

## Center

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**SUNSPOT BULLETIN**

2003

n° 7

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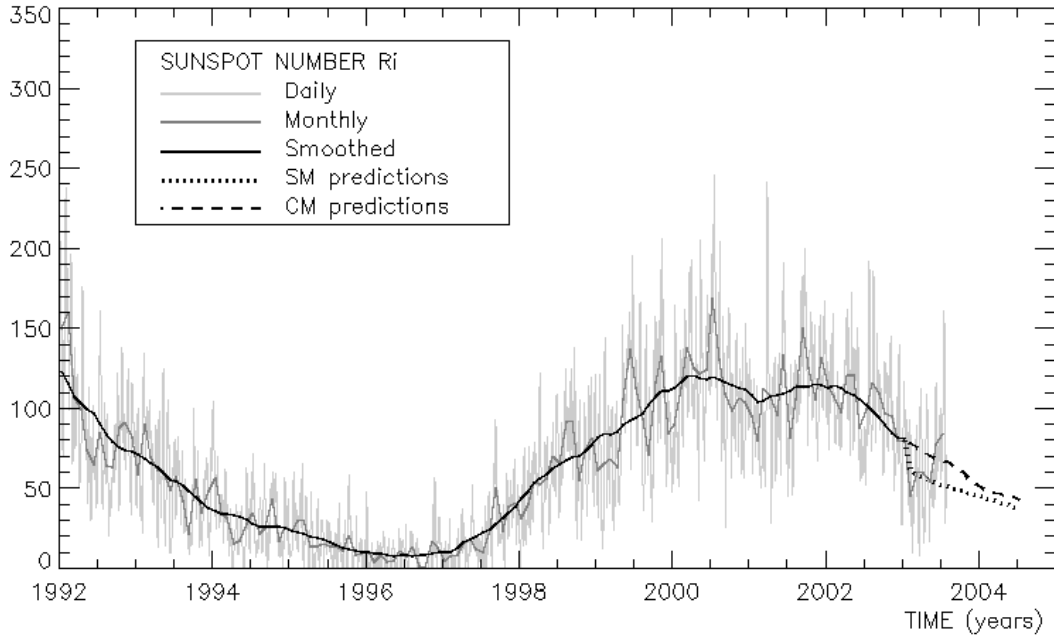
**Provisional international and normalized hemispheric daily sunspot numbers for July 2003**


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computed at the *Observatoire Royal de Belgique* 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                           | 100             | 78              | 22              |
| 2                           | 97              | 88              | 9               |
| 3                           | 80              | 80              | 0               |
| 4                           | 67              | 67              | 0               |
| 5                           | 56              | 56              | 0               |
| 6                           | 63              | 63              | 0               |
| 7                           | 85              | 51              | 34              |
| 8                           | 89              | 46              | 43              |
| 9                           | 90              | 46              | 44              |
| 10                          | 74              | 30              | 44              |
| 11                          | 61              | 13              | 48              |
| 12                          | 68              | 17              | 51              |
| 13                          | 96              | 37              | 59              |
| 14                          | 96              | 50              | 46              |
| 15                          | 105             | 63              | 42              |
| 16                          | 105             | 65              | 40              |
| 17                          | 112             | 72              | 40              |
| 18                          | 121             | 72              | 49              |
| 19                          | 128             | 67              | 61              |
| 20                          | 161             | 72              | 89              |
| 21                          | 146             | 66              | 80              |
| 22                          | 123             | 52              | 71              |
| 23                          | 100             | 47              | 53              |
| 24                          | 78              | 45              | 33              |
| 25                          | 43              | 25              | 18              |
| 26                          | 28              | 20              | 8               |
| 27                          | 91              | 70              | 21              |
| 28                          | 50              | 31              | 19              |
| 29                          | 43              | 21              | 22              |
| 30                          | 38              | 22              | 16              |
| 31                          | 42              | 20              | 22              |
| <b>Monthly mean</b>         | <b>85.0</b>     | <b>50.1</b>     | <b>34.9</b>     |
| <b>Cooperating stations</b> | <b>31</b>       | <b>30</b>       | <b>30</b>       |

