Gravity waves in the mesosphere observed by the PANSY radar and a numerical simulation using NICAM

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The Antarctic Syowa MST/IS Radar (PANSY radar) is the largest MST radar installed at Syowa Station in the Antarctic (39E, 69S) which enables us to observe vertical profiles of three-dimensional wind vectors with fine time and height resolutions in the troposphere to the mesosphere. In the time period from 16-24 March 2015, we succeeded in the first observation with a full-system of the PANSY radar. In the time period 20-23 March 2015, clear wave-like wind disturbances with downward phase propagation are observed in the mesosphere. The wave parameters are estimated by using a hodograph analysis assuming that they are due to inertia-gravity waves. Horizontal and vertical wavelengths are estimated at about 570 km and 6.5 km, respectively. The ratio of estimated vertical and horizontal wavelengths accords well with that of the amplitudes of vertical wind component and horizontal one parallel to the horizontal wavenumber vector, which is consistent with the theoretical characteristics of gravity waves. Thus, it is likely that the observed wave disturbance are due to inertia-gravity waves.

Moreover, we performed a numerical simulation using a Non-hydrostatic ICosahedral Atmospheric Model (NICAM) whose top was extended to the upper mesosphere for the observed time period. The vertical resolution of the model is 400 m from the troposphere to the mesosphere. We adopted a grid configuration such that a finer horizontal resolution around the polar region of the Southern Hemisphere. The horizontal grid spacing is nearly-uniform, which is about 35 km, to the south of 40S. The NICAM successfully simulated wave-like wind disturbances similar to the PANSY radar observations. We will examine the generation mechanism and propagation characteristics of the inertia-gravity waves in the mesosphere by combination of radar observations and model simulations for future study.

Key words: Gravity wave, the PANSY radar, mesosphere, NICAM