

## Center

*Data Analysis Service supported by the FAGS*

**SUNSPOT BULLETIN**

2010

n° 8

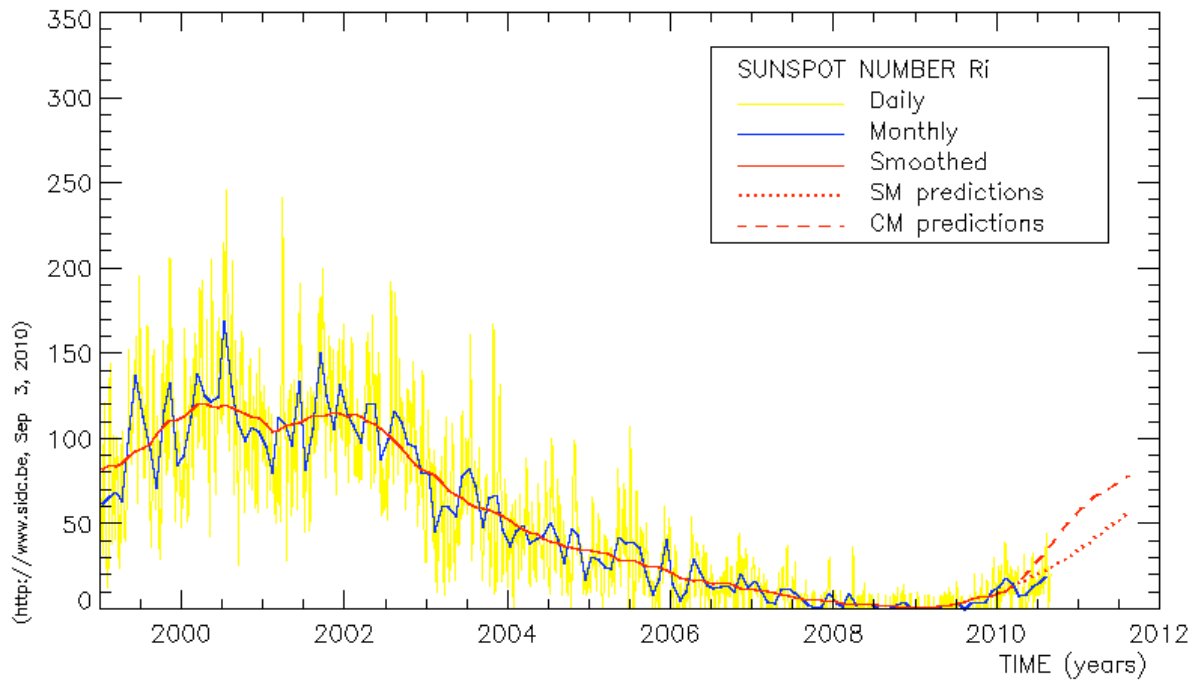
---

**Provisional international and normalized hemispheric daily sunspot numbers for August 2010**


---

computed at the *Royal Observatory of Belgium* 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	16	16	0
2	16	16	0
3	9	9	0
4	21	21	0
5	34	27	7
6	34	26	8
7	32	19	13
8	25	17	8
9	36	28	8
10	38	31	7
11	44	37	7
12	33	33	0
13	27	27	0
14	22	22	0
15	25	25	0
16	34	28	6
17	17	10	7
18	15	8	7
19	10	0	10
20	8	0	8
21	0	0	0
22	0	0	0
23	0	0	0
24	8	8	0
25	15	8	7
26	15	8	7
27	8	8	0
28	8	8	0
29	18	18	0
30	19	19	0
31	20	20	0
<b>Monthly mean</b>	<b>19.6</b>	<b>16.0</b>	<b>3.6</b>
<b>Cooperating stations</b>	<b>68</b>	<b>56</b>	<b>56</b>



**Predictions of the monthly smoothed Sunspot Number**  
using the last provisional value, calculated for February 2010: 10. ( $\pm 5\%$ )

		SM	CM		SM	CM		SM	CM		
2010	Mar	12	14	2010	Sep	20	40	2011	Mar	34	66
	Apr	14	17		Oct	22	46		Apr	36	68
	May	13	21		Nov	24	50		May	39	71
	Jun	15	25		Dec	26	55		Jun	42	73
	Jul	16	30	2011	Jan	29	59		Jul	45	75
	Aug	18	35		Feb	31	63		Aug	48	79

