Localized mesospheric ozone destruction below isolated proton aurora at subauroral latitudes

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Energetic particle precipitation (EPP) is one of major sources of catalytic destruction of ozone in the polar region due to the production of EPP-driven odd nitrogen (NOx) and odd hydrogen (HOx). In this study, we focus on atmospheric impacts by relativistic electron precipitation (REP) driven by electromagnetic ion cyclotron (EMIC) waves in the inner magnetosphere. It is well known that EMIC waves can effectively precipitate relativistic electrons and energetic keV protons to the loss cone, however the atmospheric impacts are not quantitatively well understood due to difficulties of recognizing for location and duration of REP events. We use EMIC-driven isolated proton aurora typically observed at subauroral latitudes for the proxy of EMIC-driven REP location and duration. We found localized mesospheric ozone destruction on a spatial scale of ~400 km in the magnetic latitudinal direction (Ozaki et al., 2022). The mesospheric ozone loss just below isolated proton aurora was 10 to 60% within 1.5 hours of the initiation of the related EMIC/Pc1 wave activities on the ground. The EMIC/Pc1 waves in the O + band were simultaneously observed during the ozone loss events. In this presentation, we will discuss the REP-driven atmospheric impacts below isolated proton aurora and the particle loss efficiency by EMIC waves in different ion frequency bands.

References

Ozaki, M., Shiokawa, K., Kataoka, R. et al. Localized mesospheric ozone destruction corresponding to isolated proton aurora coming from Earth's radiation belt. Sci Rep 12, 16300 (2022). https://doi.org/10.1038/s41598-022-20548-2