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Variation of Nitric Oxide in MLT region associated with energetic particle precipitation

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Energetic particle precipitation (EPP) due to large solar proton events or geomagnetic storms induces ion-molecule reactions and changes abundances of some minor molecules in the lower thermosphere, the mesosphere and the upper stratosphere. Energetic solar protons directly enter the middle atmosphere, causing increase of HO_x and NO_x radicals and decrease of ozone (e.g., *Lopez-Puertas et al. 2005*). Energetic electrons also increase NO_x in the thermosphere, and the NO_x-rich air is transported downward in the polar vortex during the polar winter (e.g., *Seppala et al. 2007*). To understand the variation mechanism of those molecules related to the solar activities and the polar vortex in the MLT region, we newly installed a microwave spectroscopic radiometer at Syowa Station in Antarctica (69.00S, 39.85E). We have been carrying out the ground-based continuous monitoring of microwave NO (250.796 GHz) spectral lines since January 2012, and 189 daily averaged NO spectra have been obtained.

Typical rms noise of the NO spectra is estimated 21 mK. Most of the spectra have been fitted by a single Gaussian with a half-power band width (HPBW) of 0.5 MHz, suggesting that the NO-line emitting region is lower thermosphere or mesosphere. The total intensity of NO emission shows a long-term or seasonal variation that increases more than a factor of two during a period from autumn to winter. The period of NO enhancement roughly corresponds to the polar vortex activity that are observed by CO downward descend obtained by MLS, but there is no significant increase of the line width of NO, suggesting that NO enhanced air mass does not reached down below ~60km. On the other hand, energetic electron precipitation events observed by GOES occurred more frequently during the NO long-term enhancement. The temperature below 100 km did not show significant variation throughout the observed period based on the SABER data, suggesting that the temperature variation did not affect on the NO total intensity. Thus, the enhancement of the NO total intensity reflects actual enhancement of NO column density. In addition to the long-term variation, we have detected short-term variations with a timescale of several days directly related with the energetic electron precipitation caused by large geomagnetic storms. The NO total intensity peaks during the recovery phase of the geomagnetic storms about 2-7 days after the main phase.

In this presentation, we will discuss about possible cause of the NO enhancement by comparing with satellite data such as SABER, GOSE, POES and MLS.

Keywords: microwave spectroscopy, Nitric Oxide, MLT region, Energetic Particle Precipitation