Solar Influences Data analysis Center

Data Analysis Service supported by the FAGS

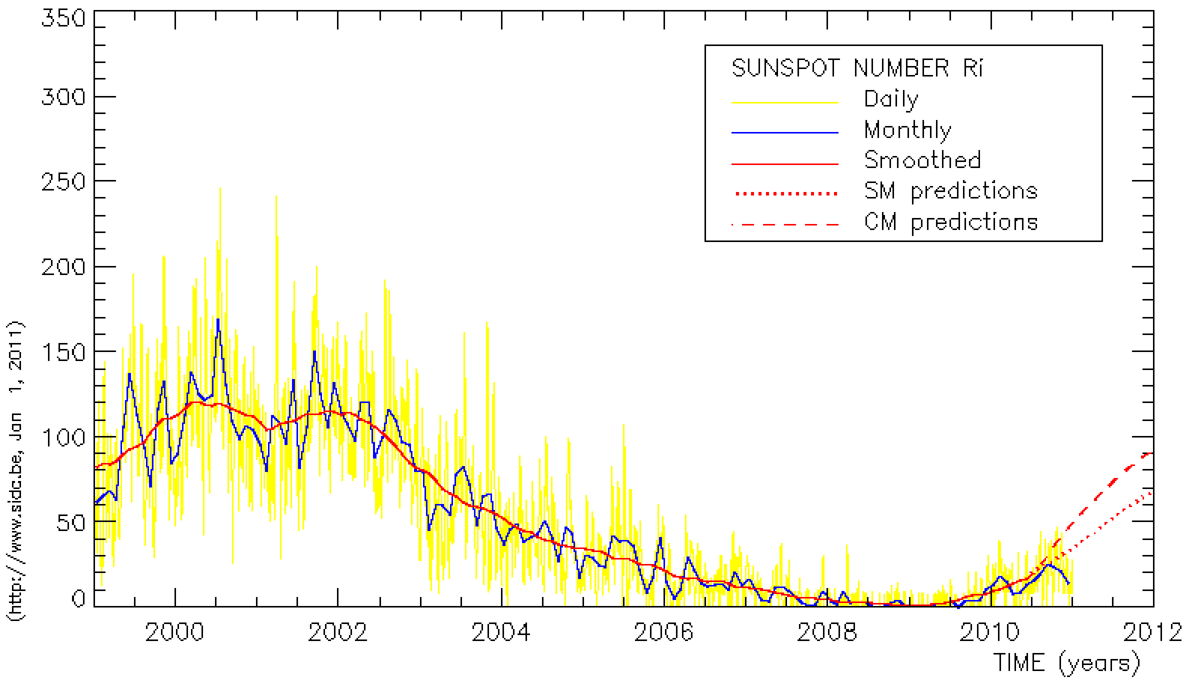
SUNSPOT BULLETIN

2011 n° 1

Provisional international and normalized hemispheric daily sunspot numbers for January 2011

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	37	22	15
2	33	17	16
3	32	19	13
4	33	17	16
5	25	10	15
6	19	7	12
7	24	8	16
8	17	8	9
9	22	15	7
10	18	18	0
11	17	17	0
12	15	15	0
13	9	9	0
14	0	0	0
15	8	8	0
16	14	14	0
17	19	11	8
18	22	13	9
19	18	10	8
20	20	12	8
21	23	23	0
22	22	22	0
23	23	23	0
24	20	20	0
25	21	21	0
26	17	17	0
27	14	14	0
28	9	0	9
29	10	0	10
30	13	0	13
31	14	0	14
Monthly mean	**19.0**	**12.6**	**6.4**
Cooperating stations	**66**	**61**	**61**



Predictions of the monthly smoothed Sunspot Number
using the last provisional value, calculated for July 2010: 16. (± 5%)

	SM	CM		SM	CM		SM	CM
2010 Aug	17	21	2011 Feb	29	53	2011 Aug	45	79
Sep	18	27	Mar	31	57	Sep	48	82
Oct	20	33	Apr	34	61	Oct	51	85
Nov	22	38	May	37	66	Nov	54	88
Dec	24	43	Jun	40	70	Dec	57	91
2011 Jan	27	48	Jul	42	74	2012 Jan	59	93

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

Ed. Ronald Van der Linden, Ass. Ed. Petra Vanlommel
Editing contributions from various members of the SIDC team

