The statistical analysis of correlation between solar flares and photospheric magnetic field

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A solar flare is caused by the explosive release of magnetic energy and sometimes greatly disturbs the Earth’ s electromagnetic environment and may impact socio-economic system. For that reason, the prediction of flare occurrence is important for space weather forecast. However, the accurate prediction of flare occurrence has not been realized yet, because the mechanism of flare trigger is not well understood yet. According to previous studies, some parameters, such as the area of active region, total magnetic flux, the magnetic shear on PIL and the magnetic gradient have certain relation with the flare activities. Recently, Kusano et al. (2012) indicated that the magnetic reconnection in the small magnetic structures that appear in the strong-sheared magnetic field near the magnetic polarity inversion lines can trigger solar flares. In addition, Ishiguro & Kusano (M25a for ASJ meeting 2016 in March) found a possibility that the magnetic twist causes instability which is able to cause flares and CMEs.
The object of this study is to give a new parameter related to flare activity on the basis of these previous studies. In order to achieve it, we have performed the statistical analysis of magnetic field data on photosphere surface. For 294 ARs which sunspot area is relatively large in 2012 to 2016, we took the correlation analysis on the total flux and various magnetic parameter in each AR using the magnetic field data of SDO/HMI. The results suggest that not only magnetic free energy but also the shape of distribution of magnetic free energy correlates with the flare activity. We report the preliminary results of the analyses and discuss about the application to space weather forecast.

Keywords: Solar flare, Space weather, SDO/HMI

