Magnetic Field Evolution of AR5747 with Linear Force-Free Fields

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We have analyzed a set of MSO(Mees Solar Observatory) magnetograms of AR5747 observed from October 20 to 22, 1989. The active region was one of very active regions at which strong X-ray flares occurred during the observing period. The magneotgram data were obtained using Haleakala Stokes Polarimeter which provides simultaneous Stokes profiles of the Fe I doublet, 6301.5 and 6302.5. A non-linear least square method was adopted to derive the magnetic field configuration from the observed Stokes profiles and a multi-step ambiguity solution method was employed to resolve the 180° ambiguity.

From the ambiguity-resolved vector magnetograms, we have derived a set of physical quantities characterized by the field configuration, such as magnetic flux, vertical current density, magnetic shear angle, angular shear, magnetic free energy density, and a measure of magnetic field discontinuity (MAD: Maximum Angular Difference between two adjacent field vectors). Our results show that all the physical parameters decrease as time increases, implying that the active region was in a relaxation period.

We also show that the active region was approximately linear force-free throughout the observing days by calculating the net Lorentz force and comparing the longitudinal field components B_z and the corresponding vertical current densities J_z. The variation of linear force-free coefficients with time is consistent with those of other physical parameters. This fact implies that the change of linear force-free coefficient with time should be a good measure describing a global status of the active region. Finally, we present magnetic field line configurations deduced from a linear force-free extrapolation method(Gary 1989).