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Millimeter-wave spectroscopic observations from Syowa Station to study the effect of energetic particle precipitation on

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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 effect of ion-molecular reactions triggered by energetic particle precipitation (EPP) onto the middle atmosphere is expected to become conspicuous for the next few years as the solar activity increases toward the solar maximum. Such effects due to the EPP can be seen prominently in polar regions. Some examples of the EPP effects have been reported such as Ozone destruction in the mesosphere coincident with a strong solar proton event (e.g., Jackman et al, 2001) and NOx enhancement and Ozone reduction due to auroral electron and descending vortex air during the polar nights (e.g., Seppala et al. 2007). Most of those observations were carried out by satellite instruments, and the observing positions moves from hour to hour. Although satellite observations favorable to obtain 2-D/3-D images that are useful to identify the affected area, they may not be suitable to analyze the short-time variation of the vertical profiles of chemical compositions caused by a solar proton event whose typical time scale is only for a few days. On the other hand, continuous observations from a fixed ground position with a highly sensitive remote sensing system allow us to obtain fine sampling time-domain dataset and should be appropriate to elucidate the short-time variation. Thus we conceived of a plan to install a millimeter-wave spectroscopic radiometer at Syowa Station and to conduct a continuous monitoring to detect the composition change due to EPP.

However, in order to execute the plan, we had to reduce the electric power requirement of the radiometer system, since the supplying capacity of the power generator is limited and the current usage is close to the limit in Syowa Station. Finally, we newly developed a power-saving and portable spectroscopic radiometer system. Two researchers, Isono and I went to Syowa Station in the end of 2010 as members of the 52th Japanese Antarctic Research Expedition (JARE52) team in order to install the new radiometer system and to start steady observation. As of February 2011, the installation has not been completed, but we expect to obtain the spectral data of some minor constituents by the JPGU meeting. In my talk, I will present the aim of the project, specifications of the new radiometer system, and the initial observational results.

This research project is a part of the sub-project of the VIII-th term Prioritized Research Project of National Institute of Polar Research (NIPR) entitled ”Global environmental change revealed by observations of the Antarctic middle and upper atmosphere” and the medium-term project of Solar-Terrestrial Environment Laboratory (STEL) of Nagoya University entitled ”Research on magnetic storm and atmospheric change at the solar maximum”.

Keywords: Mesosphere Stratosphere, Millimeter-wave spectroscopy, Remote sensing, Energetic particle precipitation