



# Sunspot Index and Long-term Solar Observations

World Data Center supported by the ICSU – WDS

## ***SUNSPOT BULLETIN***

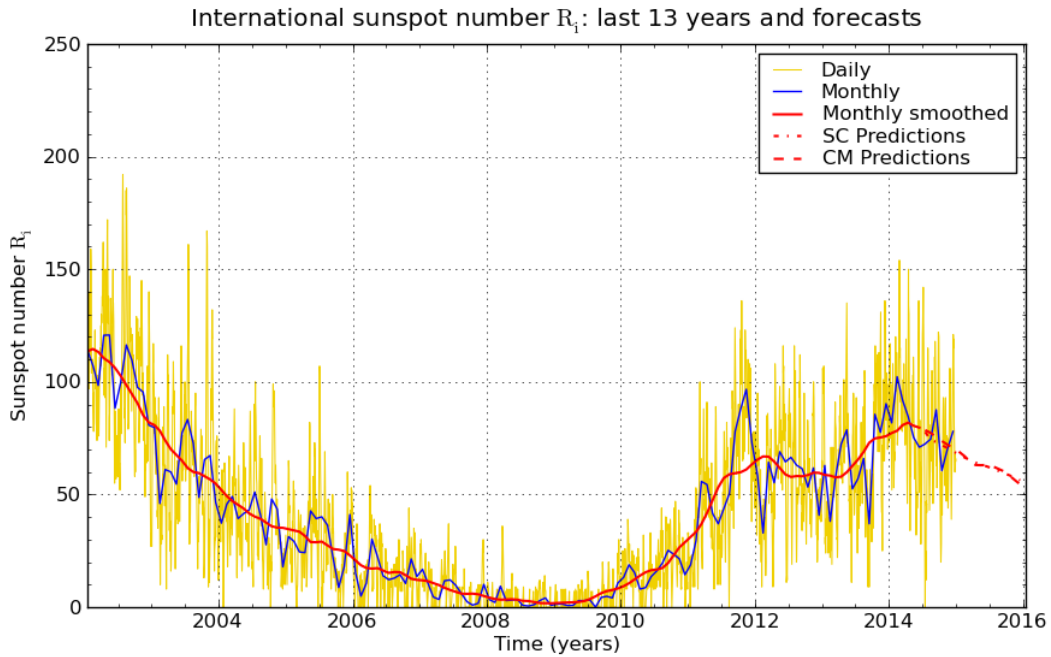
2014

n° 12

### Provisional international and normalized hemispheric daily sunspot numbers for December 2014

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                           | 96              | 39              | 57              |
| 2                           | 85              | 25              | 60              |
| 3                           | 78              | 20              | 58              |
| 4                           | 73              | 24              | 49              |
| 5                           | 44              | 9               | 35              |
| 6                           | 42              | 9               | 33              |
| 7                           | 39              | 8               | 31              |
| 8                           | 48              | 16              | 32              |
| 9                           | 47              | 18              | 29              |
| 10                          | 61              | 21              | 40              |
| 11                          | 75              | 31              | 44              |
| 12                          | 78              | 36              | 42              |
| 13                          | 95              | 44              | 51              |
| 14                          | 110             | 48              | 62              |
| 15                          | 113             | 43              | 70              |
| 16                          | 119             | 41              | 78              |
| 17                          | 121             | 35              | 86              |
| 18                          | 115             | 29              | 86              |
| 19                          | 119             | 37              | 82              |
| 20                          | 94              | 26              | 68              |
| 21                          | 93              | 26              | 67              |
| 22                          | 80              | 32              | 48              |
| 23                          | 78              | 26              | 52              |
| 24                          | 63              | 16              | 47              |
| 25                          | 66              | 15              | 51              |
| 26                          | 60              | 21              | 39              |
| 27                          | 62              | 16              | 46              |
| 28                          | 68              | 16              | 52              |
| 29                          | 64              | 17              | 47              |
| 30                          | 66              | 23              | 43              |
| 31                          | 65              | 9               | 56              |
| <b>Monthly mean</b>         | <b>78.0</b>     | <b>25.0</b>     | <b>53.0</b>     |
| <b>Cooperating stations</b> | <b>71</b>       | <b>63</b>       | <b>63</b>       |



