Inertia-gravity waves in the mesosphere observed by the PANSY radar

*Ryosuke Shibuya[1], Kaoru Sato[1], Masaki Tsutsumi[2,3], Yoshihiro Tomikawa[2,3], Toru Sato[4], Koji Nishimura[2], Takuji Nakamura[2], Masashi Kohma[1]

1.Graduate School of Science, The University of Tokyo, 2.National Institute of Polar Reserch, 3.University for Advanced Studies (SOKENDAI), 4.Department of Communications and Computer Engineering, Kyoto University

The PANSY (Program of the Antarctic Syowa MST/IS radar) radar installed at Syowa Station (39°E, 69° S), the first MST/IS radar in the Antarctic, provides vertical profiles of three-dimensional wind vectors with fine height and time resolutions in the troposphere, stratosphere and mesosphere. We performed the first successful observation with a complete system of the PANSY radar in 16–24 March 2015. During this observation period, strong wave-like wind disturbances propagating phases downward were observed in the mesosphere. Their zonal wind amplitudes, vertical wavelengths and vertical phase velocities were estimated at about 30 m/s, 13 km and −0.3 m/s, respectively. This means that wave periods are about 11 h. We newly developed a grid configuration which were fine and equally-spaced only for high latitudes of the Southern Hemisphere, and performed a simulation using NICAM (a Nonhydrostatic ICosahedral Atmospheric Model) with the newly-developed grids. We successfully simulated strong wind disturbances similar to the PANSY radar observations with wave periods from 10–13 h in the mesosphere. First we examined amplitudes of the diurnal and semi-diurnal migrating tidal components and those of gravity wave components with horizontal wavelengths smaller than 1000 km as frequently examined by previous studies in the model-simulated wind field. Their amplitudes were much smaller than the observation, suggesting that dominant wave-structures in the mesosphere were not due to migrating tides nor small-scale gravity waves. The remaining components have quite similar structure and amplitudes to the observations. We estimated wave parameters of five dominant wave packets simulated near Syowa Station. Wave parameters of each wave packet were estimated as was consistent with the linear theory of hydrostatic inertia-gravity waves. Horizontal wavelengths are about 2000 km, which is also consistent with those estimated for the wavelike disturbances observed by the PANSY radar assuming that they are due to inertia-gravity waves. We examined propagation and sources of these wave packets using backward ray tracing method. It was suggested that a wave packet simulated at 00 UTC 19 March at 40° E in the mesosphere was generated by spontaneous radiation from the imbalance of polar night jet at the height of 50 km, while a wave packet simulated at 09 UTC 21 March at 120° W in the mesosphere was generated by spontaneous radiation from the imbalance of polar front jet at the tropopause.

Keywords: Atmospheric gravity waves, mesosphere

