



# Sunspot Index and Long-term Solar Observations

World Data Center supported by the ICSU - WDS

## ***SUNSPOT BULLETIN***

2015 n° 12

### **WARNING OF MAJOR DATA CHANGE**

Over the past 4 years a community effort has been carried out to **revise entirely the historical sunspot number series**. A good overview of the analyses and identified corrections is provided in the recent review paper: *Clette, F., Svalgaard, L., Vaquero, J.M., Cliver, E. W. (2014), "Revisiting the Sunspot Number. A 400-Year Perspective on the Solar Cycle", 2014, Space Science Reviews, Volume 186, Issue 1-4, pp. 35-103.*

Now that the new data series has been finalized, **we replaced the original version of our sunspot data by an entirely new data set on July 1st**. On this occasion, we decided to simultaneously introduce changes in several conventions in the data themselves and also in the distributed data files.

The most prominent change in the sunspot number is the choice of a new reference observer, A. Wolfer (pilot observer from 1876 to 1928) instead of R. Wolf himself. This means **we dropped the conventional 0.6 Zürich scale factor**, thus raising the scale of the entire sunspot number time series to the level of modern sunspot counts. This major scale change may thus strongly affect some user applications: keep an eye out for eventual problems.

Regarding data files, various files have been replaced by new ones, with new more homogeneous names and new internal column formats. The included information sometimes changes: combining data (e.g. hemispheric numbers together with total numbers), separating data (monthly smoothed numbers in a separate file) or adding new values that were not provided previously (standard errors on values).

All those changes are explained in the information accompanying our data. While the core files have been replaced in early July, some other changes will still occur over the next months. During this transitory phase, we thus invite you to visit the main SILSO Web site to follow the possible changes: <http://www.sidc.be/silso>.

For specific technical questions, in particular, if you need to adapt automated data import software used for operational purposes, please contact us by e-mail at [silso.info@oma.be](mailto:silso.info@oma.be)



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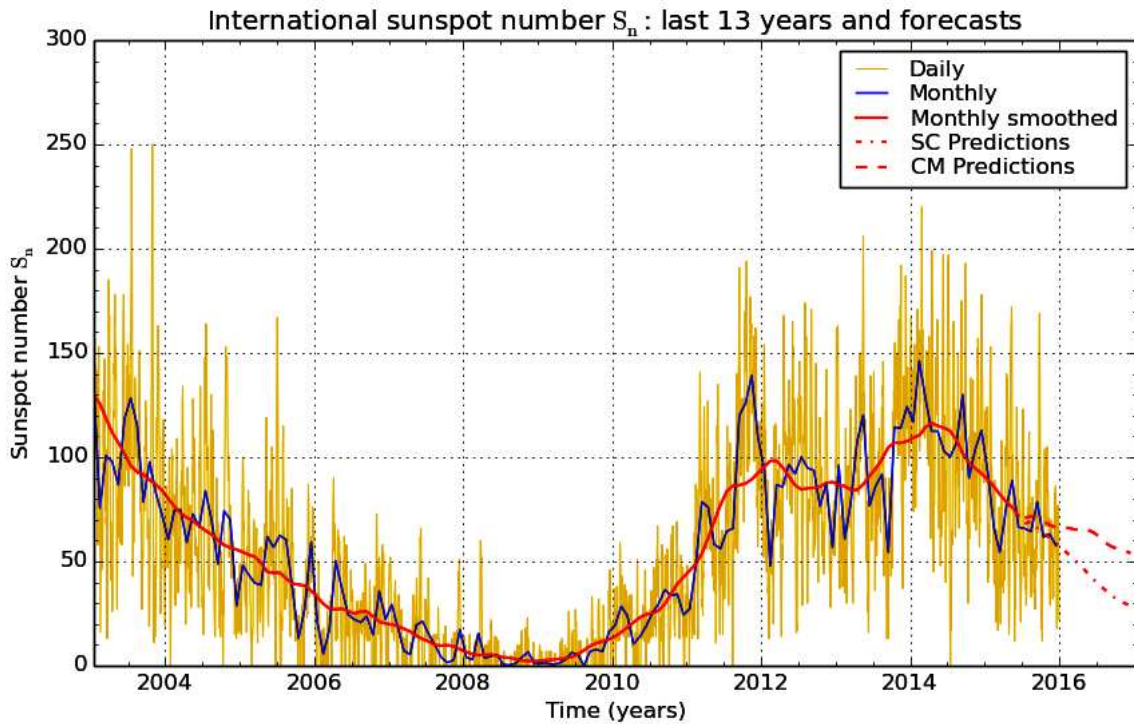
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## *SUNSPOT BULLETIN* 2015 n° 12

### Provisional international and normalized hemispheric daily sunspot numbers for December 2015

Computed at the *Royal Observatory of Belgium* using observations from an international network with the *Specola Solare Ticinese Locarno* as reference station.

