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The Quiet-Sun Variability as Seen by CDS and SUMER

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Abstract. We investigate brightness variations of the quiet Sun using movies obtained with CDS and SUMER time series on SOHO. We compare the variability and relative variability detected with the two instruments and find that SUMER reveals a factor 2–3 higher variability than CDS.

1. Introduction

Using CDS Brković et al. (2000) found that all parts of the quiet Sun were significantly variable on time-scales longer than 5 min in the He I 584.3 Å and O V 629.7 Å lines, while the variability in the Mg IX 368.1 Å line was more marginal. The same work showed that the highest relative variability was observed in O V, then in He I and the least one in Mg IX. Now we extend the analysis to the new data obtained simultaneously with CDS and with SUMER.

2. Observations and data

Two co-aligned measurements of quiet regions at sun centre were carried out on 23rd April 1997 with the Normal Incidence Spectrometer (NIS) of the Coronal Diagnostic Spectrometer (CDS) (Harrison et al. 1995) and the Solar Ultraviolet Measurements of Emitted Radiation (SUMER) spectrometer (Wilhelm et al. 1995) onboard the SOHO satellite. NIS was in its movie mode, i.e. $90'' \times 240''$ slit with a pixel size of $1.68'' \times 1.68''$. The He I, O V and Mg IX lines were recorded at a cadence of 15 seconds for durations of 230 and 300 min. SUMER observed simultaneously with CDS at cadences of 19 seconds (1st measurement with the He I 584.3 Å and O I 1152.1 Å lines) and 34 seconds (2nd measurement with the O V 629.7 Å and C I 1267.6 Å lines). The SUMER data were obtained with the $1'' \times 120''$ slit, with the pixel size being $1'' \times 1''$. The SUMER slit was kept at a fixed location on the solar surface.

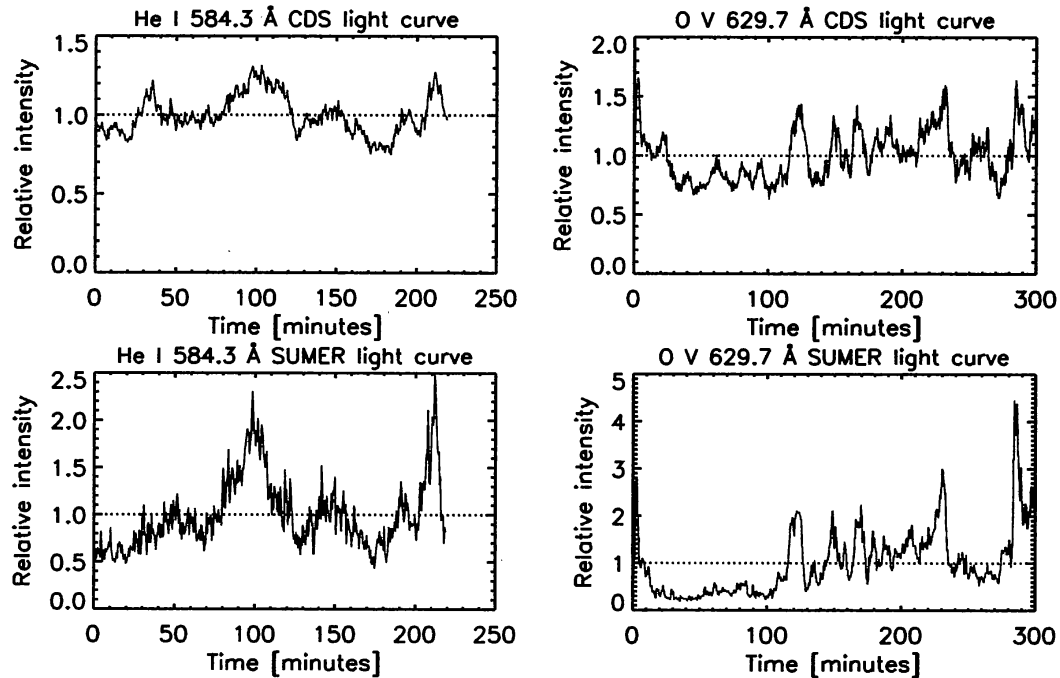


Figure 1. Sample light curves for the He I and O V lines of CDS and SUMER. The vertical axes of the light curve frames show the intensity relative to the averaged intensity (the horizontal dotted lines). Note the difference in scale between the SUMER and CDS light curves.

