COMPARISON OF QUIET-SUN RADIANCES MEASURED BY CDS AND SUMER ON SOHO

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Abstract. Since the beginning of the SOHO (Solar and Heliospheric Observatory) mission an intercalibration programme was carried out which included simultaneous observations of the EUV instruments CDS (Coronal Diagnostic Spectrometer) and SUMER (Solar Ultraviolet Measurements of Emitted Radiation) of common targets on the quiet Sun. The observations in the chromospheric line of He I (584 Å) and the two coronal lines of Mg X (609 Å and 624 Å) thus cover the long period of 4 years and provide a data set highly suitable not only for instrumental comparison but also for studies of the quiet Sun's long term variability. Up to the SOHO accident, both instruments show a very good temporal correlation and stability. Even after the loss and recovery of the spacecraft, when the instruments had been exposed to extreme temperature conditions, the performance of the CDS and SUMER instruments is still good, as is the temporal correlation. However, the ratio between the efficiencies of the two instruments, which remained constant with time until the SOHO accident seems to have changed afterwards. In the coronal lines both instruments show an increase of average radiances towards the solar maximum.

1. Introduction

The CDS (Coronal Diagnostics Spectrometer) and SUMER (Solar Ultraviolet Measurements of Emitted Radiation) telescopes and spectrometers on board the Solar and Heliospheric Observatory (SOHO) perform observations in the far and extreme

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ultraviolet spectral domain (see relevant articles in Fleck *et al.*, 1995). SUMER observes in the wavelength range from 500 to 1610 Å, and the CDS normal incidence spectrometer (NIS) observes in the two bands from 310 to 380 Å and from 517 to 633 Å. Since the beginning of the SOHO mission an intercalibration programme was carried out which included simultaneous observations of CDS and SUMER of common targets on the quiet Sun, i.e. atmospheric regions near the solar disk center devoid of any notable activity. The spectral lines recorded simultaneously during the intercalibration measurements were He I at 584 Å and the two Mg X lines at 609 Å and 624 Å. The data used for this investigation are raster images taken during the period from March 1996 to July 2000, and they provide a data set over a time span of more than four years in which the two instruments have independently observed quiet Sun areas. Here we give a short overview over the analysis of this extraordinary and large data set. A detailed study on the CDS and SUMER intercalibration is in preparation (Pauluhn *et al.*, 2000).

2. The Data

After the instrumental corrections and the radiometric calibration, the solar radiances were determined by integration over Gaussian fits to the line profiles (see Pauluhn *et al.*, 1999). Following the loss of the SOHO spacecraft in June 1998 and because of the subsequent unusual temperature conditions, both instruments suffered changes in their configurations and special corrections have to be applied. The SUMER measurements are offset to smaller intensities but otherwise show the correct trends (Schühle *et al.*, 2000). The absolute radiometric calibration of CDS has not changed, but the shape of the line profiles has, and special fitting routines are required to account for this (Thompson, 2000). The uncertainty of SUMER's radiometric calibration is estimated to 20% before and 36% after the spacecraft loss and recovery. The corresponding CDS uncertainties are 15% (He I) and 25% (Mg X), and 20% (He I) and 30% (Mg X), respectively.

3. Results of the Comparison

In Figure 1 we show the averaged radiances of the chromospheric line He I 584 Å and the coronal line Mg X 624 Å for the SUMER and the CDS measurements. The offset between the two instruments in He I 584 Å varies between 30 and 40%. The difference in the coronal lines of Mg X is smaller but has changed after SOHO's loss and recovery. Table 1 contains the average differences of the measurements relative to the CDS values (av(CDS)–av(SUMER))/av(CDS) for three different time periods: (March 1996–August 1996), when only SUMER's detector A was used; (September 1996–June 1998), when SUMER's detector B was used; and the post-recovery period (November 1998–July 2000), when SUMER alternately used

TABLE I

Average relative differences between the CDS and SUMER time series (CDS-SUM)/CDS (in %)

Wavelength (Å)	March 1996–August 1996 (I)	September 1996–June 1998 (II)	November 1998–July 2000 (III)
584	33.3	38.0	42.1
609	7.2	1.6	−5.1
624	16.4	9.3	5.0

