R010-12
Zoom meeting C ：11/4 AM1 (9:00-10:30)
9:00〜9:15

Statistical study on the effect of solar flare emission spectra on the Earth's ionosphere using numerical simulations

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The X-rays and extreme ultraviolet (EUV) emitted during solar flares can rapidly change the physical composition of the Earth's ionosphere, causing sudden ionospheric disturbances and other space weather phenomena (Dellinger 1937). Therefore, to understand how solar flare emission spectra affects the ionosphere, it is important to have an accurate understanding of the solar flare emission spectra. Solar flares with a long duration have a large effect on the ionosphere due to the large total energy (Qian et al., 2010). So, it is also important to accurately estimate the emission profile of solar flare.

The model based on physical process of the flare is useful for this purpose. We verify the extent of reproducing the flare emission spectra using a newly developed simple method based on the physical process of the flare loop (Kawai et al., 2020). In this method, we convert the soft X-ray light-curves observed during flare events into EUV emission spectra using a one-dimensional hydrodynamic calculation and the CHIANTI atomic database (Dere et al., 2019). We examined the "EUV flare time-integrated irradiance" and "EUV flare line rise time" of the EUV emissions for 21 events by comparing the calculation results of the proposed method and observed EUV spectral data. Proposed method succeeded in reproducing the EUV flare time-integrated irradiance of Fe lines which have relatively higher formation temperature, as well as the 5.5-35.5 nm band. For the EUV flare line rise time, there was acceptable correlation between the proposed method estimations and observations for all Fe flare emission lines (Nishimoto et al., 2020).

We used the solar flare emission spectral models and the Earth's whole atmospheric model to study the effect of X-rays and EUV emissions from flares on the ionosphere. For the solar flare emission spectral models, we used the physical model described above and an empirical model, the Flare Irradiance Spectral Model (FISM; Chamberlin et al., 2020). For the Earth's whole atmospheric model, we used the Ground-to-Topside Model of Atmosphere and Ionosphere for Aeronomy (GAIA; Jin et al., 2011). We compared the total electron content (TEC) variations corresponding to various solar flare emission spectra for 6 X-class flare events that occurred from 2010 to the 2021. The results show that the wavelengths of solar flare emissions that mainly affect TEC variations are soft X-rays ($<$10 nm) and EUV emissions (especially 28-30, 32-34 nm).