

Development of middle and upper atmosphere observations at Syowa Station toward JARE Phase IX

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JARE (Japanese Antarctic Research Expedition) has been carrying out a six year prioritized project of the Antarctic research observations since 2010. One of the sub projects is entitled "The global environmental change revealed through the Antarctic middle and upper atmosphere." Ground-based radio and optical observations of profiling dynamical parameters such as temperature, winds, and minor constituents are the key components of observations in this project, together with long-term observations using existent various instruments in Syowa, 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.

This paper will report recent studies and observations of this project at Syowa Station. The PANSY radar started research observation in April 2012 with the 1/4 of full-array antenna system. Observations of troposphere/lower stratosphere and mesosphere have been performed almost continuously except for the intermittent system adjustment periods. Our observations have successfully observed more frequent PMWEs (Polar Mesospheric Winter Echo) than other studies and indicated their local-time and height dependence in detail. The PANSY radar recently succeeded in a 24-hour experimental observation with 47/55 of full-array antenna system (i.e., 893 antennas and modules) and will start a full-system operation in 2015. The Rayleigh/Raman lidar has been observing gravity waves in the stratosphere/mesosphere by temperature perturbations, and recently the altitude range has been successfully extended down to the upper troposphere by combining Raman scatter signals to the Rayleigh signals. In order to extend the height coverage up to the lower thermosphere, a resonance scatter lidar system is being developed and experimental observations in Tokyo at mid-latitude have been started. 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. We expect that the full-power operation of all the instruments planned in Phase IX of JARE will establish a very powerful radio/optical observation core site for the middle and upper atmosphere studies as well as troposphere, at Syowa Station.