

Relationship between the solar proton events and the molecular compositions of nitrogen monoxide and ozone in the middle atmosphere at Syowa Station

*Riku Ishijima¹

1. Nagoya University Institute for Space-Earth Environmental Research

A millimeter-wave spectroscopy group of ISEE, Nagoya University has made monitoring nitrogen monoxide (NO) and ozone (O₃) since 2012, and revealed the correlation between NO and Energetic Particle Precipitation (EPP) in the middle atmosphere at Syowa Station (Isono et al. 2014). In this study, in order to verify the relationship between the solar proton events (SPEs) and the molecular compositions of NO and O₃, we focused on SPEs whose proton flux greater than 10 MeV exceeded 1000 pfu during the period from 2012 to 2016. The proton events were extracted based on the list released from NOAA SPACE ENVIRONMENT SERVICES CENTER. Five events meet the criteria, but there was not enough mm-wave data due to bad weather for two of the five SPEs. Finally, we made further analysis of O₃ and NO for the 3 SPEs around 24th January 2012, 23rd May 2013, and 21st June 2015. For the SPE in 2013, we detected a decrease of O₃ by 64% at 70 km altitude on the next day after the SPE. Nevertheless, NO was not increased at the same time, but it was increased after a week. For the SPE in 2012, which is the biggest event, O₃ at 60 km changed with a value of 26%, but the decline of O₃ was marginal because O₃ variation with an amplitude of a few tens percent were seen during the period unrelated to the proton event. In the event of 2015, no significant decrease in O₃ could be detected. On the other hand, NO increased at 3 days after the event in 2015 but did not increase considerably in 2012.

As a result, the influence of protons was confirmed in 2013, although it could not be regarded at the other two events. It suggests that solar protons do not precipitate in large amounts above the Syowa Station and do not much influence on atmospheric composition in the mesosphere, because the magnetic latitude of Syowa Station is 66 degrees and it is far from the geomagnetic pole.