the M9.8 flare was responsible for another increase. But the extra input of energy was not strong enough to trigger a proton event. The >10MeV proton fluxes were very slightly elevated on Sep 18, 19 and 20 following the proton events of the previous week, though nowhere close to storm levels. All proton fluxes thereafter remained nominal for the duration of the month.

II. Geomagnetic Activity

Catania sunspot group 37 (NOAA 0808) was violent enough to cause extreme geomagnetic disturbances for the first half of the month. The successive arrivals of CME shock fronts bombarded the geomagnetic field continuously in a violent way. From the moment the source region rotated over the west limb, geomagnetic conditions became again quiet.

Geomagnetic conditions were completely determined by the arrival of the halo CMEs associated with the large flares of this week.
To resume, 6 CMEs were detected:

1. On Sep 7, associated with the X17 flare. No LASCO images were available.
2. On Sep 9, associated with the X6.2 flare. First visible in LASCO/C2 at 19:48UT.
3. On Sep 10, associated with the X2.1 flare. First visible in LASCO/C2 at 21:52UT.
4. On Sep 11, associated with the M3.0 flare. First visible in LASCO/C2 at 13:00UT.
5. On Sep 13, associated with the triple X-flare. First visible in LASCO/C2 at 20:00UT. CACTus measured a plane-of-sky-speed of 1453 km/s.
6. On Sep 28, first visible in LASCO/C2 at 01:54UT. Based on EIT imagery, this semi-halo event appeared to be backsided. It is possible that 37/0808 was responsible for this event. The group was at that moment located on the backside.

Clear shocks were seen in different physical quantities measured by ACE at the L1 point. The numbers of the list coincide with the numbers of the list above.

1. On Sep 9, around 13:15UT. The solar wind speed jumped from 350 to 500 km/s, the IMF field strength became 20nT (maximum value), Bz went down to -10nT.
2. On Sep 11, a shock passed just before 01 UT. The IMF field strength increased to 30nT with a significant southward component. Since the ACE plasma channels were affected by the ongoing proton storm, the speed cannot be given.
3. On Sep 12, around 6UT: the total IMF jumped from 6 to 10nT, the Bz went down to -10nT, solar wind speed increased from 700 to 1000 km/s.
4. On Sep 13, around 9UT: the total IMF jumped from 6 to 10nT, Bz decreased to -10nT, the solar wind speed increased from 700 to 760 km/s.
5. On Sep 15, around 08:30UT: solar wind speed jumped from 550 to 650 km/s, Bz became -7nT, the total IMF went up to 10nT. A few hours later, the total IMF became +20nT and the solar wind speed peaked at 900 km/s.

Geomagnetic consequences were large. As the energy carried by the CMEs cumulated, the earth magnetic field was disturbed in an extreme way and K(p) reached high values. Related to the arrivals of the CME shock fronts, we list in a similar structure the geomagnetic consequences:

1. The Kp index estimated by NOAA/SEC (Boulder), increased to 4 on Sep 9 and 5 on Sep 10 as a consequence of the glancing blow of the CME associated with the X17 flare.
2. On Sep 11, Kp peaked to 9 as the geomagnetic field was disturbed further by the arrival of the CME associated with the X6.2 flare.
3. In the declining phase of the passage of previous CMEs, the geomagnetic storm got a boost at the arrival of a shock front on Sep 12: the planetary K index as estimated by Boulder stayed most of the time 6.
4. The major storm of the previous day continued until midday on Sep 13 as a shock related with the CME of Sep 11 arrived. On Sep 14, a minor storm was going on.
5. Sep 15, Kp became 7 as consequence of the disturbances induced by the arrival of the full halo CME of Sep 13. The storm peaked on Sep 15 and faded away as Kp became 4 on Sep 16.

From Sep 19, geomagnetic activity was low. The IMF Bz suddenly dropped to ~-10nT midway through Sep 25 but the excursion was short-lived and the solar wind speed slow, so geomagnetic conditions were not strongly affected: only Kp of 4 a few times until Sep 28. Late on Sep 30, the solar wind picked up speed, reaching a peak of 540 km/s on Oct 1. In response to this moderate-speed stream, the geomagnetic activity rose slightly from Sept 30 until Oct 2.