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**Predictions of the monthly smoothed Sunspot Number**  
 using the last provisional value, calculated for January 2003 : 81.0 ( $\pm 5\%$ )

|          | SM | CM |          | SM | CM |          | SM | CM |
|----------|----|----|----------|----|----|----------|----|----|
| 2003 Feb | 75 | 79 | 2003 Aug | 56 | 66 | 2004 Feb | 48 | 49 |
| Mar      | 69 | 76 | Sep      | 54 | 63 | Mar      | 47 | 48 |
| Apr      | 64 | 73 | Oct      | 53 | 61 | Apr      | 46 | 47 |
| May      | 62 | 71 | Nov      | 52 | 57 | May      | 44 | 46 |
| Jun      | 60 | 69 | Dec      | 51 | 54 | Jun      | 43 | 45 |
| Jul      | 58 | 68 | 2004 Jan | 49 | 51 | Jul      | 42 | 43 |

**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

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

| Date | R' <sub>i</sub> | PPSI | 600 | 2800 | COS | SFI | XI  | Ak | SEA |
|------|-----------------|------|-----|------|-----|-----|-----|----|-----|
| 30   | 92              | 148  | 51  | 128  | 826 | 16  | 0/0 | 20 |     |
| 1    | 100             | 141  | 46  | 131  | 822 | 1   | 0/0 | 11 |     |
| 2    | 97              | 128  | 48  | 135  | 831 | 13  | 1/0 | 16 |     |
| 3    | 80              | 158  | 49  | 132  | 832 | 11  | 0/0 | 22 |     |
| 4    | 67              | 199  | 46  | 140  | 831 | 17  | 0/0 | 22 |     |
| 5    | 56              | 189  | 49  | 142  | 835 | 5   | 0/0 | 22 |     |
| 6    | 63              | 187  | 47  | 130  | 837 | 8   | 1/0 | 14 |     |
| 7    | 85              | 137  | 47  | 133  | 835 | 1   | 0/0 | 16 |     |
| 8    | 89              | 119  | 49  | 131  | 838 | 17  | 0/0 | 6  |     |
| 9    | 90              | 54   | 50  | 126  | 843 | 7   | 1/0 | 6  |     |
| 10   | 74              | 46   | 48  | 123  | 840 | 4   | 1/0 | 10 |     |
| 11   | 61              | 55   | 48  | 122  | 835 | 0   | 0/0 | 41 |     |
| 12   | 68              | 66   | 48  | ///  | 837 | 0   | 1/0 | 35 |     |
| 13   | 96              | 70   | 47  | 127  | 840 | 5   | 0/0 | 17 |     |
| 14   | 96              | 68   | 44  | 127  | 835 | 4   | 0/0 | 16 |     |
| 15   | 105             | 91   | 44  | 126  | 838 | 0   | 0/0 | 31 |     |
| 16   | 105             | 79   | 46  | 133  | 842 | 3   | 0/0 | 31 |     |
| 17   | 112             | 97   | 48  | 139  | 846 | 15  | 0/0 | 18 |     |
| 18   | 121             | 119  | 49  | 140  | 847 | 12  | 0/0 | 19 |     |
| 19   | 128             | 137  | 51  | 146  | 843 | 17  | 0/0 | 32 |     |
| 20   | 161             | 219  | 57  | 157  | 842 | 17  | 0/0 | 21 |     |
| 21   | 146             | 229  | 47  | 156  | 845 | 11  | 0/0 | 10 |     |
| 22   | 123             | 181  | 52  | 153  | 842 | 20  | 0/0 | 11 |     |
| 23   | 100             | 121  | 50  | 144  | 846 | 16  | 0/0 | 12 |     |
| 24   | 78              | 64   | 49  | 125  | 845 | 0   | 0/0 | 12 |     |
| 25   | 43              | 33   | 45  | 112  | 842 | 0   | 0/0 | 10 |     |
| 26   | 28              | 24   | 41  | 103  | 841 | 0   | 0/0 | 41 |     |
| 27   | 91              | 23   | 42  | 102  | 827 | 0   | 0/0 | 24 |     |
| 28   | 50              | 48   | 44  | 103  | 831 | 3   | 0/0 | 23 |     |
| 29   | 43              | 56   | 43  | 100  | 834 | 11  | 1/0 | 34 |     |
| 30   | 38              | 51   | 45  | 99   | 833 | 0   | 1/0 | 30 |     |
| 31   | 42              | 59   | 47  | 102  | 836 | 1   | 0/0 | 39 |     |

