Precise Profiling of Antarctic Middle and Upper Atmosphere from the Ground by Radio and Optical Observations over Syowa Station by JARE AJ1 Project

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The VIIIth term JARE (Japanese Antarctic Research Expedition) in 2010 – 2016 carried out a prioritized project. One of the subproject is entitled 'the global environmental change revealed through the Antarctic middle and upper atmosphere'. In this project, precise profiling of Antarctic middle and upper atmosphere from the ground by radio and optical observations has been developed and performed at Syowa, in the Antarctic (39.6E, 69.0S). The PANSY (Program of the Antarctic Syowa MST/IS) radar, a Rayleigh/Raman/Resonance scatter lidar, and a millimeter-wave spectrometer are the new instruments which were installed at Syowa and started observations during the project. These are cooperated with existing instruments such as an MF radar, an HF radar, an all-sky airglow imager and OH airglow temperature spectrometer etc.

We report studies and observations of this project at Syowa Station. The PANSY radar has almost continuously been observing troposphere/lower stratosphere and mesosphere with the 1/4 of full-array antenna system since winter in 2012. In 2015, the system installment was completed, and we started full-system continuous observation since the end of September 2015. It revealed characteristic of Antarctic atmosphere over Syowa, such as strong generation of the waves near the surface and effect of high energy particle precipitation on the middle atmosphere. The Rayleigh/Raman lidar has been observing gravity waves in the upper troposphere/stratosphere/mesosphere by temperature perturbations, and characteristic clouds (PMC/PSC) over Syowa. A resonance scatter lidar system is being developed for mesosphere lower thermosphere studies and experimental observations in Tokyo at mid-latitude have been carried out. The millimeter-wave spectrometer has been observing both ozone and NO, and revealing their seasonal and short-term variabilities related to the solar activities and atmospheric circulations. Sodium airglow imaging data at 90 km altitude since 2002 have extensively been analyzed for clarifying a behavior of short-period gravity waves in the MLT region. These findings are important for understanding vertical couplings of Antarctic atmosphere in order to evaluate global change of the middle and upper atmosphere. However, we expect much more will be conducted by the next term using a full capability of PANSY and collaborations with collocated and network observations.