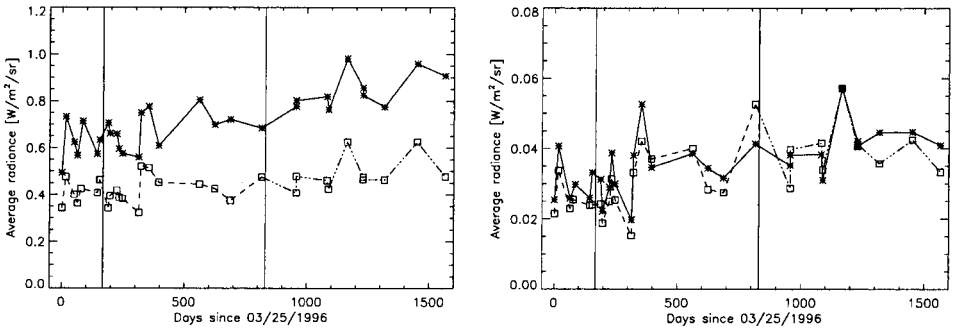

Figure 1. Left: spatially averaged radiances in He I 584 Å measured simultaneously with CDS (stars) and SUMER (squares). Right: The same for Mg X 624 Å. The three phases of the intercalibration record (SUMER detector A, SUMER detector B, post-recovery) are separated by vertical lines.

both detectors. Until the SOHO accident the performance and correlation of both instruments was stable. After the loss and recovery of the spacecraft the correlation of both time series remains good. Nevertheless, the responses of both instruments have changed, and some effects need further investigation.

It can be seen that with the approach of the solar activity maximum, both instruments show an increase of the 'quiet-Sun' radiance. This increase is slightly stronger in the corona than in the chromosphere and is also detectable in a change of the corresponding histograms of the radiances with time, which is depicted in Figure 2. The CDS resolution is coarser and consequently the corresponding histograms are noisier. However, the shift of the histograms towards higher radiance values is seen very clearly in the measurements of both instruments.

Acknowledgements

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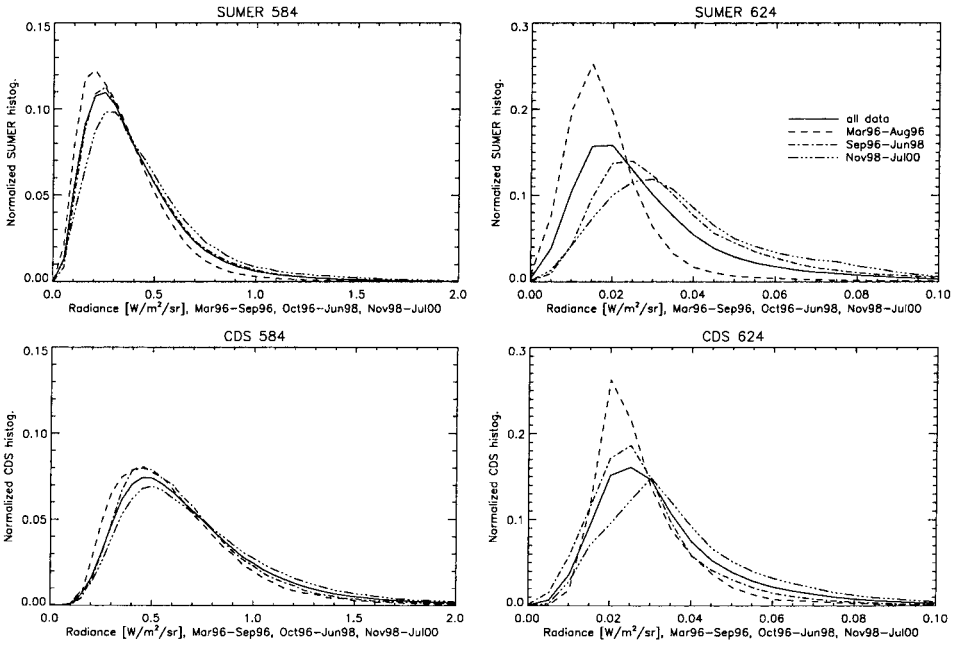

Figure 2. Histograms of the radiances in He I 584 Å and Mg X 624 Å, from the SUMER and CDS data. The long time series has been split in three sub-series. (March 1996–September 1996, October 1996–June 1998, November 1998–July 2000). Upper plots: SUMER, lower plots: CDS.

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