**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 :  $1 \times \text{Sn} + 10 \times \text{"I"} + 100 \times \text{">1"}$ ).  
**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 JULY 2003

| DATE | UT   | NUMBER       |             | RELATIVE SUNSPOT NUMBERS |       |       | PPSI<br>10-3 | QUAL  | OBS |         |
|------|------|--------------|-------------|--------------------------|-------|-------|--------------|-------|-----|---------|
|      |      | OF<br>GROUPS | OF<br>SPOTS | TOTAL                    | NORTH | SOUTH |              |       |     | CENTRAL |
| 1    | 940  | 9            | 45          | 135                      | 108   | 27    | 24           | 87.4  | 4   | OB      |
| 2    | 800  | 8            | 39          | 119                      | 107   | 12    | 49           | 86.4  | 2   | DC      |
| 5    | 1232 | 4            | 54          | 94                       | 94    | 0     | 94           | 86.2  | 2   | ST      |
| 6    | 1330 | 3            | 53          | 83                       | 83    | 0     | 41           | 77.6  | 2   | ST      |
| 7    | 1030 | 6            | 37          | 97                       | 62    | 35    | 32           | 44.0  | 2   | VI      |
| 8    | 810  | 7            | 44          | 114                      | 59    | 55    | 33           | 40.4  | 3   | DC      |
| 9    | 1245 | 7            | 44          | 114                      | 58    | 56    | 23           | 24.7  | 2   | DC      |
| 10   | 920  | 7            | 36          | 106                      | 45    | 61    | 50           | 18.6  | 3   | DC      |
| 11   | 935  | 6            | 16          | 76                       | 34    | 42    | 31           | 25.2  | 3   | DC      |
| 12   | 715  | 5            | 50          | 100                      | 13    | 87    | 83           | 80.1  | 3   | OB      |
| 13   | 1155 | 8            | 52          | 132                      | 43    | 89    | 74           | 76.3  | 3   | OB      |
| 14   | 1003 | 7            | 46          | 116                      | 54    | 62    | 29           | 54.8  | 3   | OB      |
| 15   | 800  | 8            | 47          | 127                      | 71    | 56    | 46           | 63.8  | 3   | OB      |
| 16   | 950  | 10           | 55          | 155                      | 99    | 56    | 52           | 67.6  | 3   | OB      |
| 18   | 1350 | 7            | 105         | 175                      | 95    | 80    | 142          | 110.7 | 3   | OB      |
| 19   | 910  | 6            | 75          | 135                      | 69    | 66    | 94           | 112.4 | 2   | JY      |
| 20   | 1140 | 9            | 54          | 144                      | 50    | 94    | 95           | 113.9 | 2   | JY      |
| 22   | 845  | 9            | 73          | 163                      | 62    | 101   | 46           | 127.3 | 3   | OB      |
| 23   | 1015 | 7            | 58          | 128                      | 42    | 86    | 23           | 101.7 | 3   | OB      |
| 25   | 830  | 5            | 9           | 59                       | 36    | 23    | 11           | 50.7  | 3   | OB      |
| 28   | 1345 | 4            | 25          | 65                       | 36    | 29    | 11           | 49.3  | 3   | OB      |
| 29   | 1020 | 3            | 25          | 55                       | 29    | 26    | 11           | 49.5  | 3   | OB      |
| 30   | 1250 | 3            | 14          | 44                       | 24    | 20    | 11           | 52.0  | 3   | OB      |
| 31   | 940  | 4            | 15          | 55                       | 34    | 21    | 22           | 52.6  | 3   | OB      |

The relative mean sunspot number is 108.0.

