

Statistical analysis of solar flare multi-wavelength observation data

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Impulsive energy release phenomena such as solar flares, sometimes affect to the solar-terrestrial environment. Usually, we use soft X-ray flux as the index of flare scale. However, the magnitude of effect to the solar-terrestrial environment is not proportional to the GOES X-ray class. To identify the relationship between solar flare phenomena and influence to the solar-terrestrial environment, we need to understand the full spectrum of solar flares. For this purpose, we are performing statistical analysis of electromagnetic data of solar flares. In this study, we use solar flare events larger than C3-class from the Hinode flare catalogue (Watanabe et al., 2012). We use the soft X-ray flux, flare duration, location, and type and size of flaring active region as the fundamental parameters of a solar flare. For the first step, we focus on the flux of EUV emission, because the sudden ionospheric disturbance (SID) is caused by a solar flare especially due to soft X-ray and UV emissions. We use EUV data from the Extreme Ultraviolet Variability (EVE) onboard the Solar Dynamics Observatory (SDO). We examined the EUV lines (Fe VIII, Fe XII, Fe XV, Fe XVIII, Fe XX) for 111 events larger than M3-class flares, and found positive correlation between the “soft X-ray flux” and the “EUV peak intensity” for all lines. The “EUV peak time” of hot lines are earlier than that of cool lines. Next, we examined the relationship between the size of flaring active regions and the flare intensity. We found very weak correlation between them when we plot 5578 flare events larger than C-class from November 2006 to July 2016. In addition, we also check the occurrence timing of flare events during evolution or dissipation of active region, and found that there is no relationship between them. Then, we also examined the hard X-ray data obtained by Reuven Ramaty High Energy Solar Spectroscopic Imager (RHESSI). We also found correlation between the hard X-ray intensity and the soft X-ray intensity, especially in low energy. In this paper, we also show the spectral index of hard X-ray spectra, and discuss their relationship for other electromagnetic emissions.

Keywords: solar flare, solar flare spectra