A plan of the millimeter-wave measurements of mesospheric ozone, HOx and NOx

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Mesospheric chemical composition largely varies caused by environmental changes of the earth inside and outside. Recent studies reported enhancement of NOx and HOx and ozone depletion in the mesosphere at the solar proton event (SPE) in 2003 (e.g. Jackman et al. 2005). These changes were induced by an injection of the solar proton particles into the atmosphere, suggesting that injections of other high energy particles such as a magnetospheric electron also have influence on the chemical composition in the mesosphere. In order to investigate the relationship between the mesospheric chemical composition and space weather, continuous monitoring of the mesospheric minor constituents provides valuable information on it, and we can estimate influences of environmental changes on the mesospheric chemical composition.

A ground-based millimeter-wave measurement is one of the suitable methods to monitor the mesospheric minor constituents whose vertical distribution is estimated from their high resolution emission spectrum with the heterodyne spectroscopy. Because their densities in the mesosphere are small enough, the line intensity is generally week. For evaluation of the possibility of measurements with a ground-based millimeter-wave radiometer, it is useful to simulate the emission intensity of each molecular line.

For this reason, we evaluated the measurement possibility from the spectral simulation of mesospheric ozone, NOx (NO and NO2) and HOx (HO2). We assumed that the measurements were made with the ground-based millimeter-wave radiometer at the Atacama desert in Chile (23S, 68W, Alt. 4800m). Molecular line parameters were taken from the HITRAN 2000 database. Vertical profiles of pressure and temperature were calculated from CIRA86, and those of minor constituents were taken from MIPAS reference atmosphere (2001). Emission line spectra were calculated by using the radiative transfer model.

Simulation results show that the spectral line intensities of HO2 and NO2 are estimated to be ˜20 mK and that of NO is ˜3 mK. If we assume that the system noise temperature of the radiometer is 200 K, we can detect HO2 and NO2 emissions above 3 sigma level in 6 hours measurement. On the other hand, the NO spectrum may be able to be detected at the time when the NO distribution is enhanced by the order of magnitude.

We present the details of our simulation results and the measurement plan at the Atacama site.