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	27	8	-	91	////	0	0/0	4	
1	37	27	-	91	////	1	0/0	6	
2	33	28	-	91	////	0	0/0	6	
3	32	40	-	92	////	1	0/0	7	
4	33	33	-	91	////	0	0/0	7	
5	25	27	-	88	////	0	0/0	3	
6	19	37	-	87	////	0	0/0	9	
7	24	24	-	86	////	0	0/0	18	
8	17	23	-	85	////	0	0/0	10	
9	22	15	-	83	////	0	0/0	8	
10	18	6	-	83	////	0	0/0	8	
11	17	8	-	83	////	0	0/0	12	
12	15	3	-	80	////	0	0/0	7	
13	9	2	-	80	////	0	0/0	12	
14	0	///	-	79	////	0	0/0	16	
15	8	1	-	80	////	0	0/0	4	
16	14	3	-	80	////	0	0/0	6	
17	19	10	-	82	////	0	0/0	8	
18	22	17	-	81	////	0	0/0	6	
19	18	17	-	81	////	0	0/0	9	
20	20	19	-	82	////	0	0/0	8	
21	23	20	-	88	////	3	0/0	5	
22	22	36	-	88	////	0	0/0	4	
23	23	36	-	84	////	0	0/0	2	
24	20	30	-	83	////	0	0/0	9	
25	21	19	-	81	////	0	0/0	8	
26	17	13	-	80	////	1	0/0	5	
27	14	1	-	81	////	0	0/0	3	
28	9	1	-	81	////	2	1/0	6	
29	10	4	-	81	////	1	0/0	5	
30	13	5	-	83	////	0	0/0	1	
31	14	12	-	81	////	0	0/0	6	

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 2011

DATE	UT	NUMBER OF GROUPS	NUMBER OF SPOTS	RELATIVE SUNSPOT NUMBERS TOTAL	NORTH	SOUTH	CENTRAL	PPSI 10-5 WM-2	QUAL	OBS
2	1330	4	13	53	25	28	28	24.5	2	AE
4	1000	2	11	31	11	20	20	3.1	1	OB
5	930	2	7	27	11	16	16	3.2	2	OB
9	1030	3	5	35	24	11	0	1.6	2	OB
10	930	3	4	34	34	0	0	1.2	3	AE
16	1200	1	1	11	11	0	0	0.6	1	AE
20	1015	1	6	16	16	0	0	4.8	1	SV
21	1340	2	11	31	31	0	31	7.5	2	SV
26	1315	2	5	25	25	0	0	1.0	2	OL
27	1300	3	3	33	33	0	0	0.6	1	OL
28	900	1	2	12	0	12	0	0.1	2	OL
29	1333	1	3	13	0	13	0	0.7	3	OL
30	1100	1	7	17	0	17	0	0.9	2	OL
31	1230	1	4	14	0	14	0	17.9	2	OB

The relative mean sunspot number is 25.1.

NORMALISED UCCLE OBSERVATIONAL SUNSPOT NUMBERS U'=K'U FOR JANUARY 2011

K'= 0.882 (*)

1	***	7	***	13	***	19	***	25	***
2	47	8	***	14	***	20	14	26	22
3	***	9	31	15	***	21	27	27	29
4	27	10	30	16	10	22	***	28	11
5	24	11	***	17	***	23	***	29	11
6	***	12	***	18	***	24	***	30	15
								31	12

The normalised relative monthly mean sunspot number is 22.

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

The Sun has been observed 14 days on 31 possible.

UCCLE OBSERVATIONAL MAJOR SUNSPOT GROUPS FOR JANUARY 2011
E AND F BRUNNER'S TYPE GROUPS

NONE

PROBABLE RETURN OF MAJOR GROUPS FOR FEBRUARY 2011
NONE

MONTHLY SUMMARY OF SOLAR AND GEOMAGNETIC ACTIVITY

I. Solar Activity

Catania sunspot group 98/ NOAA active region 1147 next to Cat 01/AR 1149 dominated the eruptions of this month.

On Jan 13 and 14, two long duration flares took place. The first flare was in the B-level, while the second one reached the C-level. Cat 98/AR 1147 was the source region. Only on Jan 15, it was recognized as an on-disk sunspot. From Jan 16, the sunspot got also a NOAA AR label. Besides the two flares mentioned, this active region produced two more C-flares on Jan 14 and 15. The flaring activity of that sunspot was associated with 3 partial/full halo CMEs from the viewpoint of STEREO A/B. The COR2 instrument captured the series of halo CMEs on Jan 12, 13 and 14. There was no impact for Earth due to these CMEs.

On Jan 21, a bi-polar sunspot group was born in the vicinity of Cat 98/AR 1147, at that moment near the central meridian (CM). This group increased the magnetic complexity. The structure became instable especially during the rising phase of the group. The result was a series of C-flares on Jan 21-22, Jan 24 and Jan 27-28. From Jan 23 to Jan 26, STEREO A-B/COR2 recorded daily CMEs. The strongest energy release took place on Jan 28: an M1.3 flare peaking at 01:03UT, associated with a CME and an increase of the proton flux. The group was at that moment at the very west of the solar disk. The CME was seen as a near full halo CME by STEREO A-B/COR2. The type II emission of the event is not in the list of the radio burst recorded at Humain, see IV since it occurred during the night when the dishes receive no solar radiation.

