Quasi 12 h inertia-gravity waves in the lower mesosphere observed by the PANSY radar at Syowa Station (39.6°E, 69.0°S)

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The first observations made by a complete PANSY radar system (Program of the Antarctic Syowa MST/IS Radar) installed at Syowa Station (39.6°E, 69.0°S) were successfully performed from March 16 – 24, 2015. Over this period, quasi-half-day period (12 h) disturbances in the lower mesosphere at heights of 70 km to 80 km were observed. Estimated vertical wavelengths, wave periods and vertical phase velocities of the disturbances were approximately 13.7 km, 12.3 h and −0.3 m s^{-1}, respectively. Under the working hypothesis that such disturbances are attributable to inertia-gravity waves, wave parameters are estimated using a hodograph analysis. The estimated horizontal wavelengths are longer than 1100 km, and the wavenumber vectors tend to point northeastward or southwestward. Using the non-hydrostatic numerical model with a model top of 87 km, quasi 12 h disturbances in the mesosphere were successfully simulated. We show that quasi 12 h disturbances are due to wave-like disturbances with horizontal wavelengths longer than 1400 km and are not due to semi-diurnal migrating tides. Wave parameters, such as horizontal wavelengths, vertical wavelengths and wave periods, simulated by the model agree well with those estimated by the PANSY radar observations under the above-mentioned assumption. The parameters of the simulated waves are consistent with the dispersion relationship of the inertia-gravity wave. These results indicate that the quasi 12 h disturbances observed by the PANSY radar are attributable to large-scale inertia-gravity waves. By examining a residual of the nonlinear balance equation, it is inferred that the inertia-gravity waves are likely generated by the spontaneous radiation mechanism of two different jet streams. One is the mid-latitude tropospheric jet around the tropopause while the other is the polar night jet. Large vertical fluxes of zonal and meridional momentum associated with large-scale inertia-gravity waves are distributed across a slanted region from the mid-latitude lower stratosphere to the polar mesosphere in the meridional cross-section. Moreover, the vertical flux of the zonal momentum has a strong negative peak in the mesosphere, suggesting that some large-scale inertia-gravity waves originate in the upper stratosphere.