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Detection of the mesospheric NOx enhancement due to solar proton event by the mm-wave spectrometer at Syowa Station

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Minor constituents in the middle atmosphere play important roles in the atmospheric structure, energy transfer, and photochemistry. Atmospheric composition of such minor constituents change due to the anthropogenic causes such as human industrial activities and the natural causes such as chemical reactions, solar UV, atmospheric circulation, volcanic eruption, and so on. Among such natural causes, the energetic particle precipitation (EPP) onto the middle atmosphere triggers the ion-molecular reactions resulting in the enhancement of NOx and HOx and depletion of ozone. Such effects are expected to increase for the next few years toward the solar maximum.

In order to detect such EPP effects on the atmospheric composition observationally, we installed a millimeter-wave spectroscopic radiometer at Syowa Station in the 52th Japan Antarctic Research Expedition (JARE52), and we started the steady observation in March 2011. In the winter season, we observe NO_2 and ozone, and NO and ozone are observed in the summer season because of the difference of the daylight hours.

On August 4, 2011, a solar proton event (SPE) with proton (>10MeV) flux of ˜100 pfu occurred, but we could not detect significant NO_2 spectrum with an upper limit of 20mK (1-sigma) in antenna temperature. On January 23, 2012, we had a large SPE with proton flux of ˜6,300 pfu, and we have detected NO emission line with an intensity of ˜60 mK. The line width is ˜ 1MHz, and it is interpreted that the spectral line corresponds to the enhancement of NO above ˜ 60 km altitude. At present, we continue the follow up observation and make data reduction.

In our presentation, we will discuss the time variation of NO due to the SPE and relationship with the ozone that is also observed with the millimeter-wave spectrometer.

Keywords: atmospheric chemistry, mesosphere, stratosphere, energetic particle precipitation, solar proton event, remote sensing