Atmospheric ionization of EMIC-wave driven energetic electron precipitation events

Kiyoka Murase[1], Ryuho Kataoka[1,2], Takanori Nishiyama[1,2], Yasunobu Ogawa[1,2],
Yoshimasa Tanaka[1,2], Masaki Tsutsumi[1,2], Kaoru Sato[3]
[1]*SOKENDAI*
[2]*NIPR*
[2]*Univ. of Tokyo*

Electromagnetic ion cyclotron (EMIC) waves have been known as one of the main drivers of energetic electron precipitation (EEP) into the Earth's atmosphere. Ozaki et al. (2022) showed that EEP associated with EMIC wave activity causes localized mesospheric ozone depletion, suggesting a non-negligible impact on atmospheric variabilities. However, it is difficult to quantitatively discuss the global impact of EMIC-wave driven EEPs due to the lack of comprehensive observations of the energy range (i.e., ionization altitude), ionization intensity, and spatial extent.
In this study, we attempt to characterize these ionization profiles focusing on the evaluation of the ionization impact of EMIC-wave driven EEPs based on the intensity, duration, and spatial extent of the ionization captured by ground-based measurements. We use observational data of the imaging riometer, the atmospheric radar, PANSY, and the magnetometer at Syowa Station (CGMLAT=-66.5°) in 2016-2019, which provide information of ionization altitudes, intensity, and wave spectra, respectively. We have found at least 350 events of EMIC-EEP candidates in which the mesospheric ionization coincides with the EMIC wave activities. The MLT distribution of events peaks on the afternoon side (14 MLT). Most of the events are related to the injection during substorms, and only about 10% are thought to be caused by solar wind compressions. Ionization signatures at altitudes below 60 km, suggesting >MeV electron precipitation, are confirmed for 40 % of the events. So far, only these basic statistical investigations have been completed, while the the evaluation of ionization impact is still ongoing. In this presentation, we will discuss the evaluation in terms of the characteristics of ionization profiles for different types of wave excitation and physical properties of waves, i.e., wave intensity/frequency..

References

M. Ozaki et al., "Localized mesospheric ozone destruction corresponding to isolated proton aurora coming from Earth's radiation belt," Sci Rep, vol. 12, no. 1, Art. no. 1, Oct. 2022, doi: 10.1038/s41598-022-20548-2.