Variation of OH airglow with various time scales revealed by long-term ground observation at Syowa Station

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OH (8-4) airglow spectral observations conducted at Syowa Station, Antarctic, during the winter season from February 2008 until October 2019. We derived the rotational line intensity of OH airglow (OH airglow intensity) and the rotational temperature for 12 years dataset. We detected distinct intensity variations with various time scales; (1) a decadal scale that may be caused by the solar cycle, (2) seasonal intensity variations with a maximum around April and a minimum around the winter solstice, (3) relatively long-timescale events that lasted for several days and (4) relatively short-time scales of several tens of minutes to several hours.

The intensity of OH airglow is thought to be a fluctuation due to changes in atmospheric composition in the upper polar mesosphere associated with the energetic particle precipitation (EPP) and the vertical transport of air masses with rich [O] from altitudes higher than the OH airglow layer. We compared the peak altitude of the airglow layer, temperature distribution, and timing of the vertical transport enhancement with satellite data from TIMED/SABER, AURA/MLS. The results showed that the (1) ~ (3) variations can be generally understood by the supply of oxygen atoms associated with vertical transport to the OH layer. Regarding the variations (4), we focused on the relationship with auroral particles, which had been reported only once by Suzuki et al. (2010). We extracted EPP events from the cosmic noise absorption (CNA) data from the riometer observations at Syowa Station. Superposed epoch analysis of OH airglow intensity for three hours before and after the events suggested the OH airglow intensity decayed for about tens of minutes after the EPP events. We used a simple 1-D model for numerical experiments to understand the mechanism of the temporary decrease in OH airglow intensity associated with EPP.

In this presentation, we will present OH airglow intensity variations detected at Syowa Station with various time scales, as well as the results of satellite data analysis and initial results of 1-D numerical experiments. We discuss the specific dynamics occurring in the upper polar mesosphere region.

Reference

Suzuki, H., M. Tsutsumi, T. Nakamura, and M. Taguchi, The increase in OH rotational temperature during an active aurora event, Ann. Geophys., 28, 705–710, 2010.