Modeling of solar active regions using local linear force-free fields to estimate magnetic twist

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The prediction of solar flares is an important issue for space weather forecasting. Although solar flares are believed to be caused by the magnetohydrodynamic (MHD) instability in solar active regions, the method for accurately evaluating the stability of solar magnetic field is not yet established. Recently, Ishiguro & Kusano (2017) proposed that a new instability called the Double Arc Instability (DAI) plays a role of initial driver of solar flares and the critical parameter for this instability can be used to evaluate the stability of active regions. The parameter can be derived by the integration of the magnetic twist as the function of magnetic flux. One way for it is given by the nonlinear force-free field (NLFFF) extrapolation using the photospheric vector magnetic field data. However, the NLFFF extrapolation demands heavy computation and it sometimes cannot well work as a model of solar coronal magnetic field because the force-free condition is limited on the photosphere. Therefore, in order to improve the efficiency and applicability of the flare prediction using , it may be required to develop a method to approximately but much quickly capture the overall features of magnetic field in solar active regions, especially in the flare triggering region. From this point of view, we try to develop a method to extract the characteristic feature of magnetic field in solar active regions using the linear force-free field (LFFF) model. For this objective, we compare the several methods to accurately capture the structure of using LFFF. In this study, we report the result of the analysis for the solar active region NOAA 11429.

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