3. Analysis

For each pixel we determined the variability, the temporal average brightness and the ratio of these values (i.e. relative variability) in the same manner as described by Brković et al. (2000). Figure 1 shows examples of light curves for the He I and O V lines for the same spatial locations. The differences in scales of relative intensities between lines and those between instruments are remarkable. The differences in scales between He I and O V are of solar origin, while the differences between the instruments have its cause in the higher spatial resolution of SUMER compared to CDS.

Figure 2 shows relative variabilities for the CDS and SUMER lines. The two sets of CDS data were combined since the relative variabilities on time scales of 230 and 300 min were practically the same for a given line. A comparison of the He I and O V lines shows that the level of relative variability seen by both instruments is higher in O V than in He I, as already cited. It also shows that the observed levels of relative variabilities are roughly a factor of 3 higher in the SUMER than in the CDS measurements. The median variabilities are 9.5% for He I and 17.5% for O V as seen with CDS, while corresponding values as seen with SUMER amount to 23.5% for He and 55.0% for O V. In other respects both instruments give similar results, which agree with those of Brković et al. (2000). E.g., we found that the absolute variabilities are well correlated between different lines, the relative variabilities are independent of the time-averaged brightness in all lines and the brightness fluctuations are mainly due to brightness changes

on time-scales longer than 5 min. Fluctuations in O I and C I differ in the sense that brightness changes on time-scales ≤ 5 min are also very significant.

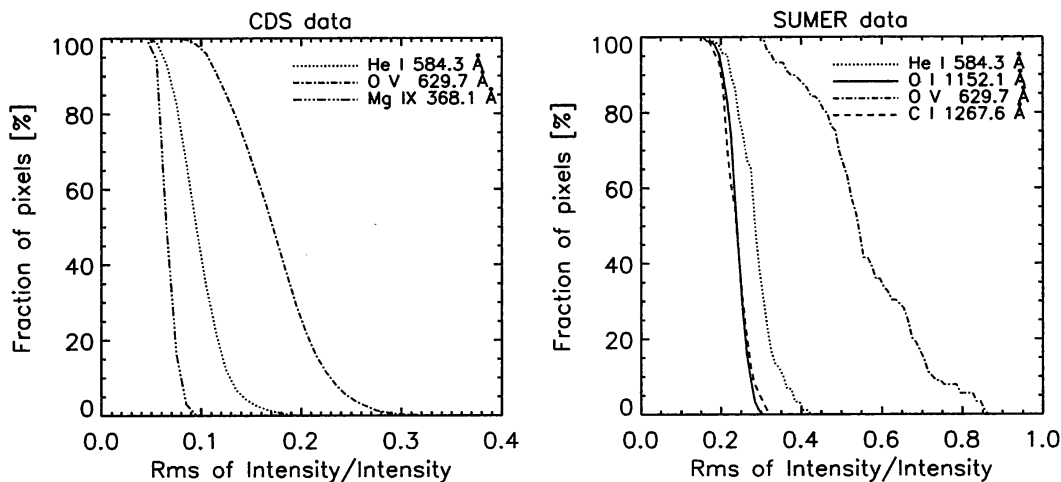


Figure 2. Fraction of points with relative variability lying above the corresponding value on the abscissa for CDS and SUMER lines.

4. Summary

The analysis of co-aligned movies of the quiet-Sun centre obtained with CDS and SUMER confirmed the results of Brković et al. (2000). It has also been found that the level of relative variability increases strongly with increasing spatial resolution of the instrument involved.

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