Coronal index of solar activity for 1996

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Abstract. We present the coronal index of solar activity (CI) for 1996. To compute CI, we used only the intensities of the green corona from Lomnický Štít and Sacramento Peak coronal stations. Values of CI were low with an increase toward the end of 1996. It appears that the minimum of solar activity in the green corona occurred in March 1996. The rotational rate of CI, as measured during the last half of 1996, is 26 days. The results are compared to the Wolf number and 2800 MHz flux over the entire cycle 22 (1986-1996).

Key words: The Sun-corona-heliosphere

1. Introduction

The coronal index of solar activity (CI) represents an averaged daily power (irradiance), emitted in the coronal green line (Fe XIV, 530.3 nm) from the entire emission corona as seen from the Earth, into 1 sterradian towards the Earth. It is derived from ground-based observations of the emission corona, and the method of its computation and results for the period 1939 - 1991 have been published by Rybanský *et al.* (1994a,b and references therein). Results for the years 1992 -1994 were published by Rybanský *et al.* (1996), and for the year 1995 by Rybanský *et al.* (1997).

This paper deals with results obtained for the year 1996. A comparison between CI, Wolf sunspot number and 2800 MHz radio flux for all of cycle 22 will be briefly discussed.

2. Observational data

The bases for the CI computation are ground-based data obtained at different coronal stations around the world. Unfortunately, we had at our disposal only data from Sacramento Peak (120 days) and Lomnický Štít (95 days) in 1996. Missing data in the homogeneous data set were computed by linear interpolation between the last and first observations (Rybanský, 1975). There was a

maximum 6 of continuous missing observational days in 1996. This period occurred between May 25 and May 30. Other missing periods were shorter. No data were available from Kislovodsk Observatory. Norikura coronal station interrupted its observation of the corona in September 1996. However, the data obtained prior to that contained mostly zeroes, and we decided to not use such data in our computation. Evidently the Norikura sensitivity was insufficient to detect the weakest coronal intensities that occurred in 1996. The method of CI computation was proposed by Rybanský (1975).

3. Results and brief discussion

Daily values of CI in 1996 are shown in Figure 1. There are also shown, for comparison, daily values of Wolf number (R) and the 2800 MHz radio flux (I_{2800}).

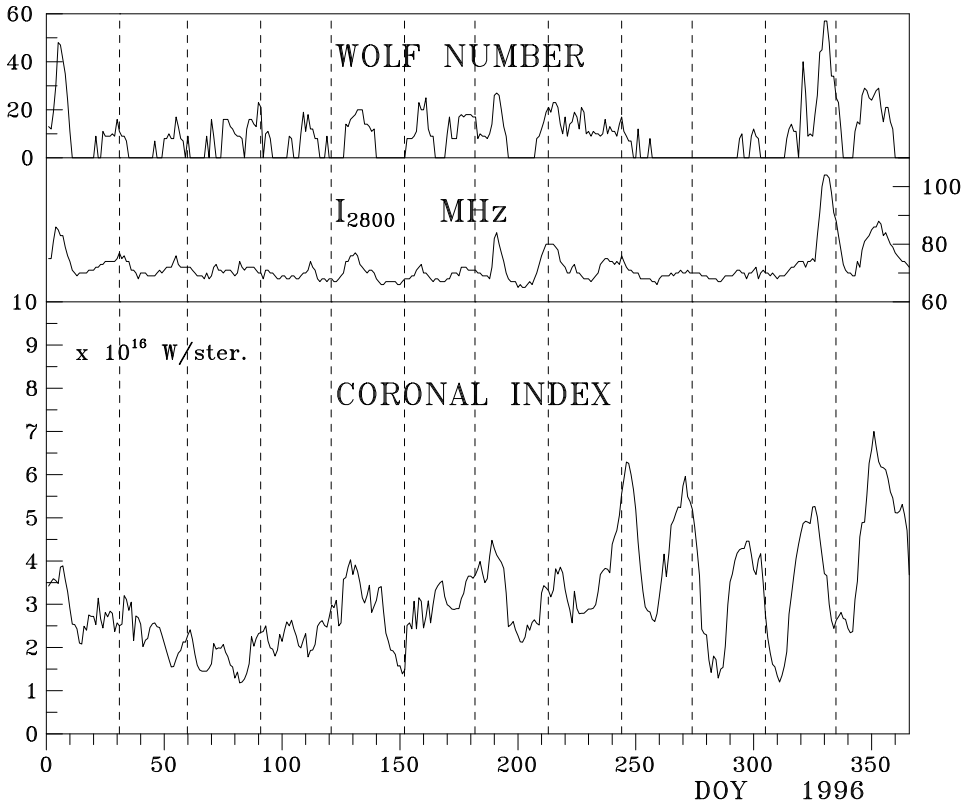

Figure 1. Plot of daily values of the sunspot number R (at the top), the radio flux I_{2800} (middle part) and the coronal index CI (at the bottom) for 1996.

