R010-11
A 会場 ：9/24　 PM2 （15:45-18:15）
17:10～17:25

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Reproduction of electron density variation in the ionospheric D region during solar flares by the PHITS and GAIA models

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Solar flares emissions cause ionization of the ionosphere and rapid variation in electron density. In particular, shortwave communication failure caused by increased electron density in the ionospheric D region (60-100 km) is known as the Dellinger phenomenon (Dellinger 1937) and are mainly attributed to flare X-ray emission. In order to estimate the occurrence of Dellinger phenomenon and their magnitude, it is necessary to accurately understand the altitude distribution of electron density variation in the ionosphere caused by solar flare emission. The GAIA (Jin et al., 2011) is one of the effective numerical simulation models which can provide the electron density variations throughout the ionosphere in solar flare emissions, but it does not yet account for ionization in the ionospheric D region.

In this study, we used PHITS code (Sato et al., 2018), a particle transport and collision simulation code using the Monte Carlo method, to simulate electron density variations in the ionospheric D region due to flare X-ray emission. The X-ray data observed by GOES/XRS are input into PHITS with the solar zenith angle taken into account, and the altitude distribution of the ionization rate (q) is calculated. The electron density (n_e), which includes ionized recombination, is derived from ${n_e}^2$ = α_{eff} / q using the effective recombination coefficient (α_{eff}) given by Gledhill (1986).

The scale of the Dellinger phenomenon can be known from the minimum reflection frequency f_{min} value observed by the ionosonde. We derived f_{min} value from the PHITS calculation results, and are compared with the f_{min} values obtained from the GAIA calculation and the observed. The results showed that the f_{min} value derived from the PHITS calculation more accurately reproduces the observed f_{min} value than the f_{min} value from the GAIA, and the blackout capture rate is better.

In this presentation, the differences between the PHITS and GAIA simulations and their evaluation will be discussed in detail.