THE MEAN PHOTOSPHERIC MAGNETIC FIELD FROM SOLAR MAGNETOGRAMS: COMPARISONS WITH THE INTERPLANETARY MAGNETIC FIELD

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Abstract. Large-scale averages of daily solar magnetograms have been compared by cross-correlation with the interplanetary magnetic sector pattern during a 21/2 yr interval. A significant correlation was found at a lag of about 41/2 days, with the amplitude of the correlation depending on the area included in the magnetogram averages. The highest correlation was found when an area of one quarter of the solar disk was used, which is consistent with the idea that the photospheric features which are to be associated with the interplanetary sector pattern are large scale features.

1. Introduction

By viewing the Sun as a star, Severny et al. (1970) found a correlation between the photospheric magnetic field averaged over the visible disk and the interplanetary magnetic field sector structure. This average field was measured by letting light from all parts of the solar disk fall on the entrance aperture of the magnetograph and measuring the Zeeman splitting of the iron line λ5250 Å in the resulting integrated light. One would expect to obtain similar results by measuring the field with the magnetograph operating in the normal method and averaging over large portions of the disk. We have compared large-scale averages of Mount Wilson Observatory daily magnetograms with the interplanetary sector structure for a 21/2 yr interval beginning in July 1967, and have seen that if one averages over the proper area of the disk, significant correlation results.

2. Observations

The photospheric field averages which we used in this analysis were available for the interval July 1967 through June 1970. Ten averages were found for each day’s magnetogram by averaging the photospheric field included in ten concentric circles with radii 0.1, 0.2, ..., 1.0 R☉. We have labeled both the circles and the resulting averages Disk 1 through Disk 10 with Disk 10 being the whole solar disk. Figure 1 is a schematic drawing of these disks with Disk 5 shown cross-hatched as an example. These

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Fig. 1. Schematic drawing showing areas of disk averages of the photospheric magnetic field.

Fig. 2. Cross-correlation of disk averages of the photospheric magnetic field with interplanetary magnetic field polarity for the six months, July through December 1967. The curve near the line labeled ‘disk 5’ represents the cross-correlation of the disk 5 data for lags −36 to +36 days. The line labeled ‘disk 5’ represents a correlation coefficient of zero. The line labeled ‘disk 4’ represents a correlation coefficient of 1.0 for disk 5, and similarly the line labeled ‘disk 6’ represents a correlation coefficient of −1.0. All the other disk and ring correlations are in the same format.