Three coronal holes exerting an influence on the Earth passed over the solar disk. A first northern CH in two parts reached the CM on Jan 02. The second CH was located in the northern hemisphere and reached the CM on Jan 10. Several small equatorial dark regions are present near the CM in the period between Jan 24 and Jan 27. A very large well-defined northern coronal hole touched the CM on Jan 30.

II. Geomagnetic Activity

We had a mixture of two sorts of geomagnetic influences: fast solar wind linked with a coronal hole and CME-arrival. The geomagnetic disturbances were limited in size and time.

Looking at the solar wind speed curve of ACE, we can distinguish 3 intervals with a typical CH signature. The first co-rotating interaction region arrived late on Jan 06. This structure had a strong magnetic field imbedded. Bt rose above 10 nT. Due to a strong negative Bz during the remaining hours, Kp became once 5 and once 4. Once the CIR had passed, the solar wind speed increased up to above 600 km/s, but the magnetic field imbedded in this fast solar wind was only moderate resulting in unsettled to quiet conditions.
On Jan 13, another increase of the solar wind speed was measured by ACE. The geomagnetic response was limited: only unsettled conditions were seen.
On Jan 31, the CIR of the last mentioned CH arrived. The magnetic field of the Earth responded to this arrival on Feb 01 with one period of active conditions.

III. Noticeable solar events

DAY	BEGIN	MAX	END	LOC	XRAY	OP	TENCM	TYPE	Cat	NOAA	NOTE
28	0044	0103	0110		M1.3			III/1,II/1	69 01	1149	CME

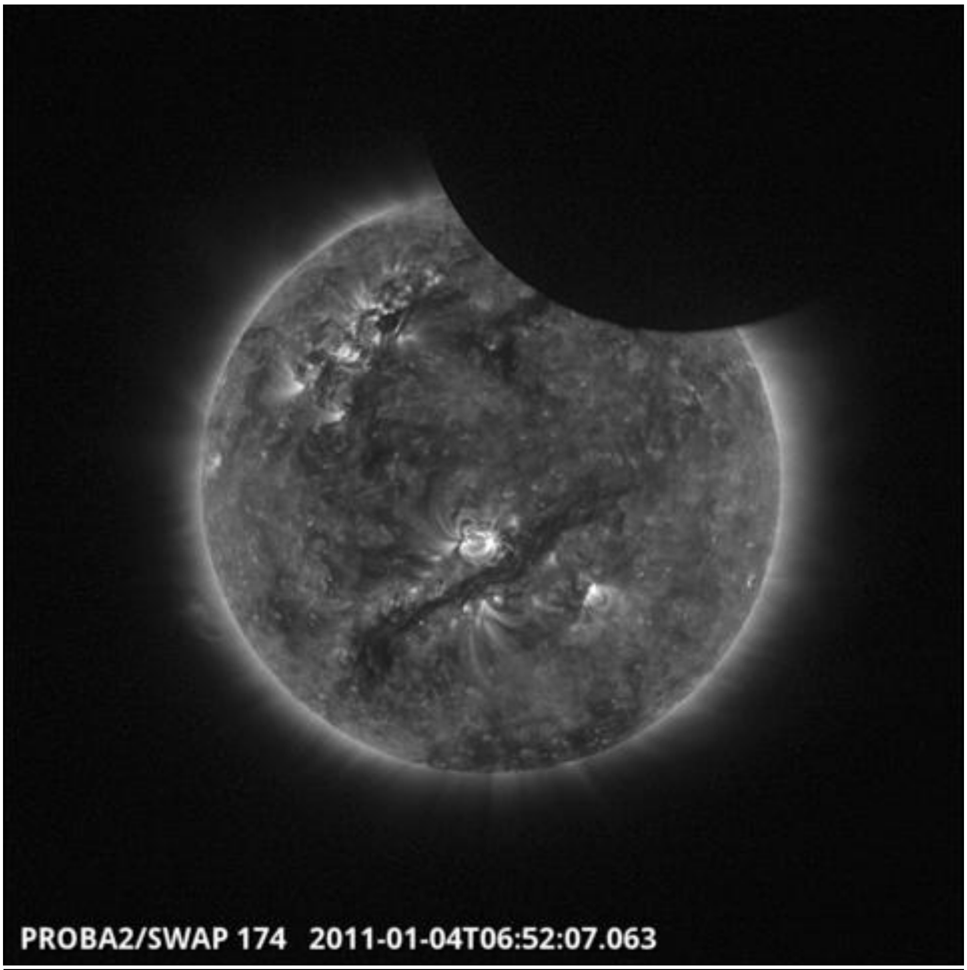
LOC: approximate heliographic location
XRAY: X-ray flare class
OP: optical flare class
10CM: peak 10 cm radio flux
RADIO TYPE: radio burst type
Cat: Catania sunspot group number
NOAA: NOAA active region number
NOTES: **p** = proton event
CME = coronal mass ejection