**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

Reproduction permitted if source mentioned.  
Ed. Ronald Van der Linden, Ass. Ed. Petra Vanlommel  
Editing contributions from various members of the SIDC team

Fax 32-(0)2-374 98 22 Tel 32-(0)2-373 04 91  
e-mail : [arille@oma.be](mailto:arille@oma.be), [ronald@oma.be](mailto:ronald@oma.be)  
ftp anonymous : [omaftp.oma.be](ftp://omaftp.oma.be), directory dist/astro/sidcdata  
<http://sidc.oma.be>

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

Date	R' <sub>i</sub>	PPSI	600	2800	COS	SFI	XI	Ak	SEA
31	17	28	-	82	////	1	0/0	7	
1	16	33	-	80	////	1	0/0	6	
2	16	40	-	79	////	0	0/0	7	
3	9	36	-	81	////	0	0/0	25	
4	21	36	-	81	////	0	0/0	47	
5	34	43	-	83	////	0	0/0	9	
6	34	42	-	82	////	0	0/0	8	
7	32	29	-	91	////	0	1/0	5	
8	25	32	-	83	////	0	0/0	6	
9	36	36	-	84	////	0	0/0	12	
10	38	37	-	84	////	0	0/0	8	
11	44	32	-	86	////	0	0/0	9	
12	33	28	-	84	////	0	0/0	6	
13	27	18	-	84	////	0	0/0	4	
14	22	20	-	85	////	5	0/0	4	
15	25	7	-	86	////	3	0/0	7	
16	34	10	-	85	////	1	0/0	8	
17	17	3	-	81	////	0	0/0	7	
18	15	2	-	81	////	0	0/0	5	
19	10	1	-	78	////	0	0/0	4	
20	8	1	-	77	////	0	0/0	4	
21	0	1	-	76	////	0	0/0	3	
22	0	0	-	75	////	0	0/0	2	
23	0	1	-	75	////	0	0/0	8	
24	8	0	-	74	////	0	0/0	22	
25	15	6	-	74	////	0	0/0	18	
26	15	11	-	73	////	1	0/0	12	
27	8	14	-	73	////	0	0/0	18	
28	8	14	-	72	////	0	0/0	8	
29	18	36	-	74	////	0	0/0	3	
30	19	32	-	75	////	0	0/0	1	
31	20	39	-	75	////	0	0/0	4	

- 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 2010

DATE	UT	NUMBER		RELATIVE SUNSPOT NUMBERS			PPSI 10-5 WM-2	QUAL	OBS	
		OF GROUPS	OF SPOTS	TOTAL	NORTH	SOUTH				CENTRAL
1	735	1	7	17	17	0	0	4.8	3	OL
2	710	1	11	21	21	0	21	5.6	2	OL
3	725	1	3	13	13	0	13	6.2	3	OL
4	1045	2	7	27	27	0	13	3.2	1	OL
5	705	3	13	43	43	0	11	7.1	4	OL
6	720	4	9	49	38	11	0	6.6	3	OL
7	1330	3	4	34	22	12	0	4.6	2	OL
8	1050	3	8	38	25	13	27	6.5	2	OL
9	705	4	12	52	41	11	41	6.3	3	SV
10	730	4	15	55	44	11	44	9.7	4	SV
11	905	5	14	64	53	11	12	4.8	3	SV
12	825	3	7	37	37	0	14	3.5	3	SV
13	615	2	11	31	31	0	14	10.3	3	SV
14	900	1	8	18	18	0	0	31.5	3	SV
17	715	2	6	26	15	11	0	1.1	3	AE
18	1045	2	2	22	11	11	0	0.4	2	AE
19	830	2	2	22	0	22	0	0.4	2	AE
20	800	1	1	11	0	11	0	0.3	2	AE
21	900	1	1	11	0	11	0	0.3	2	AE
22	900	0	0	0	0	0	0	0.0	2	AE
23	1300	0	0	0	0	0	0	0.0	2	OB
24	715	1	1	11	11	0	0	0.2	2	OB
25	730	1	1	11	11	0	0	0.5	3	OB
28	900	1	1	11	11	0	11	1.9	3	OB
30	815	2	5	25	25	0	25	3.7	3	OB
31	620	2	11	31	31	0	11	20.3	3	FC

The relative mean sunspot number is 26.2.