NORMALISED UCCLE OBSERVATIONAL SUNSPOT NUMBERS U'=K'U FOR JULY 2003

K' = 0.755 (\*)

|   |     |    |    |    |     |    |     |    |     |
|---|-----|----|----|----|-----|----|-----|----|-----|
| 1 | 102 | 7  | 73 | 13 | 100 | 19 | 102 | 25 | 45  |
| 2 | 90  | 8  | 86 | 14 | 88  | 20 | 109 | 26 | *** |
| 3 | *** | 9  | 86 | 15 | 96  | 21 | *** | 27 | *** |
| 4 | *** | 10 | 80 | 16 | 117 | 22 | 123 | 28 | 49  |
| 5 | 71  | 11 | 57 | 17 | *** | 23 | 97  | 29 | 42  |
| 6 | 63  | 12 | 75 | 18 | 132 | 24 | *** | 30 | 33  |
|   |     |    |    |    |     |    |     | 31 | 42  |

The normalised relative monthly mean sunspot number is 82.

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

The Sun has been observed 24 days on 31 possible.

UCCLE OBSERVATIONAL MAJOR SUNSPOT GROUPS FOR JULY 2003  
E AND F BRUNNER'S TYPE GROUPS

| Uccle<br>Nø | East Limb<br>Date | Date and type |        |          | West Limb<br>Date |
|-------------|-------------------|---------------|--------|----------|-------------------|
|             |                   | 1st obs       | CMP    | Last obs |                   |
| 26-2004     | 6 26.8            | 27 D          | 7 3.5  | 10 E     | 7 10.3            |
| 3-2005      | 7 4.9             | 7 A           | 7 11.7 | 16 C     | 7 18.4            |
| 11-2005     | 7 11.8            | 13 C          | 7 18.5 | 25 E     | 7 25.3            |
| 12-2005     | 7 12.2            | 13 D          | 7 19.0 | 25 E     | 7 25.7            |
| 19-2005     | 7 11.8            | 20 B          | 7 18.5 | 23 E     | 7 25.2            |

PROBABLE RETURN OF MAJOR GROUPS FOR AUGUST 2003

| Nø | New East Limb | New CMP | New West Limb |
|----|---------------|---------|---------------|
| 26 | 7 24.7        | 7 31.4  | 8 7.2         |
| 3  | 7 31.8        | 8 7.6   | 8 14.3        |
| 11 | 8 8.8         | 8 15.5  | 8 22.3        |
| 12 | 8 8.8         | 8 15.6  | 8 22.3        |
| 19 | 8 7.7         | 8 14.4  | 8 21.2        |

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## MONTHLY SUMMARY OF SOLAR AND GEOMAGNETIC ACTIVITY

### I. Solar Activity

Solar activity was generally speaking low to moderate this month. Some occasional M-flares were recorded from various sunspot groups, but most of the time flaring activity was limited to small C-class flares.

The dominant sunspot groups at the beginning of the month were Catania sunspot group 52 (NOAA 0397), and to a lesser extent group 57 (NOAA 0400). Group 52 was in fact an old acquaintance, being the return of Catania sunspot group 22 (NOAA 0375), which produced 3 X-flares and more than 30 M-flares in June on its previous rotation in. On the current month's rotation the group was again very active, but on a smaller scale: it produced 3 M-flares besides about 30 C-flares. The last M-flare recorded from this group, and M3.6 on July 10, was also the largest flare of the month. The sunspot group was fairly large (covering 0.1% of the solar disk and counting about 50 spots at its maximum extent) and had a complex magnetic structure during its entire transit over the disk. It rotated out of view over the western edge of the solar disk on July 10.

A few days later, on July 12, an M1.4 flare occurred from Catania sunspot group 70 (NOAA 0409) while it was still behind the eastern solar limb. The sunspot group became visible on July 14, also showing a beta-gamma magnetic configuration. It however only produced a few more significant flares, none exceeding C-class. Sunspot group 68 (NOAA 0410) similarly developed into such a beta-gamma configuration. It grew quite large (up to 0.08% of the solar disk with about 30 spots) and generated about 20 C-class flares, but no M-flares. In fact, not a single M-flare was recorded between July 12 and July 29, which is again remarkable, seeing that precisely in this period the Wolf number was highest and that besides sunspot groups 68 and 70, also groups 69 (NOAA 0412) and 77 (NOAA 0417) had a beta-gamma magnetic class. The spell of low solar activity was finally broken near the end of the month, with the rapid growth out of the blue of sunspot group 81 (NOAA 0422), and the appearance of the active sunspot group 83 (NOAA 0421) at the eastern limb on 28 July. Both groups developed into a beta-gamma magnetic configuration. On July 29 group 83 spawned its first M-flare. The day after, July 30, sunspot group 81 followed suit and closed this month's solar activity with an M2.5 flare peaking at 04:10 UT.