IV. Noticeable radio bursts in Humain

DAY	BEGIN	END	TYPE	DESCRIPTION	BRIGHTNESS	START FREQ	STOP FREQ
16	14:52:22	14:52:49	III	G	3	80	45X
21	10:49:25	10:52:53	III	GG	3	80	45X
21	11:12:26	11:12:47	III	G	3	80	45X
22	08:03:46	08:45:56	III	GG, N	3	80	45X
24	11:20:48	11:21:00	III	B	3	80	47
25	10:55:11	10:56:50	III	G	3	80	45X
25	11:51:47	11:53:02	III	G	3	172	45X
26	10:43:38	10:43:59	III	G	3	80	46
26	14:58:17	14:59:23	III	G, U	3	79	45X
26	15:13:10	15:13:21	III	B	3	80	45X
27	08:46:03	08:51:02	III	G, N	3	255	45X
27	12:08:43	12:20:06	II		3	80	45X
29	08:14:41	08:15:52	III	G	3	79	45X

Explanations: times are in UT. G and GG mean respectively group of less and more than 10 type III bursts; N means sporadic occurrence; B means single burst; U means type U burst. Frequencies are expressed in MHz. An X in the frequency column means that the burst extends beyond the frequency range of the instrument. Only the brightest bursts (brightness of 3) or the ones significant for space weather are reported.

V. News: Sun, Moon, Earth line up for PROBA2



ESA's PROBA2 microsatellite experienced a remarkable conjunction of the spheres on January 4, 2011. The Sun, Moon and Earth lined up in front of the satellite, in a real-life version of the opening of science fiction classic 2001.

The Moon partially blocked PROBA2's view of the Sun, causing a partial eclipse as observed from the Sun-watching satellite. At the same time PROBA2 was flying into the shadow of the Earth, causing it to see a sunset. At that point the Sun, Moon, Earth and PROBA2 were all on the same line in space.

'This is a spectacular event,' said Bogdan Nicula of the Royal Observatory of Belgium (ROB), who calculated where and when this double-eclipse would happen. *'It is a nice exercise to model the orbit and relative positions of all three celestial bodies.'*

The images making up this video were observed by PROBA2 with its SWAP imager, designed by Centre Spatial de Liège (CSL) and operated by the Royal Observatory of Belgium (ROB) as one of the projects of the Solar-Terrestrial Center of Excellence (STCE). SWAP operates at extreme ultraviolet (EUV) wavelengths to monitor the swirling layer of the solar corona just above the Sun's surface.

During the eclipse event, SWAP's view of the Sun and Moon can be seen to become gradually fainter as EUV is progressively blocked by Earth's atmosphere - an EUV-sunset. After passing through Earth's shadow, PROBA2 sees a gradually more EUV-bright Sun - an EUV-sunrise. At that point of the orbit the Moon is no longer eclipsing the Sun.

'We had to work very hard to get this high-resolution pointing needed for these images,' explained David Berghmans, SWAP's principal investigator, adding that with the whole of PROBA2 less than a cubic meter in volume, SWAP is only the size of a large shoe box. *But the results speak for themselves. And, as far as I am aware, the Mayans did not predict this should cause concerns!'*

The event proved scientifically useful for LYRA, PROBA2's other Sun-watching instrument normally used to monitor solar radiation intensity, explained LYRA principal investigator Marie Dominique: *'While the EUV sunset-sunrise season blinds SWAP, it allows LYRA to track the amount of solar EUV light passing through Earth's atmosphere, which helps determine its particle content.'*

PROBA2's eclipse season

A terrestrial solar eclipse occurs when the Moon moves between the Sun and Earth. The Moon orbits Earth every 27 days, but eclipses are much rarer because the Moon-Earth orbital plane is tilted five degrees relative to the Earth-Sun orbital plane. Satellites can experience eclipses more often however - and ESA's forthcoming Proba-3 mission will be a double-spacecraft generating artificial eclipses to view faint outer layers of the solar corona.

PROBA2's own orbit is optimized for solar observation, but for part of the winter season it experiences a sunset and sunrise, with Earth obstructing PROBA2's view of the Sun for a few minutes per orbit. In addition, because both SWAP and LYRA are observing in particular areas of the EUV spectrum, these instruments experience gradually progressing EUV sunsets (and sunrises), as the light in question is being absorbed by the lower layer of the terrestrial atmosphere.

Outside of this sunset-sunrise season, PROBA2 has the Sun in view throughout its orbit, turning 90 degrees every 25 minutes to keep its navigational star trackers pointed away from Earth.