A plot of the monthly means of R, I_{2800} and CI for the complete cycle 22 (1986 - 1996) is shown in Figure 2. Daily values of CI for the total period of the green corona observations, 1939 -1996, are available via Internet at http://www.ngdc.noaa.gov/stp/SOLAR/solar.html, click on "Get Data".

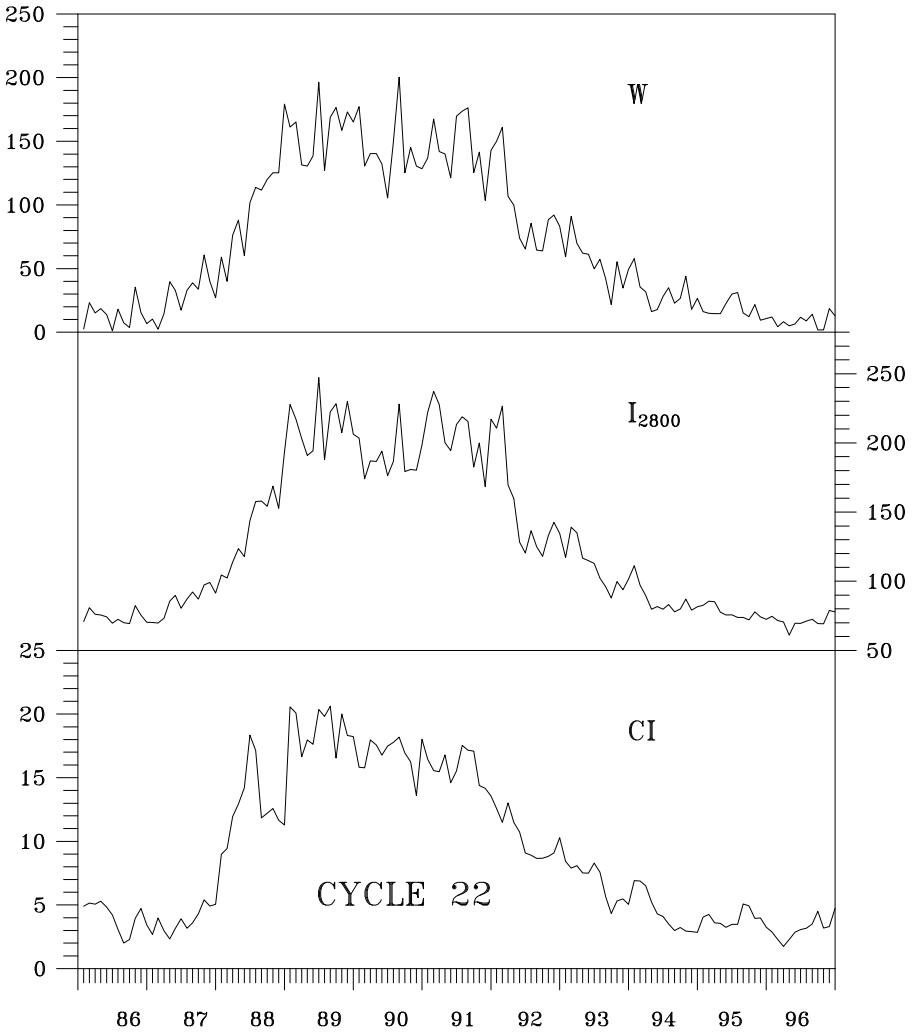

Figure 2. Plot of the monthly averages of R, I_{2800} and CI for cycle 22 (1986-1996).

As can we see from Fig. 1, daily values of CI in 1996 are low and typical of the minimum of activity, especially at the beginning of the year. On the basis of the CI plot one could infer that the minimum of solar activity occurred in March 1996. The previous minimum occurred in August 1986, so the length of