SILSO graphics (<http://sidc.be>) Royal Observatory of Belgium 2015 January 3

**Predictions of the monthly smoothed Sunspot Number**  
using the last provisional value, calculated for June 2014: 79.7 ( $\pm 5\%$ )

|      |     | SM | CM |      |     | SM | CM |      |     | SM | CM |
|------|-----|----|----|------|-----|----|----|------|-----|----|----|
| 2014 | Jul | 78 | 79 | 2015 | Jan | 68 | 69 | 2015 | Jul | 62 | 63 |
|      | Aug | 74 | 77 |      | Feb | 67 | 67 |      | Aug | 61 | 62 |
|      | Sep | 73 | 76 |      | Mar | 65 | 65 |      | Sep | 60 | 60 |
|      | Oct | 72 | 74 |      | Apr | 64 | 63 |      | Oct | 59 | 59 |
|      | Nov | 71 | 72 |      | May | 63 | 63 |      | Nov | 58 | 57 |
|      | Dec | 69 | 71 |      | Jun | 63 | 63 |      | Dec | 56 | 55 |

**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, due to K. Denkmayr.

Ref. : **K. Denkmayr, P. Cugnion**, 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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**THE WDC - SILSO TEAM WISHES YOU A HAPPY AND SUNNY YEAR 2015**

Please note that the maximum of solar cycle 24 was most probably reached in **April 2014 ( $R_i = 81.8$ )**

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

| Date | R' <sub>i</sub> | PPSI | 600 | 2800 | COS  | SFI | XI  | Ak | SEA |
|------|-----------------|------|-----|------|------|-----|-----|----|-----|
| 30   | 104             | 239  | -   | 177  | //// | 8   | 0/0 | 10 |     |
| 1    | 96              | 227  | -   | 168  | //// | 16  | 1/0 | 12 |     |
| 2    | 85              | 185  | -   | 168  | //// | 11  | 0/0 | 13 |     |
| 3    | 78              | 172  | -   | 154  | //// | 15  | 0/0 | 8  |     |
| 4    | 73              | 160  | -   | 158  | //// | 117 | 3/0 | 10 |     |
| 5    | 44              | 106  | -   | 137  | //// | 19  | 1/0 | 12 |     |
| 6    | 42              | 57   | -   | 129  | //// | 21  | 0/0 | 12 |     |
| 7    | 39              | 66   | -   | 132  | //// | 5   | 0/0 | 31 |     |
| 8    | 48              | 51   | -   | 133  | //// | 2   | 0/0 | 20 |     |
| 9    | 47              | 57   | -   | 140  | //// | 44  | 0/0 | 18 |     |
| 10   | 61              | 74   | -   | 150  | //// | 4   | 0/0 | 10 |     |
| 11   | 75              | 108  | -   | 148  | //// | 7   | 0/0 | 5  |     |
| 12   | 78              | 102  | -   | 154  | //// | 7   | 0/0 | 18 |     |
| 13   | 95              | 135  | -   | 160  | //// | 16  | 0/0 | 12 |     |
| 14   | 110             | 136  | -   | 166  | //// | 45  | 1/0 | 11 |     |
| 15   | 113             | 190  | -   | 169  | //// | 16  | 0/0 | 18 |     |
| 16   | 119             | 186  | -   | 185  | //// | 28  | 0/0 | 8  |     |
| 17   | 121             | 317  | -   | 192  | //// | 137 | 4/0 | 6  |     |
| 18   | 115             | 418  | -   | 213  | //// | 138 | 1/0 | 6  |     |
| 19   | 119             | 459  | -   | 216  | //// | 49  | 1/0 | 9  |     |
| 20   | 94              | 329  | -   | 203  | //// | 121 | 0/1 | 8  |     |
| 21   | 93              | 245  | -   | 206  | //// | 35  | 2/0 | 14 |     |
| 22   | 80              | 174  | -   | 179  | //// | 30  | 1/0 | 19 |     |
| 23   | 78              | 92   | -   | 166  | //// | 14  | 0/0 | 13 |     |
| 24   | 63              | 59   | -   | 151  | //// | 105 | 0/0 | 22 |     |
| 25   | 66              | 48   | -   | 145  | //// | 0   | 0/0 | 13 |     |
| 26   | 60              | 48   | -   | 137  | //// | 11  | 0/0 | 17 |     |
| 27   | 62              | 69   | -   | 134  | //// | 113 | 1/0 | 7  |     |
| 28   | 68              | 48   | -   | 133  | //// | 20  | 0/0 | 12 |     |
| 29   | 64              | 56   | -   | 132  | //// | 24  | 0/0 | 25 |     |
| 30   | 66              | 71   | -   | 130  | //// | 20  | 0/0 | 14 |     |
| 31   | 65              | 90   | -   | 134  | //// | 39  | 0/0 | 8  |     |

