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Analysis of the factors of seasonal variation of the thermosphere-mesosphere NO observed at Syowa Station

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When high-energy particles such as solar protons and energetic electrons fall down to the earth's atmosphere, the nitrogen oxides (NO, NO2) are increased in the mesosphere and the upper stratosphere in the polar regions (e.g. Lopez-Puertas et al. 2005). In collaboration with the National Institute of Polar Research, Nagoya University Solar-Terrestrial Environment Laboratory installed a millimeter-wave spectroscopic radiometer at Syowa Station in Antarctica. We have conducted continuous observation of the NO spectrum since January 2012. The NO column density derived from this observation shows a seasonal variation that the NO column density increases up to about 1.7×10^{15} cm^{-2} in winter and decreases down to about 0.5×10^{15} cm^{-2} in summer. In order to understand the mechanism of the seasonal variation, we compared it with seasonal variation of CO vertical distribution in thermosphere-mesosphere and the length of sunshine hours at Syowa Station. Since CO photochemical lifetime is longer than or equal to the horizontal and vertical transport in the thermosphere and the stratosphere, CO can be considered as a good tracer of atmospheric transport. We used CO data obtained by AULA / MLS (Version3.3).

The CO volume mixing ratio in a latitude range of 65 S-75 S and an altitude range of 0.1-0.01 hPa shows a tendency that the mixing ratio increased in winter and decreased in summer. The peak altitude of the mixing ratio changed from upper altitude to lower altitude during winter, suggesting downward transport of the atmosphere. The commencements of the increment of the NO column density and the CO mixing ratio were almost coincident, but the temporal variation patterns of NO and CO did not agree well with each other especially in the decrement phase. On the other hand, the temporal variation pattern of the NO column density and the length of night time showed good correlation throughout the period during which the NO enhancement was significant. Thus the variation of the NO column density in the lower thermosphere-mesosphere is considered to be caused by both the descending of the air mass and the photochemical process.

In this poster, we will present more detailed discussion on the relationship among the NO column density, CO mixing ratio, and length of the night time based on the dataset including the new data acquired this year.

Keywords: microwave spectroscopy, Nitric Oxide