

Daily Variation of Tilt Angles of Sunspot Groups

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Abstract. The influence of polarity separation on the daily tilt angle variation of sunspot groups has been studied from a selected number of observations of the Sun spanning the entire 22nd solar cycle. Daily white-light images of the Sun from Kodaikanal Observatory have been utilized to obtain both polarity separation and axial tilt of sunspot groups. Over 100 long-lived spot groups that had well distinct leading and following parts are chosen from different latitude belts for this purpose. Variation of tilt angle with polarity separation has been studied after classifying the spot groups according to its age and area. Preliminary results of this analysis are discussed in this paper.

1. Introduction

In an earlier paper (Muneer and Singh 2002), we described the nature of occurrence of negative and positive tilt angles (as defined in the paper) of sunspot groups during the course of a solar cycle. It has been suggested that the coriolis force acting on the rising flux tubes that form the active region is largely responsible for the axial tilt observed in spot groups (D’Silva and Choudhuri 1993). The leading and following portions of the spots tend to move apart in the earlier stages of evolution of the active region and move closer together in the latter part of its lifetime (Kiepenheuer 1953, Zwaan 1985). Howard (1994 & 1996) showed that the effect of Coriolis force on this polarity separation could be directly observed in the tilt angle change. To study the effect of polarity separation on daily tilt angle variations, we analyzed solar data consisting of sunspot groups of different stages of its evolution across the solar disc.

2. Data and Results

Measurements of tilt angle of sunspot groups and the details of the data can be found in Muneer and Singh (2002). To study the influence of polarity separation on the change in tilt angles

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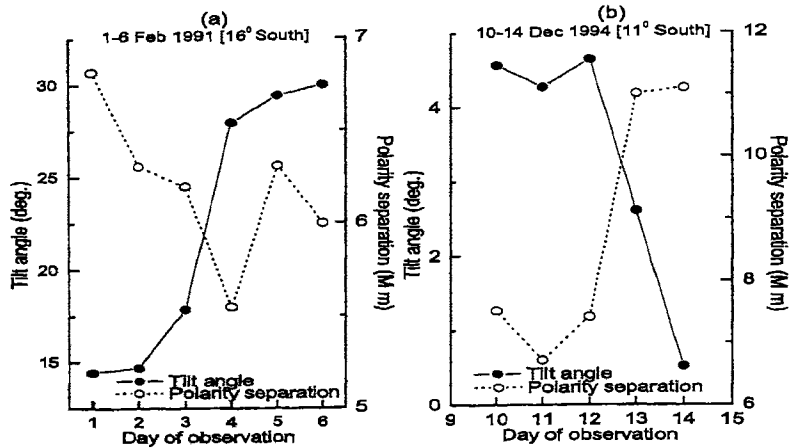


Figure 1. Daily Variation in tilt angles (solid lines) and the polarity separation (dotted lines) of two spot groups that appeared on consecutive days.

of sunspot groups in magnitude and direction when they passed over the disc on several days, we examined the whole data to choose bipolar spot groups from different latitudes, which have well defined leading and following portions and long lived, so the ambiguity, if any, involved in the measurements of their mean positions has been greatly reduced. Figures 1(a) and 1(b) show the daily variation in the tilt angles and the corresponding changes in polarity separation of two different spot groups that appeared continuously from 1 to 6 February 1991 and from 10 to 14 December 1994 respectively. Both spot groups are from southern hemisphere at mean latitudes of 16° and 11° . The spot group of February 1991 was on the declining stage while that of December 1994 was growing. The tilt angle of the decaying spot group increased continuously while the polarity separation decreased over the period. The distance between the leading and following parts of the growing sunspot group increased over the period but the tilt angle declined.

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