PHOTOMETRIC MEASUREMENTS OF SUNSPOT DEFICITS AND FACULAR EXCESSES

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ABSTRACT. Photometry of the whole solar disk has been used to determine the irradiance deficit due to sunspots and the irradiance excess due to faculae. The sunspot fluctuations correlate well with simple models, with scale factors between 0.9 and 1.1 times published values. The facular irradiance excess must be modelled from the pixels detected as “facular.” For a four-week interval in 1988, these ground-based data could be correlated with data from the ACRIM experiment on the SMM satellite with a multiple correlation coefficient of 0.9917 (18 degrees of freedom). The fit gave a non-magnetic solar irradiance of 1366.8 ± 0.1 W/m², on the scale of the ACRIM/SMM.

1. INTRODUCTION

The variation of the total solar irradiance has been accurately measured by the ACRIM experiment on the Solar Maximum Mission (SMM) satellite. These variations have been confirmed by Nimbus7 and other satellites. A major question for solar physicists is to determine the cause of these variations. Furthermore, the times of the greatest solar irradiance occur when dark sunspots are most frequent. The resolution of this dilemma will require an improved understanding of the flow of energy through the outer layers of the Sun.

2. OBSERVATIONAL MATERIAL

The photometric data have been obtained at the San Fernando observatory/CSUN during the summer of 1988. These data consist of photometric images at two wavelengths, 6723Å with a 100Å bandpass and 3934Å with a 10Å bandpass. The images, consisting of the solar disk and nearby sky, have a spatial scale of 5 arc-sec per pixel. Each pixel has an intensity resolution of 12 bits. Each line of the image includes a measurement of the sky transparency. For each image, the intensity variation due to the quiet Sun is removed and the resulting contrast image searched for sunspots and faculae. Sunspots are defined to be those pixels with a negative contrast greater than −8.5%; facular pixels are defined to be pixels with a positive contrast greater than, typically, 4.8%. A paper submitted to the Journal of Geophysical Research (Chapman, et al., 1992) is the first thorough attempt to correlate this ground-based data with that of a precision space-borne radiometer.

3. REFERENCE


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