A study of inertia-gravity waves in the middle stratosphere based on intensive radiosonde observations

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We made intensive radiosonde observations in the time period from 15:00LST 11 to 18:00LST 12 May 2006 at Shigaraki (136.1E, 34.9N), Japan. Balloons were launched every 3 hours and reached up to a 36km height on average. Horizontal wind and temparature data were obtained in the middle stratosphere, in which region analysis had rarely been performed, with high accuracy and fine resolution (about 10m).

Wavelike structures whose phases propagates downward with increasing time were observed around a height of 33km height in all vertical profiles of the zonal wind, meridional wind and temperature. We made a hodograph analysis assuming an inertia-gravity wave(IGW) for the wavelike structures. As a result, wave parameters were estimated at 11 hours for the observed period, 850km for the horizontal wavelength, 6km for the vertical wavelength. It was also shown that the vertical group velocity was upward. The amplitude of tempareture fluctuations which was estimated from the polarization relation using amplitudes of the wind fluctuations was consistent with observation. Phase difference between wind and tempareture fluctuations indicates that the wave propagates south-south-eastward with a horizontal phase speed of about 23m/s. This fact assures the validity of the IGW assumption.

Next, we examined the horizontal structure of the disturbances and the large-scale background field using ECMWF operational analysis data. Results of the analysis of the potential vorticity and the geopotential height field suggest that the stratospheric polar vortex was in the phase of breaking and the summer anticyclonic circulation was formed during the observation period. The horizontal wind divergence field was examined for the height where the IGW was clear in the radiosonde observation data. The horizontal wavelength and phase orientation are consistent with the result of the hodograph analysis. Large values of the Rossby number are observed on 100-200hPa levels in the region to hte northwest of thte observation site. Thus, it is likely that the observed IGW is generated by the spontaneous adjustment around the large Rossby number region.