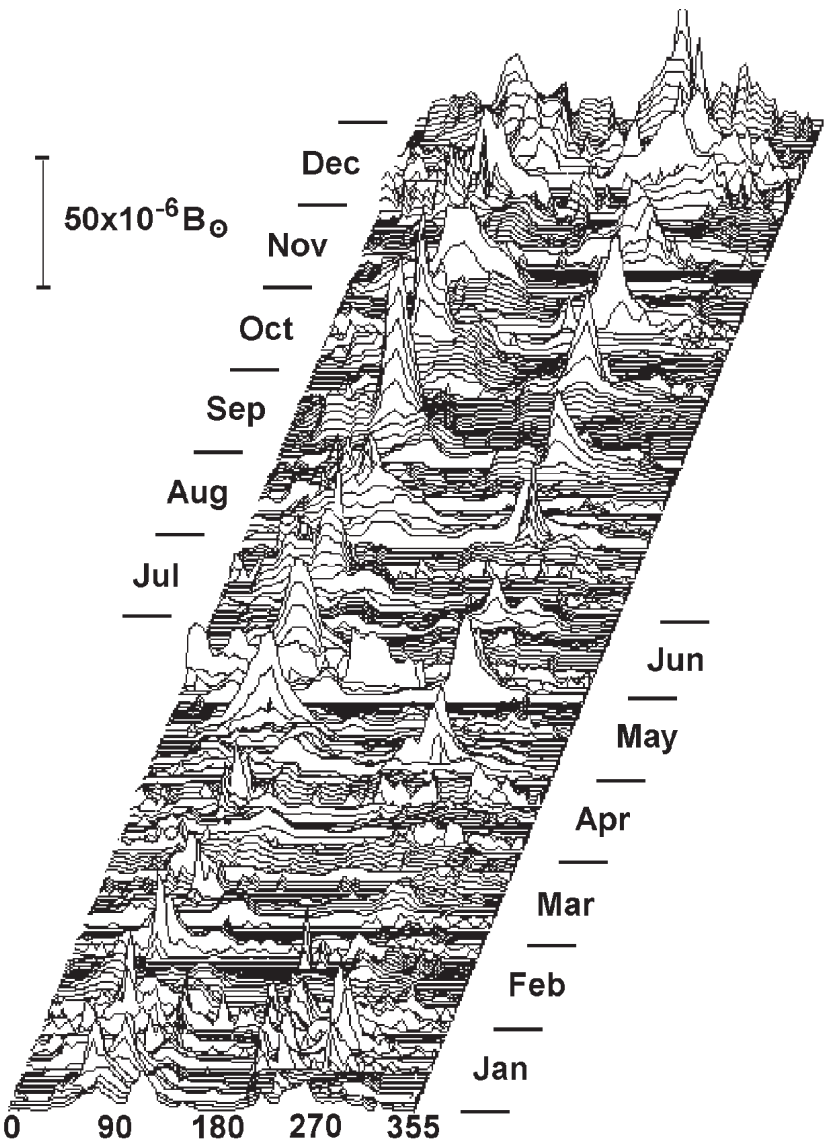

Figure 3. Spatial-temporal distribution of the green corona as derived from homogeneous coronal data set in 1996.

solar cycle 22 according to CI was only 9.6 years. This is very short in comparison with earlier cycles in CI. At the moment, the length of the cycle 22 according to the Wolf number can not be derived because of lack of data (the cycle minimum is derived from the 24-month running mean, half before the minimum and half after the minimum). The amplitude of the 2800 MHz radio flux during the minimum is very low. It only rarely exceeded the minimum-observable value of 68 units. Comparing I_{2800} and R, it seems that the minimum could have occurred in the autumn (September or October).

In general, the longer the window used for averaging, the better is the agreement between different indices, when comparing indices of solar activity. This is confirmed by the data shown in Fig. 2. From Fig. 2 one can see that a good agreement exists between monthly averages of CI, R and I_{2800}, except in 1988, when a strong enhancement was observed in CI.

Usually, we can recognize the beginning of a new cycle from the position of sunspots on the solar surface. They first appear at higher heliographic latitudes. Inspection of CI in Fig. 1 shows that the maximum values increase nearly monotonically from April 1996 to the end of September 1996, and after declining in October and November, the increase continues in December 1996. However, this increase in CI was caused by enhanced intensities above the active region that occurred at latitude $B = -10^{\circ}$. A similar behavior of CI was observed in 1986 between cycles 21 and 22 (Rušin and Rybanský, 1989), when the lowest CI values were detected in February-March 1987 (the minimum occurred in autumn 1986). It is very difficult to say whether the 1996 enhancement was caused by cycle 22 or by the forthcoming cycle 23. As was discussed by Mouradian and Soru-Escaut (1993) there are two systems of magnetic fields in equatorial regions in the minimum. For comparison, the spatial-temporal development of the green corona in 1996, as seen in the homogeneous coronal data set, is shown in Figure 3. The previously-referenced active region at latitude $B = -10^{\circ}$ is seen throughout the middle of the year appearing alternately near the 90° and 270° position angles.

The synodic rotation rate of this region in the solar corona is 26 days, 1 day shorter than the average value for sunspots at the same latitude.

4. Conclusion

Daily values of CI in 1996 are very low, and a rotational rate of 26 days is well observed in the second half of the year. According to CI, it appears that the minimum between solar cycles 22 and 23 occurred in March 1996, which results in a length for cycle 22 in the emission corona of only 9.6 years.

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