

Comparison of solar activity during last two minima on turn of Activity Cycles 22/23 and 23/24

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Abstract. The subject of our work is the review and comparison of solar activity during the last two solar minima that occurred between recent activity cycles. We use the soft X-ray global solar corona observations covering the two nine-months long time intervals in 1997/98 and 2009. Data from RF15-I multichannel photometer are used for the penultimate minimum. For the last unusually deep and prolonged solar activity minimum in 2009 the data from SphinX spectrophotometer are used. Comparison of measurements from both minima takes place in the overlapping energy range 2–15 keV. We focus on the active region formation, evolution and flaring productivity during respective minima.

Keywords. Sun: activity, Sun: corona, Sun: X-rays, gamma rays

1. Introduction

Two 281-days long time periods were selected for the present comparison analysis. Both periods cover similar parts of two consecutive solar cycles minima of activity. Their start times were found as equidistant to start times of respective solar cycles. The first time interval covered by RF15-I (Sylwester *et al.* 2000) measurements consist of data from 02 July 1997 to 10 April 1998 while the second period of SphinX (Sylwester *et al.* 2008; Gburek *et al.* 2011) measurements extends from 20 February to 29 November 2009. The duration of both periods equals to active lifetime of the CORONAS-*Photon* mission.

2. Observations

In Figure 1 there are light curves of RF15-I and SphinX which were obtained by integrating spectra over overlapping energy ranges of the instruments. Active regions (AR) related characteristic features and flares can be recognized on the light curves in both cases. For the comparison the solar flux observed by *GOES* in energy range 1–8 Å during analysed time periods are shown. A very good match is evident in both cases. For the second time interval it is clearly seen that SphinX sensitivity is much superior in respect to *GOES*. Right panels of Figure 1 present ARs trajectories on the visible solar hemisphere during analysed time periods. Times and locations of regions on solar disc were taken from Joint USAF/NOAA Solar Region Summary Reports.

In Table 1 we present comparison of activity indicators for both analysed time intervals on turn of solar cycles of activity 22/23 and 23/24. Number of days when sunspots were observed was obtained based on data provided by NOAA. In the second column we compare number of flares with *GOES* class above B1.0. We used *GOES* flares catalog for this statistics. Last column contains the number of ARs visible on solar disc.

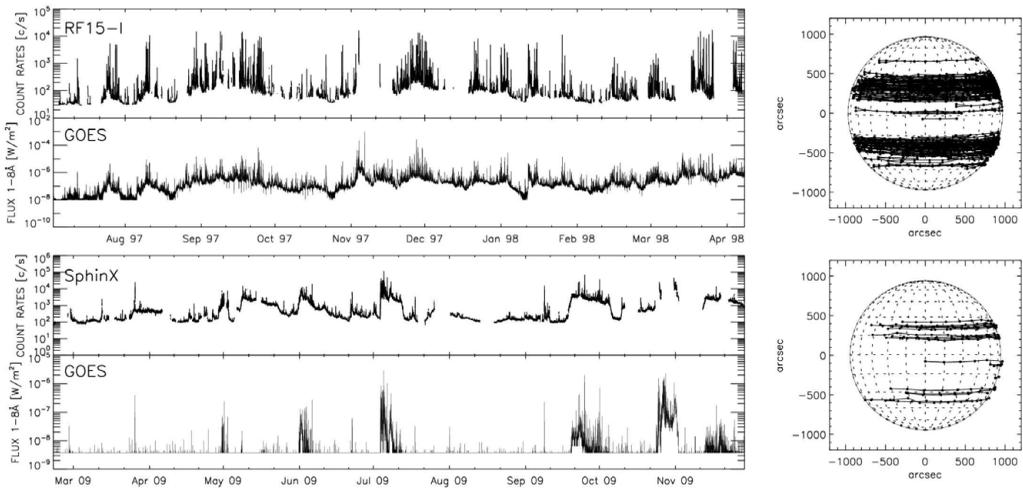


Figure 1. Top-left: RF15-I count rates observed during period from 02 July 1997 to 10 April 1998. Bottom-left: SphinX count rates covering period from 20 February to 29 November 2009. Below respective plots of *GOES* fluxes in 1–8 Å spectral band are shown. Right plots: Trajectories of ARs visible on the solar disc for respective time periods.

	Number of Days with Sunspots	Number of Flares over B1.0 <i>GOES</i> Class	Number of ARs on Solar Disc
02 Jul 1997 - 10 Apr 1998 (minimum 22/23)	265 (94% of time)	1465	150
20 Feb 2009 - 29 Nov 2009 (minimum 23/24)	71 (24% of time)	131	22

Table 1. Comparison of solar activity indicators for two analysed time intervals.

3. Conclusions

Comparison of magnetic activity indicators shows that the active Sun atmosphere displayed substantially different conditions during analysed periods. Number of days with spots on solar disc was about four times smaller in the second period than in the first one. Number of flares above *GOES* B1.0 class decreased approximately ten-fold and the number of ARs dropped by a factor of ~ 7 as it is seen from Table 1. The ARs paths of preceding minimum covered much wider latitudinal belts in comparison with the recent minimum. Formation of near-equator ARs during recent minimum was almost suppressed. This supports the common opinion of unusual character of the recent activity minimum (Dikpati 2011).

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