Global Distribution of Vertical Wavenumber Spectra in The Lower Stratosphere Observed Using High-Vertical-Resolution Temperature Profiles from COSMIC GPS Radio Occultation

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We retrieved temperature (T) profiles with a high vertical resolution using the full spectrum inversion (FSI) method from the Constellation Observing System for Meteorology, Ionosphere and Climate (COSMIC) GPS radio occultation (GPS-RO) data from January 2007 to December 2009. We studied the characteristics of temperature perturbations in the stratosphere at 20–27 km altitude. This height range does not include a sharp jump in the background Brunt–Vaisala frequency squared (N^2) near the tropopause, and it was reasonably stable regardless of season and latitude. We analyzed the vertical wavenumber spectra of gravity waves (GWs) with vertical wavelengths ranging from 0.5 to 3.5 km, and we integrated the (total) potential energy E_p^T. Another integration of the spectra from 0.5 to 1.75 km was defined as E_p^S for short vertical wavelength GWs, which was not studied with the conventional geometrical optics (GO) retrievals. We also estimated the logarithmic spectral slope (p) for the saturated portion of spectra with a linear regression fitting from 0.5 to 1.75 km.
Latitude and time variations in the spectral parameters were investigated in two longitudinal regions: (a) 90–150° E, where the topography was more complicated, and (b) 170–230° E, which is dominated by oceans. We compared E_p^T , E_p^S , and p, with the mean zonal winds (U) and outgoing longwave radiation (OLR). We also show a ratio of E_p^S to E_p^T and discuss the generation source of E_p^S . E_p^T and p clearly showed an annual cycle, with their maximum values in winter at 30–50° N in region (a), and 50–70° N in region (b), which was related to the topography. At 30–50° N in region (b), E_p^T and p exhibited some irregular variations in addition to an annual cycle. In the Southern Hemisphere, we also found an annual oscillation in E_p^T and p, but it showed a time lag of about 2 months relative to U. Characteristics of E_p^T and p in the tropical region seem to be related to convective activity. The ratio of E_p^T to the theoretical model value, assuming saturated GWs, became larger in the equatorial region and over mountainous regions.