- 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 DECEMBER 2014

| DATE | UT   | NUMBER       |             | RELATIVE SUNSPOT NUMBERS |       |       | PPSI<br>10-5<br>WM-2 | QUAL  | OBS |         |
|------|------|--------------|-------------|--------------------------|-------|-------|----------------------|-------|-----|---------|
|      |      | OF<br>GROUPS | OF<br>SPOTS | TOTAL                    | NORTH | SOUTH |                      |       |     | CENTRAL |
| 6    | 950  | 4            | 9           | 49                       | 11    | 38    | 12                   | 12.0  | 2   | AM      |
| 9    | 940  | 5            | 21          | 71                       | 27    | 44    | 55                   | 18.1  | 2   | OB      |
| 10   | 1050 | 5            | 31          | 81                       | 28    | 53    | 54                   | 40.0  | 3   | OB      |
| 14   | 1040 | 11           | 46          | 156                      | 67    | 89    | 29                   | 43.1  | 3   | OB      |
| 16   | 1050 | 9            | 98          | 188                      | 62    | 126   | 104                  | 112.8 | 3   | OL      |
| 25   | 945  | 7            | 32          | 102                      | 25    | 77    | 56                   | 33.7  | 3   | OL      |
| 26   | 1045 | 5            | 18          | 68                       | 24    | 44    | 24                   | 33.6  | 1   | AE      |
| 28   | 1015 | 7            | 18          | 88                       | 23    | 65    | 39                   | 16.9  | 2   | AE      |
| 29   | 1240 | 6            | 19          | 79                       | 22    | 57    | 14                   | 26.4  | 2   | OB      |
| 30   | 950  | 8            | 31          | 111                      | 34    | 77    | 62                   | 31.0  | 3   | OL      |
| 31   | 950  | 6            | 41          | 101                      | 11    | 90    | 46                   | 38.2  | 3   | OL      |

The relative mean sunspot number is 99.5.

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NORMALISED UCCLE OBSERVATIONAL SUNSPOT NUMBERS  $U'=K'U$  FOR DECEMBER 2014

$$K' = 0.868 (*)$$

|   |     |    |     |    |     |    |     |    |     |
|---|-----|----|-----|----|-----|----|-----|----|-----|
| 1 | *** | 7  | *** | 13 | *** | 19 | *** | 25 | 89  |
| 2 | *** | 8  | *** | 14 | 135 | 20 | *** | 26 | 59  |
| 3 | *** | 9  | 62  | 15 | *** | 21 | *** | 27 | *** |
| 4 | *** | 10 | 70  | 16 | 163 | 22 | *** | 28 | 76  |
| 5 | *** | 11 | *** | 17 | *** | 23 | *** | 29 | 69  |
| 6 | 43  | 12 | *** | 18 | *** | 24 | *** | 30 | 96  |
|   |     |    |     |    |     |    |     | 31 | 88  |

The normalised relative monthly mean sunspot number is 86.

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

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The Sun has been observed 11 days on 31 possible.