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Investigation of energetic particle precipitation events on the polar mesopause region

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We have been conducting spectral observations of OH (8-4) airglow at Syowa Station during the winter seasons. The OH airglow, emitted at an altitude of approximately 86 km, is a key tracer of atmospheric processes in the mesopause region. From these observations, we derived the rotational line intensity of the OH (8-4) airglow (OH airglow intensity) and its rotational temperature.

This study aims to investigate the effects of energetic particle precipitation (EPP) on the polar mesosphere during auroral activity. OH∗is produced by the reaction of ozone with atomic hydrogen. EPP is believed to produce NOx and HOx in the upper atmosphere, which subsequently destroy ozone molecules. Therefore, we hypothesize that the intensity of OH airglow should vary depending on the chemical changes caused by EPP.

The temporal variation of OH intensity is a superposition of contributions from various atmospheric phenomena. To isolate the effects of EPP from other atmospheric variabilities, we applied the following analyses. First, image data from an infrared all-sky imager at Syowa Station were processed to detect the influence of atmospheric gravity waves. We also derived the local time dependence of OH intensity from averaged spectral data and subtracted this diurnal variation from the observed time series. EPP events were identified from imaging riometer data at Syowa Station from 2016 to 2024, defined by CNA values exceeding 1.0 dB.

In this presentation, we will report on our analysis of OH (8-4) airglow spectral data from 2016 to 2018 and from 2021 to 2024. Our preliminary findings reveal a complex relationship between OH airglow intensity and EPP events. Following strong EPP events, we observe a tendency for OH intensity to decrease over several hours, consistent with prior studies (e.g., Suzuki et al., 2010). However, an instantaneous enhancement is sometimes detected when CNA values are high. This enhancement is inconsistent with the slower, chemical process of ozone destruction. We are investigating the possibility that this enhancement is caused by auroral contamination, likely from the first negative band of $N_2{}^+$.