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Forecast of the Solar Flare Magnitude from the Photospheric Magnetic Field Properties

TETSUYA YAMAMOTO[1], TAKASHI SAKURAI[2], KANYA KUSANO[3], TAKAAKI YOKOYAMA[4]

[1] *Department of Astronomy, Graduate School of Science, The University of Tokyo*

[2] *National Astronomical Observatory of Japan*

[3] *Earth Simulator Center*

[4] *Department of Earth and Planetary Physics, Graduate School of Science, The University of Tokyo*

The solar flare is a transient phenomenon, and has great influence on the sun-earth environment. It is important to forecast when, where and how a large flare occurs. In this study, we compared solar flare magnitudes and photospheric magnetic properties quantitatively for the purpose of forecasting how large a flare may be. We applied a linear fitting method to the data of photospheric magnetic properties and solar flare magnitudes, and evaluated a simultaneous tolerance interval. Data samples are composed of 22 flares and 14 active regions. The solar flare magnitude is obtained from the GOES satellite 1-8 angstrom data. The largest and smallest flares in the sample are X17 (1.7 x 10^-3 W/cm^2) and A5 (5.0 x 10^-8 W/cm^2), respectively. The photospheric magnetic properties are derived from the vector magnetograms of the Solar Flare Telescope (Mitaka, Japan) and from the SoHO/MDI magnetograms. The photospheric magnetic properties are evaluated by using magnetic flux, magnetic field strength, current density and others. We applied the linear fitting method to the data of the flare magnitudes and the magnetic properties of the regions. In the linear fitting equation a probability and a confidence level are set, and then a simultaneous tolerance interval is obtained. If we use the magnetic field strength and the flare region area as magnetic parameters, a simultaneous tolerance interval is about a factor of 1.8 with 0.90 probability and 0.90 confidence level, and about a factor of 13.8 with 0.95 probability and 0.95 confidence level. These photospheric magnetic properties are derived from the regions which showed flare brightening. However, it is difficult to forecast where a next flare occurs. So we also use the magnetic properties obtained from strong shear regions and from the entire active regions. In this presentation, we explain these parameters and results in detail.