III. Noticeable solar events

DAY	BEGIN	MAX	END	LOC	XRAY	OP	10CM	RADIO TYPE	Cat	NOAA	NOTE
17	0558	0605	0615	S10W39	M9.8	2N	1000		37	0808	
16	1918	1936	1948	S11W37	M3.5	1F	100		37	0808	
16	1735	1748	1810	S11W33	M1.3	SF	26		37	0808	
16	0141	0149	0156	S13W26	M4.4	1B	220		37	0808	
15	1855	1910	1926	S11W19	M1.0	SF	190		37	0808	
15	0830	0838	0846	S12W14	X1.1	2N	450		37	0808	
15	0152	0212	0218	S11W08	M1.3	1F					
14	1005	1038	1054		M4.6		IV/2				
13	2315	2322	2330	S10E03	X1.7	1B	180		37	0808	
13	1944	2004	2042		X1.4			37 0808			
13	1919	1927	2057	S09E10	X1.5	2B	6000	V/2,III/2	37	0808	CME, proton event
13	1041	1121	1124		M1.3	120					
12	2005	2009	2011	S11E24	M1.5	1N	410		37	0808	
12	0837	0903	0920	S11E25	M6.1	2F	980		37	0808	
12	0656	0701	0705	S11E33	M1.3	1F	64		37	0808	
12	0449	0505	0527		M1.5	2005					
11	2029	2040	2049		M1.3		III/1 2005				
11	1244	1312	1353	S16E39	M3.0	1F	310		37	0808	CME
11	0229	0235	0240	S10E42	M3.4	1N		III/2,IV/2	37	0808	
10	2130	2211	2243	S13E47	X2.1	1600	II/1,IV/2		37	0808	CME, proton event
10	1910	1936	1950	S10E45	M4.1	1N	65		37	0808	
10	1634	1643	1651	S11E47	X1.1		600		37	0808	

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10 0859 0907 0931 S12E51 M1.9                          37 0808
10 0606 0614 0617 S11E51 M3.7 2N       III/2,CTM/1     37 0808
9  1913 2004 2036 S10E58 X6.2 2B  4200 II/2,IV/3       37 0808   CME, proton event
9  1732 1751 1810 S11E60 M1.9 SF                       37 0808
9  0942 0959 1008 S11E66 X3.6    270                   37 0808
9  0532 0548 0600 S13E71 M6.2 1F 200                   37 0808
9  0446 0503 0512 S10E67 M1.8 SF                       37 0808
9  0243 0300 0307 S12E68 X1.1                          37 0808
9  0233 0236 0239 S13E66 M1.1 2F                       37 0808
9  0208 0219 0229 S13E69 M1.0 SF                       37 0808
8  2052 2106 2117 S11E74 X5.4 2B 990   III/2,IV/1      37 0808
8  2023 2029 2041        M2.1                          37 0808
8  1649 1703 1711 S10E81 M2.1 SF                       37 0808
7  1717 1740 1803 S06E89 X17. 3B 27000 II/3,IV/2       37 0808   proton event, CME
6  1932 2202 0044        M1.4                                    beyond east limb
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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

IV. Halo CME list

onset time	e-mail time CACTus	da	e-mail time LASCO	e-mail time FF	Ass. Events	consequences
09/01 11:06	09/02 01:48	194	-	-	Filament eruption in SW at limb	Sept. 4, minor storm (?)
09/01 23:54	09/02 16 :39	232	09/02 15:30	09/03 23:17	B4.5+backsided	Sept. 4, minor storm (?)
09/03 03:24	09/03 07 :56	334	09/04 22:00	09/05 18:55	Backsided ?	-
09/05 09:48	09/05 15:24	320	09/06 12:04	09/05 20:58	LDE C2.7	Sept. 7, active intervals (?)
09/06 20 :00	-	-	-	09/07 17:08	LDE M1.4	?
	NO LASCO	-	NO LASCO	09/08 00:05	LDE X17.1	Sept. 9** 12 hrs active (Bz=-10 nT)
	NO LASCO	-	NO LASCO	09/09 02:54	LDE X5.4	Sept 10, minor storm
09/09 17:12	09/11 01:40	214	-	-	-	-
09/09 19:48	09/11 01:40	352	09/10 19:45	09/10 23:23	LDE X6.2	Sept. 11, severe storm (Bz=~-25 nT)
09/10 21:52	-	-	09/11 19:51	09/11 02:00	LDE X2.1	Sept. 12, major storm (Bz=-10 nT)
09/11 13:00	09/12 01:52	208	09/11 20:40	09/12 01:01	LDE M3.0	Sept. 13, major storm (Bz=-10 nT)
09/13 20:00	09/14 00:44	204	09/14 12:44	09/14 23:20	LDE X1.5	Sept. 15, major storm (Bz= -7 nT)
09/12 12:24	09/14 12:24	280	-	-	-	-
09/28 01:54	09/29 13:18	186	-	-	backsided	-

Onset time: Utime first visible in C2 field of view
CACTus: Computer Aided CME Tracking (software developed by the SIDC)
LASCO: SOHO-LASCO Operations, G. Stenborg

FF: Fearless Forecast (a NOAA trial service)
e-mail time CACTus/LASCO/FF: Utime alert e-mail sent by group
da: angular width of CME, measured by CACTus
Ass. Events: Associated Events, Long Duration Event, flare class