No proton flux enhancements were recorded during this month, but several coronal holes with equatorial extension were seen crossing the disk.

### II. Geomagnetic Activity

The transit of several coronal holes through a geo-effective position has led to variable geomagnetic activity in July, ranging from quiet to major geomagnetic storm. The highest K-index recorded in Wingst was 6, which happened on July 12 and 26.

During the first 10 days of the month, geomagnetic conditions were quiet to active. A coronal hole arrived in geo-effective position on Thursday 3 July inducing a solar wind speed increase to nearly 800km/s for a few days. Until July 7, active conditions followed with the Wingst K-index often at 4. Then followed 3 quiet days. Late on 10 July, a fifteen-hour period of negative Bz began, marking the onset of a coronal hole high speed stream that began mid day on 11 July and lasted until late on 13 July, with solar wind speed reaching 700 km/s. On 11 -12 July, activity was at minor storm level, followed by mostly active levels until July 20, with occasional brief periods of minor storm conditions. Most disturbed days were July 15 and especially July 16 with minor magnetic storm levels following a moderate southward excursion of the interplanetary magnetic field.

In the period July 21-25, conditions were generally quiet with K-indices typically at 2 or 3 and an isolated K=4 value. On July 26, the influence of a large coronal hole, covering a significant fraction of

the southern solar hemisphere and reaching up to the solar equator, triggered a change in character of the solar wind resulting in a short period of major geomagnetic storm on that day (K=6 in Wingst). Early on July 28, the solar wind speed briefly dipped down to 550km/s, yielding quiet geomagnetic conditions for a short time. Near the middle of this UT day, the solar wind speed rose again sharply to 800km/s, and remained near that value until the end of the month. With the interplanetary magnetic field alternating between northwards and southwards orientation, these conditions led to a mix of active and minor geomagnetic storm conditions for the remainder of the month.

### III. Noticeable solar events

| DAY | BEGIN | MAX  | END  | LOC    | XRAY | OP | 10CM | RADIO            | TYPE       | 600 (Humain) | Cat  | NOAA |
|-----|-------|------|------|--------|------|----|------|------------------|------------|--------------|------|------|
| 02  | 0706  | 0728 | 0746 | N13E25 | M3.0 | 1F | 230  |                  |            | 0710         | 52   | 0397 |
| 06  | 0006  | 0032 | 0040 | N04E18 | M2.3 | SF |      | III/2            |            |              | 57   | 0400 |
| 09  | 2159  | 2238 | 2245 | N05W35 | M2.0 | SF | 67   |                  |            |              | 52   | 0397 |
| 10  | 1354  | 1412 | 1423 |        | M3.6 | SF | 140  | III/2, V/3, II/3 | 1400       |              | 52   | 0397 |
| 12  | 1857  | 1906 | 1913 | N16E79 | M1.4 | SF | 55   | II/2             | 1859, 1909 | 70           | 0409 |      |
| 29  | 0128  | 0139 | 0143 | S13E72 | M1.3 | 1F | 34   |                  |            |              | 83   | 0421 |
| 30  | 0404  | 0410 | 0412 | N14W55 | M2.5 | 1B | 190  |                  |            |              | 81   | 0422 |

**loc:** approximate heliographic location

**Xray:** X-ray flare class

**op:** optical flare class

**10 cm:** radio flux on 10 cm

**type:** type of radio-burst

**600:** peak UT time of 600 Mhz radio-bursts in Humain

**Cat:** Catania sunspot group identification

**NOAA:** NOAA active region identification

**p:** proton event

**CME:** Coronal Mass Ejection.