NORMALISED UCCLE OBSERVATIONAL SUNSPOT NUMBERS  $U'=K'U$  FOR AUGUST 2010

$K'= 0.747$  (\*)

1	13	7	25	13	23	19	16	25	8
2	16	8	28	14	13	20	8	26	***
3	10	9	39	15	***	21	8	27	***
4	20	10	41	16	***	22	0	28	8
5	32	11	48	17	19	23	0	29	***
6	37	12	28	18	16	24	8	30	19
								31	23

The normalised relative monthly mean sunspot number is 20.

(\*)  $K'$  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 2010  
 E AND F BRUNNER'S TYPE GROUPS

Uccle Nø	East Limb		Date and type			West Limb Date
	Date		1st obs	CMP	Last obs	
1-2100	8	3.4	4 C	8 10.1	14 E	8 16.9

PROBABLE RETURN OF MAJOR GROUPS FOR SEPTEMBER 2010

Nø	New East Limb	New CMP	New West Limb
1	8 30.6	9 6.3	9 13.1

## MONTHLY SUMMARY OF SOLAR AND GEOMAGNETIC ACTIVITY

### I. Solar Activity

*Solar activity is like expected for the time of the solar cycle: moderate with a tendency of slowly increasing activity. There was a peculiar event at the beginning of August: a series of moderate events cumulating to an energetic impact on Earth.*

On Aug 01, a series of solar events gave rise to a combination of Earth-directed halo CME's. We give a chronological overview and colour the numbers associated with one event. The movies can be found on <http://www.sidc.be/news/129/welcome.html>.

Aug 01, 2010

Nr	Time	Instrument	description
1.	02:59UT	SDO/AIA-193	a coronal dimming of small extent in NOAA AR 1092
2.	03:39UT	STEREOA/COR2	CME front coming from behind the occulted area directed to the upper left of the COR2 field of view (FOV). This CME is associated with event 1.
3.	05:29UT	STEREOA/HI1	CME front coming from behind the occulted area on the right directed to the left of the HI1 FOV. This is the same faint CME as in 2
4.	05:29UT	SDO/AIA-193	Start of rise of filament in the western hemisphere, near the North Pole, stretched from N60W0 to N30W50
5.	05:30UT	SDO/AIA-304	Start of rise of filament in the western hemisphere, near the North Pole, same as event 4.
6.	07:55UT	GOES-X-rays	Start of long duration C3.2 flare
7.	07:59UT	SDO/AIA-193	EUV-wave, seen as a running EUV intensity disturbance, and a coronal dimming, i.e. the evacuated plasma leaves a black gap in EUV-images, around NOAA AR 1092
8.	08:24UT	STEREO/COR2	CME front coming from behind the occulted area in the upper left of the COR2 FOV, associated with 6. <b>This is a halo CME.</b>
9.	08:26UT	GOES-X-rays	peak of C3.2 flare
10.	09:30UT	SDO/AIA-304	Polar filament, mentioned in event 5 lift off
11.	09:54UT	STEREOA/COR2	CME front coming from behind the occulted area directed to the upper left of the COR2 FOV, this CME has a smaller angular extent compared to the CME mentioned in 7. <b>This is a halo CME</b> associated with the polar filament mentioned in 10.
12.	09:59UT	SDO/AIA-193	Start of rise of post-flare loops in NOAA AR 1092
13.	10:09UT	STEREOA/HI1	CME front coming from behind the occulted area on the right directed to the left of the HI1 FOV. This is the same CME as in 8
14.	10:14UT	SDO/AIA-193	Start of rise of magnetic arcade at the position of the filament mentioned in 4.
15.	10:30UT	SDO/AIA-304	Start of rise of a filament at the same position of the filament mentioned in 5.
16.	11:15UT	SDO/AIA-304	Last SDO/AIA-304 image of the filament mentioned in 15.
17.	13:29UT	STEREOA/HI1	CME front coming from behind the occulted area on the right directed to the left of the HI1 FOV. This is the same CME as in 11
18.	13:59UT	SDO/AIA-193	Start of the slow rise of the filament at the lower base of the filament arcade mentioned in 12. This filament is situated at +/- the same latitude as NOAA AR 1092: N35W0.
19.	14:45UT	SDO/AIA-304	Start of the slow rise of the filament, same as in 18.

