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Characteristics of inertia-gravity waves revealed in rawinsondes at Jang Bogo Station, Terra Nova Bay, Antarctica

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Wind and temperature structure and characteristics of inertia-gravity waves (IGWs) are investigated using high-vertical resolution rawinsonde data observed at Jang Bogo Station (JBS), Terra Nova Bay, Antarctica (74˚374'S, 164˚13.7'E) during 13 December 2014 to 31 March 2016. Comparison of the observed wind and temperature data with those from four global reanalysis data (ERA-Interim, MERRA, CFSR, and NCEP/NCAR) at JBS showed that the reanalysis data represent the observation reasonably well, although NCEP/NCAR reanalysis data show stronger wind speed at 850 hPa. The gravity-wave analyses are carried out for two atmospheric layers covering the troposphere (Z= 2–7 km) and the lower stratosphere (Z= 15–22 km) considering tropopause height at JBS. The average total GW energy per unit mass is much greater in the stratosphere (7.30 J kg-1) than in the troposphere (2.76 J kg-1). Based on the dispersion relationship of inertia-gravity waves, wave characteristics are obtained. The average intrinsic frequency, vertical and horizontal wavelengths of IGWs in the troposphere (stratosphere) are 3.42f (1.81f) (where f is the Coriolis parameter), 1.19 km (1.29 km), and 65.51 km (215.28 km), respectively. The vertical and horizontal wavelengths are much shorter than those reported from the polar region. This is because the analyzed layers in the current study are much shallower than those in the previous studies, which leads to less spectral power at long vertical wavelengths, and, consequently, shorter horizontal wavelengths, based on the dispersion relationship of IGWs. The intrinsic phase speeds of IGWs are typically less than 10 m s-1 in both layer but the direction of propagation is nearly isotropic in the troposphere and westward in the stratosphere. The dominant ground-based phase and group velocities direct east and southward, with relatively larger magnitude in the stratosphere. The upward propagating waves are much more prevalent than downward propagating waves in the stratosphere, indicating that most of waves might be generated in the troposphere. For upward propagating IGWs in the stratosphere, the zonal momentum flux is prevalently westward, while the difference between the north- and southward momentum fluxes is not significant. All downward propagating IGWs in the stratosphere are shown during the wintertime with westward and southward momentum fluxes.