Date	$S_n$	$S_n(N)$	$S_n(S)$
1	32	32	0
2	49	36	13
3	36	36	0
4	33	16	17
5	49	13	36
6	54	12	42
7	60	14	46
8	57	13	44
9	77	13	64
10	82	0	82
11	81	0	81
12	83	13	70
13	81	34	47
14	86	42	44
15	65	37	28
16	63	45	18
17	56	38	18
18	53	39	14
19	50	37	13
20	21	21	0
21	18	18	0
22	73	42	31
23	68	35	33
24	68	35	33
25	77	41	36
26	64	17	47
27	67	22	45
28	70	25	45
29	58	16	42
30	35	10	25
31	22	0	22
Monthly mean	57.7	24.3	33.4
Cooperating stations	77	66	66



SILSO graphics (<http://sidc.be/silso>) Royal Observatory of Belgium 2016 January 1

**Predictions of the monthly smoothed Sunspot Number**  
 using the last provisional value, calculated for June 2015: 72.0 ( $\pm 5\%$ )

	SM	CM		SM	CM		SM	CM
2015 Jul	68	71	2016 Jan	56	66	2016 Jul	39	62
Aug	69	72	Feb	54	66	Aug	36	59
Sep	66	71	Mar	51	65	Sep	34	57
Oct	64	70	Apr	48	65	Oct	32	56
Nov	61	68	May	45	65	Nov	30	55
Dec	59	66	Jun	42	64	Dec	29	54

**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 method of standard curves, designed by 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.

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**Summary of the URSIGRAMs from S.I.D.C.**

Date	S <sub>n</sub>	PPSI	600	2800	COS	SFI	XI	Ak
30	48	18	-	96	////	13	0/0	14
1	32	8	-	95	////	2	0/0	21
2	49	6	-	95	////	2	0/0	10
3	36	2	-	95	////	1	0/0	3
4	33	4	-	98	////	6	0/0	5
5	49	10	-	101	////	5	0/0	20
6	54	9	-	102	////	4	0/0	23
7	60	15	-	101	////	1	0/0	25
8	57	19	-	111	////	1	0/0	12
9	77	30	-	109	////	4	0/0	14
10	82	25	-	109	////	2	0/0	28
11	81	23	-	114	////	12	0/0	27
12	83	10	-	117	////	2	0/0	13
13	81	20	-	123	////	12	0/0	6
14	86	36	-	124	////	6	0/0	27
15	65	64	-	119	////	2	0/0	20
16	63	67	-	126	////	13	0/0	6
17	56	85	-	118	////	3	0/0	11
18	53	84	-	117	////	15	0/0	7
19	50	66	-	119	////	1	0/0	15
20	21	66	-	117	////	1	0/0	65
21	18	66	-	122	////	4	2/0	40
22	73	59	-	130	////	26	1/0	13
23	68	59	-	134	////	22	1/0	16
24	68	69	-	133	////	13	1/0	12
25	77	94	-	126	////	3	0/0	8
26	64	87	-	117	////	6	0/0	19
27	67	78	-	110	////	6	0/0	12
28	70	62	-	112	////	3	1/0	5
29	58	48	-	105	////	11	0/0	8
30	35	25	-	102	////	13	0/0	4
31	22	15	-	96	////	1	0/0	33

**S<sub>n</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** : Solar Flare Index from the S.I.D.C. (origin: Ursigrams - UGEOR, evaluation :  $1 \times S_n + 10 \times "1" + 100 \times ">1"$ ).

**XI** : X-flares index from the Ursigrams (M-flares/X-flares) (origin: Ursigrams - UGEOR, UGEOI).

**Ak** : geomagnetic index from Wingst, Germany (origin: Ursigrams).

SOLAR PHYSICS DEPARTMENT

UCCLE DAILY PROVISIONAL RELATIVE SUNSPOT NUMBERS FOR DECEMBER 2015

DATE	UT	NUMBER		RELATIVE SUNSPOT NUMBERS			PPSI	QUAL	OBS	
		OF GROUPS	OF SPOTS	TOTAL	NORTH	SOUTH				CENTRAL
2	1045	3	10	40	27	13	24	1.3	2	OB
3	930	2	3	23	23	0	0	0.3	2	OB
4	945	2	6	26	11	15	0	1.5	3	OB
6	1400	3	4	34	11	23	0	6.0	1	LL
7	1226	4	9	49	11	38	26	9.4	3	OL
8	940	4	8	48	11	37	37	10.3	2	OL
9	935	5	23	73	11	62	56	19.5	3	OL
10	948	5	9	59	0	59	36	19.7	2	OL
17	945	3	8	38	27	11	38	35.7	2	AE
19	1400	2	6	26	15	11	15	37.2	2	AE
20	1015	1	3	13	13	0	13	35.3	1	AE
23	1015	3	25	55	30	25	0	49.4	3	OB
24	1310	3	26	56	30	26	0	51.2	3	AM
26	1020	2	27	47	13	34	47	63.2	3	AM
27	1015	2	35	55	18	37	55	66.7	3	AM
28	1110	2	71	91	30	61	91	65.5	3	OL
29	1330	2	47	67	18	49	67	57.5	2	OL
30	952	2	12	32	11	21	0	26.9	2	OL
31	1005	1	9	19	0	19	0	19.4	3	OL

The relative mean sunspot number is 44.8.

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NORMALISED UCCLE OBSERVATIONAL SUNSPOT NUMBERS U'=K'U FOR DECEMBER 2015

K'= 1.041 (\*)

1	***	7	51	13	***	19	27	25	***
2	42	8	50	14	***	20	14	26	49
3	24	9	76	15	***	21	***	27	57
4	27	10	61	16	***	22	***	28	95
5	***	11	***	17	40	23	57	29	70
6	35	12	***	18	***	24	58	30	33
								31	20

The normalised relative monthly mean sunspot number is 47.

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

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The Sun has been observed 19 days on 31 possible.