20.	16:29UT	SDO/AIA-193	Coronal dimming at N20W50
21.	17:09UT	STEREOA/COR2	CME front coming from behind the occulted area in the upper left of the COR2 FOV, possibly linked with 20
22.	20:09UT	STEREOA/HI1	CME front coming from behind the occulted area on the right directed to the left of the HI1 FOV. This is the same CME as in 21
23.	20:44UT	SDO/AIA-193	Last SDO/AIA-193 image of the filament mentioned in 18.
24.	22:00UT	SDO/AIA-304	Filament mentioned in 16, large on disk arcade, ready to lift off.
25.	22:24UT	STEREOA/COR2	CME front coming from behind the occulted area directed to the upper right of the COR2 FOV. This CME is ejected backwards seen from the Earth which is located to the left of the COR2 images. This is the filament mentioned in 23 and 24
26.	22:09UT	STEREOA/HI2	CME front coming from behind the occulted area on the right directed to the left of the HI2 FOV. This is the same CME as in 13. The CME front 17 cannot be clearly distinguished.

Events Nr 7 and 10 of the list were important for space weather: two Earth directed CMEs that possibly can enhance each other.

From Aug 03 till 04, a weak proton event occurred. This event had nothing to do with the series of plasma explosions on Aug 01. The source region, probably located to the north-west of NOAA AR 1092/Catania 09, was magnetically connected with the Earth.

The next noticeable event was an M1 flare on Aug 07 from NOAA AR 1093/Catania 12. At the same time, an EUV coronal wave and a coronal dimming occurred. The EUV wave visible in SDO/AIA-193 is rather a spectacular one involving almost the whole solar disk. A metric type II burst, another indication of the presence of a CME, was measured by the Humain radio station. Since the AR was located in the eastern hemisphere, the CME was not ejected in the direction of the Earth.

The same sunspot group was responsible for a C4.4 flare on Aug 14. The flare itself is not really a noticeable event, but the event was associated with a EUV-coronal wave. In SDO/AIA-193, a limb disturbance is visible: the magnetic field lines wiggle when a disturbance passes. The associated CME was nicely captured by STEREOA/COR2 as a halo around the occulted area. This means that the CME was not ejected in the direction of the Earth but straight to STEREOA. The event was also associated with a proton enhancement, however not passing the threshold level.

On Aug 15, a filament eruption took place in the NW part of the solar hemisphere. From Kanzelhoehe H-alpha images, it is clear that a filament disappeared in between Aug 14, 07:03UT and Aug 15, 09:15UT. This CME was ejected towards the west and was not geo-effective.

The last event worth mentioning is the long duration C4.5 flare on Aug 18. The source region, NOAA AR 1098/Catania 18 was at that moment located on the west limb. The associated CME was directed to the west viewed from Earth. We were, however, magnetically connected: the solar proton flux at Earth increased, but did not pass the event threshold.

We identified on SDO/AIA-193 3 coronal holes (CH):

- in the southern hemisphere reaching the central meridian (CM) on Aug 05,
- a very small one in the southern hemisphere, at the CM on Aug 11,
- a strong northern hemispheric CH, reaching the CM on Aug 21.

## **II. Geomagnetic Activity**

*Three periods of geomagnetic disturbances were measured in August. One of them was caused by the arrival of a CME, the other two by a coronal hole.*

The Aug 01 event triggered two Earth directed CMEs. In the coronagraph STEREOA/HI1 it is clear that the second CME follows the first CME very closely. One could even argue that there is only one CME: the second one overtook the first one. This is called CME cannibalism. The plasma structure

can be followed in STEREOA/HI2 up to the arrival of a first shock at Earth on Aug 03 just before 17:00UT. This shock arrival is detected by ACE and is visible in all solar wind parameters as a sudden jump. A second structure passed ACE on Aug 04 around 10:00UT. The signature of the magnetic structure in ACE data is however weak. This structure could be eventually brought back to the second CME. The arrival of the CME's on Aug 03 (and 04), triggered a minor storm (Kp=6) and active conditions lasting up to Aug 05.

The influence of the first two CHs of previous section was limited: one period with Kp=4 was measured on Aug 09. The very thin CH had almost no influence because of the limited longitudinal extent.

The co-rotating interaction region linked with the third CH mentioned in the previous section arrived on Aug 23. The compressed region and the fast solar wind emanating from the coronal hole caused active to minor storm conditions while flowing over the Earth's magnetosphere from late Aug 23 to Aug 27.

### **III. Noticeable solar events**

DAY	BEGIN	MAX	END	LOC	XRAY	OP	TENCM	TYPE	Cat	NOAA	NOTE
07	1755	1824	1847	N11E34	M1.0	2F	100	II/2	12	1093	

**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